NASA Technical Memorandum 105380

Experimental Ice Shape and Performance Characteristics for a Multi-Element Airfoil in the NASA Lewis Icing Research Tunnel

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December 1991

NASA

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SUMMARY

An investigation of the ice accretion patterns and performance characteristics of a multi-element airfoil was undertaken in the NASA Lewis Icing Research Tunnel. Several configurations were examined to determine the ice shape and performance characteristics. The testing included glaze, rime, and mixed icing regimes. Tunnel cloud conditions were set to correspond to those typical of the operating environment for commercial transport aircraft. Measurements acquired included ice profile tracings and aerodynamic forces both during the accretion process and in a post-accretion evaluation over a range of angles of attack. Substantial ice accretions developed on the main wing, flaps and slat surfaces. Force measurements indicate severe performance degradation, especially near CL max, for both light and heavy ice accretions. Frost was seen on the lower surface of the airfoil which was found to contribute significantly to the force components.

INTRODUCTION

Several studies have been completed of ice accretions and resulting performance losses for typical airfoil profiles (refs. 1-6). To date, most studies have been for single element airfoils such as the NACA 0012 profile with the exception of Ingelman-Sundberg et. al. (ref. 7). The use of slats and flaps has the potential for development of significant ice accretions at many locations on an airfoil other than the leading edge. In an effort to document these accretions and their effects on airfoil performance, icing tests were performed on a 2D multi-element model representing a Boeing 737 wing section. This model, configured for four simulated flight conditions, was tested in the NASA-Lewis Icing Research Tunnel (IRT) while mounted in a horizontal position between two splitter walls, as shown in Figure 1. The actual model mounted in the IRT is shown in Figure 2.

The conditions of the test were set to attempt reproduction of natural icing conditions for this airfoil during hold and approach situations, as specified in the FAR-25 specifications for commercial aircraft (ref. 8). This was not always possible given the restrictions imposed by the scale of the models and the capabilities of the IRT. In several cases, the spray durations were extended in order to accumulate ice of sufficient quantities to allow tracings to be feasible. Additionally, it was desired to obtain results for glaze, rime, and mixed conditions in order to develop an understanding of how these may impact the several configurations examined. Glaze ice accretions occur at warm temperatures and high cloud liquid water content, while rime ice accretions occur at cold temperatures and low cloud liquid water content. Glaze ice accretions can produce large protuberances called horns at locations slightly downstream of the stagnation region. A mixed ice accretion has a glaze ice core at the stagnation region with surrounding layers of rime ice. Further explanation of these differences is found in reference 6.

The goal of this report is to present the complete set of ice shapes and performance characteristics for the multi-element airfoil for a wide rand of icing conditions. Previous reports by Potapczuk and Berkowitz (refs. 9, 10) have presented a summary of the test results along with several ice shape and performance predictions for the cruise wing configuration. However, this technical report will focus entirely on the experimental results. For each test run, ice shape profiles and performance characteristics will be presented along with a summary of the test results for each of the four configurations.

APPARATUS AND PROCEDURE

Wind Tunnel

This test program was conducted in the NASA Lewis Icing Research Tunnel (IRT). The IRT, shown in Figure 3, is a closed loop subsonic wind tunnel with a 6' X 9' foot solid wall test section. The maximum test section velocity is 300 mph with no blockage. The IRT airstream temperature is controlled by a 2100 ton Freon cooling system which allows the total temperature to range between 32° and -20°F. Atmospheric icing clouds are simulated in the tunnel by spraying water droplets into the cold airstream slightly upstream of the contraction section. Calibrated clouds may be generated with liquid water contents ranging from 0.5 to over 2.0 gm/m^3 and with volume median droplet diameters ranging from 10 to 20 microns.

Wind Tunnel Model

The test article was a 0.18 scale model of a Boeing 737-200ADV 2D wing section. The model was mounted horizontally between two splitter walls which spanned the height of the tunnel test section. A diagram of the model mounted in the splitter walls is seen in Figure 1. The model could be rotated about its spanwise axis using a turntable mounted in the splitter walls. This allowed variation of the angle of attack both during and after the duration of the spray. For most of the test runs the model was set at 5° angle of attack during the icing encounter.

The Boeing 737-200ADV 2D wing section is a multi-element airfoil with a leading edge slat and three trailing edge flaps. Figure 4 shows the four configurations that were tested in the NASA Lewis IRT. The cruise wing configuration, shown at the top, had a chord length of 1.5 ft. The other three multi-element configurations, 1°, 5° and 15° flap, had varying slat and flap positions that correspond to various high lift configurations to simulate possible flight conditions that may be encountered during hold and approach situations.

Measurements

The tunnel velocity at the location of the model was obtained by use of a calibration curve produced during earlier ground de-icing tests. This was done by relating a static pressure probe reading located at the model location, without the model present, to that of a static pressure probe located in the ceiling upstream of the splitter walls. The output of this probe was referenced to a heated total pressure probe, also located in the tunnel ceiling, to yield the corrected free stream velocity at the model location.

Aerodynamic loads on the models were measured during and after each test run using two three-component force balances. One balance was mounted in each splitter wall and attached to the end of the model. These balances allowed the measurement of the normal and axial forces and of the bending moment on the airfoil. From these measurements, the lift, drag, and pitching moment could be determined with an estimated accuracy of 3 percent.

During the De-/Anti-Icing tests which preceded these, a problem developed in the axial force component of the left hand balance. This meant that any spanwise variation of the axial loading would lead to errors in the measurements. A simple examination of the relative magnitudes of the axial loads to either the lift or drag values indicated that an axial load imbalance could contribute to a 3 percent error in lift and as much as a 75 percent error in drag. It was decided to use the balance under these conditions and to take note of any test runs which had a non-uniform distribution of ice in the spanwise direction. It was felt that lift values would be acceptable and that if the ice accretion was uniform across the span then the drag measurements would also be meaningful. This indeed was the case for most of the test runs. Four runs (2B, 15, 20 and 21) had non-uniform ice accretions and the drag data for these runs should be used with caution.

Test Procedure

A typical test run consisted of the following steps. The force coefficients versus angle of attack were determined for the clean airfoil. The spray conditions were set and the tunnel was brought to the correct temperature and airspeed. As the spray was allowed to impinge on the airfoil, the force balance measurements were taken in order to determine changes during the encounter. These measurements were taken with the airfoil at a set angle of attack. Upon completion of the icing encounter, the force coefficients versus angle of attack were again taken to determine changes due to ice accretion and frost. After these measurements were completed, the tunnel was brought to idle and frost was removed using plastic scrapers. The tunnel was then brought back to speed and the force measurements versus angle of attack were repeated without the frost.

After each icing test was conducted, a set of ice shape tracings were made at pre-determined locations along the span of the airfoil. A steam knife was used to cut a 0.25 inch wide slice into the ice and flush with the clean airfoil. Figure 5 shows the distance and section name for each of the 5 cuts. After each cut was made, a cardboard template was inserted into the cut and a tracing of the ice shape profile was made. At section C, ice shape tracings were obtained on both sides of the template.

Test Conditions

The test program consisted of twenty-four runs, ten with the cruise wing configuration and fourteen with the three high lift configurations. The test conditions were selected to simulate cruise and approach conditions for the Boeing 737-200ADV. This consisted of determining combinations of temperature, liquid water content, and drop size within the FAR-25 envelope and scaling these conditions to the size of the model using scaling laws similar to those described by Ruff (ref. 11). Velocities and accretion times were also adjusted in an attempt to achieve proper scaling of the total mass of ice accreted. The attempt to remain close to real flight conditions was done to produce realistic ice shapes but was not intended to achieve complete simulation of actual flight conditions. Since the main objective was to produce a database for code validation, it was decided in several runs to deviate from the simulation conditions in order to produce ice accretions suitable for modeling. Typically, the deviations consisted of running for longer periods of time in order to accumulate enough ice to yield a suitable shape for testing the computer codes. Table 1 lists the actual test conditions for each of the 24 runs.

RESULTS AND DISCUSSION

Detailed results of the ice shapes and performance characteristics will be presented for each of the 24 test runs. Because of the quantity of data presented in this report, it will not be possible to discuss each figure individually. Therefore, a brief summary of the test results will be given for each of the 4 configurations tested. For a more thorough discussion of the data, refer to references 9 and 10.

The experimental data for each run will be presented in the following order:

1) plots of the digitized ice shapes for each section and for each element of the airfoil
2) data tables of the digitized ice shape coordinates
3) lift, drag and pitching moment coefficients versus angle of attack for the clean airfoil, iced airfoil with frost, and iced airfoil without frost
4) ratio of force coefficients/force coefficient of clean airfoil versus time
5) data tables of force coefficients versus angle of attack and time
6) table of the IRT tunnel conditions

The experimental ice shapes shown for each section were created by digitizing the actual ice shapes that were traced on the templates. The digitized ice shapes were then compared to the original tracings for accuracy. Each experimental ice shape will be shown full scale on a section of the airfoil/slat/or flap on which the ice shape was accreted. However, the data tables that follow each set of ice shapes will include only the digitized ice shape coordinates. Unless otherwise noted, all plots of the airfoil and ice shapes are shown full scale with the coordinates given in inches.

Before the results are presented for each run, it is necessary to discuss briefly the frost that was encountered during these tests. During many of the tests, frost formed on the lower surface of the airfoil. The frost was especially evident for the 15° flap configuration. Frost was distinguished from the actual ice accretions by its appearance. The ice accretions had a growth pattern which indicated development in the upstream direction. The frost on the other hand seemed to have no preferred direction of growth. Instead, the frost appeared as a thin layer with a uniformly rough surface. Olsen (ref. 6) has suggested that the frost is due to a free-stream turbulence level higher than that in flight. However, since only the lower surface of the airfoil had any frost, some other reason is suspected. With the exception of runs 1-10, the effect of the frost on the airfoil performance was evaluated by taking force measurements before and after removal of the frost.

Cruise Wing Configuration

The Boeing 737-200ADV 2D cruise wing configuration was the first to be tested and is shown in Table 2 along with the airfoil coordinates. Ice shape and performance characteristics for the cruise wing configuration are shown in Figures 6-25 and Tables 2-42. In general, the ice accretions produce premature stall and increased drag. The drag values are larger over the entire range of angles of attack, while the lift is not generally affected until near CL max. This apparently happens because the ice shape does not substantially alter the pressure distribution over the airfoil until flow separation occurs, while the boundary layer is significantly altered at lower angles of attack. The moment coefficient changes from being nearly constant over the range of angles of attack to being a linearly increasing value with angle of attack until stall. Changes to this parameter reflect both the changes to the boundary layer at small angle of attack values and to the pressure distribution at large angles of attack. All these results indicate significant changes in handling characteristics for the iced airfoil. Since the lift values do not change substantially until near CL max, this can be an extremely important result for incorporation into flight simulators (refs. 12, 13).

The drag appeared to increase with time very rapidly during the initial change from clean surface to iced surface. Within the first minute, the rate of increase declined to a near linear rise with time. The lift values did not change very much at all with time due to the low angle of attack at which the ice was accreted. The moment coefficient did not seem to follow any pattern in how it changed during the accretion time. Thus, it appears that as the ice accretes it initially disturbs the boundary layer causing an increase in drag. This is most likely due to premature tripping from laminar to turbulent flow. Then, as the ice continues to grow, separation regions develop behind the ice shape and changes to the boundary layer aft of the ice shape are reduced. Further changes to lift and pitching moment are determined not by the spray duration but by the type of ice accreted with the more significant changes occurring at the warmer temperatures. This latter effect is due to changes in the overall flow pattern as opposed to alterations in the boundary layer. These trends have been seen in other single element airfoil studies and have been reproduced in analytical simulations.

Frost developed on the lower surface of the airfoil. The extent of this frost varied from the first 30 per cent of the airfoil to the entire lower surface. The major effect of frost is to increase the pitching moment over the entire range of angle of attack. The changes in lift and drag due to frost are not as dramatic as will be seen in the next series of runs. This indicates that the results for lift and drag previously discussed should apply whether or not the frost is present.

Multi-Element Configurations

The Boeing 737-200ADV 2D multi-element configuration is shown in Figure 26. Tables 43-47 show the coordinates for each of the 5 elements that make up the multi-element configuration. Note in Figure 26 that the airfoil is shown at 0° flap and the axis origin is defined at the leading edge of the slat. All subsequent coordinates for each element and for all ice shapes will be given with respect to the airfoil at 0° flap with the origin being at the leading edge of the slat.

Figures 27 and 28 show the orientation of the leading edge slat and the trailing edge flaps to the main airfoil element for each of the three configurations (1°, 5° and 15° flaps). The coordinates for each airfoil element and ice shapes will be given with respect to the 0° flap configuration as shown in Figure 26.

5° Flap Configuration

The 5° flap configuration was the second configuration to be tested with results shown in Figures 29-37 and Tables 48-64. The distinguishing characteristic of this high lift configuration is the sharp drop in lift at angles of attack near stall. The icing runs covered mixed to rime ice conditions and these accretions altered the lift curve and stall characteristics significantly. Apparently the ice shape causes early transition to turbulent flow resulting in trailing edge separation. Confirmation of this would require pressure distributions and velocity profiles around the airfoil, which were not obtained for this experiment.

The other interesting feature of this set of runs is the effect of the frost. The lift and drag values were altered only slightly by the presence of the frost. On the other hand, the frost had a significant effect on the moment coefficient. The change in pitching moment is larger than would be suggested by the accompanying changes in lift and drag. Apparently the distribution of forces over the surface of the airfoil is changed by the frost. Since frost is considered to be a phenomena found only in the tunnel and not in flight, tunnel tests must be evaluated with great care when extrapolating to airfoil performance in icing.

1° Flap Configuration

Results for the 1° flap configuration are shown in Figures 38-50 and Tables 65-87. The ice shapes from these runs all tended to be on the upper surface of the leading edge slat. This is quite different than the prior configurations where the ice accreted at the leading edge and on the lower surface. These runs produced lift curves with very flat tops such that stall would occur early but may not be as severe as other configurations. The drag and moment coefficient curves also appear to be affected similarly for all runs. All five of these runs were in the mixed ice regime and hence this could account for the similarities between runs.

15° Flap Configuration

The last five runs were made with the 15° flap configuration. The results for these runs are shown in Figures 51-69 and Tables 88-115. The interesting aspect of these runs was the lift values at low angles of attack. Unlike the previous configurations, the lift values at angles of attack well below stall are lower than those of the clean airfoil. Obstruction of the flow over the flaps by the ice must have reduced the lift available from these elements. This could lead to a potentially more hazardous condition for this configuration. The stall condition is also altered by the ice accretion. The lift decreases more gradually than for the clean airfoil and this decrease starts at a lower angle of attack. As suggested earlier, this is considered to be due to a change in stall mechanism from leading edge stall to trailing edge stall.

CONCLUSIONS

The test results indicate that the changes in performance characteristics are most affected by the temperature and duration of the ice accretion. The warmer temperatures, leading to glaze ice conditions, tend to produce the largest loss of lift. The duration of the accretion does not influence the changes to the lift, as shown in the lift history plots, once the accretion has developed beyond some minimal size. The drag increase is not so dependent on temperature while it does increase significantly with time. The drag rise was seen to rise rapidly during the initial change from a clean condition to an iced condition with a linear increase thereafter. The moment coefficient normally increased as a result of the accretion. This tended to produce a less stable condition for the airfoil as the tendency towards stall was enhanced.

Test results also indicate that performance changes due to icing can be dependent on the airfoil configuration. For the cruise configuration and the 1° flap configuration, the performance changes due to glaze or mixed ice accretions were similar. The cruise configuration actually had increased lift as a result of rime ice accretion with the ice acting as a leading edge slat. It is doubtful that this would occur for the other configurations. The 15° flap configuration accumulated ice on the flaps which resulted in lift loss for all angle of attack conditions. This indicates that high-lift configurations may be more sensitive to icing problems than the cruise wing configuration. This suggests that an airplane is most sensitive to icing performance losses just at the time it is most likely to experience icing conditions.

Another significant result was documentation of the effect of frost. Frost was identified as ice that developed with no preferred growth direction as opposed to accreted ice which tended to grow upstream. Typically, the frost grew on the first 30 to 40 per cent of the lower surface of the airfoil. The frost did not alter the lift or drag in many cases but did change the pitching moment. This indicates that the pressure profile was altered somewhat but more in distribution than in magnitude. It is important to insure that frost is removed prior to measurement of iced airfoil performance values in order to more accurately recreate natural icing conditions.

Variability of the ice accretion as a function of spanwise location was documented by taking ice profile tracings at several locations during each test run. Results indicated that the ice shape profiles could be quite different even when visual inspection indicated uniform ice growth.

ACKNOWLEDGMENTS

Design and construction of the model and splitter walls was performed by Boeing Commercial Aircraft Co. in conjunction with their own fluid de-icing test conducted just prior to the test described herein.

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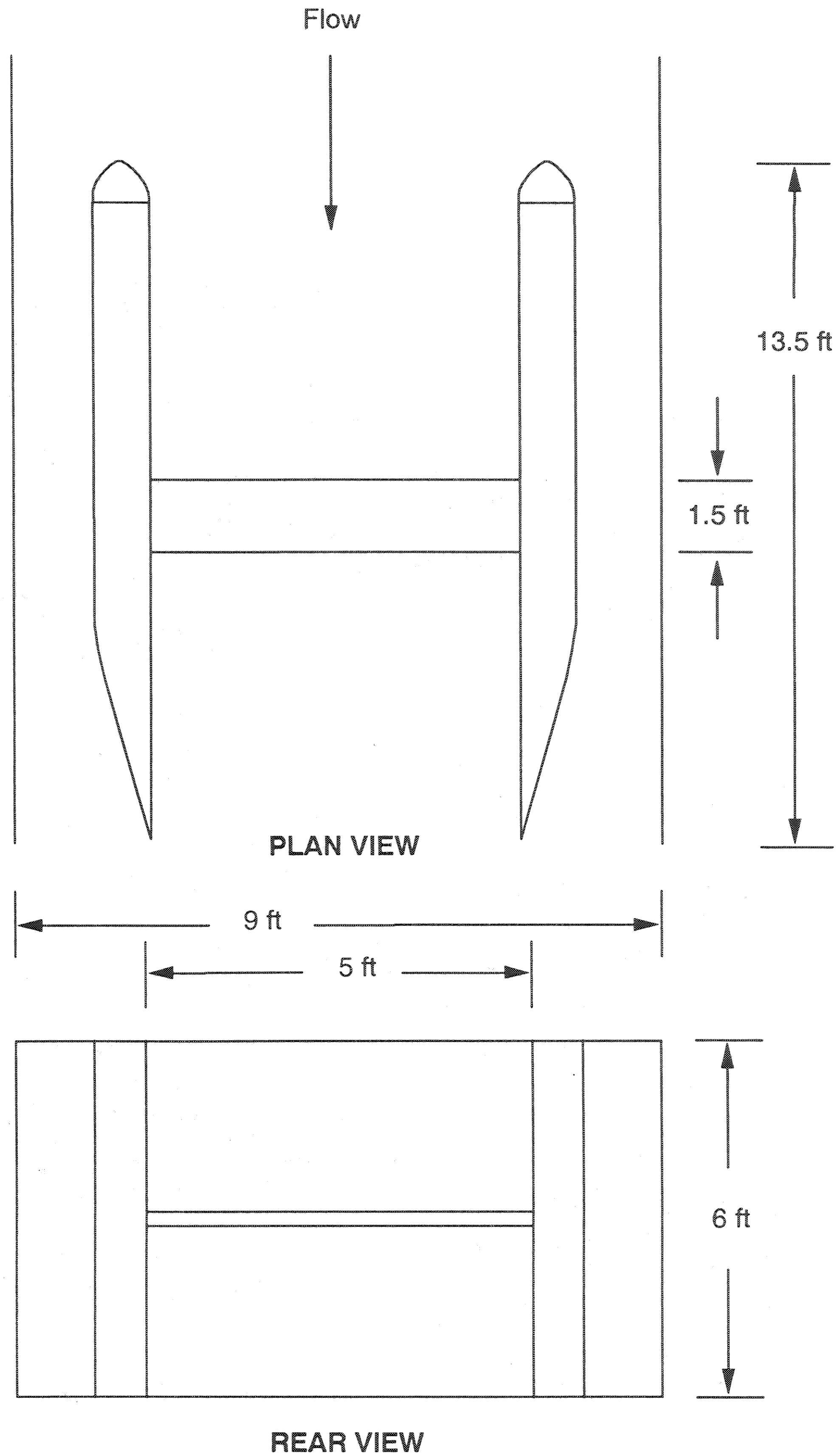


FIGURE 1 – Splitter Wall Configurations for 2D Wing Model.

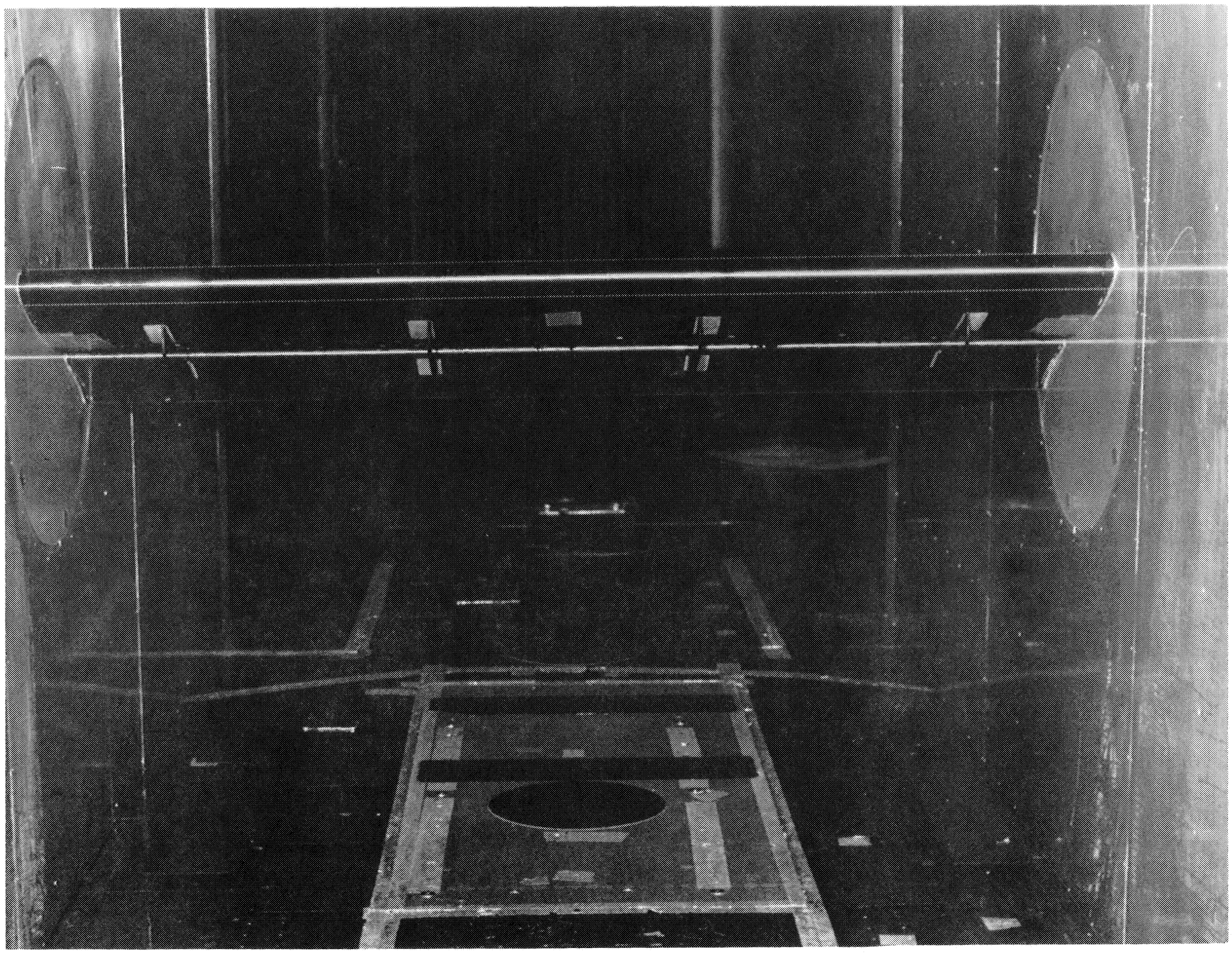


FIGURE 2 – Boeing 737-200 ADV Wing Section Installed in the NASA Lewis IRT.

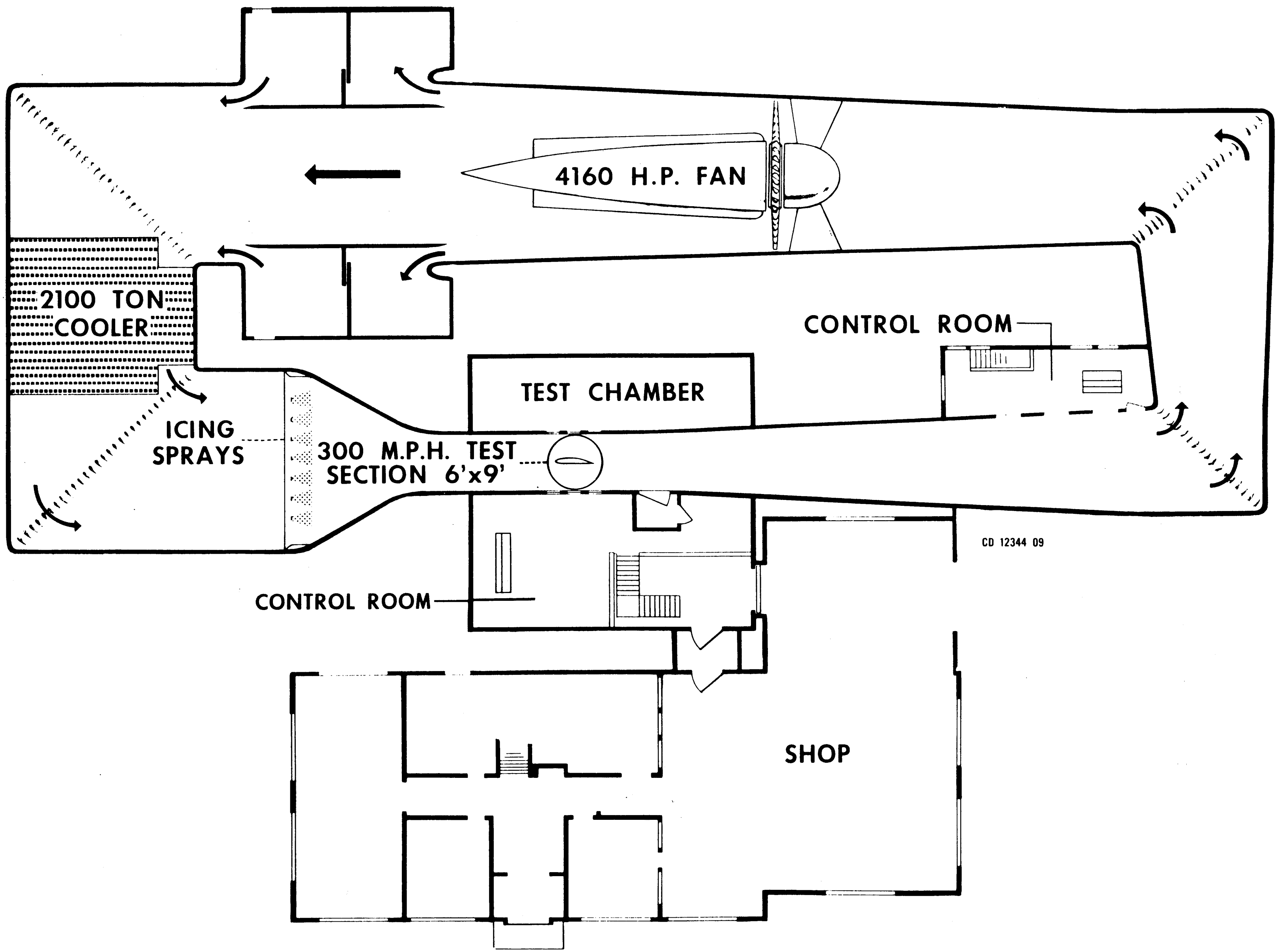


FIGURE 3 – The NASA Lewis 6' x 9' Icing Research Tunnel.

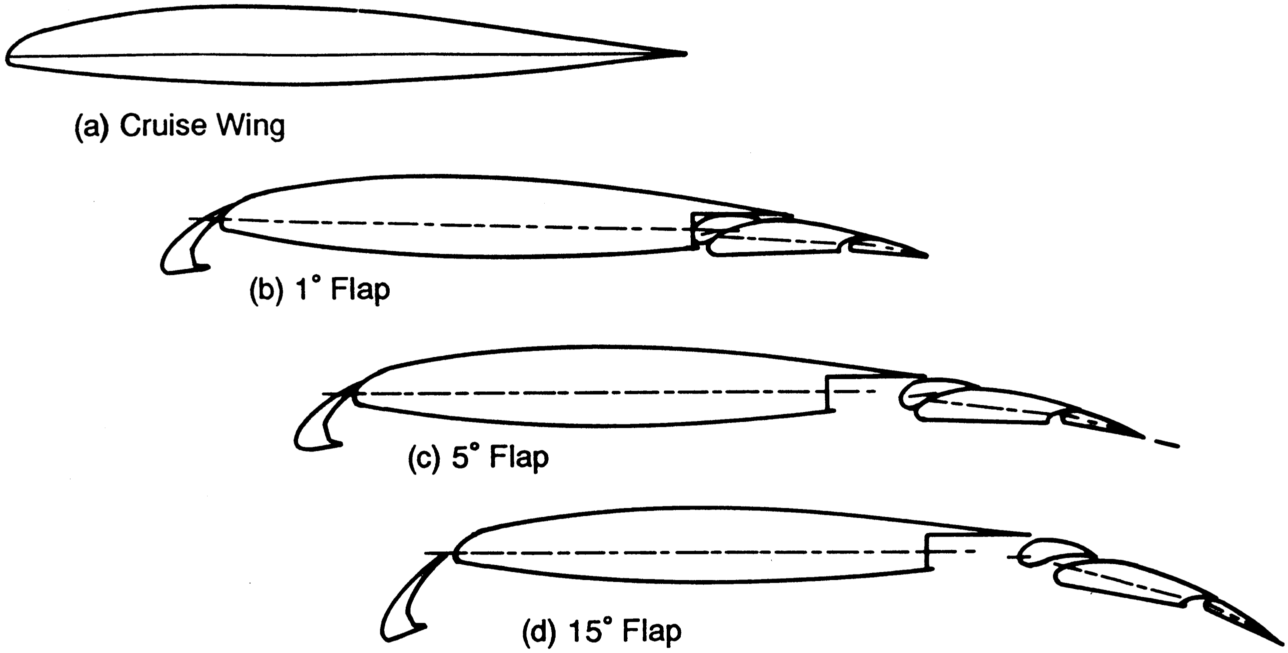


FIGURE 4 – Multi-Element Airfoil Configurations Employed During Ice Accretion Test Program.

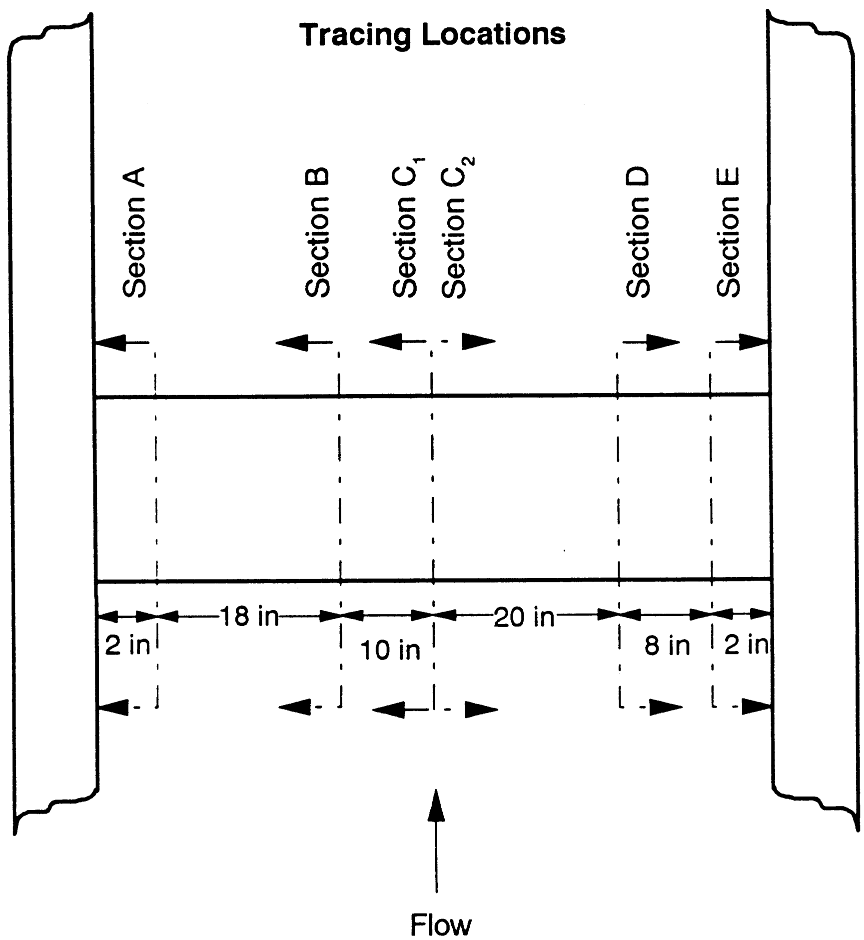


FIGURE 5 – Boeing 737-200 ADV Wing Section With Ice Shape Tracing Locations.

TABLE 1 - TEST CONDITIONS FOR THE BOEING 737-200 ADV AIRFOIL

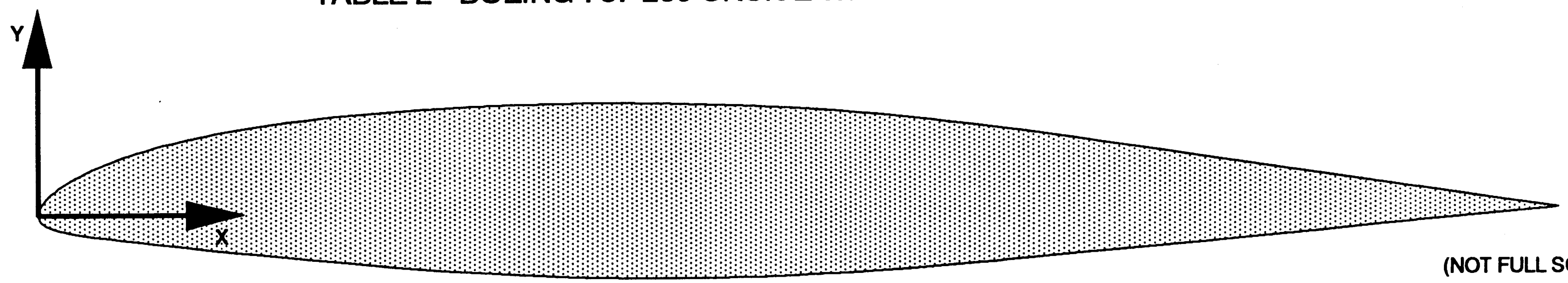
Run Number	Duration min	Temperature °F	Velocity M.P.H.	LWC, g/m³	MVD, μm
Test Conditions for the Cruise Wing Configuration					
1	5	30	108	1.49	14.0
2B	5	28	108	1.40	17.0
3	5	13	108	0.90	14.0
4B	5	10	108	1.13	17.0
5	2	20	108	0.70	14.0
6	13	20	164	0.70	14.0
7	5	16	160	1.00	12.5
8	8	15	161	0.80	14.0
9	5	-16	105	0.87	17.1
10	8	-19	104	1.38	16.0
Test Conditions for the 5° Flap Configuration					
11	4	24	108	0.48	13.4
12	11	25	108	0.46	12.0
13	8	17	108	0.42	13.4
14	8	-7	107	0.90	14.0
Test Conditions for the 1° Flap Configuration					
15	5	28	108	0.92	14.4
[a]16	10	27	108	0.92	14.4
17	10	26	108	0.92	14.4
[a]18	10	18	108	0.90	14.4
19	10	19	107	0.90	14.4
Test Conditions for the 15° Flap Configuration					
[a,b]20	8	28	108	0.92	14.4
21	8	28	108	0.92	14.4
[c]22	8	29	108	0.92	14.4
[a]23	6	-3	110	0.62	12.2
24	6	-9	108	0.62	12.5

[a] These runs were accreted with the airfoil at 0° AOA.

[b] Force measurements lost due to data system error.

[c] This run was accreted with the airfoil at 8° AOA.

TABLE 2 - BOEING 737-200 CRUISE WING AIRFOIL COORDINATES.



(NOT FULL SCALE)

X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
18.000000	0.000000	7.649682	1.334943	2.004375	0.972298	0.267095	0.353399	0.000013	0.002271	0.285112	−0.196973
17.350633	0.102129	7.435693	1.339733	1.883221	0.947091	0.248169	0.339830	0.000000	0.000000	0.314053	−0.203540
16.675104	0.208373	7.218960	1.343290	1.766913	0.921496	0.230698	0.326872	0.000000	0.000000	0.343065	−0.209717
15.999574	0.314617	6.995781	1.345638	1.655407	0.895556	0.213428	0.313609	0.000103	−0.005757	0.375664	−0.216252
15.324045	0.420861	6.768388	1.346707	1.548651	0.869316	0.197549	0.300969	0.000264	−0.009144	0.413791	−0.223442
14.648516	0.527104	6.536183	1.346478	1.446584	0.842818	0.181880	0.288030	0.001487	−0.021239	0.451977	−0.230236
13.972987	0.633348	6.417366	1.345846	1.349138	0.816105	0.167530	0.275723	0.003789	−0.033151	0.494999	−0.237486
13.297457	0.739592	6.298552	1.344835	1.256237	0.789217	0.153400	0.263124	0.007191	−0.044659	0.546724	−0.245736
12.657597	0.840226	6.070500	1.341814	1.167799	0.762194	0.140514	0.251161	0.011836	−0.056005	0.598499	−0.253574
12.393353	0.881785	5.850569	1.337531	1.083736	0.735074	0.127859	0.238914	0.017851	−0.067200	0.682030	−0.265516
12.231850	0.906928	5.633291	1.331943	1.003953	0.707894	0.116368	0.227303	0.025365	−0.078236	0.765586	−0.276784
11.981311	0.944878	5.419407	1.325088	0.928353	0.680691	0.105119	0.215416	0.029849	−0.083835	0.849178	−0.287533
11.737519	0.980513	5.208706	1.316981	0.856832	0.653497	0.094953	0.204163	0.034586	−0.089179	1.002734	−0.306692
11.499800	1.013963	5.001403	1.307650	0.789282	0.626454	0.085040	0.192643	0.040062	−0.094775	1.156326	−0.325565
11.267522	1.045348	4.797681	1.297124	0.720496	0.597535	0.076126	0.181747	0.045772	−0.100083	1.449001	−0.360644
11.040089	1.074776	4.597713	1.285434	0.685794	0.582365	0.067477	0.170597	0.052397	−0.105698	1.741943	−0.394516
10.816936	1.102344	4.401663	1.272615	0.651230	0.566840	0.059743	0.160057	0.059236	−0.110997	2.049551	−0.428734
10.597525	1.128140	4.209681	1.258702	0.619767	0.552322	0.052285	0.149276	0.067200	−0.116647	2.381133	−0.464182
10.381342	1.152245	4.021905	1.243733	0.588441	0.537477	0.045660	0.139087	0.075355	−0.121958	2.660816	−0.493081
10.167894	1.174728	3.838461	1.227745	0.558655	0.522978	0.039322	0.128672	0.084885	−0.127661	2.940559	−0.521232
9.956702	1.195655	3.659465	1.210782	0.529014	0.508151	0.033735	0.118826	0.094586	−0.133006	3.321177	−0.558583
9.747303	1.215082	3.485017	1.192883	0.501047	0.493772	0.028446	0.108770	0.105958	−0.138780	3.664380	−0.591408
9.539243	1.233059	3.315207	1.174092	0.473233	0.479067	0.023830	0.099254	0.117480	−0.144181	3.984786	−0.620885
9.332074	1.249629	3.150112	1.154453	0.447092	0.464851	0.019521	0.089549	0.131032	−0.150050	4.285215	−0.647312
9.125355	1.264830	2.989798	1.134012	0.421109	0.450311	0.015813	0.080349	0.144716	−0.155534	4.568133	−0.670981
8.918645	1.278693	2.834316	1.112812	0.396773	0.436292	0.012420	0.070980	0.160873	−0.161530	4.835714	−0.692141
8.711505	1.291244	2.683707	1.090902	0.372604	0.421951	0.009560	0.062079	0.177147	−0.167132	5.089878	−0.711006
8.503493	1.302504	2.538000	1.068326	0.350046	0.408158	0.007021	0.053031	0.196331	−0.173263	5.332339	−0.727761
8.294146	1.312488	2.397212	1.045131	0.327662	0.394047	0.004955	0.044409	0.215618	−0.178994	5.564634	−0.742566
8.082011	1.321242	2.261350	1.021364	0.306847	0.380510	0.003216	0.035659	0.237844	−0.185150	5.788152	−0.755555
7.866345	1.328761	2.130410	0.997071	0.286213	0.366657	0.000907	0.018815	0.260156	−0.190922	6.004157	−0.766844

TABLE 2 - BOEING 737-200 CRUISE WING AIRFOIL COORDINATES (con't).

X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
6.213814	−0.776529	7.416456	−0.804524	8.789466	−0.784566	10.346993	−0.699122	12.455736	−0.513070	17.223028	−0.071945
6.418203	−0.784691	7.649682	−0.804482	9.002593	−0.776801	10.599196	−0.679787	13.139650	−0.450052	17.903591	−0.008927
6.618246	−0.791393	7.890765	−0.803119	9.216013	−0.767707	10.865304	−0.658096	13.820213	−0.387034	18.000000	0.000000
6.815015	−0.796690	8.009646	−0.801920	9.431372	−0.757215	11.148121	−0.633758	14.500776	−0.324016		
7.009721	−0.800625	8.128524	−0.800356	9.650343	−0.745237	11.450870	−0.606423	15.181339	−0.260998		
7.175444	−0.802926	8.354594	−0.796336	9.874675	−0.731660	11.476741	−0.604032	15.861902	−0.197981		
7.295949	−0.803985	8.573961	−0.791076	10.106223	−0.716345	11.814344	−0.572771	16.542465	−0.134963		

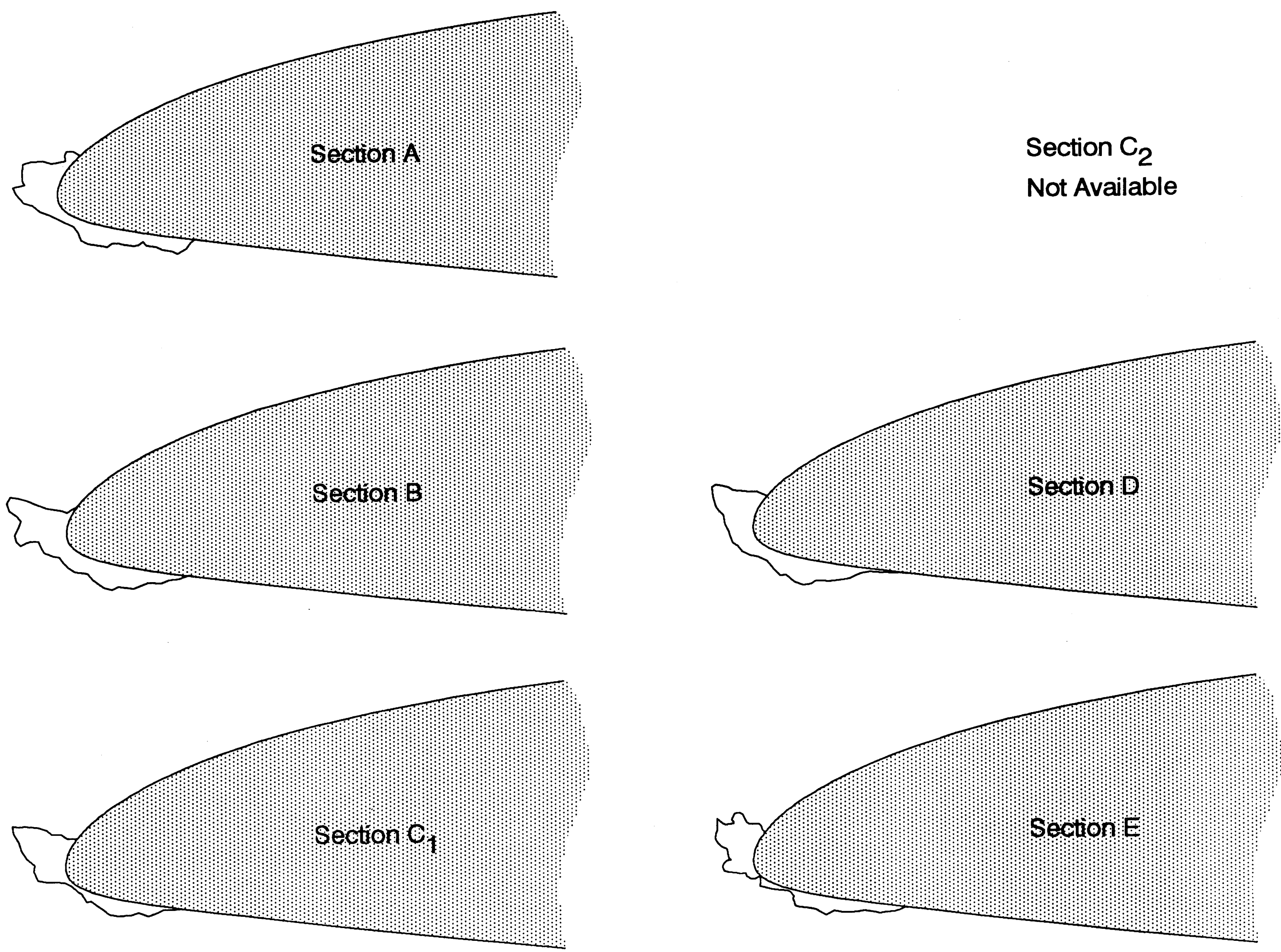


FIGURE 6 - RUN 1 ICE SHAPE TRACINGS FOR SECTIONS A - E.

TABLE 3 - RUN 1 ICE SHAPE COORDINATES FOR SECTIONS A - E.

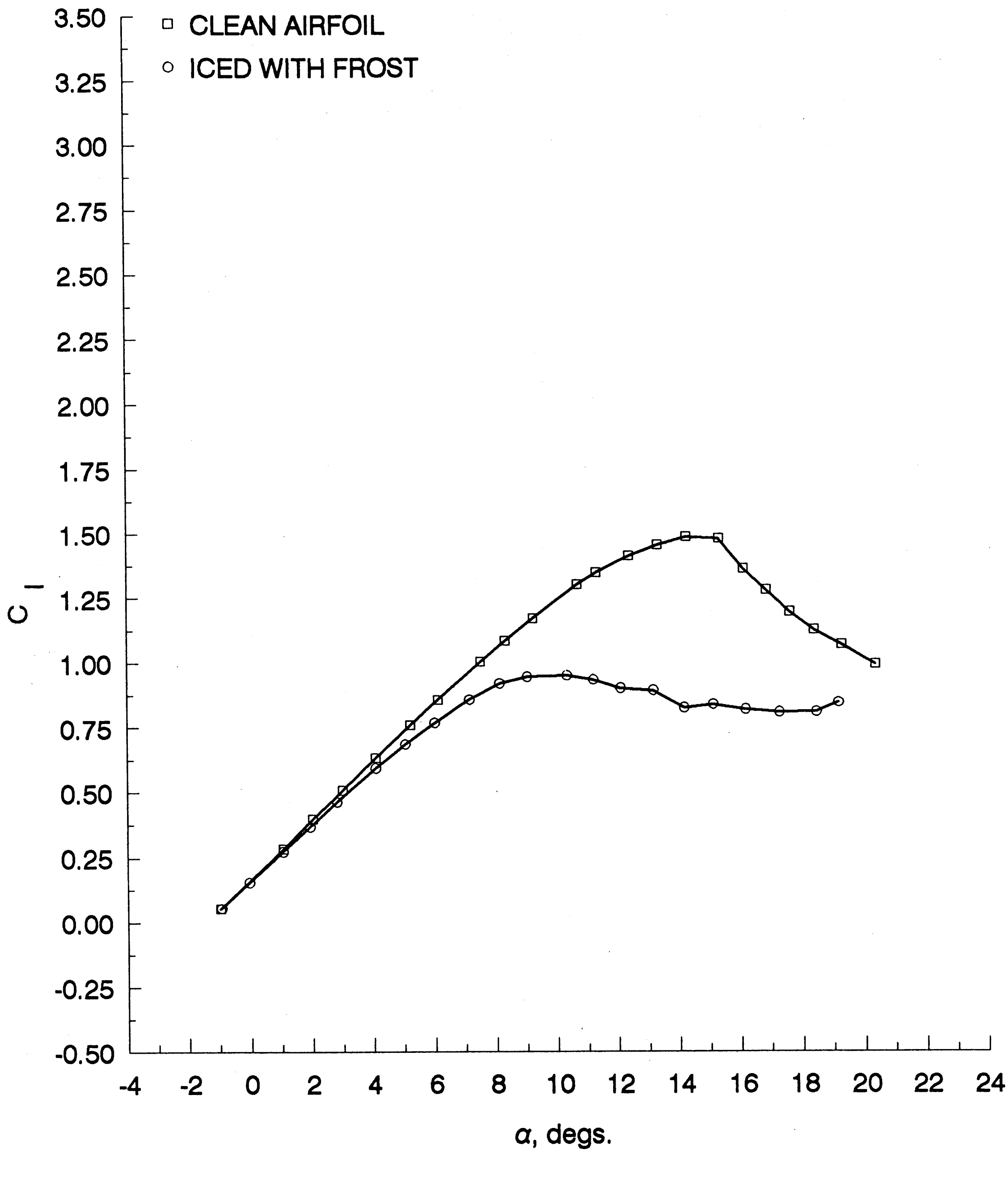
SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.146547	0.258468	0.061245	0.168514	0.069385	0.181283			0.090654	0.197774	0.075104	0.181054
0.102984	0.285626	0.029442	0.152578	0.011562	0.181158			0.024940	0.227489	0.057295	0.197176
0.059710	0.287109	0.003627	0.130715	−0.030371	0.208628			−0.026929	0.229675	0.053651	0.221011
0.050103	0.267249	−0.028258	0.144496	−0.088190	0.206535			−0.090752	0.235837	0.037786	0.233140
0.052580	0.221850	−0.074064	0.154277	−0.120158	0.235995			−0.128654	0.237962	0.007725	0.235576
−0.035733	0.207022	−0.129822	0.164031	−0.182013	0.255547			−0.160491	0.257720	−0.014342	0.235909
−0.088992	0.222218	−0.199552	0.187615	−0.227877	0.257417			−0.202349	0.267711	−0.028416	0.234140
−0.171541	0.219305	−0.259329	0.211226	−0.263776	0.261276			−0.240233	0.273761	−0.044250	0.248251
−0.224444	0.202904	−0.317100	0.228899	−0.295670	0.257270			−0.266233	0.260139	−0.055980	0.268244
−0.227710	0.143614	−0.364891	0.236693	−0.345530	0.263069			−0.260519	0.199288	−0.069593	0.296193
−0.229164	0.098171	−0.388667	0.197006	−0.337446	0.213871			−0.238868	0.132482	−0.081476	0.306281
−0.211137	0.068749	−0.370612	0.145545	−0.305425	0.160787			−0.221024	0.106898	−0.101537	0.306583
−0.289620	0.054032	−0.328732	0.115942	−0.287354	0.103737			−0.191217	0.079300	−0.117678	0.300882
−0.269427	0.006859	−0.296793	0.082351	−0.253353	0.056564			−0.181494	0.022357	−0.129960	0.285215
−0.217667	−0.049830	−0.314576	0.034755	−0.201415	0.013366			−0.159746	−0.022866	−0.138384	0.259581
−0.162420	−0.066978	−0.338347	−0.006914	−0.205311	−0.027983			−0.147923	−0.056272	−0.126500	0.249494
−0.112826	−0.105917	−0.328275	−0.050471	−0.179260	−0.086985			−0.132153	−0.099507	−0.124648	0.239557
−0.045694	−0.130830	−0.300338	−0.076149	−0.119416	−0.098667			−0.098330	−0.121236	−0.154801	0.236050
0.023515	−0.165596	−0.268535	−0.060214	−0.069569	−0.098559			−0.072548	−0.156666	−0.178936	0.232451
0.102598	−0.204199	−0.234726	−0.050216	−0.007753	−0.100395			−0.024774	−0.182378	−0.200880	0.240709
0.132555	−0.245336	−0.182975	−0.050075	0.034167	−0.121958			0.029063	−0.190459	−0.216714	0.254820
0.152770	−0.294483	−0.170940	−0.083722	0.078116	−0.159267			0.084818	−0.216207	−0.234555	0.268960
0.200220	−0.317645	−0.146941	−0.125260	0.102077	−0.174964			0.116577	−0.253624	−0.235045	0.237261
0.292754	−0.328445	−0.085174	−0.148865	0.134093	−0.226079			0.138403	−0.281188	−0.235444	0.211506
0.322355	−0.337984	−0.049335	−0.152730	0.161995	−0.220113			0.172174	−0.314689	−0.231739	0.191634
0.353543	−0.313929	−0.019365	−0.194252	0.193954	−0.245636			0.210102	−0.310929	−0.242046	0.173955
0.390875	−0.311530	0.010578	−0.225868	0.241878	−0.277030			0.235945	−0.332623	−0.246579	0.140336
0.420475	−0.321069	0.050457	−0.251514	0.277833	−0.306482			0.261770	−0.358242	−0.230899	0.116320
0.489395	−0.330162	0.130100	−0.261203	0.333688	−0.318172			0.321541	−0.378121	−0.211144	0.096205
0.526727	−0.327763	0.168038	−0.304684	0.419422	−0.316019			0.369464	−0.370479	−0.193274	0.084046
0.557893	−0.301733	0.207927	−0.334293	0.469226	−0.296225			0.399480	−0.350987	−0.171298	0.077769
0.579830	−0.329135	0.239823	−0.352036	0.537076	−0.321670			0.439395	−0.349197	−0.165648	0.053904
0.638899	−0.336364	0.289621	−0.365769	0.590867	−0.301868			0.489260	−0.353336	−0.162004	0.030070
0.684338	−0.355599	0.331370	−0.347825	0.630698	−0.280128			0.549154	−0.345746	−0.156293	0.010167
0.745416	−0.366756	0.428938	−0.361427	0.666593	−0.282019			0.617029	−0.338190	−0.146324	0.006053
0.780982	−0.382153	0.482624	−0.341470					0.649041	−0.318707	−0.174501	0.000534
0.837617	−0.347934	0.528355	−0.323515					0.689017	−0.303182	−0.194838	−0.016994

TABLE 3 - RUN 1 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.864763	−0.314049	0.613952	−0.327244					0.746916	−0.295583	−0.201194	−0.038696
0.893964	−0.288041	0.665649	−0.307292					0.822720	−0.299834	−0.191593	−0.066583
		0.729319	−0.299194							−0.157612	−0.075023
		0.792953	−0.277229							−0.117551	−0.079591
										−0.081502	−0.084099
										−0.061380	−0.080440
										−0.049343	−0.080621
										−0.043632	−0.100524
										−0.019804	−0.116737
										0.006245	−0.119112
										0.042631	−0.101827
										0.044361	−0.119688
										0.044024	−0.141481
										0.043655	−0.165255
										0.077636	−0.173694
										0.105599	−0.182043
										0.141617	−0.188532
										0.177697	−0.191058
										0.215751	−0.195596
										0.231739	−0.199801
										0.261340	−0.231954
										0.253101	−0.245701
										0.258873	−0.261641
										0.268413	−0.293491
										0.298413	−0.299889
										0.334462	−0.304397
										0.364492	−0.308814
										0.398534	−0.313291
										0.418442	−0.323500
										0.434338	−0.333648
										0.450202	−0.345778
										0.464184	−0.349952
										0.490447	−0.338459
										0.516741	−0.324985
										0.570753	−0.335709
										0.630967	−0.334637
										0.667139	−0.331220

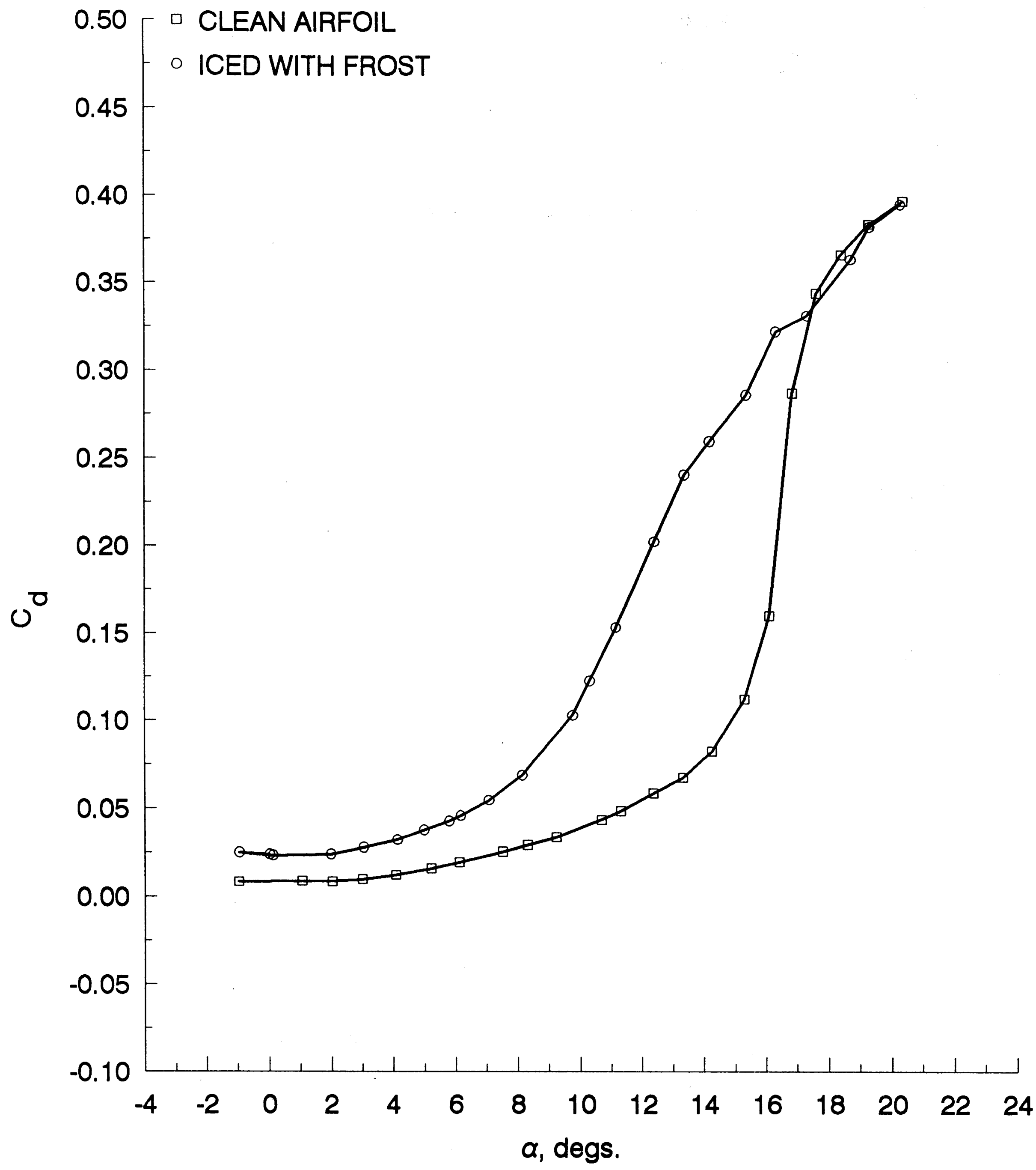
TABLE 3 - RUN 1 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
										0.713372	−0.325973
										0.763463	−0.330693
										0.811487	−0.339345
										0.853677	−0.336019
										0.901915	−0.330803
										0.932099	−0.325314
										0.972498	−0.308090



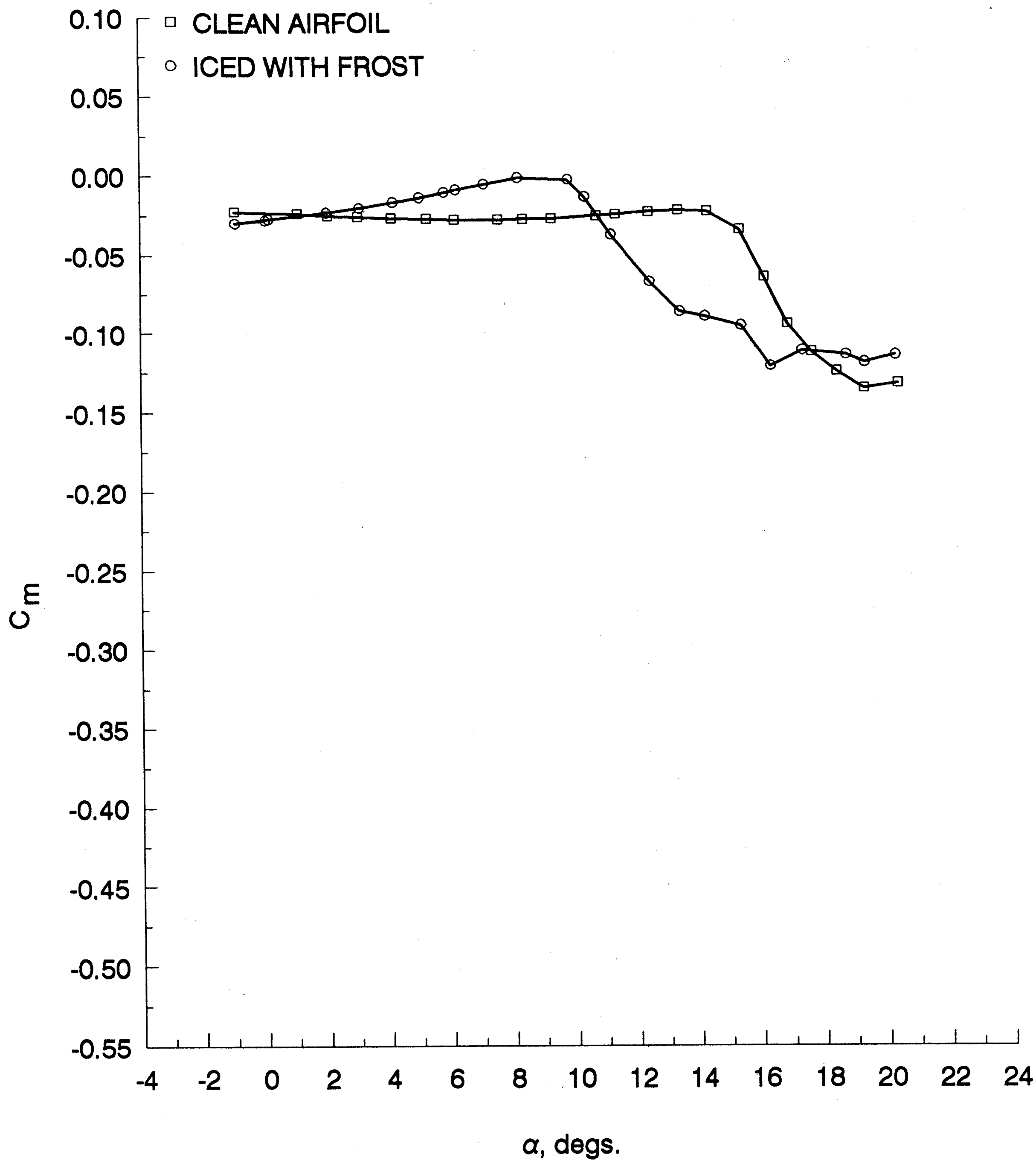
(A) C_l VERSUS α

FIGURE 7 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 2.



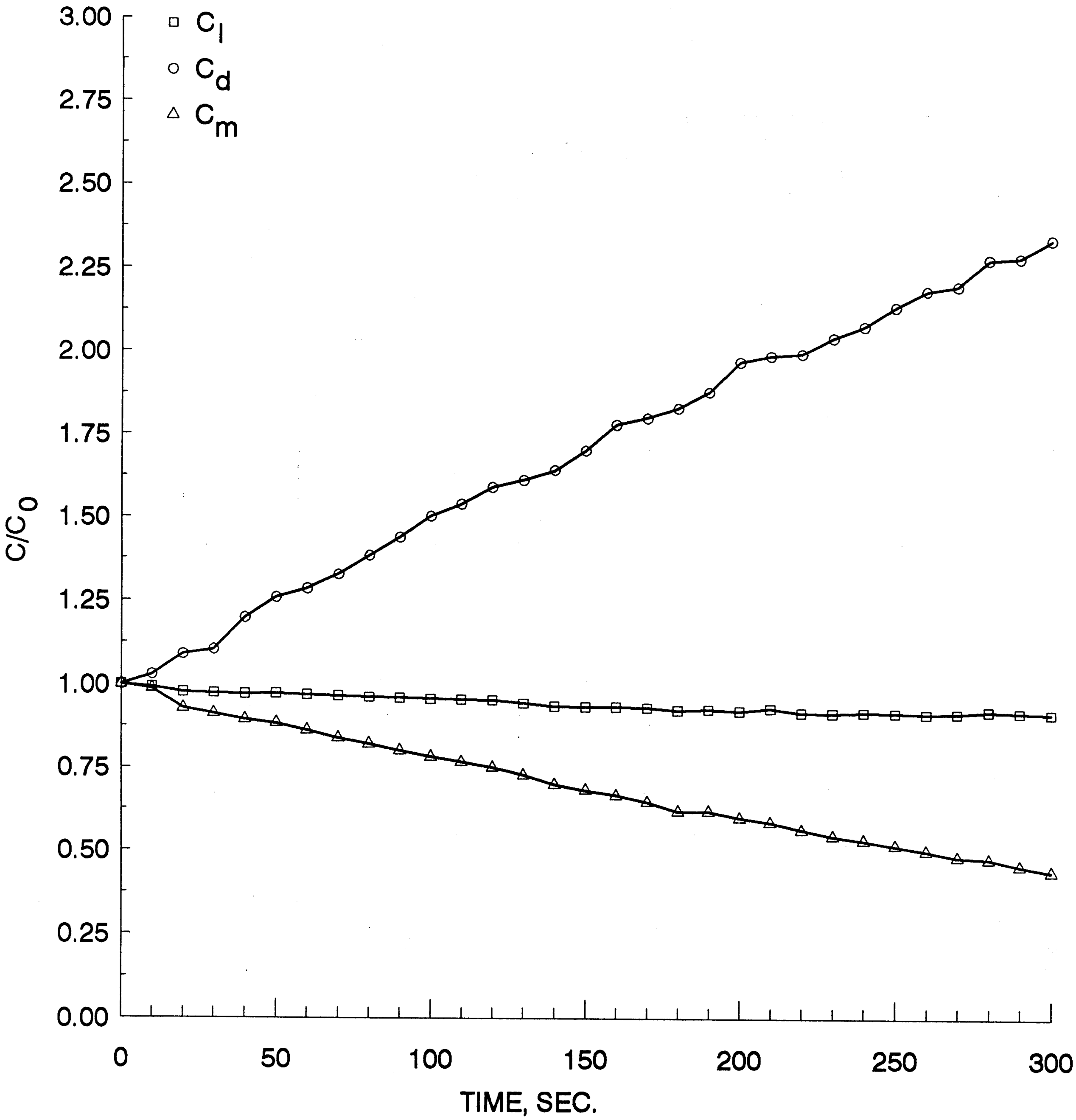
(B) C_d VERSUS α

FIGURE 7 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 1 (con't).



(C) C_m VERSUS α

FIGURE 7 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 1 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 7 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 1 (con't).

TABLE 4 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 1.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−0.9749	0.0550	0.0084	−0.0224
1.0542	0.2845	0.0088	−0.0237
2.0200	0.3989	0.0087	−0.0250
3.0006	0.5082	0.0098	−0.0258
4.0891	0.6332	0.0122	−0.0268
5.2207	0.7597	0.0158	−0.0272
6.1244	0.8574	0.0194	−0.0277
7.5180	1.0040	0.0254	−0.0277
8.3195	1.0841	0.0291	−0.0273
9.2371	1.1715	0.0336	−0.0270
10.6897	1.3013	0.0435	−0.0253
11.3100	1.3475	0.0485	−0.0245
12.3828	1.4143	0.0587	−0.0228
13.3320	1.4558	0.0675	−0.0218
14.2683	1.4875	0.0823	−0.0226
15.3200	1.4812	0.1121	−0.0341
16.1230	1.3637	0.1599	−0.0643
16.8613	1.2811	0.2871	−0.0942
17.6236	1.1962	0.3440	−0.1121
18.4185	1.1263	0.3663	−0.1242
19.2924	1.0690	0.3840	−0.1352
20.3750	0.9932	0.3973	−0.1319

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
0.0114	0.1845	0.0240	−0.0279
−0.9513	0.0757	0.0250	−0.0298
0.1195	0.1927	0.0234	−0.0272
1.9838	0.3963	0.0241	−0.0230
3.0486	0.5110	0.0279	−0.0202
4.1336	0.6171	0.0322	−0.0167
4.9869	0.7058	0.0377	−0.0138
5.7893	0.7756	0.0427	−0.0106
6.1657	0.8077	0.0458	−0.0090
7.0777	0.8829	0.0546	−0.0054
8.1565	0.9622	0.0688	−0.0013
9.7772	1.0190	0.1028	−0.0025
10.3212	1.0097	0.1225	−0.0134
11.1677	0.9938	0.1534	−0.0373
12.4140	0.9649	0.2024	−0.0671
13.3874	0.9466	0.2406	−0.0862
14.2069	0.9162	0.2596	−0.0894
15.3706	0.9131	0.2861	−0.0953
16.3286	0.8812	0.3223	−0.1209
17.3261	0.8518	0.3312	−0.1112
18.7229	0.8725	0.3635	−0.1139
19.3079	0.8963	0.3823	−0.1187
20.2924	0.8833	0.3954	−0.1142

TABLE 5 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 1.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9920	1.0292	0.9858
20	0.9767	1.0904	0.9277
30	0.9740	1.1039	0.9122
40	0.9721	1.1997	0.8939
50	0.9738	1.2605	0.8835
60	0.9703	1.2863	0.8628
70	0.9669	1.3285	0.8400
80	0.9632	1.3847	0.8224
90	0.9605	1.4397	0.8014
100	0.9573	1.5040	0.7828
110	0.9554	1.5405	0.7673
120	0.9537	1.5919	0.7509
130	0.9450	1.6130	0.7279
140	0.9356	1.6434	0.6994
150	0.9339	1.7028	0.6822
160	0.9339	1.7814	0.6668
170	0.9314	1.8019	0.6464
180	0.9239	1.8321	0.6190
190	0.9264	1.8816	0.6185
200	0.9222	1.9726	0.5995
210	0.9299	1.9909	0.5850
220	0.9174	1.9978	0.5628
230	0.9156	2.0458	0.5446
240	0.9179	2.0805	0.5320
250	0.9170	2.1378	0.5156
260	0.9139	2.1863	0.5002
270	0.9154	2.2003	0.4819
280	0.9222	2.2812	0.4747
290	0.9186	2.2866	0.4559
300	0.9153	2.3417	0.4384

TABLE 6 - TEST CONDITIONS FOR RUN NUMBER 1.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 1	Configuration Cruise Wing	Date 05-02-88	
P_{air} 76.0 psig	ΔP_W 18.5 psid	T_{avg} 25° F	V_∞ 100 mph
Spray Duration 5 min	Ice Accretion Type Glaze	A.O.A. 5°	
LWC 1.49 g/m³	MVD 14 µm		

Remarks

- Procedure not followed correctly. Possible sublimation of ice prior to force measurements. Less ice than expected. Approximately (1/4" - 3/8")
- Frost on entire lower surface
- Ice shape tracing for Section C_2 not available

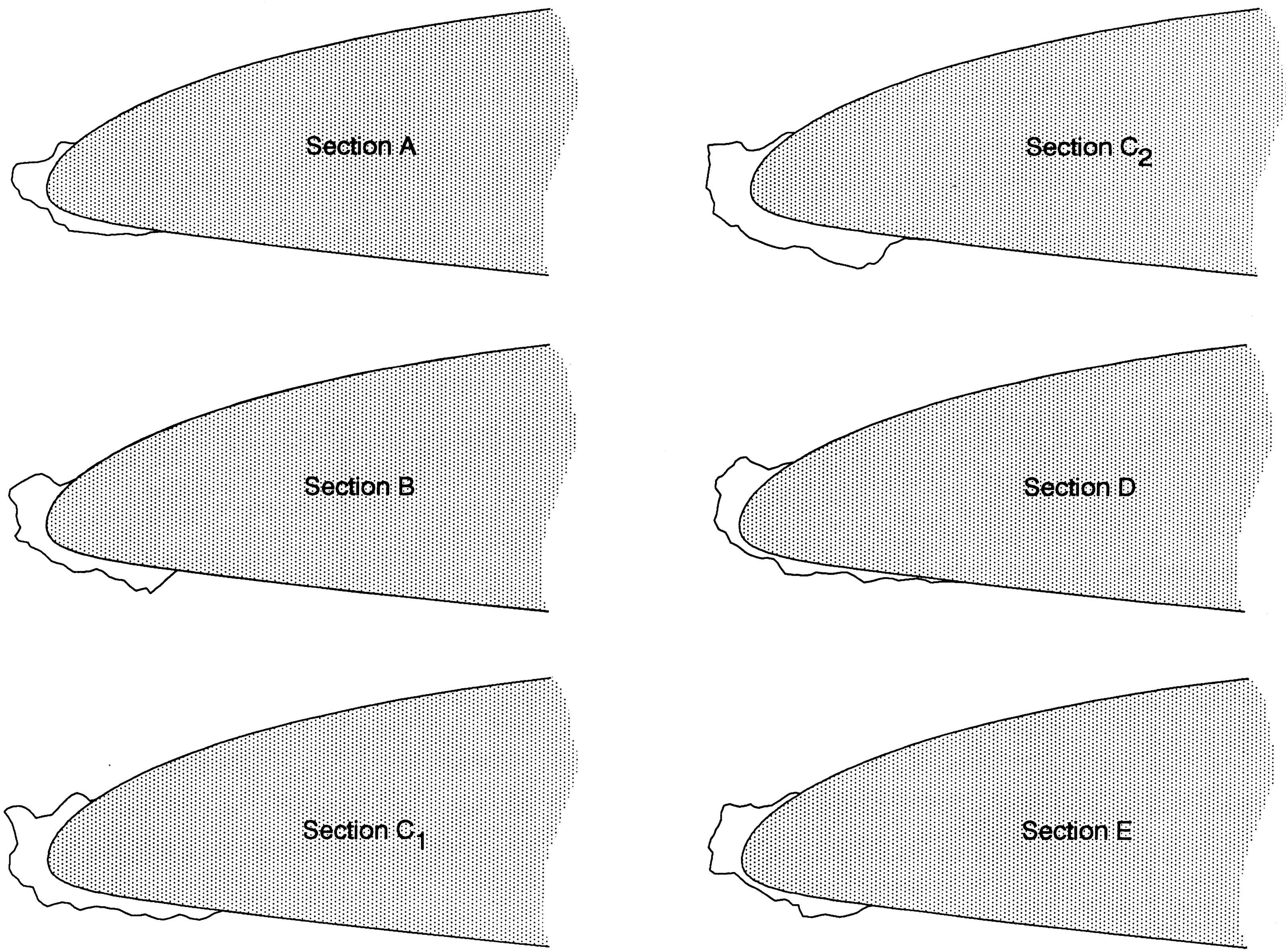


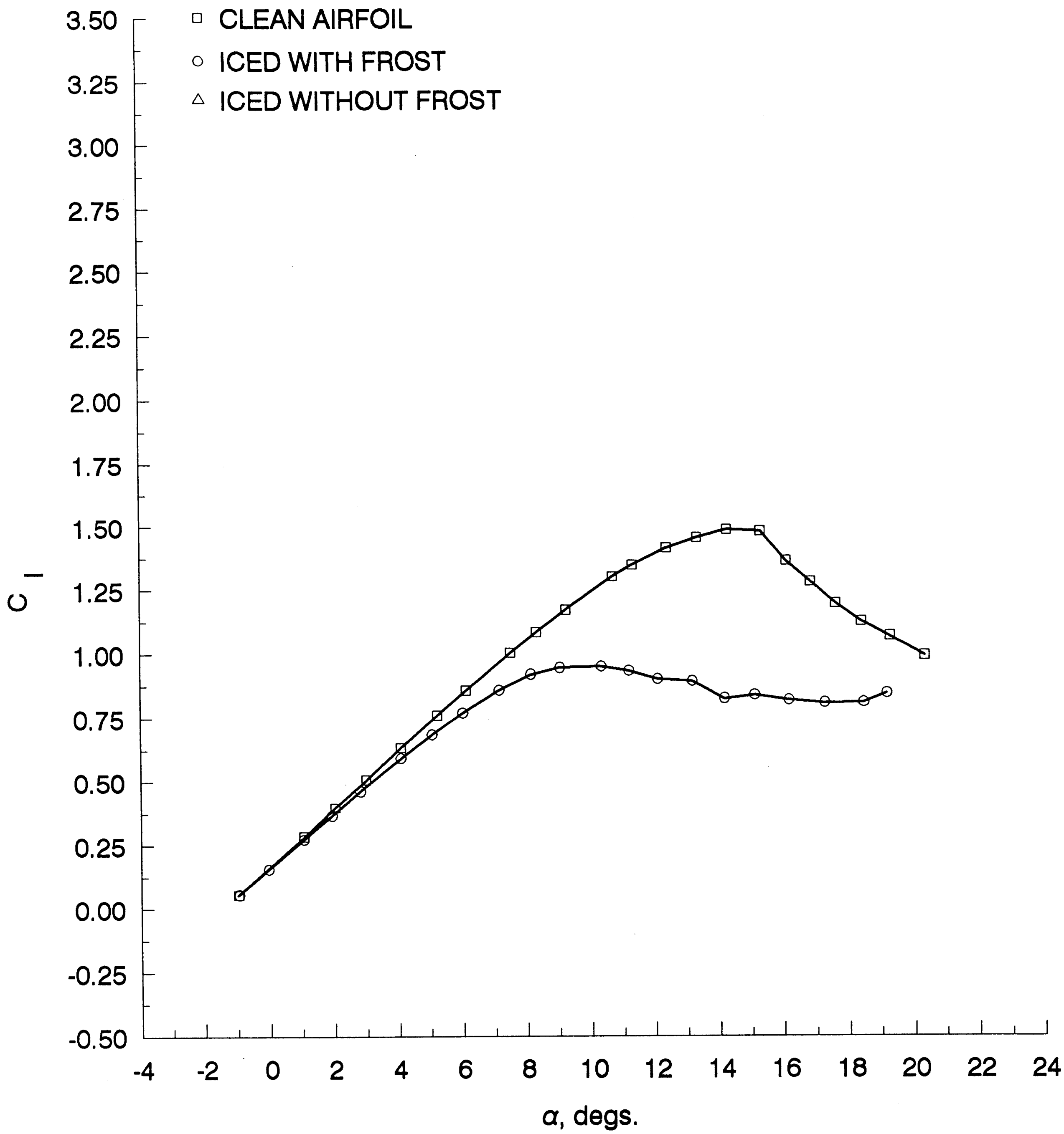
FIGURE 8 - RUN 2 ICE SHAPE TRACINGS FOR SECTIONS A - E.

TABLE 7 - RUN 2B ICE SHAPE COORDINATES FOR SECTIONS A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.182659	0.295146	0.179442	0.290424	0.308212	0.381315	0.280385	0.369292	0.338868	0.407602	0.374336	0.424528
0.150734	0.295261	0.147541	0.274725	0.270237	0.373452	0.232417	0.366858	0.284943	0.398503	0.344469	0.430424
0.118830	0.301252	0.087727	0.251177	0.254275	0.391272	0.194618	0.346688	0.240793	0.377350	0.306637	0.424528
0.088900	0.301359	0.047851	0.274725	0.228322	0.409105	0.166835	0.324630	0.186746	0.360316	0.278761	0.404874
0.070877	0.283792	0.017944	0.306122	0.190375	0.422997	0.143013	0.306572	0.143297	0.384788	0.242920	0.381289
0.056800	0.254456	−0.027913	0.327708	0.154393	0.411176	0.115173	0.290457	0.101718	0.401294	0.213053	0.359670
0.036694	0.213387	−0.075764	0.319859	0.120386	0.381552	0.083372	0.270344	0.070036	0.413682	0.191150	0.345912
0.012678	0.193882	−0.119628	0.298273	0.086372	0.345995	0.051495	0.258154	0.042580	0.441878	0.149336	0.343946
−0.017296	0.182235	−0.165485	0.270801	0.060360	0.318339	0.005584	0.249796	0.006671	0.438457	0.107522	0.332154
−0.067215	0.172618	−0.203367	0.249215	0.026346	0.282782	−0.026464	0.255438	−0.027551	0.415169	0.075664	0.340016
−0.105134	0.170795	−0.237262	0.223705	−0.033611	0.272969	−0.050685	0.278988	−0.037905	0.389532	0.055752	0.357704
−0.165023	0.163173	−0.245237	0.186421	−0.079581	0.263138	−0.062891	0.300670	−0.078163	0.362367	0.027876	0.345912
−0.196970	0.157411	−0.227293	0.158948	−0.097529	0.290849	−0.092939	0.306331	−0.102519	0.332976	−0.015929	0.340016
−0.217025	0.130055	−0.195392	0.123626	−0.123477	0.312638	−0.126834	0.296105	−0.112721	0.317258	−0.045796	0.345912
−0.225152	0.090903	−0.189411	0.090267	−0.155419	0.334434	−0.178763	0.289671	−0.132758	0.309627	−0.077655	0.357704
−0.229296	0.049776	−0.195392	0.056907	−0.183385	0.340402	−0.224750	0.289237	−0.152979	0.290093	−0.117478	0.345912
−0.213456	0.016415	−0.183429	0.011774	−0.225349	0.338478	−0.262739	0.288880	−0.153710	0.242485	−0.135398	0.298742
−0.197552	0.000686	−0.167479	−0.015699	−0.263332	0.324681	−0.278696	0.284766	−0.122515	0.198358	−0.135398	0.257469
−0.181640	−0.013085	−0.179442	−0.045133	−0.283341	0.302951	−0.274336	0.247159	−0.133173	0.152885	−0.151327	0.218160
−0.175749	−0.038574	−0.203367	−0.072606	−0.255416	0.265338	−0.268167	0.229384	−0.139787	0.111318	−0.167257	0.194575
−0.153895	−0.064120	−0.175454	−0.100078	−0.233482	0.229710	−0.273975	0.209514	−0.146280	0.077686	−0.179204	0.163129
−0.100072	−0.078027	−0.117634	−0.111852	−0.213580	0.168374	−0.271748	0.185758	−0.160922	0.032274	−0.197124	0.137579
−0.076208	−0.099662	−0.103677	−0.139325	−0.201644	0.126825	−0.265521	0.162038	−0.129909	−0.023755	−0.215044	0.082547
−0.046358	−0.121319	−0.061808	−0.155024	−0.195678	0.105062	−0.271292	0.138206	−0.090321	−0.040231	−0.189159	0.053066
0.005477	−0.133259	−0.029907	−0.172684	−0.215716	0.061576	−0.275024	0.110430	−0.074815	−0.068246	−0.191150	0.013758
0.027294	−0.168601	0.003988	−0.202119	−0.245726	0.031947	−0.286394	0.044934	−0.053517	−0.108254	−0.199115	−0.013758
0.047073	−0.215689	0.033895	−0.229592	−0.247767	−0.001673	−0.288051	0.009252	−0.023827	−0.120611	−0.205088	−0.060928
0.082931	−0.231490	0.073770	−0.243328	−0.249837	−0.057048	−0.263868	−0.010336	0.009695	−0.142947	−0.169248	−0.084513
0.118825	−0.237496	0.113646	−0.255102	−0.229904	−0.094651	−0.249435	−0.055774	0.033289	−0.163148	−0.113496	−0.084513
0.148617	−0.274825	0.137572	−0.274725	−0.191972	−0.120410	−0.235116	−0.089325	0.066811	−0.185485	−0.047788	−0.078616
0.194495	−0.278907	0.177448	−0.300235	−0.176025	−0.150097	−0.238792	−0.123044	0.108452	−0.198024	−0.017920	−0.106132
0.250342	−0.284984	0.225299	−0.302198	−0.156064	−0.165944	−0.242468	−0.156764	0.142186	−0.206475	0.023894	−0.141509
0.298216	−0.289074	0.279132	−0.296311	−0.096130	−0.173931	−0.216323	−0.172370	0.182048	−0.205098	0.057743	−0.163129

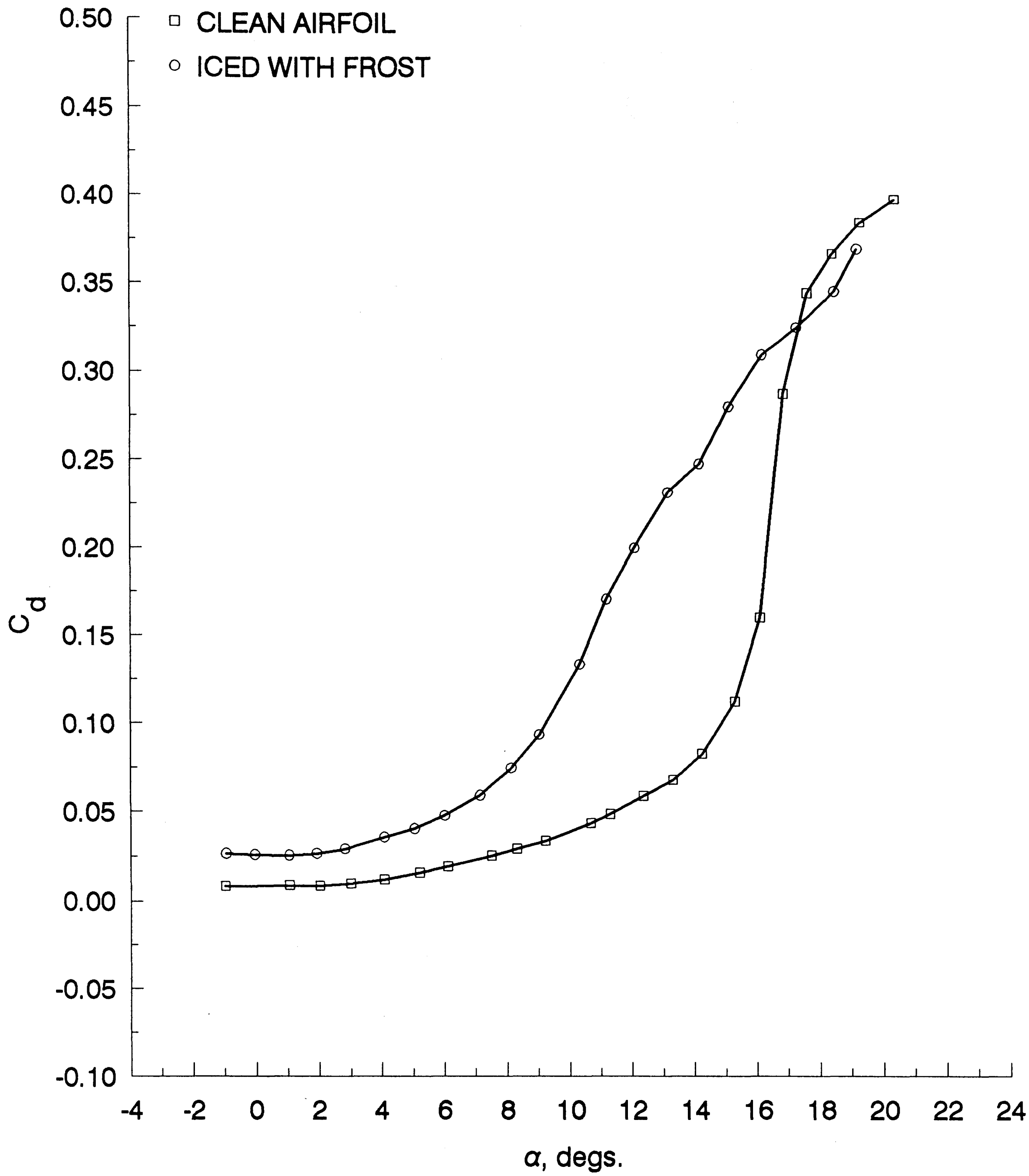
TABLE 7 - RUN 2B ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.346081	−0.295123	0.324989	−0.282575	−0.082181	−0.203616	−0.188141	−0.191920	0.225802	−0.209733	0.091593	−0.174921
0.387961	−0.301150	0.368852	−0.296311	−0.060268	−0.255066	−0.159921	−0.215432	0.249335	−0.233901	0.137389	−0.206368
0.431873	−0.297389	0.406735	−0.329670	−0.030332	−0.282792	−0.131720	−0.236963	0.270664	−0.271925	0.177212	−0.231918
0.473790	−0.293621	0.454586	−0.347331	−0.000380	−0.298653	−0.085752	−0.234548	0.298028	−0.306072	0.219027	−0.259434
0.527671	−0.291855	0.504431	−0.353218	0.047599	−0.280913	−0.067491	−0.262117	0.359645	−0.314948	0.276770	−0.247641
0.577525	−0.299869	0.536331	−0.386578	0.095565	−0.273063	−0.041270	−0.285648	0.427358	−0.315979	0.304646	−0.257469
0.639402	−0.294214	0.582189	−0.419937	0.145510	−0.279059	−0.009013	−0.313084	0.461276	−0.312528	0.332522	−0.283019
0.675362	−0.282588	0.649978	−0.404239	0.177448	−0.304811	0.047161	−0.332371	0.501321	−0.299249	0.368363	−0.283019
		0.677891	−0.435636	0.213394	−0.320678	0.095338	−0.351732	0.543082	−0.303853	0.376327	−0.314465
		0.707798	−0.412088	0.253372	−0.308862	0.137459	−0.365205	0.600808	−0.306717	0.398230	−0.357704
		0.739699	−0.388540	0.305339	−0.297061	0.185559	−0.376641	0.660677	−0.299692	0.459956	−0.361635
		0.781568	−0.345369	0.365275	−0.303070	0.223587	−0.380246	0.694564	−0.298224	0.499779	−0.351808
		0.849178	−0.287533	0.403227	−0.313007	0.281437	−0.365830	0.730169	−0.314640	0.541593	−0.343946
				0.429206	−0.311062	0.331499	−0.373285	0.765682	−0.337006	0.579425	−0.349843
				0.465162	−0.319019	0.383541	−0.378740	0.805118	−0.363401	0.633186	−0.361635
				0.495114	−0.334879	0.409743	−0.400289	0.859042	−0.354302	0.686947	−0.351808
				0.547040	−0.354722	0.452073	−0.435557	0.899118	−0.339039	0.742699	−0.336085
				0.598992	−0.354788	0.514321	−0.462712	0.935057	−0.333634	0.780531	−0.306604
				0.632969	−0.348897	0.550425	−0.474260	0.986807	−0.336407	0.814380	−0.290880
				0.676907	−0.364775	0.602524	−0.485659	1.018460	−0.350778		
				0.716855	−0.376693	0.660641	−0.498982	1.076307	−0.345707		
				0.748820	−0.380688	0.686709	−0.506662	1.108233	−0.342225		
				0.794790	−0.370857	0.720642	−0.500398	1.142181	−0.336790		
				0.852767	−0.347197	0.758385	−0.474284	1.195801	−0.347528		
				0.892718	−0.357137	0.794412	−0.477907	1.235389	−0.364004		
				0.928662	−0.374982	0.816292	−0.465812	1.293266	−0.356949		
				0.986600	−0.380988	0.849922	−0.427847	1.325131	−0.357434		
				1.032575	−0.367202	0.865537	−0.388070				
				1.080564	−0.341552	0.897167	−0.350124				
				1.132536	−0.325795	0.935061	−0.339859				
						0.982801	−0.313651				



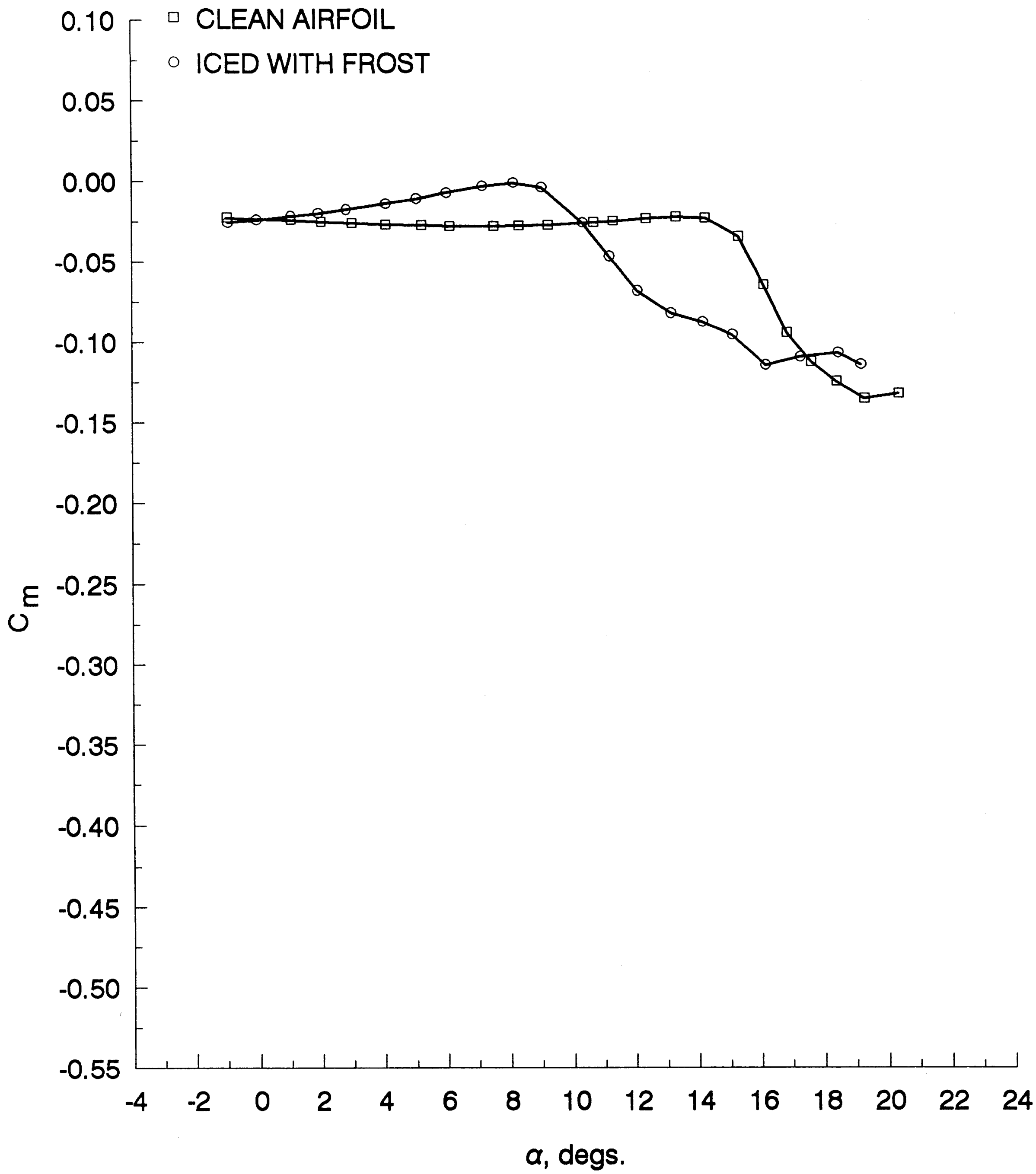
(A) C_l VERSUS α

FIGURE 9 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 2B.



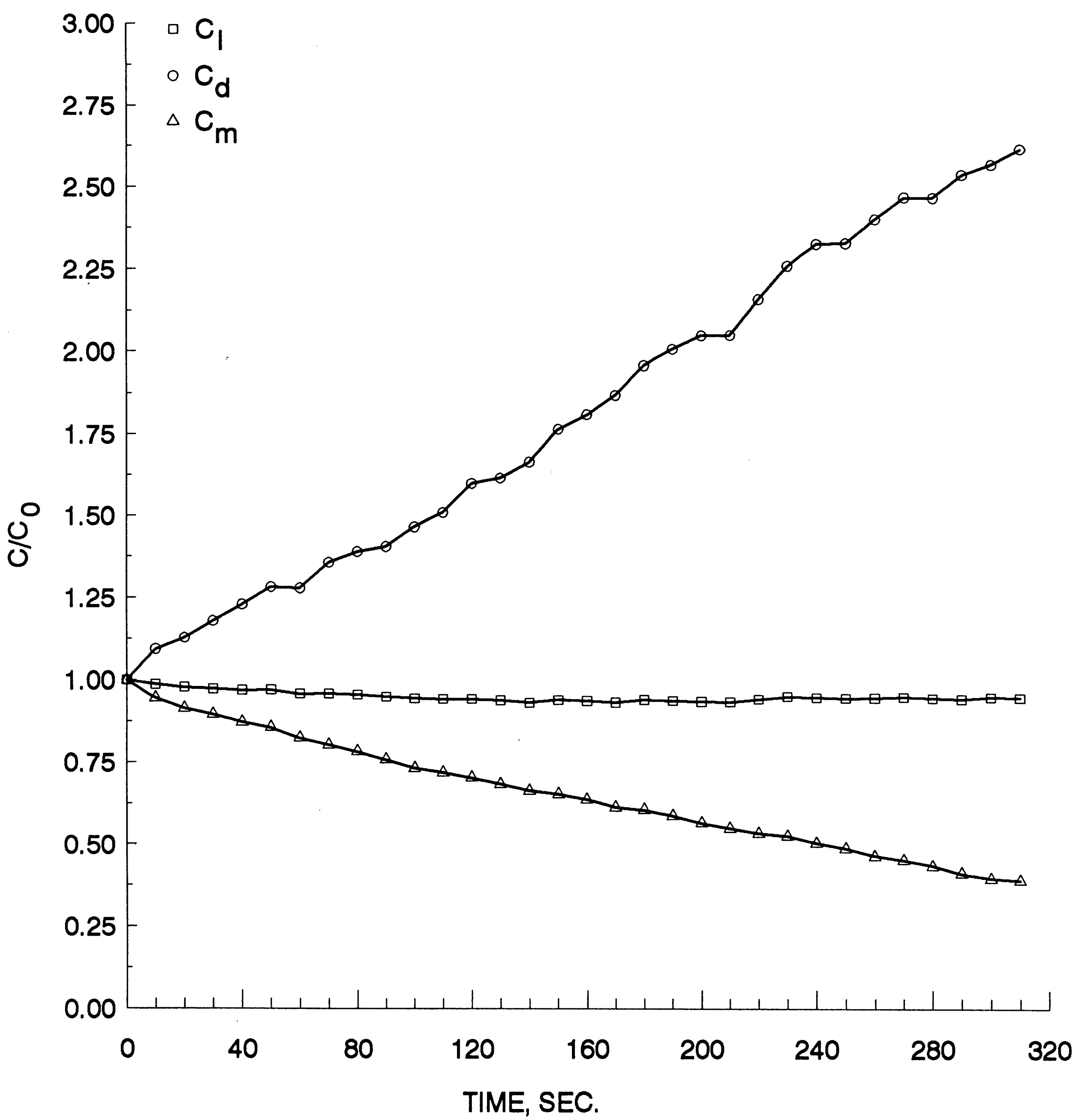
(B) C_d VERSUS α

FIGURE 9 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 2B (con't).



(C) C_m VERSUS α

FIGURE 9 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 2B (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 9 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 2B (con't).

TABLE 8 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 2B.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−0.9749	0.0550	0.0084	−0.0224
1.0542	0.2845	0.0088	−0.0237
2.0200	0.3989	0.0087	−0.0250
3.0006	0.5082	0.0098	−0.0258
4.0891	0.6332	0.0122	−0.0268
5.2207	0.7597	0.0158	−0.0272
6.1244	0.8574	0.0194	−0.0277
7.5180	1.0040	0.0254	−0.0277
8.3195	1.0841	0.0291	−0.0273
9.2371	1.1715	0.0336	−0.0270
10.6897	1.3013	0.0435	−0.0253
11.3100	1.3475	0.0485	−0.0245
12.3828	1.4143	0.0587	−0.0228
13.3320	1.4558	0.0675	−0.0218
14.2683	1.4875	0.0823	−0.0226
15.3200	1.4812	0.1121	−0.0341
16.1230	1.3637	0.1599	−0.0643
16.8613	1.2811	0.2871	−0.0942
17.6236	1.1962	0.3440	−0.1121
18.4185	1.1263	0.3663	−0.1242
19.2924	1.0690	0.3840	−0.1352
20.3750	0.9932	0.3973	−0.1319

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−0.9460	0.0559	0.0266	−0.0254
−0.0426	0.1563	0.0260	−0.0237
1.0452	0.2738	0.0257	−0.0216
1.9255	0.3685	0.0267	−0.0196
2.8167	0.4635	0.0293	−0.0174
4.0882	0.5926	0.0358	−0.0137
5.0574	0.6850	0.0405	−0.0107
6.0205	0.7683	0.0477	−0.0071
7.1579	0.8571	0.0589	−0.0030
8.1477	0.9202	0.0743	−0.0009
9.0449	0.9455	0.0932	−0.0037
10.3407	0.9505	0.1331	−0.0255
11.2005	0.9342	0.1703	−0.0465
12.1047	0.9012	0.1995	−0.0681
13.1777	0.8931	0.2309	−0.0819
14.1850	0.8246	0.2472	−0.0873
15.1277	0.8382	0.2798	−0.0953
16.1889	0.8184	0.3092	−0.1141
17.2850	0.8074	0.3245	−0.1091
18.4778	0.8090	0.3449	−0.1065
19.1901	0.8447	0.3690	−0.1138

TABLE 9 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 2B.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9866	1.0938	0.9461
20	0.9786	1.1280	0.9141
30	0.9742	1.1796	0.8954
40	0.9701	1.2297	0.8729
50	0.9715	1.2844	0.8569
60	0.9598	1.2812	0.8255
70	0.9604	1.3597	0.8046
80	0.9572	1.3928	0.7841
90	0.9497	1.4079	0.7590
100	0.9456	1.4671	0.7330
110	0.9432	1.5105	0.7190
120	0.9439	1.5994	0.7036
130	0.9395	1.6162	0.6849
140	0.9325	1.6650	0.6640
150	0.9400	1.7667	0.6539
160	0.9377	1.8115	0.6373
170	0.9326	1.8710	0.6138
180	0.9413	1.9608	0.6070
190	0.9381	2.0111	0.5894
200	0.9362	2.0520	0.5668
210	0.9354	2.0530	0.5507
220	0.9438	2.1637	0.5364
230	0.9519	2.2656	0.5268
240	0.9487	2.3327	0.5052
250	0.9465	2.3347	0.4889
260	0.9476	2.4068	0.4664
270	0.9499	2.4732	0.4547
280	0.9474	2.4724	0.4363
290	0.9445	2.5438	0.4134
300	0.9503	2.5754	0.3981
310	0.9489	2.6238	0.3922

TABLE 10 - TEST CONDITIONS FOR RUN NUMBER 2B.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 2B	Configuration Cruise Wing	Date 05-02-88	
P_{air} 43 psig	ΔP_w 16.4 psid	T_{avg} 25° F	V_∞ 100 mph
Spray Duration 5 min	Ice Accretion Type Rime		A.O.A. 5°
LWC 1.4 g/m³	MVD 17 μm		
Remarks • Ice accretion approximately 1/4" - 3/8" • More ice noticed between sections C and D than at other locations • No frost evident			

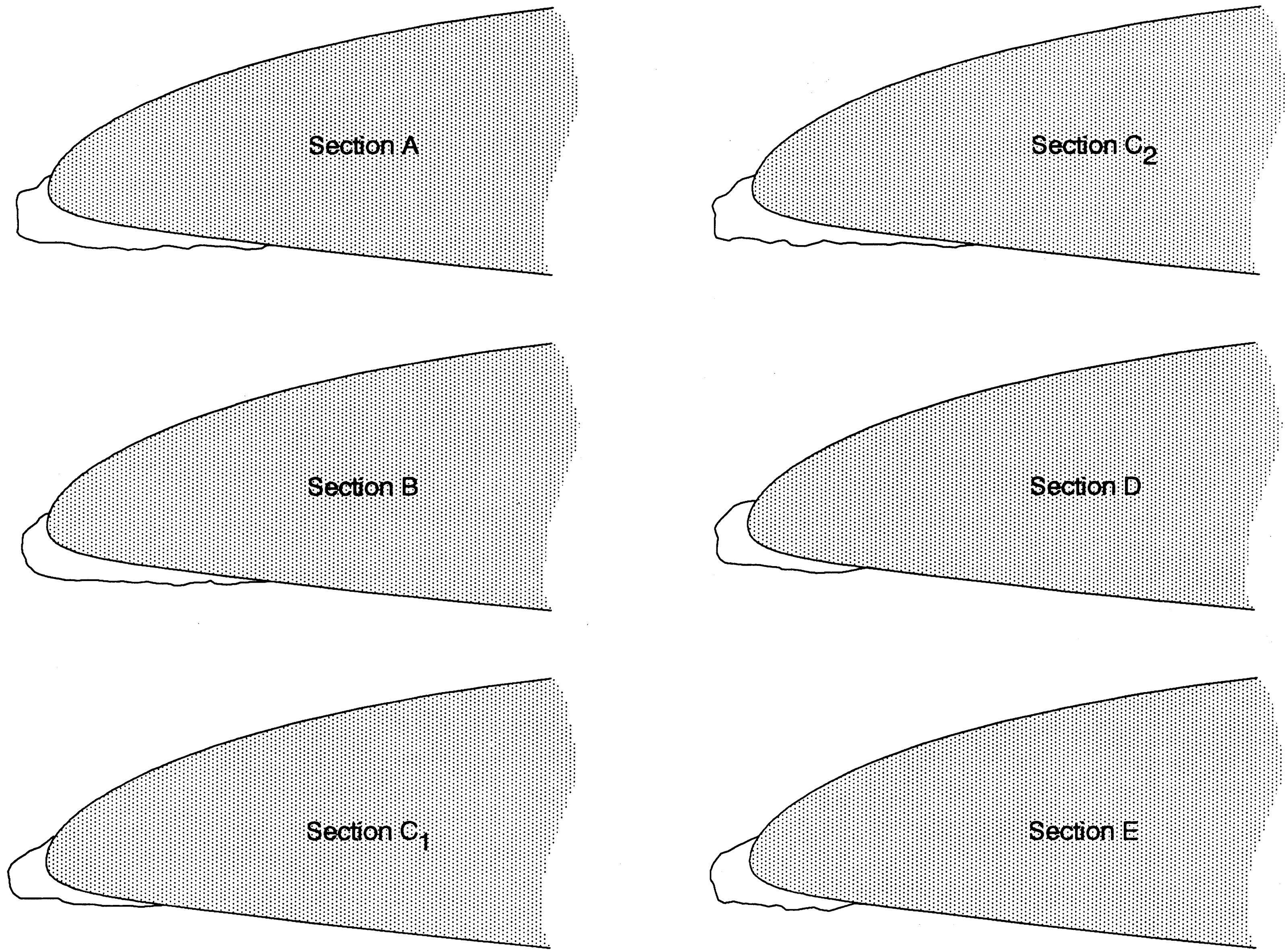


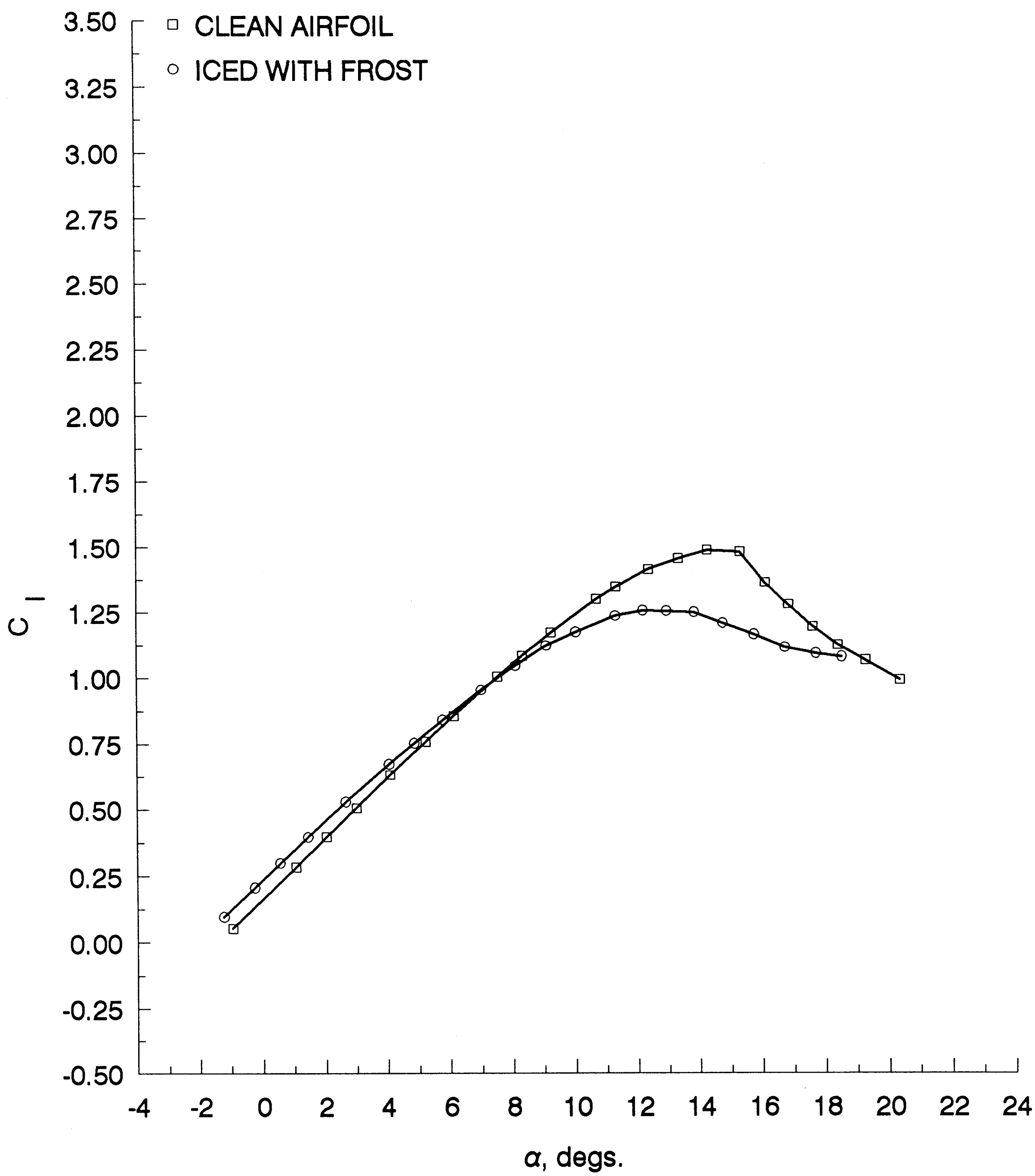
FIGURE 10 - RUN 3 ICE SHAPE TRACINGS FOR SECTIONS A - E.

TABLE 11 - RUN 3 ICE SHAPE COORDINATES FOR SECTIONS A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.025189	0.089428	0.021357	0.080022	0.048585	0.161888	0.031381	0.098339	0.045556	0.152923	0.054779	0.158075
−0.000711	0.085744	−0.008567	0.072447	0.004522	0.124972	0.009272	0.084568	0.005686	0.148926	0.018831	0.140478
−0.022787	0.071771	−0.048730	0.044936	−0.041527	0.090017	−0.030754	0.071075	−0.042148	0.139035	−0.029100	0.117015
−0.042998	0.049586	−0.067037	0.017086	−0.109464	0.068827	−0.060734	0.063474	−0.087964	0.117392	−0.081000	0.095557
−0.059233	0.027339	−0.097175	−0.004552	−0.133494	0.049401	−0.092888	0.043810	−0.111843	0.093833	−0.130960	0.066165
−0.073389	0.011196	−0.121260	−0.020256	−0.177522	0.020296	−0.121274	0.009975	−0.145671	0.060457	−0.184825	0.048681
−0.101367	0.001407	−0.141432	−0.040038	−0.227571	−0.016594	−0.147578	−0.017845	−0.175520	0.031008	−0.208917	0.017144
−0.133260	−0.004228	−0.157631	−0.059882	−0.249720	−0.061415	−0.169779	−0.037663	−0.203371	−0.000397	−0.235026	−0.018341
−0.163196	−0.011940	−0.160226	−0.100031	−0.241983	−0.116128	−0.203833	−0.051249	−0.211298	−0.023925	−0.253235	−0.063779
−0.185181	−0.019777	−0.162790	−0.138172	−0.236180	−0.157163	−0.231884	−0.062912	−0.205261	−0.051344	−0.251599	−0.119246
−0.195332	−0.033937	−0.159303	−0.170378	−0.214432	−0.202172	−0.246092	−0.080838	−0.193233	−0.082670	−0.231857	−0.145120
−0.207835	−0.072609	−0.149672	−0.190621	−0.166684	−0.233622	−0.256502	−0.110920	−0.199103	−0.137543	−0.218264	−0.198682
−0.206243	−0.099229	−0.141937	−0.204807	−0.090870	−0.235899	−0.247036	−0.143325	−0.199007	−0.184567	−0.204645	−0.248284
−0.200827	−0.136137	−0.136250	−0.222980	−0.001072	−0.234329	−0.239408	−0.165622	−0.178996	−0.219796	−0.166948	−0.268329
−0.199447	−0.177074	−0.132580	−0.243132	0.082731	−0.234688	−0.239956	−0.201905	−0.147045	−0.243245	−0.101189	−0.258843
−0.196019	−0.213951	−0.118946	−0.261428	0.110569	−0.256289	−0.240382	−0.230125	−0.091200	−0.250973	−0.041542	−0.271105
−0.198615	−0.254825	−0.099320	−0.277807	0.184327	−0.272227	−0.242799	−0.258315	−0.025389	−0.256721	0.018156	−0.275445
−0.202924	−0.277260	−0.077829	−0.302253	0.248185	−0.270547	−0.243256	−0.288551	0.024459	−0.256623	0.073872	−0.279759
−0.183414	−0.302117	−0.046222	−0.314799	0.306049	−0.270794	−0.231678	−0.312924	0.074310	−0.258484	0.123578	−0.289978
−0.145862	−0.317028	−0.002693	−0.327529	0.369848	−0.282784	−0.194039	−0.325604	0.128166	−0.268175	0.173398	−0.282371
−0.098372	−0.332096	0.048844	−0.336364	0.441687	−0.281138	−0.150368	−0.334346	0.203947	−0.273903	0.207215	−0.286546
−0.056785	−0.342979	0.086473	−0.344984	0.547439	−0.281591	−0.120326	−0.322714	0.221920	−0.287583	0.232931	−0.312458
−0.001162	−0.345900	0.120158	−0.351533	0.605269	−0.289650	−0.078402	−0.315298	0.285724	−0.287457	0.302620	−0.310919
0.072409	−0.345012	0.159896	−0.352148			−0.036630	−0.317962	0.339571	−0.293230	0.366389	−0.301420
0.130019	−0.347965	0.203576	−0.354833			0.007133	−0.320656	0.403405	−0.306819	0.414218	−0.293801
0.177539	−0.360987	0.235427	−0.351306			0.042873	−0.327258	0.459242	−0.310628	0.457914	−0.309923
0.225120	−0.369919	0.261256	−0.351706			0.062626	−0.337645	0.531015	−0.306568	0.513605	−0.318199
0.290589	−0.379132	0.322849	−0.352658			0.092394	−0.344154	0.600802	−0.306430	0.567470	−0.300715
0.334286	−0.381866	0.372460	−0.357444			0.118180	−0.350602	0.644655	−0.300466	0.629298	−0.283282
0.396023	−0.374655	0.410180	−0.360037			0.152173	−0.341048	0.720392	−0.284641	0.671181	−0.271664
0.431799	−0.375217	0.451904	−0.360682			0.174191	−0.333324	0.782183	−0.274723		
0.473448	−0.382010	0.487728	−0.357218			0.202090	−0.331740				
0.511090	−0.390785	0.521414	−0.363767			0.219944	−0.336049				
0.552921	−0.385307	0.553143	−0.368277			0.231766	−0.344297				
0.580717	−0.387790	0.588906	−0.368830			0.251429	−0.360731				

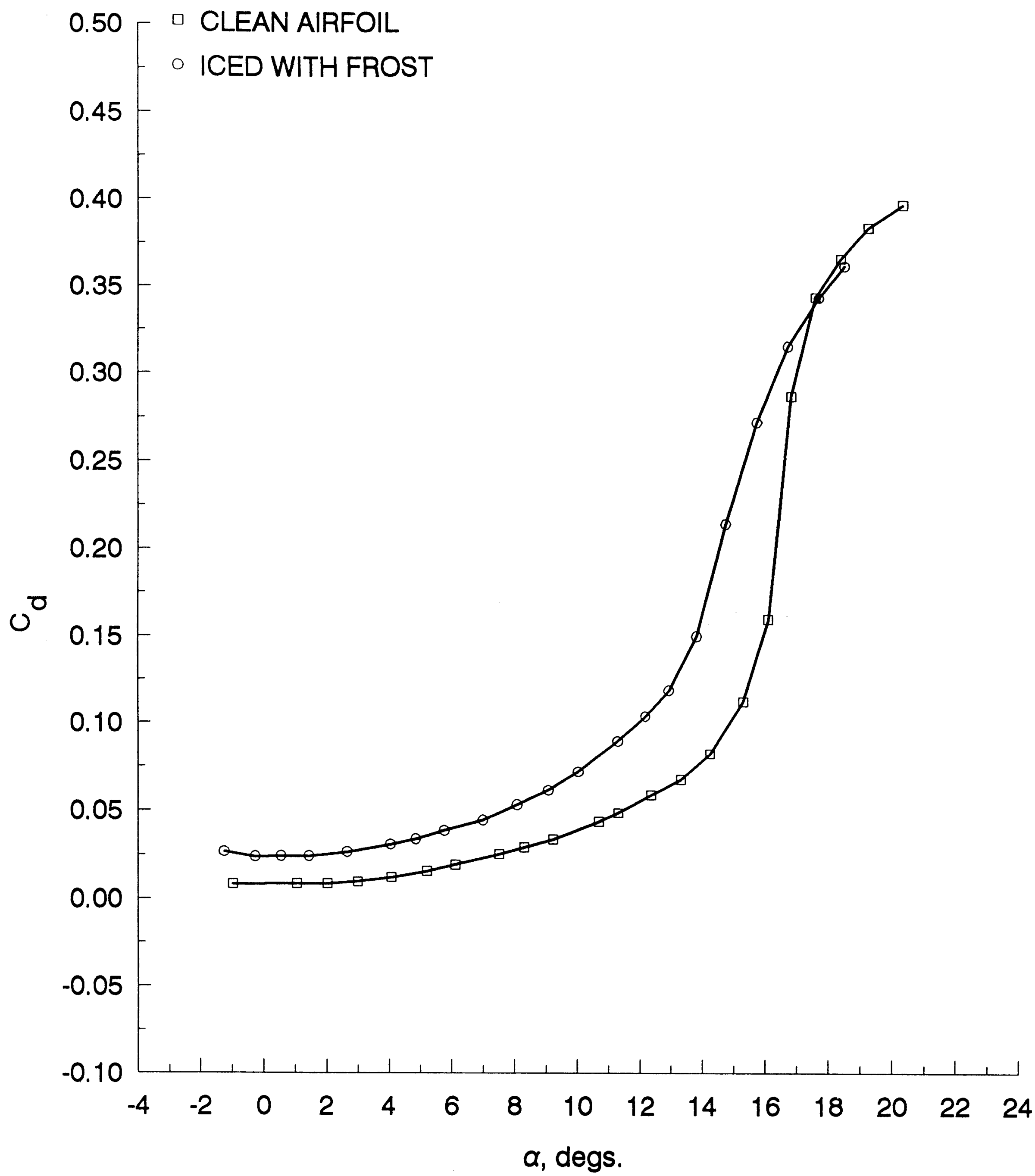
TABLE 11 - RUN 3 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.614445	−0.392412	0.614796	−0.365212			0.299112	−0.367518				
0.650344	−0.384794	0.646647	−0.361685			0.344895	−0.368227				
0.688169	−0.381298	0.684245	−0.372314			0.388901	−0.354795				
0.708166	−0.373430	0.712032	−0.374753			0.414901	−0.347133				
0.736115	−0.365686	0.747825	−0.373297			0.432877	−0.343379				
0.777854	−0.366344	0.763720	−0.373543			0.456947	−0.331655				
0.813570	−0.370997	0.793463	−0.378022			0.490696	−0.338226				
0.835403	−0.373387	0.817184	−0.386427			0.528395	−0.346875				
0.867114	−0.380023	0.841026	−0.386795			0.566125	−0.353508				
0.894879	−0.384551	0.878837	−0.383361			0.590043	−0.351862				
0.932887	−0.368784	0.918757	−0.371922			0.618003	−0.346246				
0.970773	−0.361197	0.958555	−0.368518			0.663787	−0.346956				
0.992636	−0.361541	1.000279	−0.369163			0.697475	−0.357558				
1.038290	−0.366351	1.014218	−0.367369			0.759183	−0.358514				
1.084005	−0.367070	1.050194	−0.353860			0.791033	−0.359007				
1.161521	−0.368290	1.073732	−0.374318			0.840858	−0.355747				
1.217053	−0.377347	1.105462	−0.378828			0.880609	−0.360395				
1.268609	−0.386342	1.137221	−0.381329			0.906517	−0.358780				
1.322304	−0.385141	1.165037	−0.381759			0.928536	−0.351056				
1.370098	−0.379756	1.198875	−0.378263			0.960446	−0.347518				
1.380096	−0.375822	1.224795	−0.372635			1.008191	−0.350274				
1.404160	−0.361881	1.236808	−0.366793			1.047941	−0.354922				
						1.093634	−0.361678				
						1.127474	−0.362202				
						1.157364	−0.360649				
						1.189122	−0.367189				
						1.218889	−0.373699				
						1.252699	−0.376239				
						1.298483	−0.376948				
						1.330454	−0.369378				
						1.356363	−0.367763				
						1.368336	−0.365933				



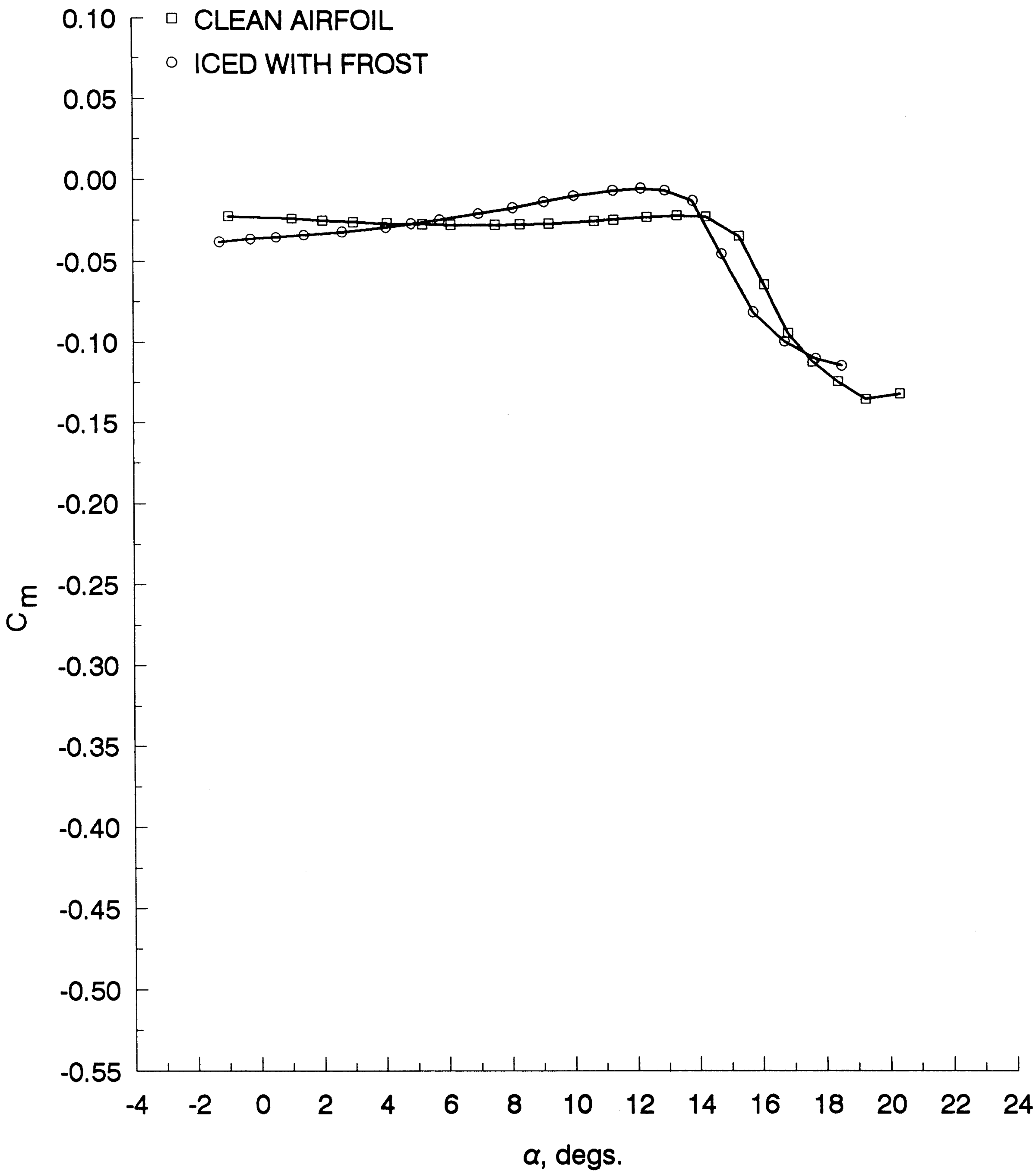
(A) C_l VERSUS α

FIGURE 11 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 3.



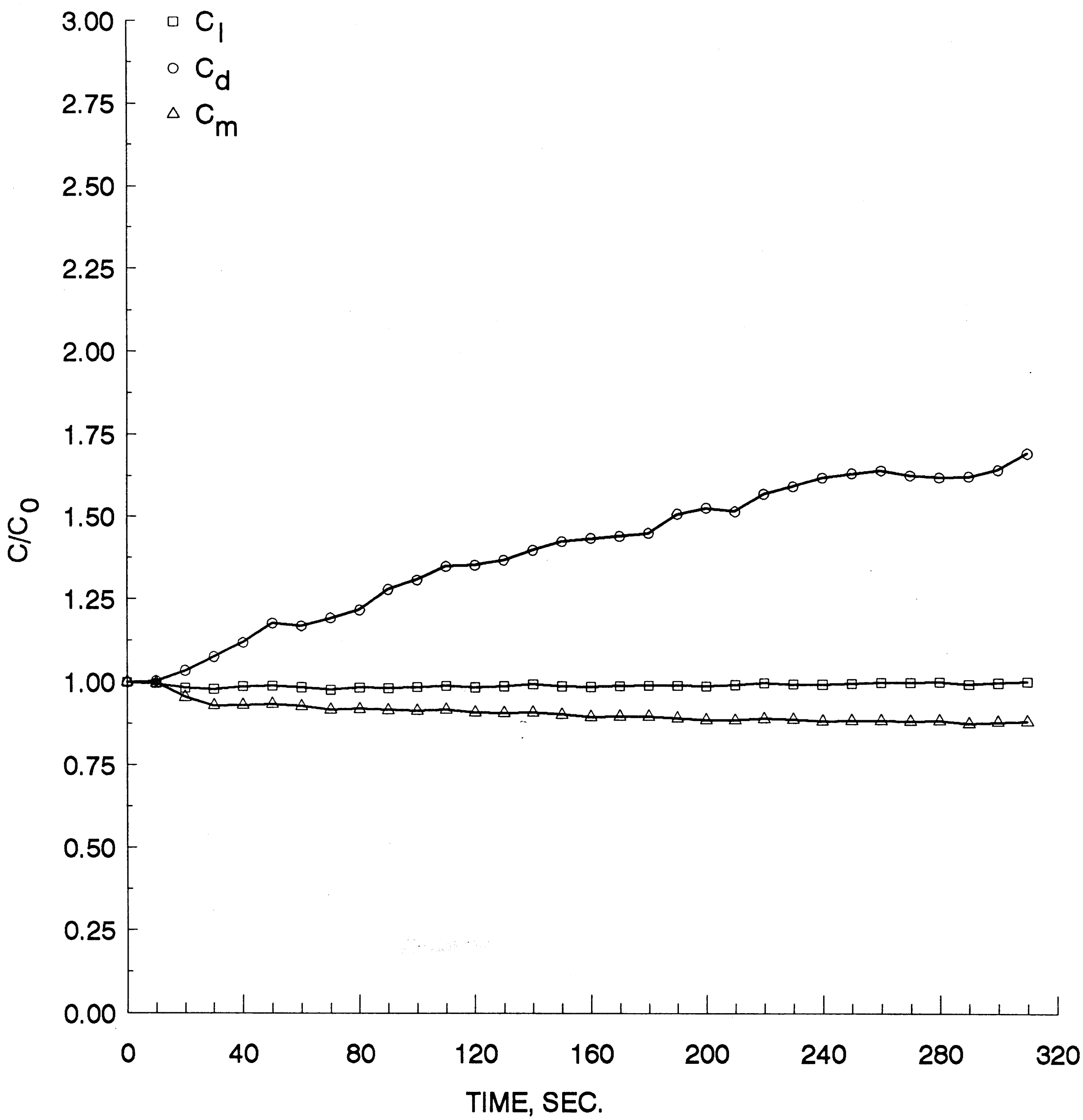
(B) C_d VERSUS α

FIGURE 11 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 3 (con't).



(C) C_m VERSUS α

FIGURE 11 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 3 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 11 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 3 (con't).

TABLE 12 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 3.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−0.9749	0.0550	0.0084	−0.0224
1.0542	0.2845	0.0088	−0.0237
2.0200	0.3989	0.0087	−0.0250
3.0006	0.5082	0.0098	−0.0258
4.0891	0.6332	0.0122	−0.0268
5.2207	0.7597	0.0158	−0.0272
6.1244	0.8574	0.0194	−0.0277
7.5180	1.0040	0.0254	−0.0277
8.3195	1.0841	0.0291	−0.0273
9.2371	1.1715	0.0336	−0.0270
10.6897	1.3013	0.0435	−0.0253
11.3100	1.3475	0.0485	−0.0245
12.3828	1.4143	0.0587	−0.0228
13.3320	1.4558	0.0675	−0.0218
14.2683	1.4875	0.0823	−0.0226
15.3200	1.4812	0.1121	−0.0341
16.1230	1.3637	0.1599	−0.0643
16.8613	1.2811	0.2871	−0.0942
17.6236	1.1962	0.3440	−0.1121
18.4185	1.1263	0.3663	−0.1242
19.2924	1.0690	0.3840	−0.1352
20.3750	0.9932	0.3973	−0.1319

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.2503	0.0984	0.0268	−0.0380
−0.2665	0.2083	0.0240	−0.0362
0.5502	0.3008	0.0244	−0.0351
1.4374	0.3988	0.0244	−0.0337
2.6522	0.5310	0.0267	−0.0318
4.0479	0.6742	0.0309	−0.0290
4.8567	0.7545	0.0339	−0.0269
5.7675	0.8427	0.0386	−0.0246
6.9966	0.9552	0.0444	−0.0209
8.0899	1.0465	0.0531	−0.0173
9.0856	1.1223	0.0613	−0.0137
10.0402	1.1745	0.0718	−0.0100
11.2984	1.2365	0.0894	−0.0066
12.1946	1.2569	0.1037	−0.0052
12.9542	1.2551	0.1187	−0.0065
13.8412	1.2503	0.1499	−0.0129
14.7653	1.2088	0.2145	−0.0452
15.7613	1.1654	0.2723	−0.0812
16.7499	1.1161	0.3154	−0.0994
17.7272	1.0941	0.3435	−0.1101
18.5435	1.0809	0.3619	−0.1145

TABLE 13 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 3.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9962	1.0042	0.9972
20	0.9833	1.0343	0.9560
30	0.9793	1.0768	0.9306
40	0.9876	1.1192	0.9327
50	0.9902	1.1785	0.9354
60	0.9858	1.1705	0.9293
70	0.9784	1.1942	0.9188
80	0.9844	1.2177	0.9208
90	0.9829	1.2802	0.9177
100	0.9862	1.3086	0.9153
110	0.9898	1.3492	0.9185
120	0.9857	1.3530	0.9103
130	0.9889	1.3683	0.9087
140	0.9952	1.3987	0.9104
150	0.9890	1.4247	0.9041
160	0.9872	1.4346	0.8973
170	0.9903	1.4411	0.8989
180	0.9915	1.4507	0.8983
190	0.9911	1.5094	0.8942
200	0.9902	1.5277	0.8884
210	0.9939	1.5173	0.8879
220	0.9995	1.5716	0.8925
230	0.9963	1.5943	0.8898
240	0.9958	1.6219	0.8850
250	0.9985	1.6345	0.8874
260	1.0018	1.6439	0.8873
270	1.0019	1.6288	0.8854
280	1.0031	1.6228	0.8877
290	0.9967	1.6263	0.8786
300	1.0007	1.6460	0.8831
310	1.0051	1.6973	0.8854

TABLE 14 - TEST CONDITIONS FOR RUN NUMBER 3.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 3	Configuration Cruise Wing	Date 05-02-88	
P_{air} 37 psig	ΔP_w 6.8 psid	T_{avg} 10° F	V_∞ 100 mph
Spray Duration 5 min	Ice Accretion Type Rime	A.O.A. 5°	
LWC 0.9 g/m³	MVD 14 μm		

Remarks

- Ice accretion approximately 1/4" - 3/8" thick
- Very uniform across span
- We were expecting mixed rime and glaze ice, but there was essentially rime ice at this condition
- Frost on lower surface to about 30% chord

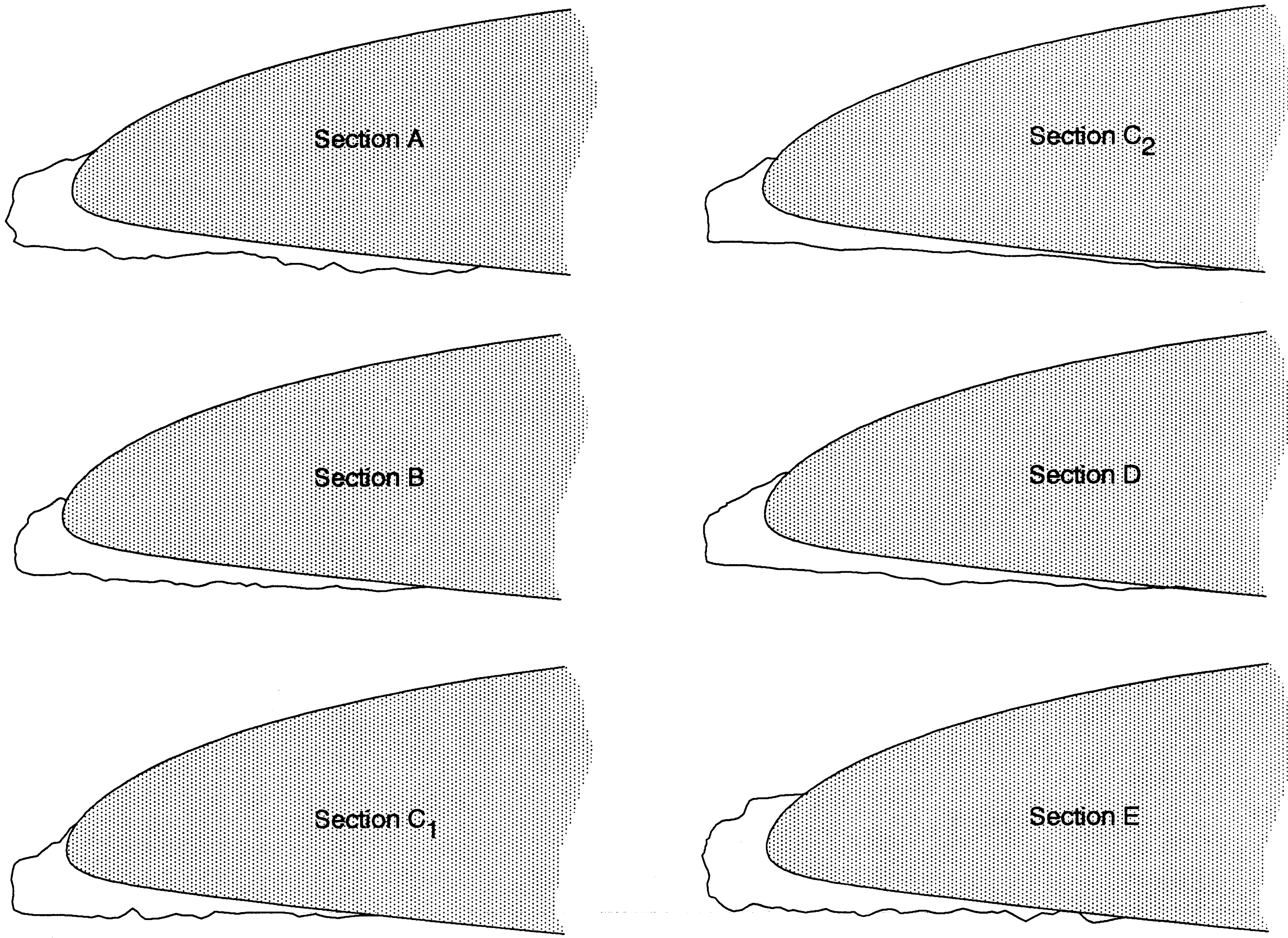


FIGURE 12 - RUN 4B ICE SHAPE TRACINGS FOR SECTIONS A - E.

TABLE 15 - RUN 4B ICE SHAPE COORDINATES FOR SECTIONS A - E.

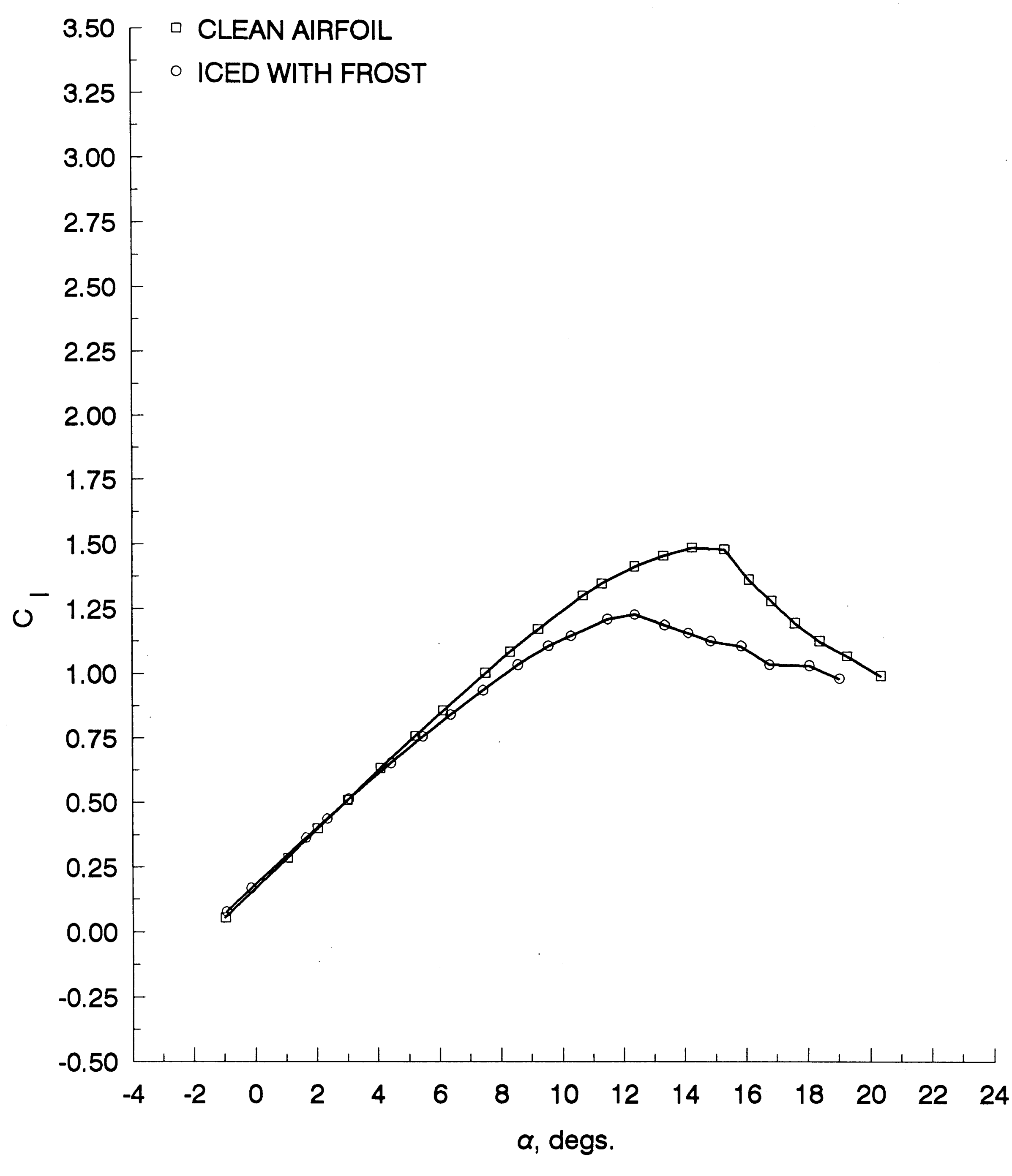
SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.114236	0.243748	0.017744	0.109049	0.020749	0.137099	0.091353	0.194006	0.142786	0.265159	0.264605	0.341269
0.061684	0.224264	−0.000288	0.113379	−0.001072	0.104669	0.063232	0.192424	0.114534	0.257657	0.149830	0.332934
0.041436	0.214429	−0.018290	0.119735	−0.030944	0.072159	0.025140	0.195021	0.096358	0.251985	0.087461	0.331873
0.021158	0.202566	−0.042691	0.101875	−0.044835	0.051888	−0.011375	0.169414	0.076051	0.238416	0.067259	0.326125
−0.003016	0.198879	−0.065082	0.083984	−0.095072	0.043338	−0.056009	0.137892	0.041402	0.207225	0.045047	0.320408
−0.039063	0.207555	−0.089453	0.068150	−0.125004	0.016869	−0.096568	0.110333	0.000910	0.188015	0.000684	0.313012
−0.079466	0.193972	−0.125917	0.050477	−0.159001	−0.005615	−0.133145	0.080701	−0.049566	0.172919	−0.035512	0.313568
−0.126051	0.170336	−0.146174	0.040658	−0.190905	−0.036131	−0.193737	0.055462	−0.083939	0.159563	−0.085816	0.312321
−0.184815	0.138771	−0.186567	0.029123	−0.247161	−0.046753	−0.242138	0.040102	−0.114538	0.130293	−0.112173	0.298591
−0.251433	0.119505	−0.213071	0.005217	−0.305369	−0.063436	−0.306928	0.002850	−0.155061	0.109101	−0.132805	0.264579
−0.295855	0.105984	−0.225471	−0.016880	−0.341319	−0.091978	−0.347425	−0.020683	−0.199602	0.087969	−0.149692	0.212336
−0.344418	0.084410	−0.225840	−0.041189	−0.349032	−0.126282	−0.370111	−0.060593	−0.238054	0.070710	−0.184277	0.186616
−0.371278	0.036115	−0.254478	−0.073167	−0.358520	−0.184766	−0.372854	−0.108861	−0.248100	0.070862	−0.220597	0.179097
−0.385958	−0.004249	−0.274920	−0.095140	−0.345928	−0.236990	−0.355869	−0.179573	−0.248315	0.056991	−0.285099	0.169991
−0.388490	−0.038712	−0.291495	−0.127304	−0.347444	−0.287341	−0.355213	−0.268151	−0.290786	0.039792	−0.327697	0.146413
−0.382831	−0.063154	−0.298080	−0.163674	−0.353045	−0.331692	−0.355612	−0.294313	−0.303241	0.014212	−0.362560	0.102524
−0.393339	−0.093435	−0.308439	−0.183776	−0.344518	−0.379930	−0.359901	−0.312363	−0.325435	0.008601	−0.373229	0.062301
−0.401745	−0.117659	−0.307075	−0.226348	−0.285893	−0.405526	−0.354281	−0.338617	−0.361939	−0.012652	−0.393553	0.048478
−0.416426	−0.158024	−0.303269	−0.240590	−0.209332	−0.412824	−0.316281	−0.347252	−0.395009	−0.071616	−0.391850	0.028259
−0.435094	−0.196297	−0.309762	−0.270883	−0.132831	−0.414083	−0.249975	−0.342230	−0.393768	−0.121188	−0.398313	0.000088
−0.413452	−0.227074	−0.302212	−0.303418	−0.050292	−0.415282	−0.167710	−0.343492	−0.388293	−0.156949	−0.404807	−0.030102
−0.389616	−0.245708	−0.290642	−0.336016	0.018178	−0.418633	−0.029326	−0.349641	−0.378800	−0.192770	−0.419222	−0.052093
−0.369860	−0.268338	−0.260824	−0.358764	0.088681	−0.423978	0.078993	−0.353315	−0.381301	−0.224446	−0.409629	−0.082530
−0.364262	−0.296838	−0.224760	−0.367424	0.165242	−0.431276	0.199473	−0.349125	−0.383864	−0.260086	−0.400036	−0.112967
−0.380768	−0.324997	−0.186685	−0.376116	0.211434	−0.420753	0.251549	−0.355962	−0.378543	−0.305755	−0.380542	−0.153653
−0.352851	−0.339635	−0.132405	−0.376953	0.267967	−0.438316	0.321530	−0.373139	−0.336564	−0.320263	−0.372929	−0.182040
−0.306911	−0.358610	−0.074103	−0.377851	0.336358	−0.433614	0.387620	−0.382205	−0.256317	−0.329402	−0.377258	−0.202166
−0.250617	−0.357450	−0.017720	−0.372642	0.392455	−0.406886	0.449698	−0.391209	−0.185994	−0.330463	−0.385763	−0.232326
−0.176300	−0.360628	0.018529	−0.369148	0.434423	−0.376270	0.507793	−0.398139	−0.121699	−0.331433	−0.384398	−0.274752
−0.106063	−0.367801	0.044817	−0.359422	0.464831	−0.398118	0.545977	−0.394698	−0.075578	−0.338075	−0.374959	−0.315283
−0.045966	−0.380907	0.062727	−0.371855	0.489241	−0.424052	0.626236	−0.395930	−0.013353	−0.342978	−0.360944	−0.319537
0.022354	−0.381962	0.096903	−0.372382	0.519630	−0.443886	0.696585	−0.388957	0.030788	−0.347608	−0.336875	−0.323945
0.076546	−0.386858	0.133121	−0.370914	0.600136	−0.443092	0.772892	−0.386102	0.088933	−0.356413	−0.313205	−0.354598

TABLE 15 - RUN 4B ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.131015	−0.373492	0.175309	−0.373590	0.650354	−0.432529	0.859109	−0.391450	0.157247	−0.357444	−0.283411	−0.379287
0.165267	−0.367933	0.205249	−0.388235	0.718585	−0.411722	0.941313	−0.396737	0.227478	−0.364450	−0.253554	−0.399939
0.211145	−0.390966	0.233241	−0.398798	0.758938	−0.421391	1.023516	−0.402024	0.291712	−0.369383	−0.215501	−0.410620
0.278881	−0.430574	0.259192	−0.411355	0.825356	−0.420735	1.101615	−0.413287	0.351836	−0.380200	−0.169158	−0.405273
0.334959	−0.443617	0.281244	−0.415747	0.881909	−0.440311	1.195919	−0.414734	0.450288	−0.381686	−0.142801	−0.391543
0.397435	−0.432404	0.313534	−0.408139	0.930074	−0.425742	1.252131	−0.413583	0.536747	−0.379025	−0.114371	−0.373806
0.443621	−0.435147	0.347710	−0.408666	0.972062	−0.397140	1.330506	−0.406734	0.590965	−0.381825	−0.088106	−0.366132
0.481737	−0.439795	0.385908	−0.409255	1.048643	−0.406451	1.416569	−0.422144	0.645122	−0.388589	−0.047950	−0.370787
0.530271	−0.420249	0.410001	−0.411653	1.119145	−0.411796	1.492723	−0.429352	0.703452	−0.385505	−0.005905	−0.383548
0.564400	−0.422806	0.444025	−0.422308	1.189510	−0.403048	1.576871	−0.438694	0.747655	−0.386171	0.034190	−0.392241
0.590399	−0.431326	0.492305	−0.421026	1.266030	−0.406320	1.709329	−0.438713	0.779741	−0.390620	0.064446	−0.386648
0.628516	−0.435974	0.524440	−0.423547	1.356580	−0.403413	1.785667	−0.433845	0.825708	−0.407170	0.088577	−0.387018
0.686973	−0.424699	0.596784	−0.426688	1.416980	−0.404830	1.913957	−0.443865	0.867748	−0.417715	0.114565	−0.397514
0.731272	−0.419295	0.643146	−0.419298	1.473414	−0.412327	2.022153	−0.455589	0.944007	−0.424811	0.140491	−0.412047
0.817830	−0.410484	0.689385	−0.420011	1.517891	−0.432022	2.128312	−0.469295	1.016370	−0.423921	0.172789	−0.404466
0.860150	−0.403019	0.711376	−0.428455	1.562110	−0.425546	2.244441	−0.487180	1.058441	−0.432484	0.212884	−0.413159
0.890353	−0.399427	0.739338	−0.441043	1.626416	−0.414844	2.332664	−0.492559	1.110435	−0.449125	0.255021	−0.419864
0.922442	−0.403982	0.789659	−0.437766	1.656686	−0.422599	2.398847	−0.495587	1.144439	−0.459549	0.299353	−0.414487
0.956571	−0.406538	0.817712	−0.444277	1.701103	−0.436255	2.457066	−0.494468	1.190651	−0.460246	0.335611	−0.411005
1.006837	−0.405285	0.857766	−0.455025	1.773599	−0.439566	2.497011	−0.507158	1.232938	−0.454938	0.390090	−0.399725
1.049126	−0.399850	0.885912	−0.455459	1.825888	−0.435023	2.540999	−0.517897	1.277326	−0.443714	0.416078	−0.410221
1.109470	−0.396722	0.914119	−0.451841	1.890234	−0.428348	2.601193	−0.518820	1.339550	−0.448617	0.444107	−0.418729
1.119548	−0.394848	0.936356	−0.444079	1.946589	−0.427792	2.663425	−0.517762	1.397726	−0.455441	0.482283	−0.421334
1.135439	−0.407271	0.962645	−0.434353			2.715593	−0.518563	1.472129	−0.452600	0.532587	−0.420088
1.177574	−0.411981	0.986893	−0.426622			2.747666	−0.521067	1.518464	−0.445370	0.570825	−0.418655
1.199677	−0.412322	1.017110	−0.423036			2.789771	−0.523726	1.552683	−0.441922	0.588738	−0.431046
1.223606	−0.424869	1.045256	−0.423469			2.853855	−0.532761	1.588941	−0.436522	0.608725	−0.439431
1.247596	−0.433358	1.085309	−0.434217			2.885897	−0.537278	1.625046	−0.441031	0.626731	−0.445765
1.293904	−0.427984	1.123477	−0.436832			2.938096	−0.536066	1.681212	−0.447825	0.658997	−0.440202
1.339998	−0.436815	1.159725	−0.433338			2.974212	−0.536620	1.745477	−0.450777	0.693367	−0.428614
1.351839	−0.451204	1.177695	−0.441720			3.004340	−0.535069	1.783622	−0.453334	0.717682	−0.416872
1.391627	−0.478203	1.205688	−0.452282			3.030516	−0.529432	1.845816	−0.460219	0.756074	−0.405345
1.435926	−0.472798	1.223843	−0.448509					1.885816	−0.472715	0.798365	−0.401956

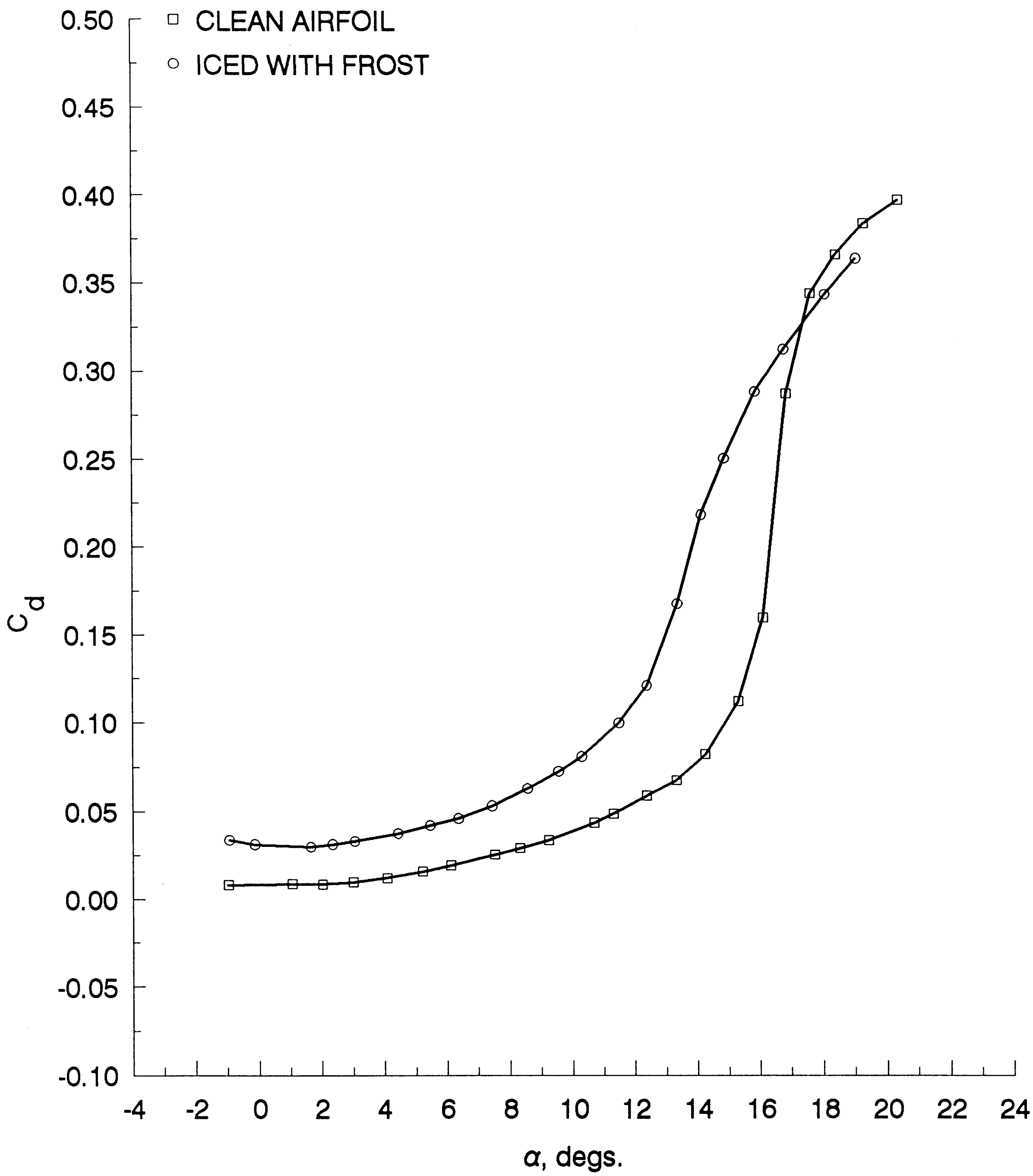
TABLE 15 - RUN 4B ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
1.492220	−0.471638	1.238038	−0.440624					1.936016	−0.475454	0.830478	−0.406488
1.522269	−0.478191	1.264235	−0.436975					1.992306	−0.474321	0.846443	−0.414810
1.582305	−0.495355	1.288206	−0.447475					2.020497	−0.470782	0.866367	−0.427232
1.606234	−0.507902	1.302125	−0.457821					2.058764	−0.465413	0.902624	−0.423750
1.636467	−0.502280	1.328198	−0.462275					2.094839	−0.471904	0.934830	−0.422225
1.662835	−0.486451	1.370539	−0.454823					2.170913	−0.490890	0.991320	−0.410977
1.699312	−0.466719	1.412758	−0.455473					2.207079	−0.491436	1.031538	−0.411594
1.755175	−0.493965	1.448976	−0.454005					2.255239	−0.496127	1.065569	−0.422214
1.801053	−0.516999	1.475080	−0.456434					2.277218	−0.504387	1.103715	−0.426838
1.841118	−0.525736	1.515258	−0.459080					2.319412	−0.505023	1.135890	−0.427332
1.885233	−0.532506	1.543341	−0.463565					2.359781	−0.493739	1.190277	−0.422109
1.917537	−0.522857	1.567404	−0.467988					2.389919	−0.494194	1.216573	−0.412416
1.990091	−0.509771	1.605541	−0.472628					2.460273	−0.493273	1.238815	−0.404681
2.034297	−0.510454	1.637769	−0.469072					2.520642	−0.488237	1.271113	−0.397099
2.106728	−0.505484	1.686018	−0.469816					2.572822	−0.492989	1.301184	−0.403619
2.154738	−0.520432	1.726380	−0.460307					2.649295	−0.486214	1.343198	−0.418399
2.266988	−0.540432	1.754556	−0.458715					2.673437	−0.484596	1.383355	−0.423055
2.351383	−0.541735	1.790804	−0.455221							1.423573	−0.423672
2.401802	−0.530337	1.810785	−0.463634							1.457851	−0.418140
2.454231	−0.518969	1.887057	−0.472915							1.491913	−0.426741
2.514329	−0.532074	1.923244	−0.473472							1.542432	−0.411362
2.568675	−0.526825	1.957390	−0.476025							1.584384	−0.430180
2.641382	−0.503593	1.983464	−0.480479							1.620273	−0.450924
		2.049653	−0.491630							1.678127	−0.482102
		2.103965	−0.490440							1.779534	−0.427119
		2.158430	−0.479123							1.853815	−0.436337
										1.898393	−0.414809
										2.022916	−0.426817
										2.042717	−0.447315
										2.074461	−0.476072
										2.114433	−0.492841
										2.201087	−0.482055
										2.259618	−0.468819
										2.328174	−0.457756



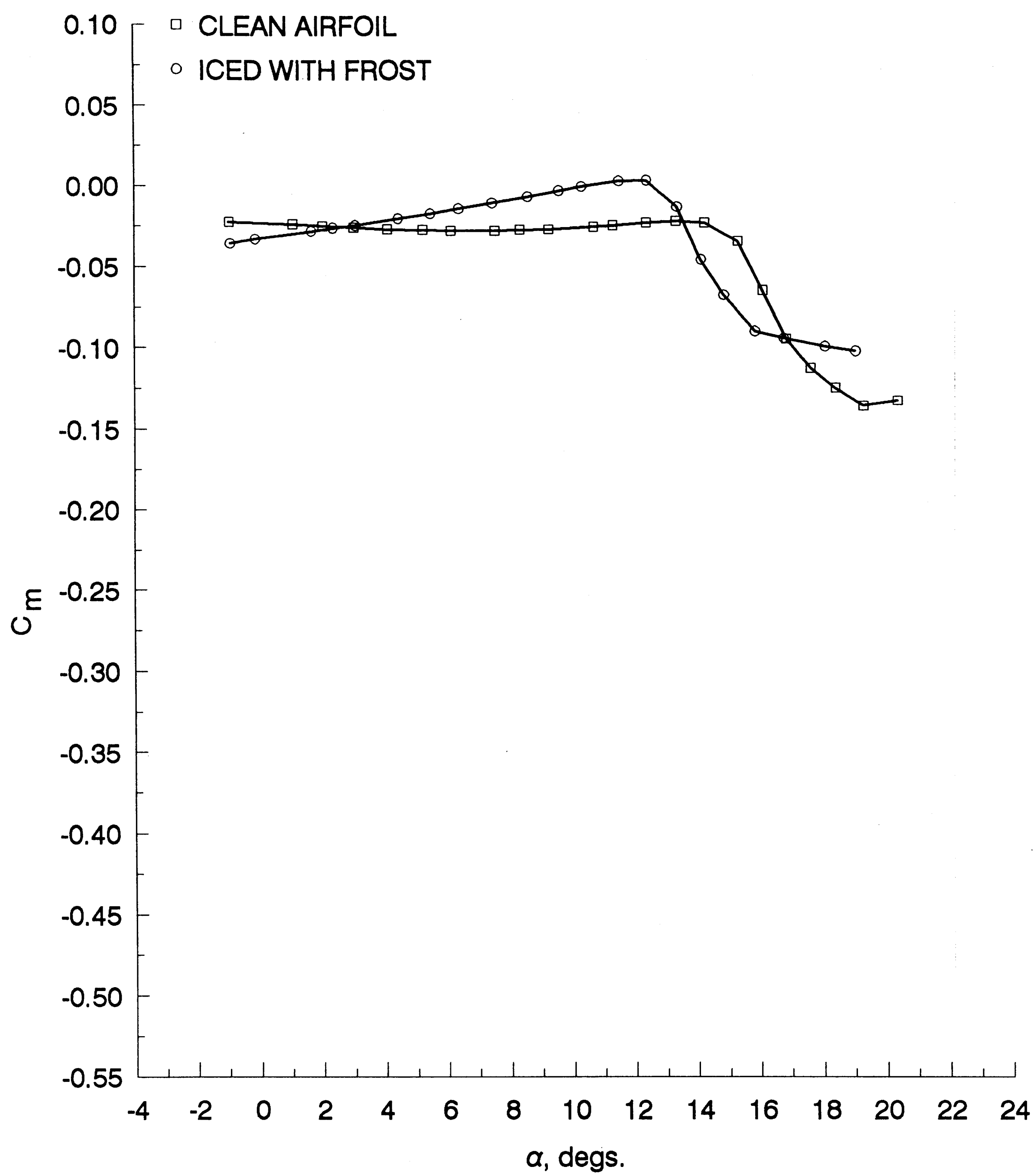
(A) C_l VERSUS α

FIGURE 13 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 4B.



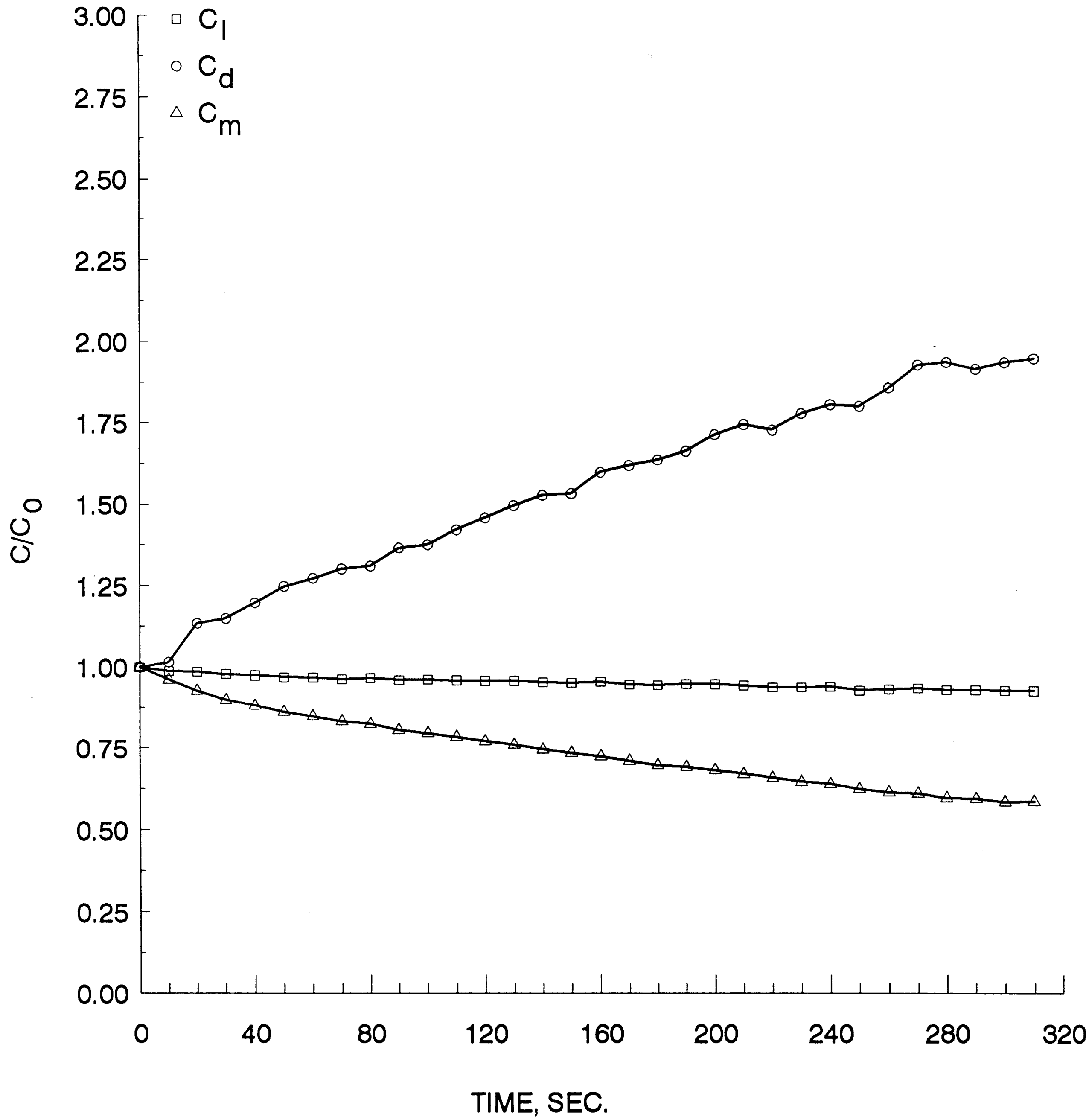
(B) C_d VERSUS α

FIGURE 13 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 4B (con't).



(C) C_m VERSUS α

FIGURE 13 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 4B (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 13 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 4B (con't).

TABLE 16 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 4B.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−0.9749	0.0550	0.0084	−0.0224
1.0542	0.2845	0.0088	−0.0237
2.0200	0.3989	0.0087	−0.0250
3.0006	0.5082	0.0098	−0.0258
4.0891	0.6332	0.0122	−0.0268
5.2207	0.7597	0.0158	−0.0272
6.1244	0.8574	0.0194	−0.0277
7.5180	1.0040	0.0254	−0.0277
8.3195	1.0841	0.0291	−0.0273
9.2371	1.1715	0.0336	−0.0270
10.6897	1.3013	0.0435	−0.0253
11.3100	1.3475	0.0485	−0.0245
12.3828	1.4143	0.0587	−0.0228
13.3320	1.4558	0.0675	−0.0218
14.2683	1.4875	0.0823	−0.0226
15.3200	1.4812	0.1121	−0.0341
16.1230	1.3637	0.1599	−0.0643
16.8613	1.2811	0.2871	−0.0942
17.6236	1.1962	0.3440	−0.1121
18.4185	1.1263	0.3663	−0.1242
19.2924	1.0690	0.3840	−0.1352
20.3750	0.9932	0.3973	−0.1319

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−0.9359	0.0786	0.0338	−0.0356
−0.1370	0.1683	0.0314	−0.0329
1.6464	0.3633	0.0300	−0.0281
2.3366	0.4369	0.0315	−0.0261
3.0504	0.5135	0.0332	−0.0245
4.4321	0.6530	0.0376	−0.0203
5.4621	0.7573	0.0421	−0.0173
6.3699	0.8421	0.0460	−0.0142
7.4397	0.9364	0.0530	−0.0109
8.5731	1.0343	0.0628	−0.0069
9.5662	1.1077	0.0725	−0.0031
10.3046	1.1460	0.0809	−0.0005
11.4987	1.2107	0.0999	0.0030
12.3914	1.2285	0.1210	0.0035
13.3745	1.1885	0.1677	−0.0129
14.1447	1.1579	0.2185	−0.0454
14.8778	1.1266	0.2505	−0.0672
15.8723	1.1079	0.2882	−0.0895
16.7897	1.0357	0.3123	−0.0937
18.0835	1.0326	0.3434	−0.0988
19.0538	0.9822	0.3639	−0.1017

TABLE 17 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 4B.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9883	1.0160	0.9619
20	0.9861	1.1361	0.9273
30	0.9792	1.1511	0.8987
40	0.9754	1.1993	0.8822
50	0.9697	1.2489	0.8624
60	0.9690	1.2745	0.8492
70	0.9648	1.3039	0.8337
80	0.9678	1.3120	0.8258
90	0.9615	1.3676	0.8065
100	0.9627	1.3776	0.7962
110	0.9602	1.4233	0.7852
120	0.9582	1.4592	0.7722
130	0.9583	1.4974	0.7606
140	0.9546	1.5294	0.7466
150	0.9527	1.5343	0.7349
160	0.9559	1.5999	0.7263
170	0.9479	1.6206	0.7122
180	0.9456	1.6379	0.6982
190	0.9485	1.6657	0.6934
200	0.9484	1.7160	0.6824
210	0.9447	1.7462	0.6719
220	0.9387	1.7302	0.6593
230	0.9388	1.7804	0.6480
240	0.9408	1.8084	0.6415
250	0.9292	1.8032	0.6258
260	0.9322	1.8598	0.6159
270	0.9360	1.9308	0.6120
280	0.9309	1.9384	0.5983
290	0.9304	1.9176	0.5957
300	0.9288	1.9384	0.5863
310	0.9276	1.9507	0.5876

TABLE 18 - TEST CONDITIONS FOR RUN NUMBER 4B.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 4B	Configuration Cruise Wing	Date 05-02-88	
P_{air} 31 psig	ΔP_W 10.5 psid	T_{avg} 10° F	V_∞ 100 mph
Spray Duration 5 min	Ice Accretion Type Rime	A.O.A. 5°	
LWC 1.13 g/m³	MVD 17 μm		
Remarks • Ice accretion approximately 1/2" thick • Uniform across the span • Beginning of ice fingers on lower surface, including light frost			

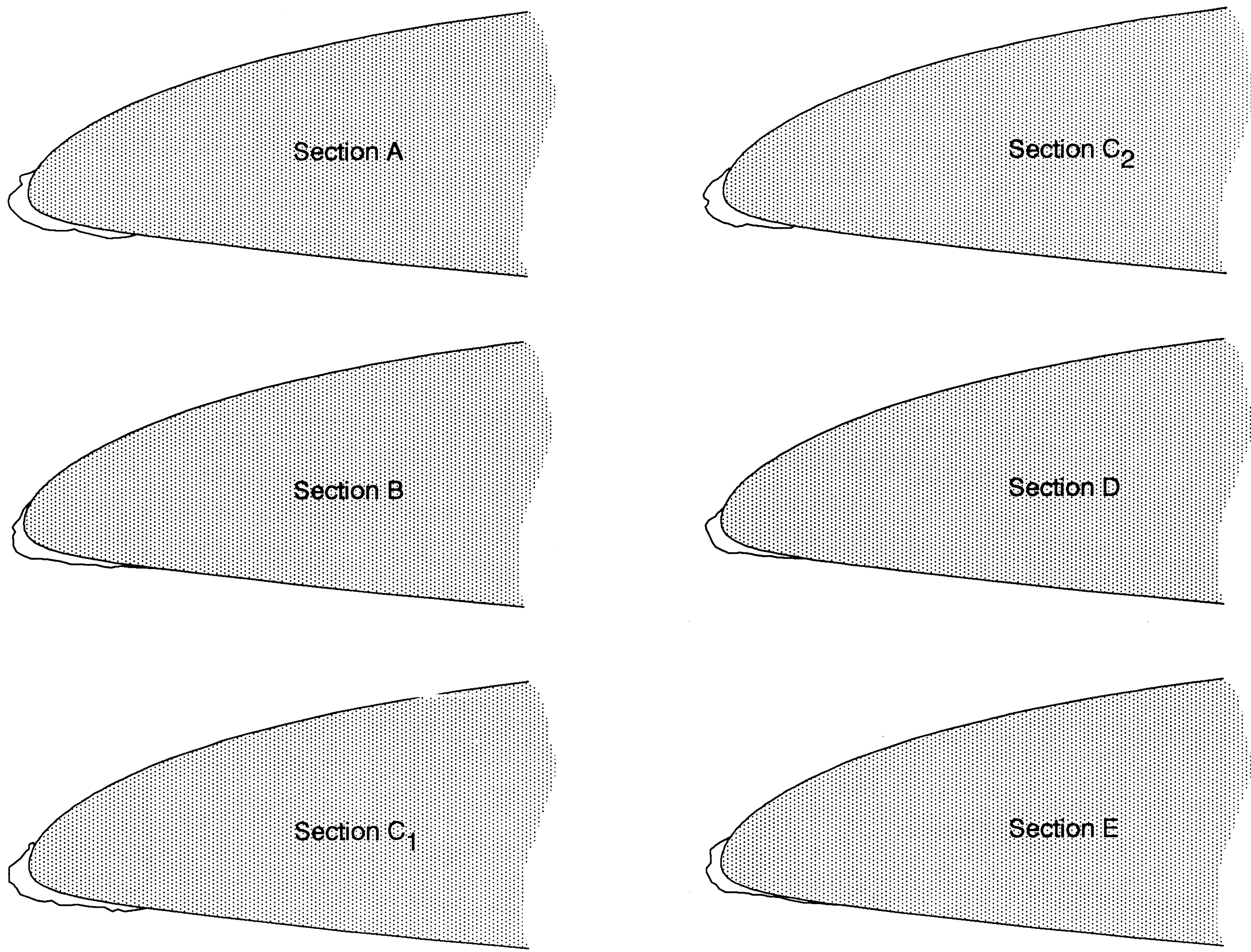
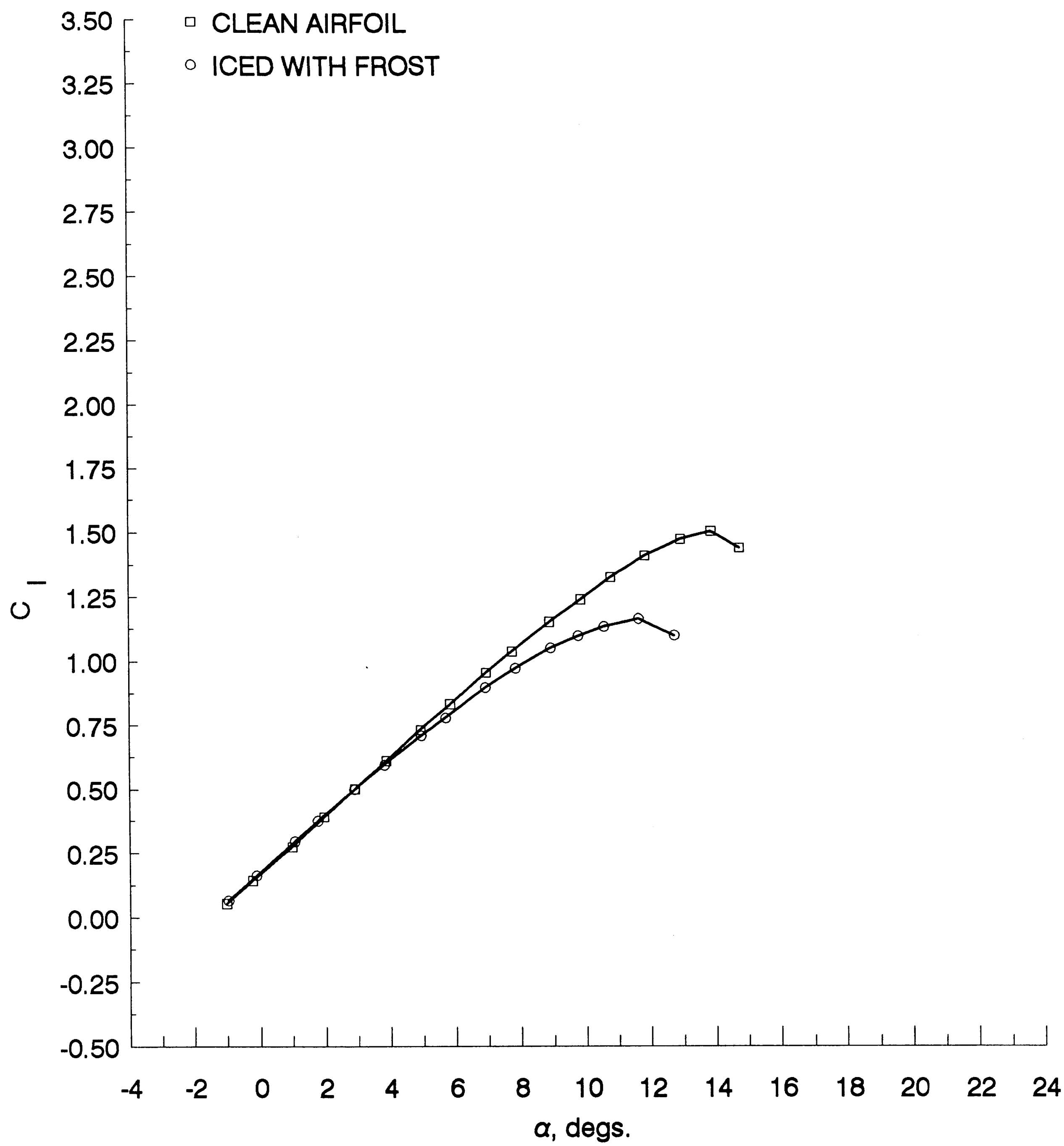


FIGURE 14 - RUN 5 ICE SHAPE TRACINGS FOR SECTIONS A - E.

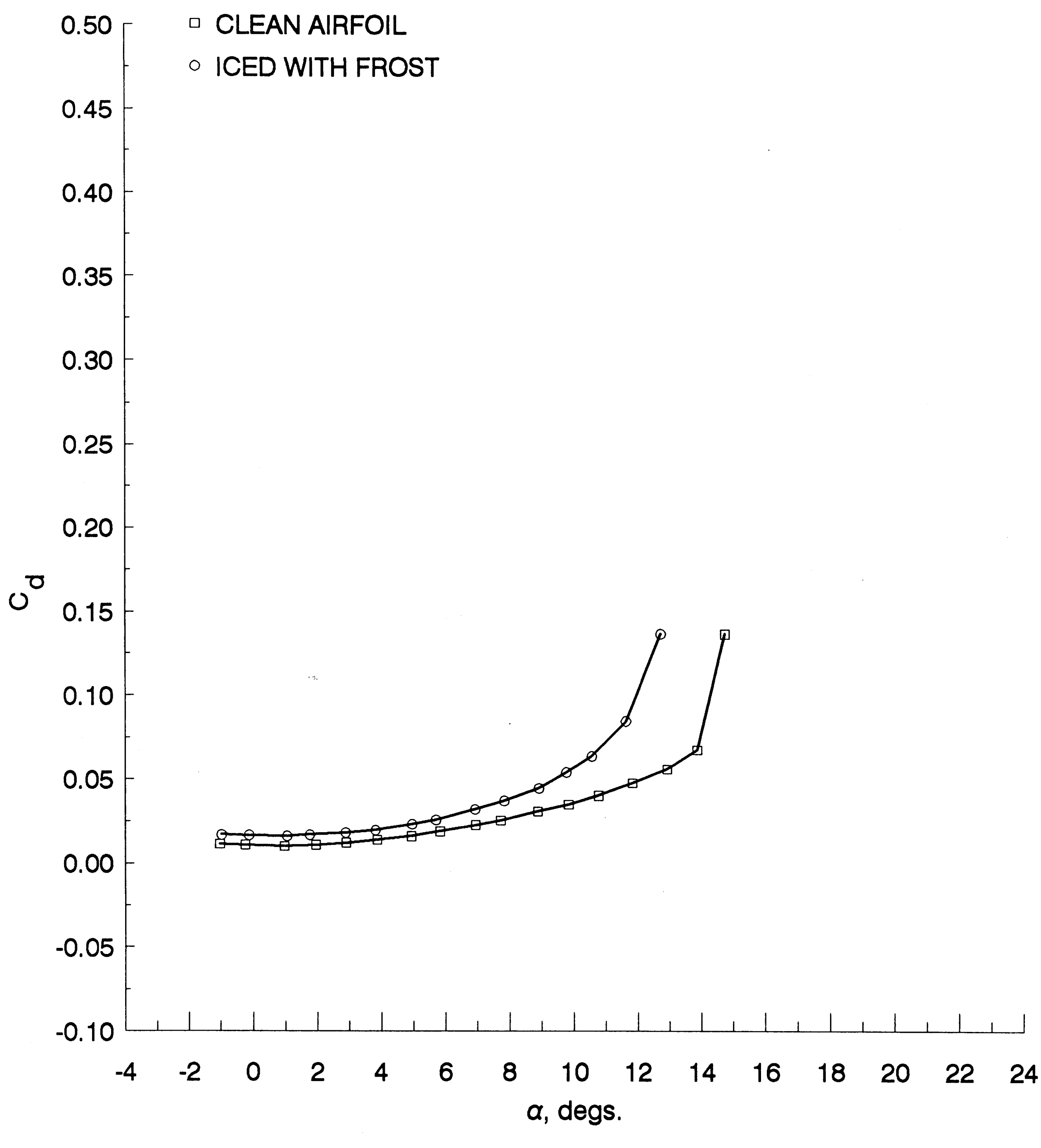
TABLE 19 - RUN 5 ICE SHAPE COORDINATES FOR SECTIONS A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.081332	0.178417	0.023562	0.125461	0.031044	0.145418	0.038170	0.145396	0.040825	0.126420	0.067298	0.164188
0.051028	0.150426	−0.000449	0.099053	0.010860	0.139465	0.010045	0.121163	0.020549	0.090359	0.024923	0.142342
0.012726	0.132522	−0.006408	0.082844	−0.001275	0.131444	−0.014062	0.092892	−0.003665	0.068387	−0.009381	0.124467
−0.041649	0.118712	−0.018354	0.056492	−0.001423	0.105153	−0.034152	0.078756	−0.027879	0.046415	−0.041683	0.104575
−0.051763	0.106703	−0.028307	0.034195	−0.025739	0.081021	−0.068304	0.056543	−0.035998	0.030383	−0.072005	0.078653
−0.053879	0.084608	−0.046331	0.017929	−0.052127	0.046789	−0.102455	0.022213	−0.056131	0.020445	−0.066256	0.024456
−0.039933	0.056408	−0.060315	−0.002364	−0.084502	0.022703	−0.118527	−0.002019	−0.080313	0.004501	−0.068427	−0.005626
−0.058111	0.040418	−0.072289	−0.022647	−0.131039	−0.011415	−0.130580	−0.028271	−0.100555	−0.025531	−0.092723	−0.033585
−0.080332	0.020428	−0.056074	−0.050893	−0.131244	−0.047818	−0.122545	−0.048465	−0.096671	−0.049666	−0.092893	−0.065684
−0.104564	0.000447	−0.072042	−0.077263	−0.129548	−0.104457	−0.096429	−0.066640	−0.082814	−0.085913	−0.074974	−0.101890
−0.118701	−0.011543	−0.069884	−0.109619	−0.103445	−0.120784	−0.100446	−0.088853	−0.068912	−0.114122	−0.059015	−0.128055
−0.128920	−0.045657	−0.069738	−0.141984	−0.081429	−0.147201	−0.116518	−0.105008	−0.056997	−0.138302	−0.034953	−0.144232
−0.125059	−0.079837	−0.047454	−0.178293	−0.055451	−0.185775	−0.096429	−0.145396	−0.039091	−0.168542	−0.008953	−0.174462
−0.109092	−0.106037	−0.017190	−0.200406	−0.019262	−0.200137	−0.062277	−0.177706	−0.005046	−0.184804	0.031186	−0.194736
−0.087071	−0.128246	0.013018	−0.210382	0.026980	−0.218602	−0.032143	−0.191842	0.018982	−0.196992	0.085516	−0.195022
−0.063049	−0.152474	0.051287	−0.224367	0.053128	−0.226840	−0.002009	−0.207997	0.047026	−0.209203	0.129765	−0.199268
−0.030991	−0.178750	0.091513	−0.226205	0.099438	−0.233170	0.030134	−0.214055	0.087194	−0.207412	0.178048	−0.201528
0.017197	−0.197064	0.147825	−0.227970	0.147831	−0.227377	0.046205	−0.222132	0.121338	−0.205589	0.206177	−0.209702
0.067387	−0.217397	0.190089	−0.235868	0.198045	−0.255976	0.076339	−0.234249	0.183536	−0.213967	0.258485	−0.211983
0.103516	−0.233644	0.238376	−0.241715	0.260508	−0.256330	0.116518	−0.232229	0.219633	−0.222202	0.320801	−0.224349
0.149740	−0.241901	0.308856	−0.263644	0.318953	−0.254639	0.156696	−0.220113	0.273812	−0.228527	0.377123	−0.228658
0.214085	−0.246225	0.363148	−0.263395	0.371284	−0.265049	0.190848	−0.228191	0.319992	−0.228779	0.433391	−0.242998
0.256325	−0.246425	0.409415	−0.267228	0.427680	−0.269413	0.239062	−0.232229	0.358085	−0.239035	0.535909	−0.263601
0.304646	−0.236606	0.469739	−0.266952	0.486101	−0.271767	0.283259	−0.238288	0.438387	−0.241483	0.630464	−0.268111
0.340775	−0.252853	0.516053	−0.280900	0.542383	−0.296356	0.319420	−0.246365	0.496603	−0.243810	0.686775	−0.274427
0.382966	−0.263100	0.566341	−0.284715	0.578732	−0.282404	0.377679	−0.244346			0.809501	−0.279086
0.411107	−0.267252	0.594474	−0.280540	0.618950	−0.296790	0.435937	−0.244346				
0.477407	−0.283642	0.640696	−0.274260	0.659272	−0.292973						
0.523611	−0.295919	0.693014	−0.282112	0.731856	−0.285295						
0.581961	−0.292176			0.766155	−0.277399						
0.624219	−0.288357										
0.670519	−0.280537										
0.712825	−0.266671										



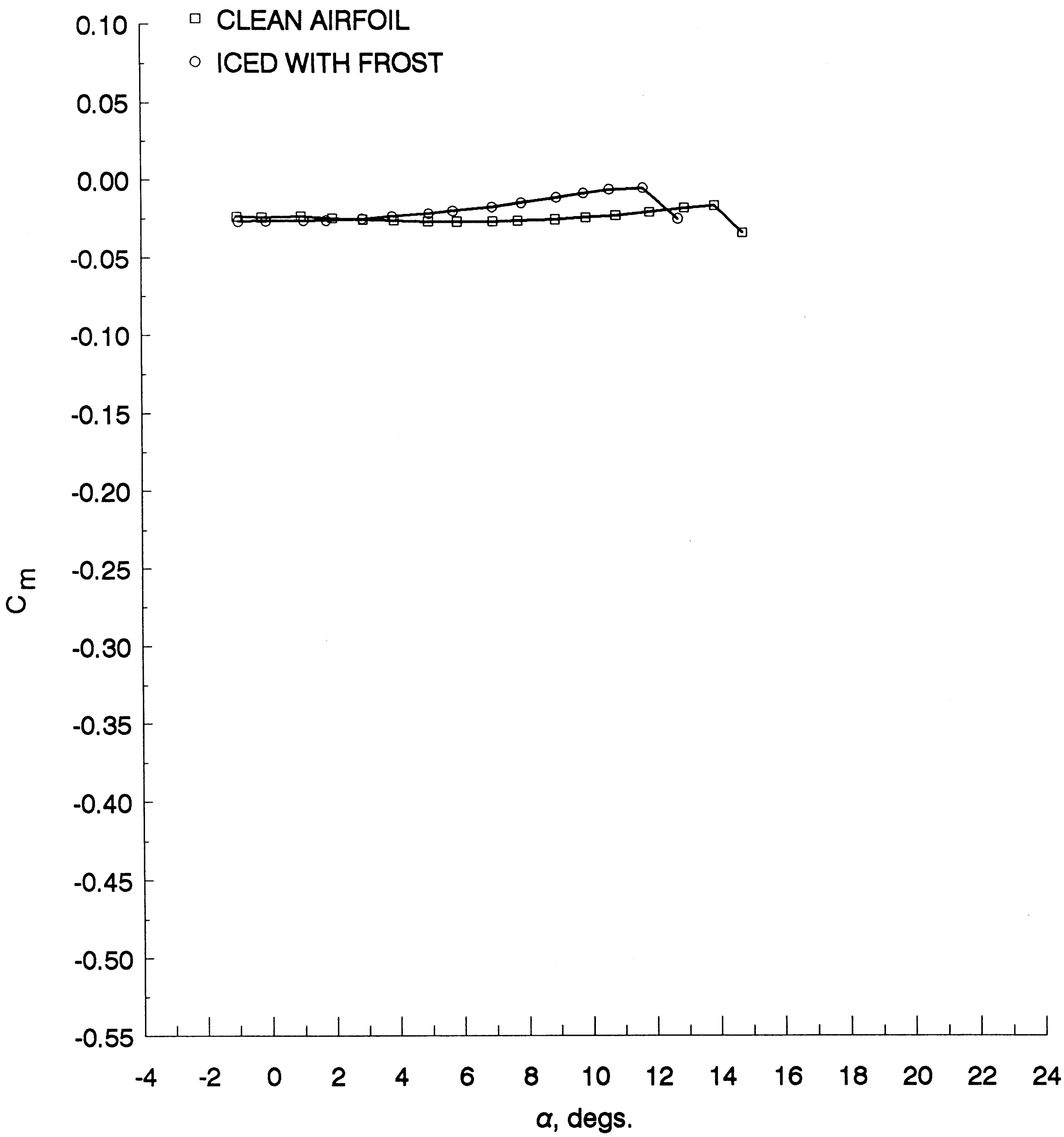
(A) C_l VERSUS α

FIGURE 15 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 5.



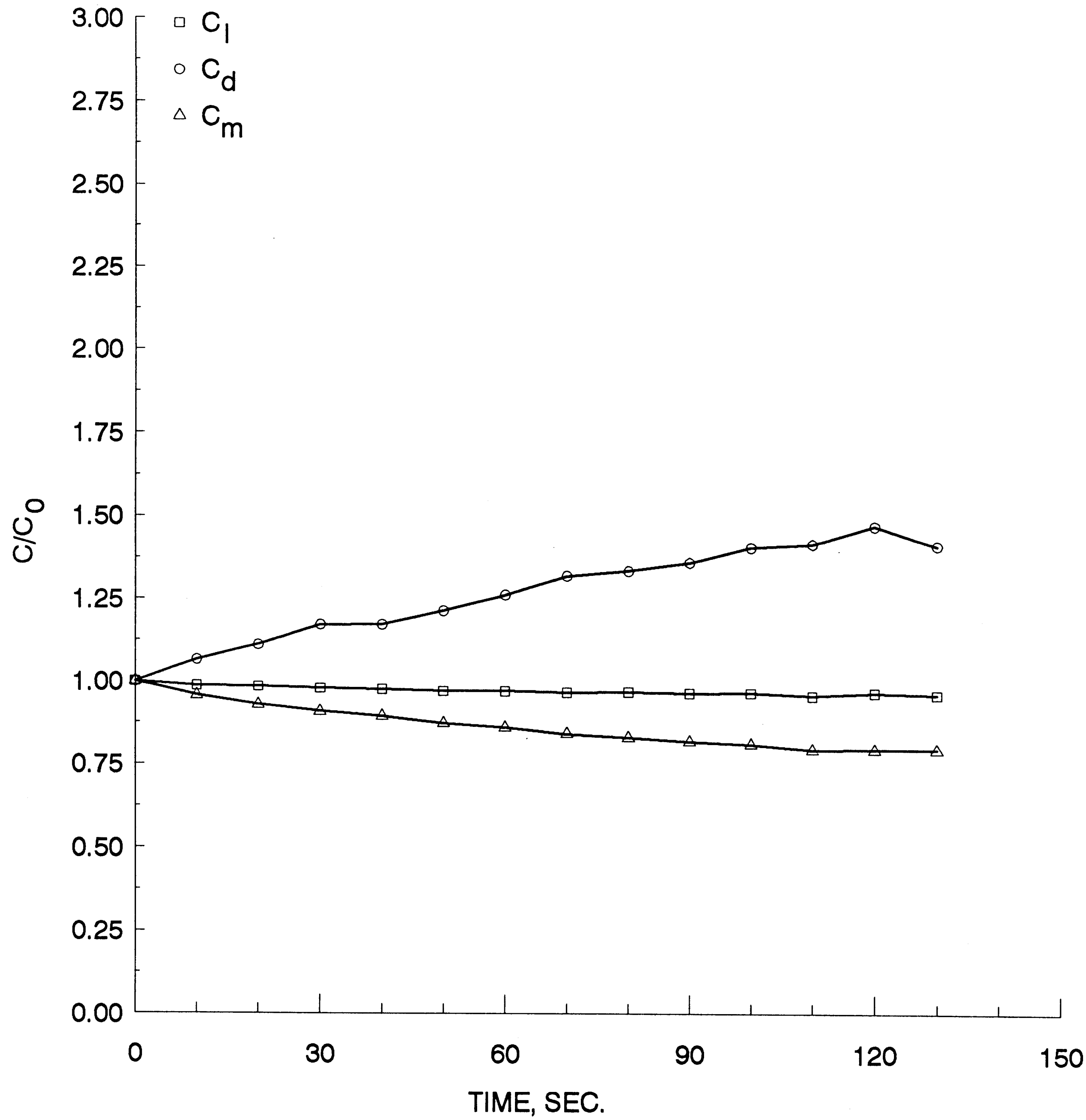
(B) C_d VERSUS α

FIGURE 15 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 5 (con't).



(C) C_m VERSUS α

FIGURE 15 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 5 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 15 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 5 (con't).

TABLE 20 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 5.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0273	0.0560	0.0115	−0.0235
−0.2439	0.1449	0.0111	−0.0239
0.9720	0.2748	0.0103	−0.0232
1.9482	0.3919	0.0111	−0.0245
2.9017	0.5012	0.0123	−0.0253
3.8735	0.6117	0.0141	−0.0259
4.9425	0.7338	0.0162	−0.0266
5.8408	0.8338	0.0190	−0.0267
6.9524	0.9564	0.0229	−0.0266
7.7398	1.0378	0.0256	−0.0261
8.8951	1.1517	0.0309	−0.0253
9.8490	1.2389	0.0352	−0.0241
10.7813	1.3250	0.0404	−0.0227
11.8453	1.4100	0.0478	−0.0205
12.9383	1.4732	0.0562	−0.0178
13.8818	1.5039	0.0676	−0.0163
14.7527	1.4393	0.1366	−0.0337

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−0.9763	0.0675	0.0171	−0.0264
−0.1231	0.1642	0.0168	−0.0262
1.0532	0.2966	0.0163	−0.0258
1.7604	0.3775	0.0171	−0.0257
2.8823	0.4996	0.0183	−0.0247
3.8196	0.5956	0.0198	−0.0233
4.9596	0.7101	0.0233	−0.0215
5.7055	0.7797	0.0259	−0.0199
6.9286	0.8993	0.0322	−0.0173
7.8463	0.9728	0.0373	−0.0146
8.9273	1.0509	0.0447	−0.0113
9.7745	1.0972	0.0542	−0.0085
10.5723	1.1336	0.0637	−0.0061
11.6382	1.1649	0.0847	−0.0050
12.7400	1.0993	0.1367	−0.0248

TABLE 21 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 5.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9870	1.0663	0.9572
20	0.9846	1.1119	0.9291
30	0.9795	1.1734	0.9092
40	0.9767	1.1743	0.8958
50	0.9715	1.2156	0.8737
60	0.9704	1.2630	0.8600
70	0.9671	1.3209	0.8416
80	0.9684	1.3363	0.8309
90	0.9656	1.3622	0.8182
100	0.9661	1.4084	0.8103
110	0.9571	1.4186	0.7936
120	0.9670	1.4731	0.7945
130	0.9614	1.4145	0.7940

TABLE 22 - TEST CONDITIONS FOR RUN NUMBER 5.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 5	Configuration Cruise Wing	Date 05-03-88	
P_{air} 38.0 psig	ΔP_w 6.8 psid	T_{avg} 20° F	V_∞ 150 mph
Spray Duration 2 min	Ice Accretion Type Mixed		A.O.A. 5°
LWC 0.7 g/m^3	MVD 14 μm		

Remarks

- Overloaded balance at original test conditions
- Model was vibrating at A.O.A. above 14°
- Changed conditions to lower the velocity and avoid this problem
- Ice accretion approximately 1/8" thick
- Top was rime-like, opaque
- Bottom was glaze-like, clear

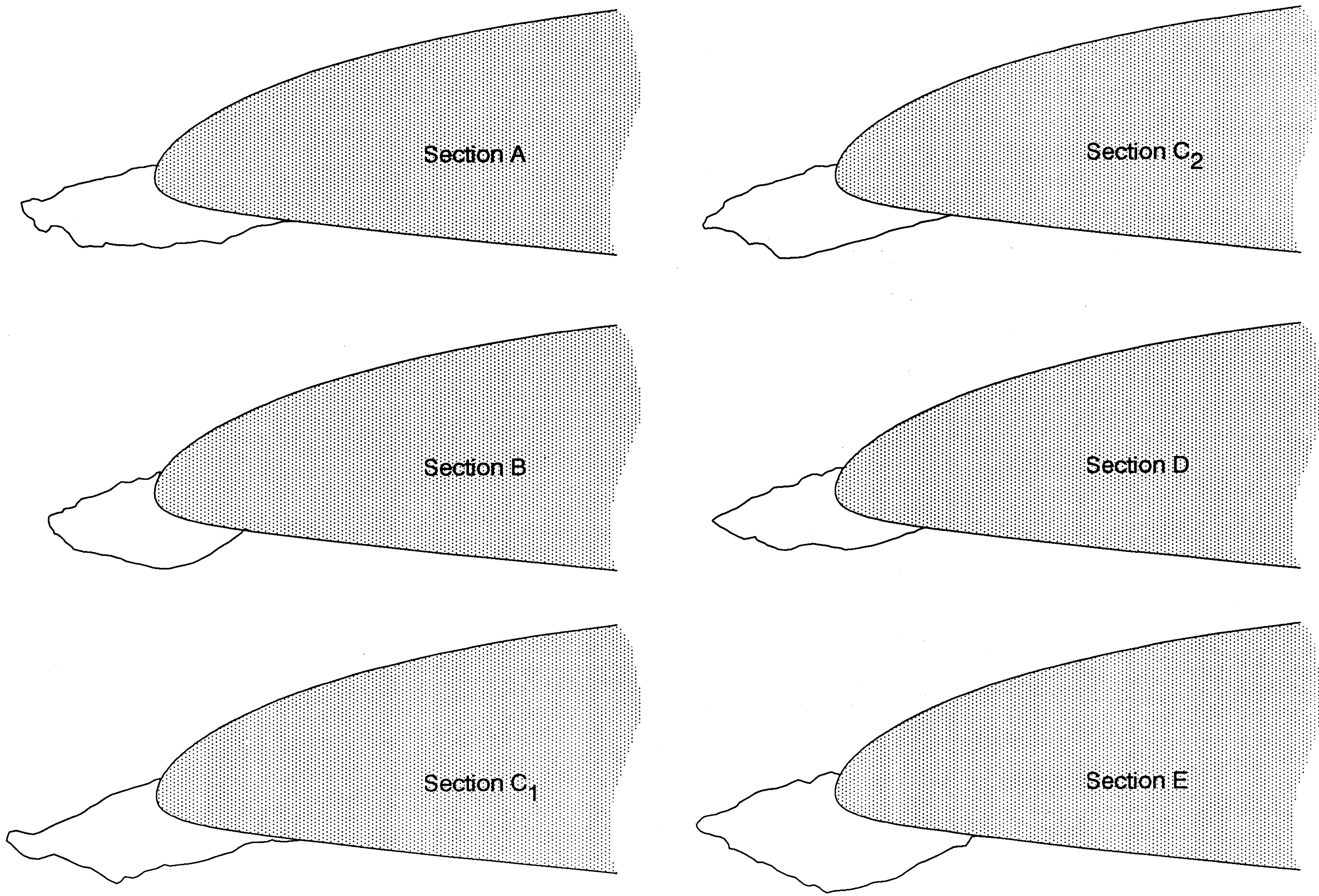


FIGURE 16 - RUN 6 ICE SHAPE TRACINGS FOR SECTIONS A - E.

TABLE 23 - RUN 6 ICE SHAPE COORDINATES FOR SECTIONS A - E.

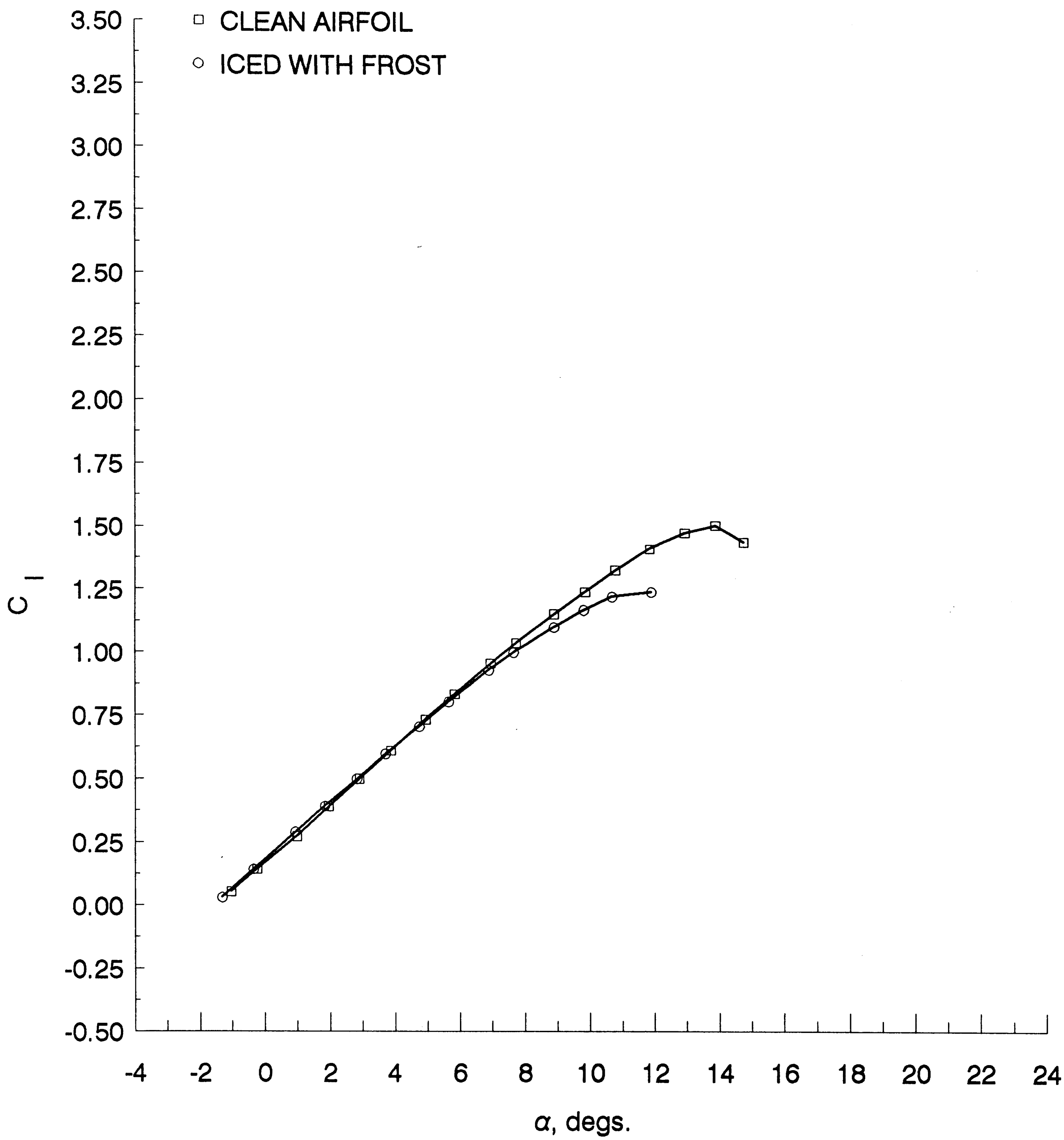
SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.016414	0.086903	0.066565	0.158364	0.030107	0.119337	0.008739	0.076289	0.052209	0.159790	0.025996	0.125237
-0.007713	0.086992	0.048464	0.154610	-0.014050	0.107201	-0.025561	0.072550	0.026104	0.157767	0.001874	0.129249
-0.041908	0.083072	0.034371	0.150795	-0.054193	0.086974	-0.055880	0.062741	0.006024	0.157767	-0.024265	0.139318
-0.074107	0.075099	0.003997	0.131102	-0.112400	0.068770	-0.096193	0.063079	-0.018072	0.143608	-0.044359	0.135257
-0.106276	0.075217	-0.020302	0.115348	-0.162578	0.054612	-0.138505	0.065446	-0.054217	0.131472	-0.116688	0.110944
-0.136457	0.069260	-0.052527	0.105763	-0.200714	0.042476	-0.162811	0.051561	-0.074297	0.121359	-0.148818	0.084657
-0.162617	0.063287	-0.076550	0.108149	-0.256913	0.026294	-0.201261	0.033769	-0.098394	0.107201	-0.174921	0.062414
-0.184785	0.049211	-0.102455	0.118627	-0.323149	0.006068	-0.221603	0.011801	-0.128514	0.115291	-0.207084	0.066418
-0.223059	0.029125	-0.124658	0.108889	-0.373327	-0.022249	-0.268065	0.000114	-0.158635	0.117314	-0.233223	0.076487
-0.265333	0.015121	-0.151023	0.089134	-0.415477	-0.048544	-0.318591	-0.015564	-0.194779	0.103155	-0.257350	0.084538
-0.307585	0.007186	-0.175046	0.091520	-0.473684	-0.078883	-0.375165	-0.031192	-0.232932	0.082929	-0.299540	0.068336
-0.345793	0.005303	-0.209122	0.092044	-0.505798	-0.105178	-0.413564	-0.042946	-0.246988	0.066748	-0.347750	0.044050
-0.363933	-0.006766	-0.267865	0.052627	-0.553970	-0.133495	-0.443916	-0.056780	-0.263052	0.044498	-0.412045	0.025805
-0.422277	-0.016665	-0.322508	0.019196	-0.648305	-0.169903	-0.482298	-0.066522	-0.299197	0.034385	-0.460275	0.019694
-0.470568	-0.026601	-0.370984	-0.004251	-0.702498	-0.192152	-0.536772	-0.072104	-0.339357	0.028317	-0.508503	0.011563
-0.504777	-0.034567	-0.427415	-0.023543	-0.756690	-0.216424	-0.581268	-0.089845	-0.387550	0.026294	-0.554710	-0.006662
-0.538986	-0.042532	-0.475769	-0.038928	-0.790812	-0.234628	-0.609707	-0.115771	-0.421687	0.024272	-0.604924	-0.037008
-0.561139	-0.052564	-0.520082	-0.052358	-0.828947	-0.252832	-0.654237	-0.137537	-0.441767	0.012136	-0.645099	-0.057247
-0.599377	-0.062536	-0.546661	-0.086221	-0.871097	-0.264968	-0.694652	-0.149274	-0.463855	-0.006068	-0.667193	-0.071407
-0.639626	-0.072502	-0.582834	-0.091713	-0.913247	-0.256877	-0.743196	-0.168994	-0.481928	-0.018204	-0.691280	-0.099704
-0.655784	-0.092668	-0.637108	-0.100958	-0.951382	-0.248786	-0.773600	-0.188866	-0.518072	-0.032362	-0.721415	-0.111854
-0.673930	-0.106760	-0.643306	-0.112959	-0.989518	-0.238673	-0.781933	-0.220998	-0.546185	-0.038430	-0.757575	-0.128049
-0.696105	-0.122860	-0.669487	-0.120621	-1.039697	-0.248786	-0.802242	-0.238942	-0.582329	-0.046521	-0.795751	-0.138188
-0.732377	-0.144975	-0.705721	-0.130143	-1.049732	-0.275081	-0.830680	-0.264867	-0.606426	-0.062702	-0.841960	-0.154394
-0.756533	-0.152977	-0.727862	-0.135851	-1.059768	-0.307443	-0.867080	-0.278651	-0.644578	-0.091019	-0.886169	-0.162520
-0.796796	-0.166988	-0.742323	-0.163852	-1.027654	-0.329693	-0.899483	-0.296493	-0.682731	-0.117314	-0.922335	-0.172656
-0.826896	-0.150697	-0.744910	-0.202117	-1.011597	-0.347896	-0.909764	-0.320559	-0.718875	-0.131472	-0.942418	-0.186814
-0.863080	-0.148542	-0.727237	-0.226580	-0.993532	-0.364078	-0.926109	-0.346586	-0.757028	-0.149676	-0.964500	-0.211071
-0.881227	-0.162634	-0.721530	-0.246828	-0.971454	-0.386327	-0.910186	-0.370871	-0.789156	-0.161812	-0.972524	-0.225216
-0.907379	-0.166583	-0.710025	-0.281277	-0.941347	-0.410599	-0.877902	-0.367116	-0.809237	-0.171926	-0.964459	-0.249440
-0.939578	-0.174555	-0.674067	-0.289894	-0.891168	-0.428803	-0.841586	-0.363395	-0.833333	-0.184061	-0.946350	-0.267595
-0.933641	-0.200871	-0.646402	-0.316528	-0.836976	-0.436893	-0.801341	-0.371782	-0.861446	-0.202265	-0.914175	-0.283715
-0.927726	-0.233254	-0.620865	-0.351193	-0.772747	-0.416667	-0.753101	-0.388287	-0.837349	-0.224515	-0.886030	-0.289743

TABLE 23 - RUN 6 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.911715	−0.253538	−0.585214	−0.379965	−0.722569	−0.404531	−0.718868	−0.392598	−0.801205	−0.248786	−0.843806	−0.305852
−0.889671	−0.273845	−0.549256	−0.388582	−0.684433	−0.418689	−0.688735	−0.404926	−0.761044	−0.271036	−0.801592	−0.311863
−0.859563	−0.288112	−0.499236	−0.395399	−0.626227	−0.444984	−0.656687	−0.429346	−0.728916	−0.291262	−0.775451	−0.323951
−0.847558	−0.304337	−0.447088	−0.394185	−0.594112	−0.459142	−0.624690	−0.459803	−0.700803	−0.307443	−0.759350	−0.344128
−0.845628	−0.326593	−0.419025	−0.394617	−0.551962	−0.479369	−0.600672	−0.480130	−0.664659	−0.321602	−0.745257	−0.366326
−0.835641	−0.344832	−0.387168	−0.409219	−0.509813	−0.491505	−0.560324	−0.476443	−0.636546	−0.335760	−0.741211	−0.390554
−0.817611	−0.363101	−0.357285	−0.421774	−0.471677	−0.495550	−0.503903	−0.478927	−0.586345	−0.325647	−0.709046	−0.396578
−0.791510	−0.373309	−0.291351	−0.436900	−0.427520	−0.523867	−0.469823	−0.501351	−0.556225	−0.319579	−0.666824	−0.410667
−0.767405	−0.379466	−0.235532	−0.457919	−0.385370	−0.550162	−0.439791	−0.525754	−0.550201	−0.335760	−0.628615	−0.430819
−0.743212	−0.361351	−0.205710	−0.474505	−0.343220	−0.580502	−0.419838	−0.550072	−0.534136	−0.349919	−0.600457	−0.448963
−0.727040	−0.337139	−0.161734	−0.483246	−0.285013	−0.604773	−0.385791	−0.576521	−0.495984	−0.364078	−0.568277	−0.469122
−0.692860	−0.337264	−0.119763	−0.491956	−0.254906	−0.596683	−0.341447	−0.576893	−0.471888	−0.380259	−0.542129	−0.487268
−0.652684	−0.347524	−0.085778	−0.498526	−0.220785	−0.560275	−0.276912	−0.573407	−0.441767	−0.390372	−0.507960	−0.489250
−0.626641	−0.373913	−0.051886	−0.511143	−0.168599	−0.568366	−0.224471	−0.569821	−0.421687	−0.396440	−0.471771	−0.499307
−0.606587	−0.388144	−0.022002	−0.523699	−0.128457	−0.556230	−0.178010	−0.558135	−0.393574	−0.408576	−0.439596	−0.515428
−0.586583	−0.416534	0.022004	−0.530424	−0.084300	−0.523867	−0.117338	−0.534491	−0.359438	−0.414644	−0.405395	−0.545681
−0.562573	−0.448983	0.078068	−0.535318	−0.028100	−0.509709	−0.020417	−0.515176	−0.309237	−0.410599	−0.367188	−0.563814
−0.536530	−0.475371	0.138418	−0.522134	0.000000	−0.503641	0.038206	−0.495541	−0.283133	−0.398463	−0.337027	−0.575897
−0.506400	−0.483572	0.208759	−0.511120	0.060214	−0.477346	0.115003	−0.472032	−0.248996	−0.382281	−0.274700	−0.596023
−0.458124	−0.477681	0.287577	−0.469996	0.094335	−0.487459	0.191750	−0.454561	−0.208835	−0.376214	−0.250561	−0.614171
−0.415909	−0.479858	0.330009	−0.448473	0.170607	−0.477346	0.272545	−0.435111	−0.150602	−0.370146	−0.210331	−0.644419
−0.367655	−0.480034	0.366335	−0.432903	0.238849	−0.469256	0.329186	−0.411434	−0.110442	−0.376214	−0.180175	−0.652463
−0.343440	−0.455852	0.406731	−0.413364	0.289028	−0.459142	0.375715	−0.391697	−0.052209	−0.382281	−0.148023	−0.646369
−0.313310	−0.464053	0.447220	−0.387779	0.359277	−0.444984	0.458525	−0.372264	−0.024096	−0.394417	−0.105797	−0.664498
−0.283166	−0.468208	0.485581	−0.370225	0.413470	−0.424757	0.535255	−0.356805	0.038153	−0.400485	−0.087686	−0.684672
−0.261063	−0.472334	0.527950	−0.352732	0.495763	−0.400485	0.597960	−0.331166	0.072289	−0.414644	−0.055513	−0.698772
−0.222855	−0.470451	0.564491	−0.323054	0.537912	−0.390372	0.662563	−0.319631	0.130522	−0.406553	−0.031403	−0.690669
−0.186679	−0.474629	0.598935	−0.299392	0.588091	−0.353964	0.719085	−0.310041	0.204819	−0.392395	0.006778	−0.684569
−0.148478	−0.474768	0.621291	−0.279576	0.626227	−0.339806	0.810026	−0.282626	0.261044	−0.382281	0.055010	−0.680477
−0.090126	−0.462847	0.629401	−0.273653	0.678412	−0.325647			0.327309	−0.362055	0.101232	−0.676387
−0.062007	−0.471040			0.732605	−0.323625			0.397590	−0.339806	0.163527	−0.666222
−0.019836	−0.485352			0.782783	−0.319579			0.441767	−0.325647	0.225813	−0.647979
0.044481	−0.491655			0.820919	−0.307443			0.495984	−0.301375	0.255943	−0.631790

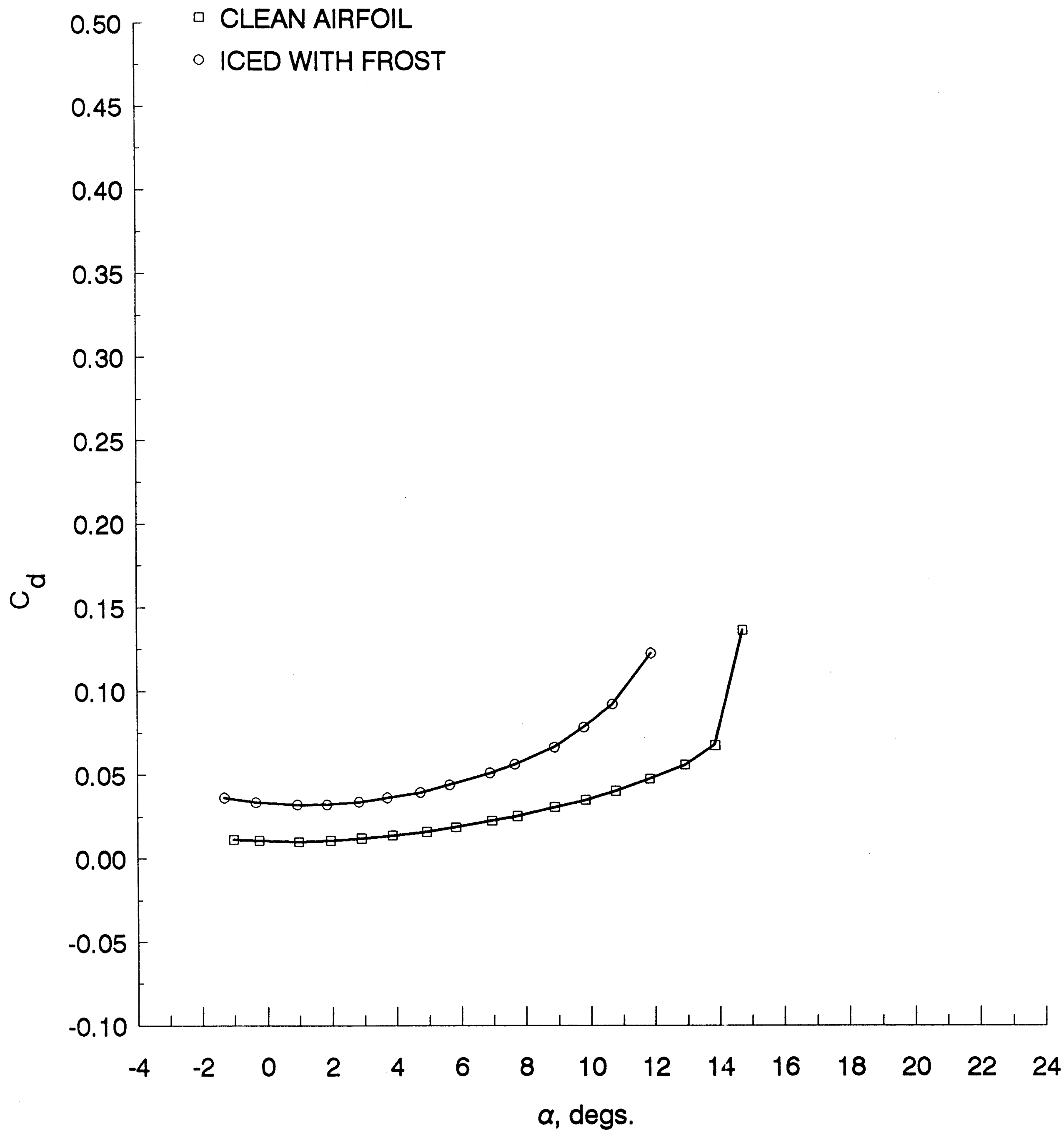
TABLE 23 - RUN 6 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.102832	−0.479733			0.838983	−0.317557			0.546185	−0.289239	0.306181	−0.623658
0.149149	−0.459677			0.909233	−0.319579			0.592369	−0.269013	0.348386	−0.621592
0.199414	−0.459861			0.977475	−0.313511			0.632530	−0.254854	0.418709	−0.601321
0.239648	−0.453941			1.021632	−0.311489					0.464911	−0.579057
0.281878	−0.452073									0.503069	−0.552762
0.318105	−0.442092									0.545246	−0.524444
0.362331	−0.444277									0.585415	−0.498148
0.414570	−0.454581									0.623587	−0.483970
0.462795	−0.462848									0.667784	−0.465747
0.484963	−0.448770									0.715996	−0.443481
0.507145	−0.430649									0.758181	−0.423240
0.537370	−0.412556									0.792325	−0.400989
0.567543	−0.408621									0.832504	−0.384790
0.615871	−0.388572									0.864660	−0.382736
0.646096	−0.370480									0.912891	−0.376624
0.674303	−0.354403									0.936978	−0.348326
0.726637	−0.338413									0.957041	−0.315993
0.766863	−0.334515									0.993212	−0.309895
0.815132	−0.330647										
0.865441	−0.318695										
0.901675	−0.306693										



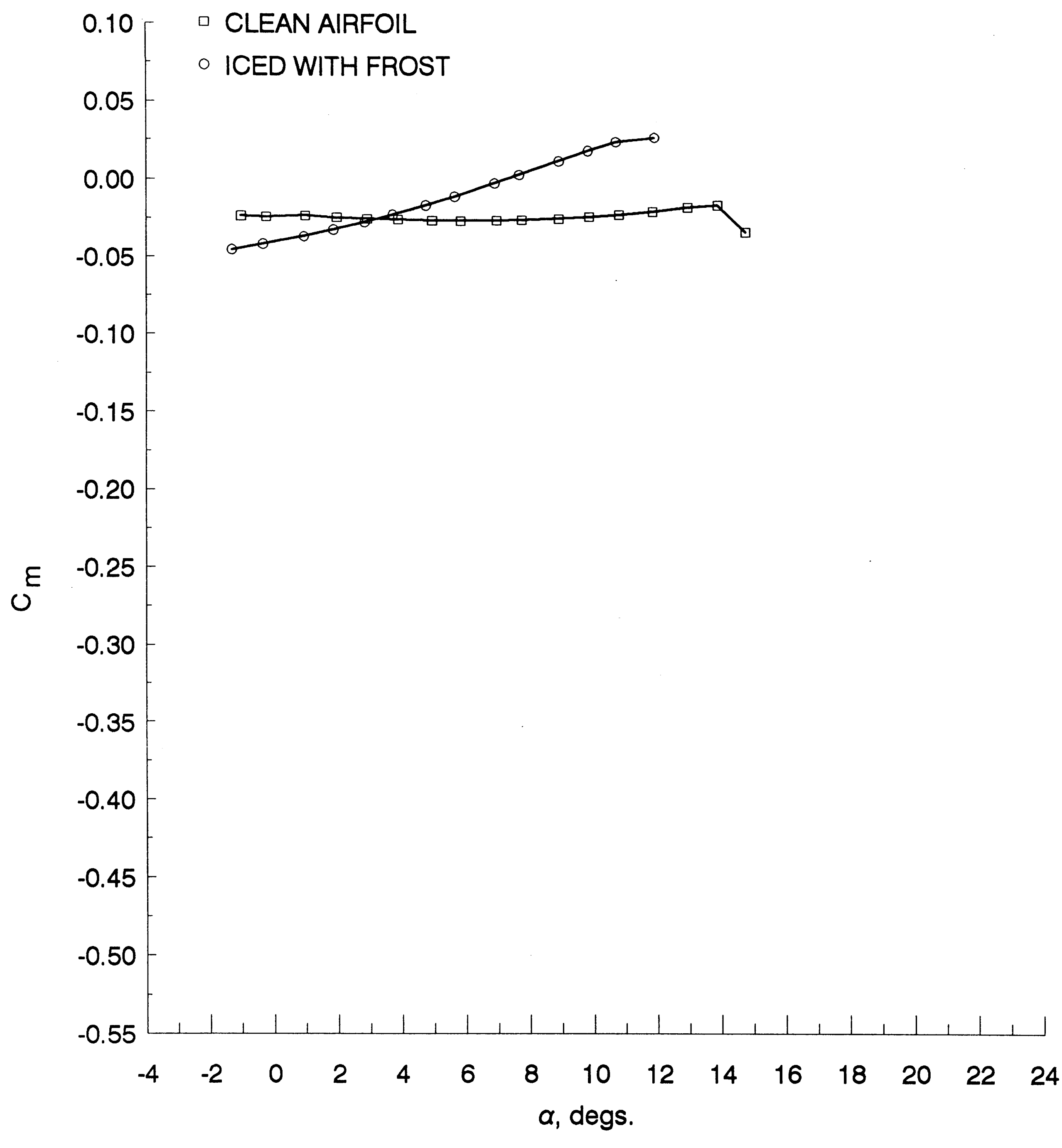
(A) C_l VERSUS α

FIGURE 17 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 6.



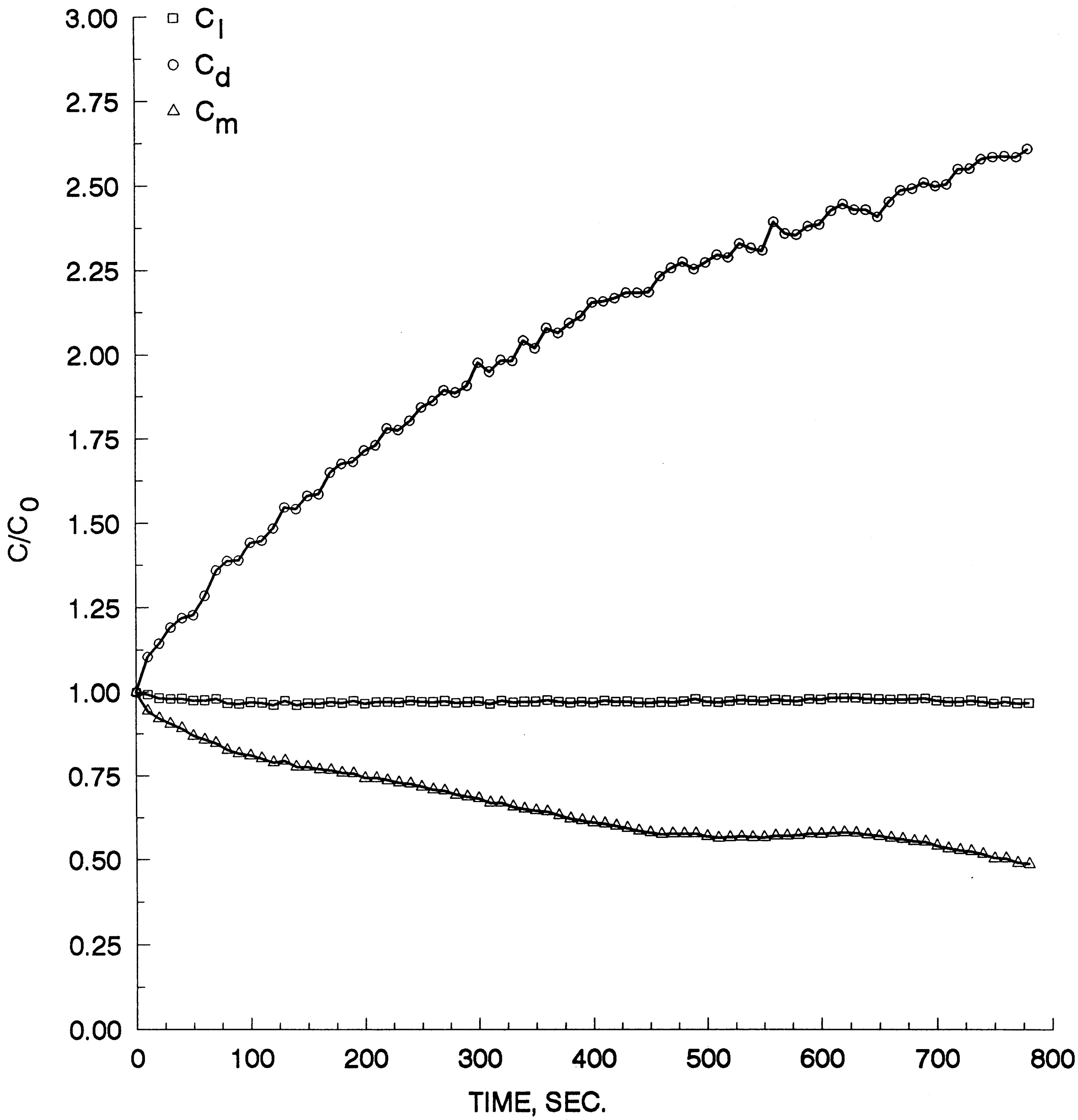
(B) C_d VERSUS α

FIGURE 17 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 6 (con't).



(C) C_m VERSUS α

FIGURE 17 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 6 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 17 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 6 (con't).

TABLE 24 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 6.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0273	0.0560	0.0115	−0.0235
−0.2439	0.1449	0.0111	−0.0239
0.9720	0.2748	0.0103	−0.0232
1.9482	0.3919	0.0111	−0.0245
2.9017	0.5012	0.0123	−0.0253
3.8735	0.6117	0.0141	−0.0259
4.9425	0.7338	0.0162	−0.0266
5.8408	0.8338	0.0190	−0.0267
6.9524	0.9564	0.0229	−0.0266
7.7398	1.0378	0.0256	−0.0261
8.8951	1.1517	0.0309	−0.0253
9.8490	1.2389	0.0352	−0.0241
10.7813	1.3250	0.0404	−0.0227
11.8453	1.4100	0.0478	−0.0205
12.9383	1.4732	0.0562	−0.0178
13.8818	1.5039	0.0676	−0.0163
14.7527	1.4373	0.1366	−0.0337

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.3091	0.0328	0.0366	−0.0453
−0.3472	0.1449	0.0338	−0.0417
0.9262	0.2916	0.0325	−0.0367
1.8409	0.3935	0.0326	−0.0324
2.8224	0.5008	0.0341	−0.0275
3.7106	0.5989	0.0366	−0.0227
4.7451	0.7054	0.0397	−0.0167
5.6507	0.8037	0.0442	−0.0112
6.8946	0.9289	0.0513	−0.0027
7.6634	0.9991	0.0564	0.0028
8.8926	1.0986	0.0665	0.0116
9.8068	1.1669	0.0784	0.0182
10.6839	1.2193	0.0922	0.0239
11.8935	1.2380	0.1228	0.0267

TABLE 25 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 6.

TIME SEC.	C_l/C_{l_0}	C_d/C_{d_0}	C_m/C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9934	1.1044	0.9441
20	0.9825	1.1447	0.9216
30	0.9804	1.1916	0.9062
40	0.9809	1.2193	0.8917
50	0.9749	1.2280	0.8699
60	0.9760	1.2845	0.8581
70	0.9802	1.3600	0.8475
80	0.9677	1.3884	0.8271
90	0.9657	1.3908	0.8165
100	0.9713	1.4423	0.8106
110	0.9695	1.4489	0.8020
120	0.9631	1.4852	0.7900
130	0.9751	1.5480	0.7956
140	0.9631	1.5429	0.7770
150	0.9691	1.5818	0.7771
160	0.9677	1.5865	0.7699
170	0.9715	1.6514	0.7678
180	0.9689	1.6764	0.7590
190	0.9748	1.6826	0.7581
200	0.9670	1.7159	0.7440
210	0.9722	1.7320	0.7436
220	0.9724	1.7820	0.7370
230	0.9700	1.7765	0.7294
240	0.9751	1.8044	0.7263
250	0.9716	1.8446	0.7175
260	0.9709	1.8636	0.7085
270	0.9746	1.8951	0.7060
280	0.9689	1.8880	0.6925
290	0.9709	1.9084	0.6873
300	0.9732	1.9772	0.6820
310	0.9657	1.9503	0.6697
320	0.9748	1.9849	0.6699
330	0.9700	1.9826	0.6577
340	0.9730	2.0437	0.6508
350	0.9727	2.0201	0.6457
360	0.9768	2.0800	0.6426
370	0.9720	2.0661	0.6318
380	0.9695	2.0946	0.6214
390	0.9722	2.1162	0.6170
400	0.9694	2.1563	0.6098
410	0.9748	2.1596	0.6067
420	0.9722	2.1686	0.5998
430	0.9728	2.1849	0.5938
440	0.9692	2.1855	0.5859
450	0.9691	2.1875	0.5809
460	0.9714	2.2347	0.5762
470	0.9707	2.2593	0.5769
480	0.9733	2.2771	0.5773
490	0.9801	2.2564	0.5774
500	0.9728	2.2758	0.5694
510	0.9705	2.2983	0.5648
520	0.9736	2.2902	0.5667
530	0.9774	2.3315	0.5683
540	0.9748	2.3177	0.5667
550	0.9733	2.3113	0.5658
560	0.9786	2.3957	0.5711
570	0.9759	2.3615	0.5705
580	0.9740	2.3571	0.5720
590	0.9802	2.3821	0.5772
600	0.9787	2.3876	0.5763
610	0.9832	2.4285	0.5791
620	0.9836	2.4484	0.5801
630	0.9835	2.4320	0.5788
640	0.9809	2.4315	0.5744
650	0.9793	2.4106	0.5699
660	0.9784	2.4551	0.5644
670	0.9797	2.4886	0.5609
680	0.9801	2.4938	0.5551
690	0.9817	2.5123	0.5525
700	0.9749	2.5014	0.5413
710	0.9719	2.5068	0.5337
720	0.9717	2.5533	0.5280
730	0.9763	2.5540	0.5249
740	0.9727	2.5831	0.5166
750	0.9672	2.5891	0.5044
760	0.9730	2.5915	0.5037
770	0.9677	2.5885	0.4911
780	0.9689	2.6131	0.4878

TABLE 26 - TEST CONDITIONS FOR RUN NUMBER 6.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 6	Configuration Cruise Wing	Date 05-03-88	
P_{air} 38.0 psig	ΔP_W 6.8 psid	T_{avg} 20° F	V_∞ 150 mph
Spray Duration 13 min	Ice Accretion Type Mixed	A.O.A. 5°	
LWC 0.7 g/m³	MVD 14 μm		

Remarks

- Ice accretion approximately 1" thick, mixed ice
- Uniform across span
- Some vibration at 13° A.O.A.
- Large fingers present on lower surface

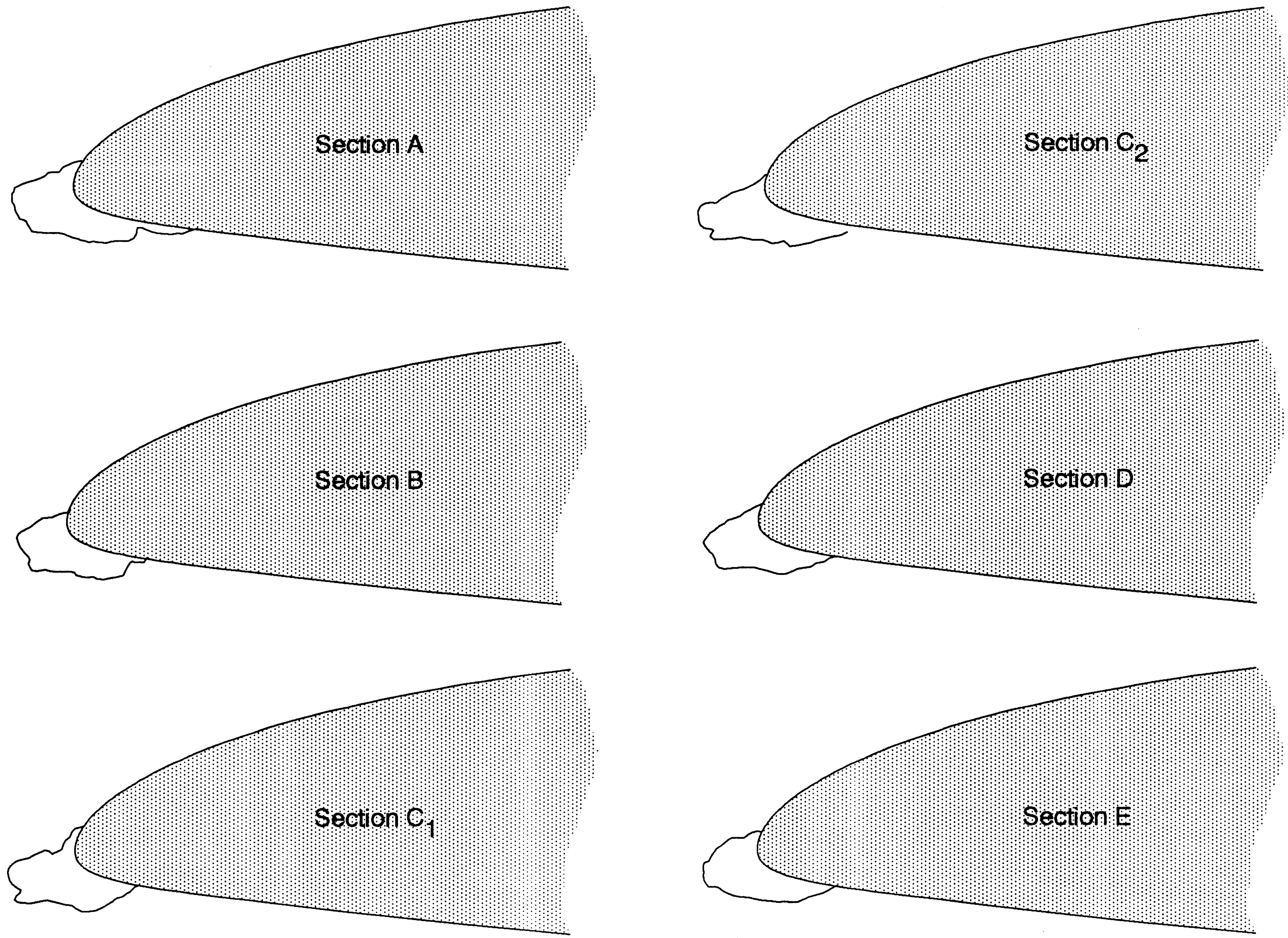


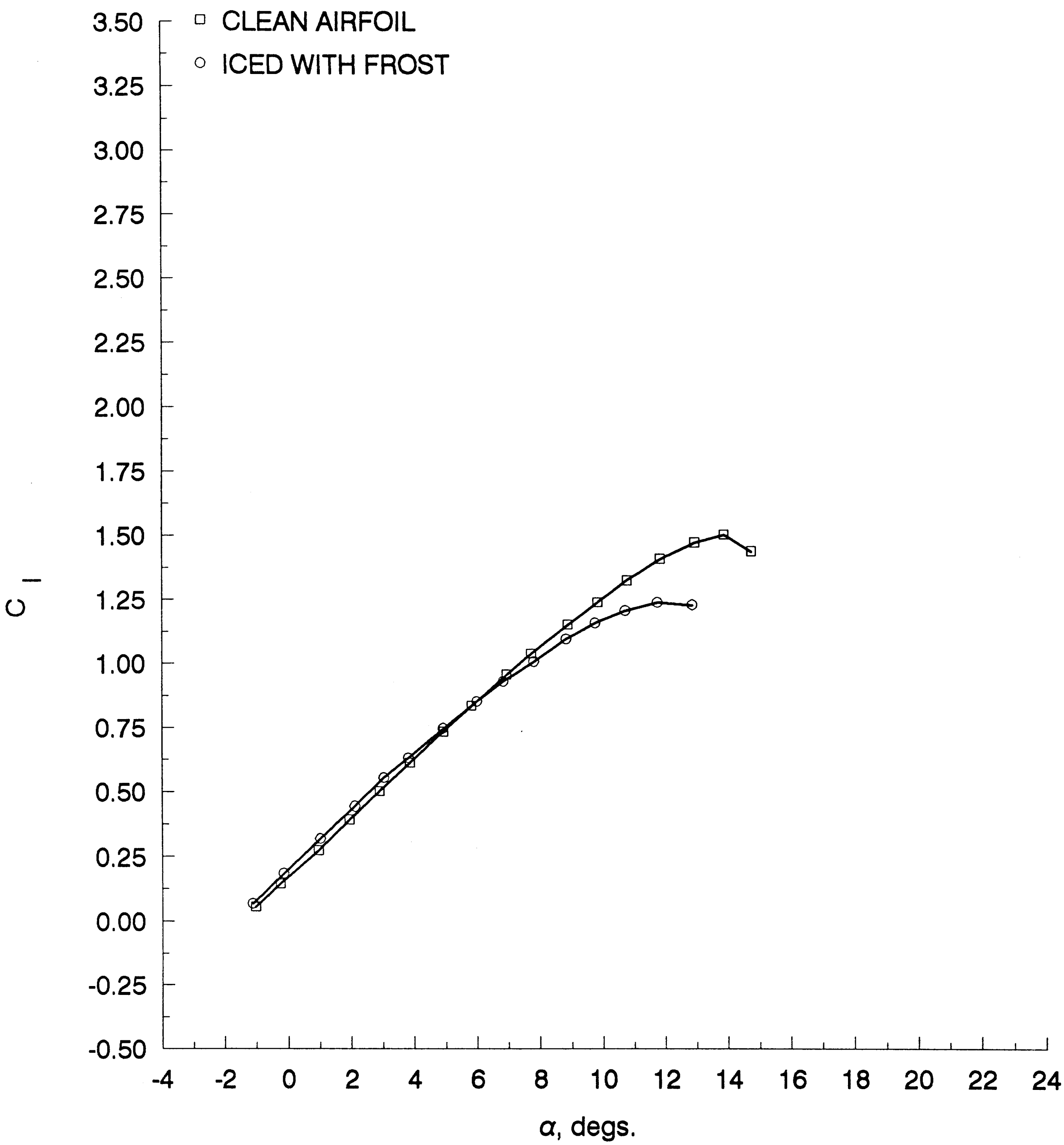
FIGURE 18 - RUN 7 ICE SHAPE TRACINGS FOR SECTIONS A - E.

TABLE 27 - RUN 7 ICE SHAPE COORDINATES FOR SECTIONS A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.054314	0.165858	0.018160	0.060363	0.053803	0.154630	-0.000718	0.077708	0.030796	0.108199	0.028541	0.112809
0.028163	0.161812	-0.014002	0.056378	0.023697	0.148529	-0.008966	0.063834	-0.007495	0.090372	0.000438	0.114928
-0.006035	0.151699	-0.044156	0.050378	-0.000378	0.140437	-0.029323	0.046143	-0.047795	0.072559	-0.029702	0.108990
-0.038221	0.137540	-0.076328	0.038342	-0.018396	0.120323	-0.059783	0.024607	-0.098203	0.044774	-0.063894	0.092986
-0.070407	0.121359	-0.096439	0.028303	-0.032371	0.090188	-0.096236	0.005162	-0.122439	0.024857	-0.086061	0.070891
-0.098569	0.093042	-0.152715	0.026362	-0.062421	0.064021	-0.130619	-0.010315	-0.146614	0.014971	-0.122196	0.073038
-0.132767	0.093042	-0.174836	0.016326	-0.074426	0.047936	-0.173004	-0.023670	-0.172774	0.009109	-0.170385	0.073215
-0.168976	0.086974	-0.203001	-0.005780	-0.086370	0.009780	-0.217428	-0.038993	-0.202990	-0.002747	-0.192522	0.059184
-0.189093	0.066748	-0.239215	-0.035926	-0.104411	-0.002308	-0.259998	-0.064346	-0.225217	-0.022675	-0.216690	0.039111
-0.217255	0.052589	-0.273405	-0.053998	-0.150548	-0.020492	-0.286318	-0.077946	-0.261509	-0.042520	-0.238835	0.023063
-0.257488	0.038430	-0.303572	-0.070062	-0.172687	-0.002494	-0.316870	-0.105480	-0.289788	-0.066425	-0.271034	0.003020
-0.295709	0.028317	-0.321675	-0.082116	-0.200811	0.001442	-0.354993	-0.102900	-0.322062	-0.086294	-0.285170	-0.019104
-0.335941	0.016181	-0.329745	-0.106260	-0.230900	-0.010679	-0.395247	-0.108287	-0.340281	-0.108253	-0.309374	-0.049257
-0.370138	-0.002023	-0.315741	-0.156599	-0.252956	-0.022778	-0.421629	-0.125886	-0.352447	-0.126236	-0.321523	-0.077437
-0.390255	-0.012136	-0.289655	-0.188838	-0.277026	-0.032876	-0.440163	-0.155604	-0.366623	-0.144207	-0.351685	-0.089423
-0.394278	-0.036408	-0.277616	-0.204957	-0.305101	-0.046998	-0.437007	-0.211653	-0.350703	-0.170383	-0.359768	-0.103506
-0.408359	-0.050566	-0.257542	-0.223098	-0.337215	-0.053105	-0.425449	-0.243830	-0.336757	-0.190529	-0.357870	-0.133754
-0.410371	-0.074838	-0.243504	-0.247270	-0.373333	-0.063237	-0.397705	-0.268253	-0.320789	-0.208681	-0.353905	-0.147880
-0.408359	-0.105178	-0.253588	-0.275437	-0.399406	-0.075347	-0.375677	-0.272588	-0.300790	-0.224851	-0.360002	-0.168019
-0.392266	-0.129450	-0.233545	-0.317733	-0.421446	-0.093465	-0.347594	-0.275016	-0.286940	-0.261046	-0.356095	-0.198274
-0.386231	-0.165858	-0.199386	-0.323815	-0.443469	-0.117603	-0.335699	-0.285197	-0.281081	-0.289168	-0.346129	-0.218471
-0.368127	-0.192152	-0.141092	-0.315838	-0.445401	-0.145700	-0.350001	-0.300980	-0.263128	-0.311344	-0.326138	-0.242736
-0.356057	-0.216424	-0.123012	-0.321899	-0.435234	-0.191821	-0.358341	-0.320853	-0.229025	-0.321580	-0.281972	-0.244913
-0.335941	-0.222492	-0.082824	-0.327989	-0.417100	-0.213843	-0.336559	-0.341185	-0.194838	-0.317772	-0.255891	-0.251057
-0.315825	-0.230582	-0.042631	-0.330053	-0.398978	-0.231852	-0.280332	-0.342041	-0.156633	-0.313989	-0.223846	-0.273351
-0.299732	-0.260922	0.019673	-0.330133	-0.374837	-0.247838	-0.219997	-0.336960	-0.108379	-0.310266	-0.187769	-0.291627
-0.273581	-0.299353	0.051826	-0.332187	-0.356747	-0.253808	-0.153576	-0.327972	-0.074216	-0.310471	-0.151671	-0.303855
-0.233348	-0.305421	0.065872	-0.350321	-0.364720	-0.275902	-0.077482	-0.343131	-0.027996	-0.310748	-0.107520	-0.310064
-0.181046	-0.307443	0.104042	-0.362446	-0.382760	-0.287990	-0.013223	-0.344110	0.008104	-0.323002	-0.059345	-0.314272
-0.126732	-0.307443	0.134186	-0.364497	-0.392778	-0.296043	0.018753	-0.354597	0.050256	-0.331280	-0.015201	-0.322497
-0.098569	-0.307443	0.176397	-0.360526	-0.400751	-0.318136	0.050668	-0.369083	0.092373	-0.345576	0.034952	-0.334777
-0.064372	-0.315534	0.204516	-0.374652	-0.378617	-0.334128	0.086906	-0.363635	0.126475	-0.355812	0.085142	-0.336976
-0.040232	-0.325647	0.244709	-0.376716	-0.348485	-0.338059	0.127252	-0.352249	0.176714	-0.356113	0.139325	-0.345238

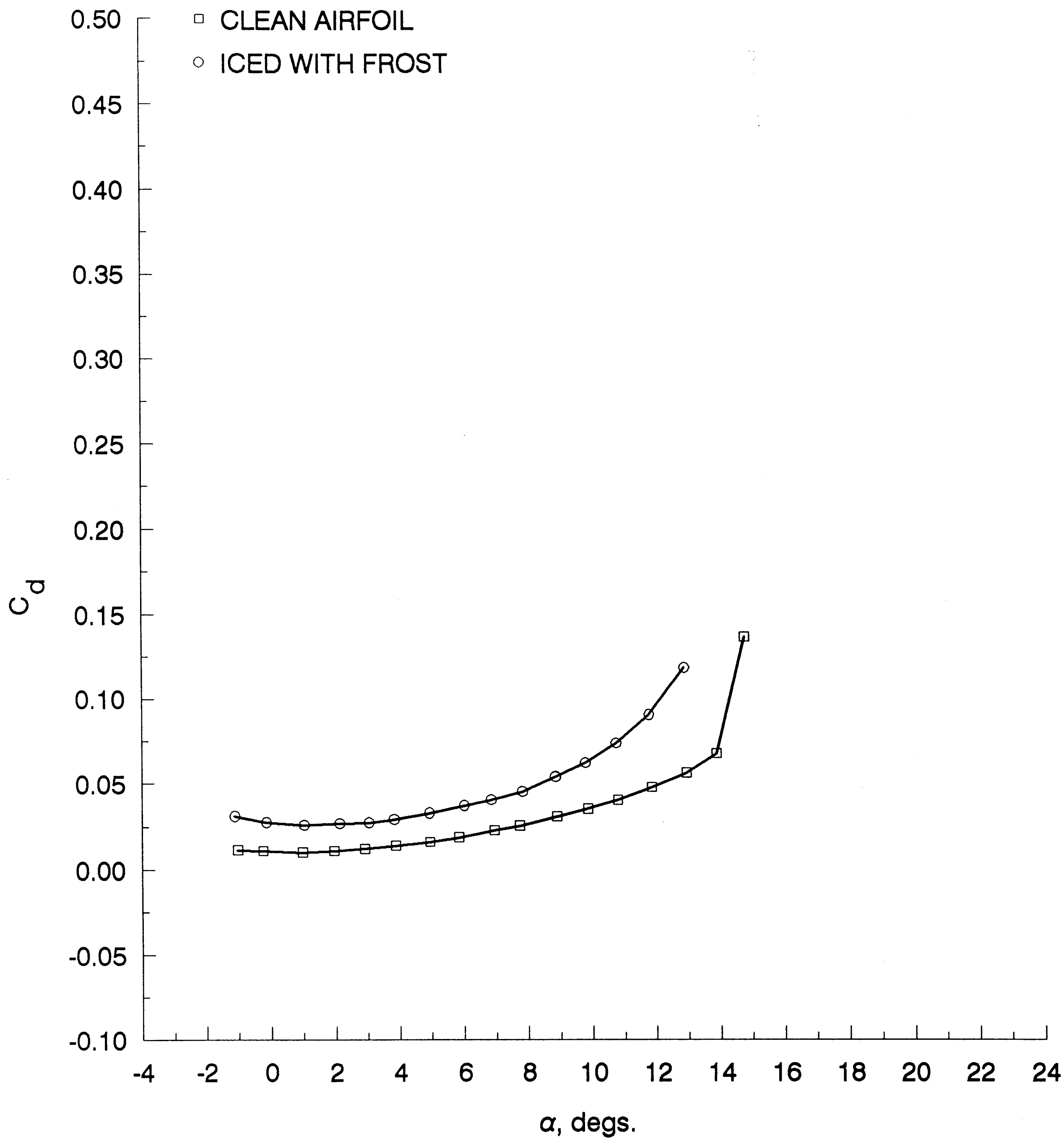
TABLE 27 - RUN 7 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.002012	−0.337783	0.272854	−0.370714	−0.296263	−0.341929	0.166892	−0.386853	0.221046	−0.336317	0.175481	−0.341338
0.028163	−0.345874	0.333157	−0.362739	−0.258125	−0.335806	0.217218	−0.379620	0.259311	−0.322503	0.229687	−0.343552
0.052302	−0.353964	0.369346	−0.352721	−0.224009	−0.327687	0.259511	−0.372264	0.313630	−0.312797	0.261806	−0.345686
0.076442	−0.358010	0.397549	−0.300422	−0.185871	−0.321563	0.301835	−0.362908	0.345820	−0.306972	0.302029	−0.327688
0.104604	−0.366100	0.415678	−0.268240	−0.141665	−0.331475	0.336187	−0.349431	0.374098	−0.283067	0.338229	−0.311691
0.134779	−0.362055	0.431766	−0.260209	−0.101476	−0.341398	0.424913	−0.326782	0.428417	−0.273361	0.386469	−0.297755
0.173000	−0.368123	0.447840	−0.264255	−0.057276	−0.349303	0.497389	−0.315886	0.462700	−0.253505	0.432694	−0.285828
0.217255	−0.372168	0.508133	−0.264332	−0.021113	−0.355224	0.541905	−0.294563	0.509017	−0.237733	0.476962	−0.259781
0.251453	−0.360032	0.526259	−0.234162	0.003034	−0.373217					0.517193	−0.239767
0.289674	−0.355987			0.047267	−0.393161						
0.360080	−0.355987			0.085427	−0.395063						
0.398301	−0.341828			0.133599	−0.386906						
0.412383	−0.315534			0.181745	−0.368716						
0.416406	−0.297330			0.225846	−0.340505						
0.420429	−0.273058			0.249905	−0.326394						
0.448592	−0.271036			0.271939	−0.306268						
0.480778	−0.283171			0.310066	−0.296132						
0.516987	−0.299353			0.336122	−0.278002						
0.555208	−0.307443			0.362189	−0.263886						
0.593429	−0.311489			0.394237	−0.233701						
0.647742	−0.313511										
0.683952	−0.307443										
0.716138	−0.311489										
0.748324	−0.299353										
0.808672	−0.277104										



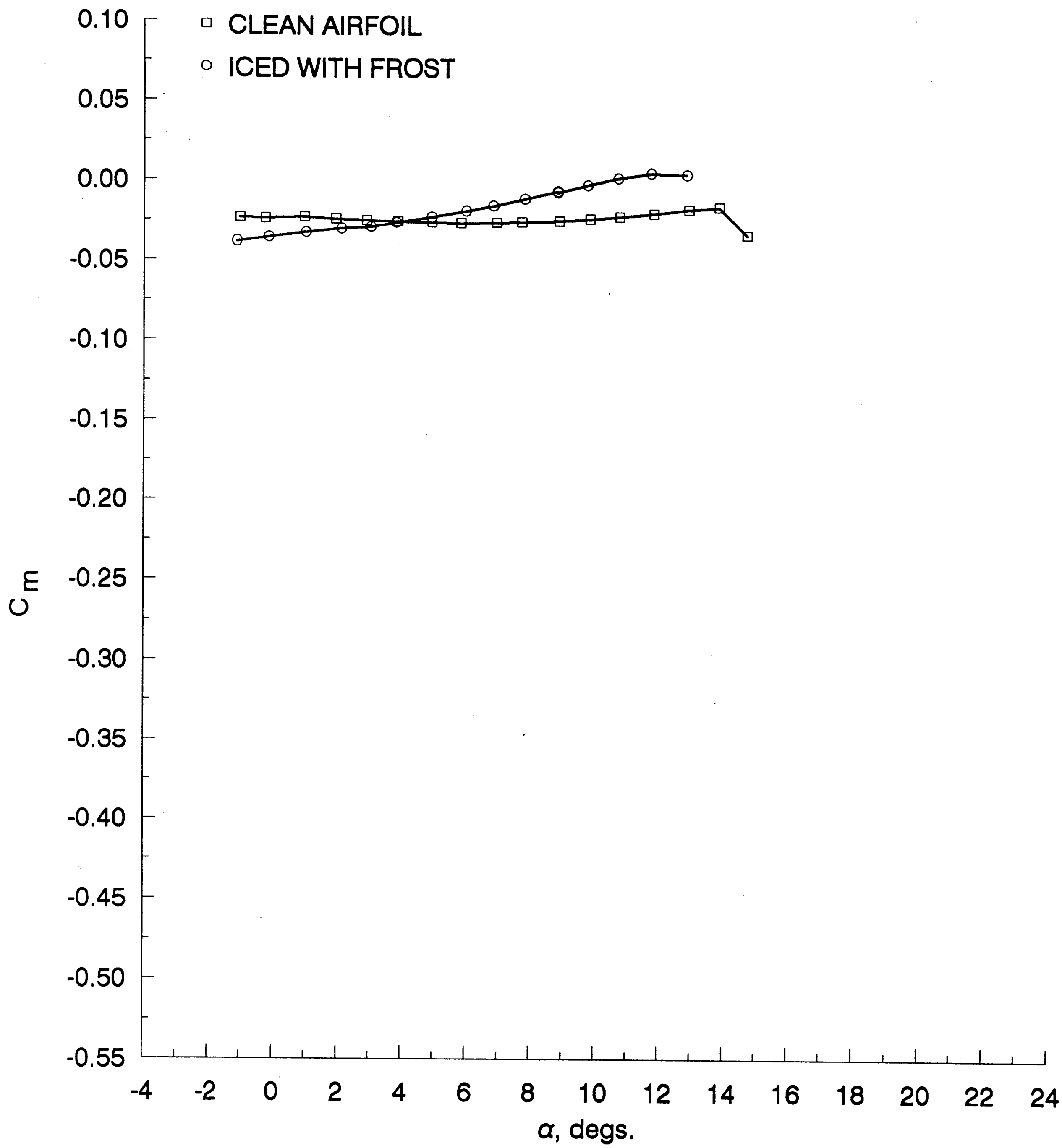
(A) C_l VERSUS α

FIGURE 19 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 7.



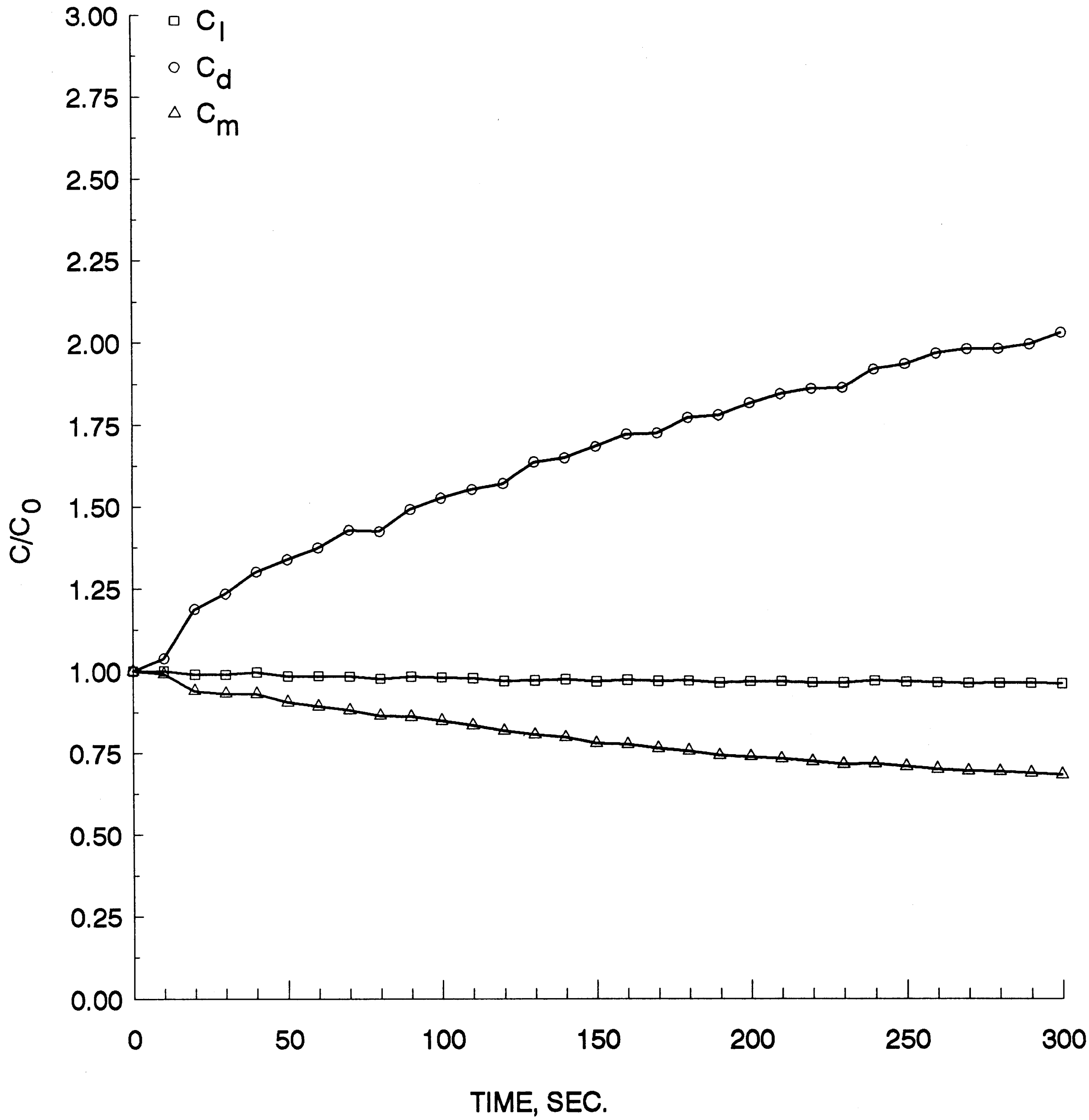
(B) C_d VERSUS α

FIGURE 19 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 7 (con't).



(C) C_m VERSUS α

FIGURE 19 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 7 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 19 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 7 (con't).

TABLE 28 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 7.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0273	0.0560	0.0115	−0.0235
−0.2439	0.1449	0.0111	−0.0239
0.9720	0.2748	0.0103	−0.0232
1.9482	0.3919	0.0111	−0.0245
2.9017	0.5012	0.0123	−0.0253
3.8735	0.6117	0.0141	−0.0259
4.9425	0.7338	0.0162	−0.0266
5.8408	0.8338	0.0190	−0.0267
6.9524	0.9564	0.0229	−0.0266
7.7398	1.0378	0.0256	−0.0261
8.8951	1.1517	0.0309	−0.0253
9.8490	1.2389	0.0352	−0.0241
10.7813	1.3250	0.0404	−0.0227
11.8453	1.4100	0.0478	−0.0205
12.9383	1.4732	0.0562	−0.0178
13.8818	1.5039	0.0676	−0.0163
14.7527	1.4393	0.1366	−0.0337

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.1174	0.0691	0.0311	−0.0383
−0.1402	0.1859	0.0276	−0.0358
1.0197	0.3187	0.0261	−0.0328
2.1197	0.4434	0.0271	−0.0304
3.0361	0.5539	0.0275	−0.0293
3.8268	0.6315	0.0293	−0.0266
4.9282	0.7462	0.0329	−0.0232
6.0045	0.8514	0.0371	−0.0193
6.8461	0.9299	0.0405	−0.0160
7.8201	1.0063	0.0453	−0.0116
8.8438	1.0953	0.0539	−0.0068
8.8444	1.0956	0.0540	−0.0074
9.7704	1.1587	0.0622	−0.0029
10.7275	1.2077	0.0736	0.0015
11.7536	1.2386	0.0904	0.0048
12.8680	1.2297	0.1182	0.0039

TABLE 29 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 7.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	1.0001	1.0375	0.9914
20	0.9899	1.1875	0.9409
30	0.9887	1.2341	0.9325
40	0.9966	1.3019	0.9317
50	0.9850	1.3399	0.9064
60	0.9854	1.3761	0.8938
70	0.9844	1.4293	0.8817
80	0.9771	1.4251	0.8646
90	0.9832	1.4922	0.8609
100	0.9806	1.5265	0.8493
110	0.9783	1.5533	0.8350
120	0.9699	1.5708	0.8184
130	0.9714	1.6363	0.8068
140	0.9748	1.6491	0.7981
150	0.9680	1.6833	0.7795
160	0.9735	1.7220	0.7767
170	0.9700	1.7255	0.7642
180	0.9709	1.7737	0.7566
190	0.9647	1.7808	0.7429
200	0.9686	1.8188	0.7385
210	0.9685	1.8463	0.7322
220	0.9654	1.8626	0.7235
230	0.9648	1.8651	0.7162
240	0.9705	1.9210	0.7178
250	0.9675	1.9379	0.7091
260	0.9660	1.9705	0.7011
270	0.9640	1.9835	0.6958
280	0.9643	1.9845	0.6938
290	0.9642	1.9990	0.6894
300	0.9632	2.0332	0.6844

TABLE 30 - TEST CONDITIONS FOR RUN NUMBER 7.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 7	Configuration Cruise Wing	Date 05-03-88	
P_{air} 88 psig	ΔP_w 13.8 psid	T_{avg} 15° F	V_∞ 150 mph
Spray Duration 5 min	Ice Accretion Type Mixed	A.O.A. 5°	
LWC 1.0 g/m³	MVD 12.5 μm		

Remarks

- Ice accretion approximately 3/8" thick, mixed ice
- Some additional spraying from 2 spray bars for about 30 sec after spray stop time
- This occured intermittently during the 30 sec
- Clear core with opaque edges
- Significant frost on the lower surface to about 30-40% chord

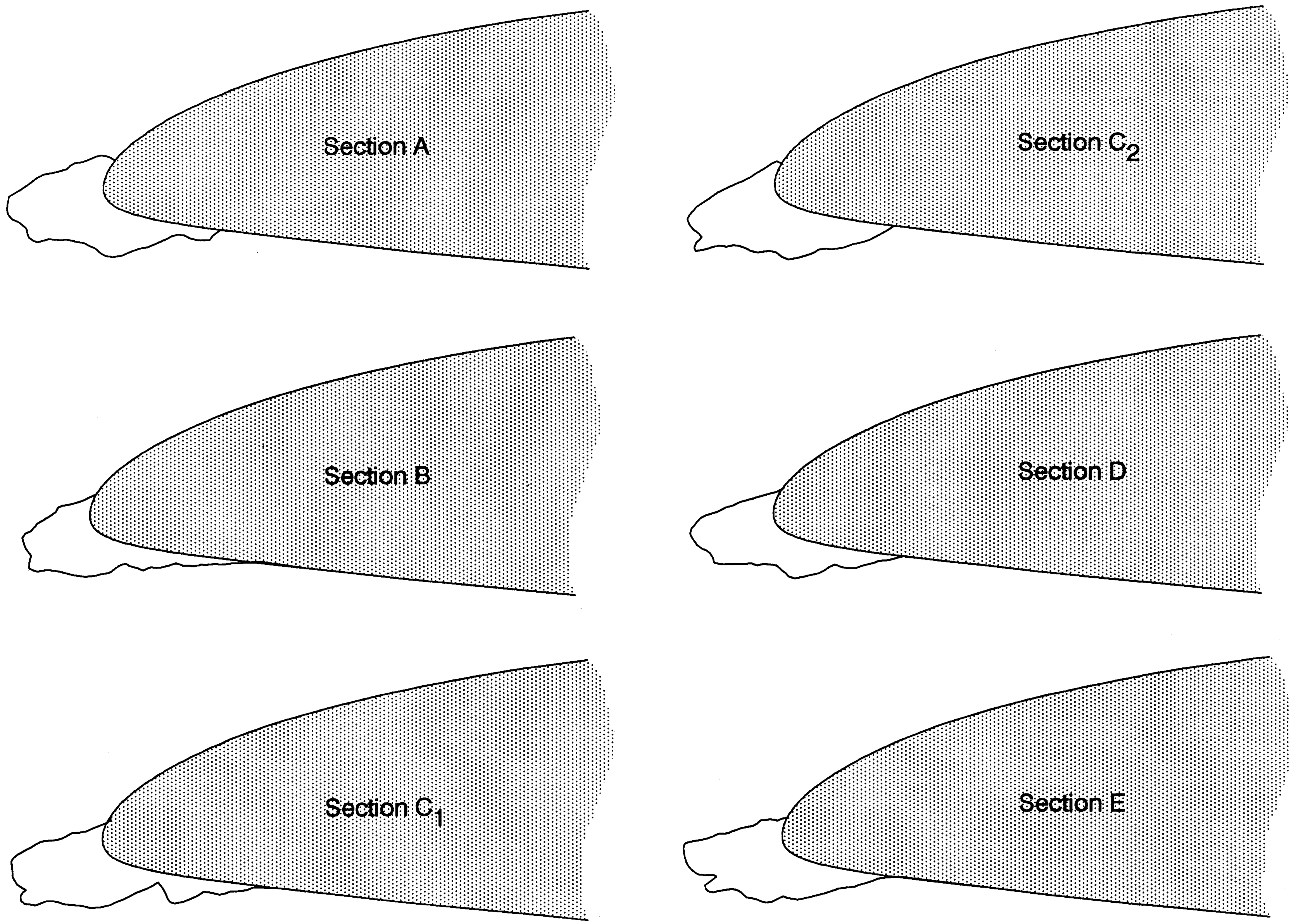


FIGURE 20 - RUN 8 ICE SHAPE TRACINGS FOR SECTIONS A - E.

TABLE 31 - RUN 8 ICE SHAPE COORDINATES FOR SECTIONS A - E.

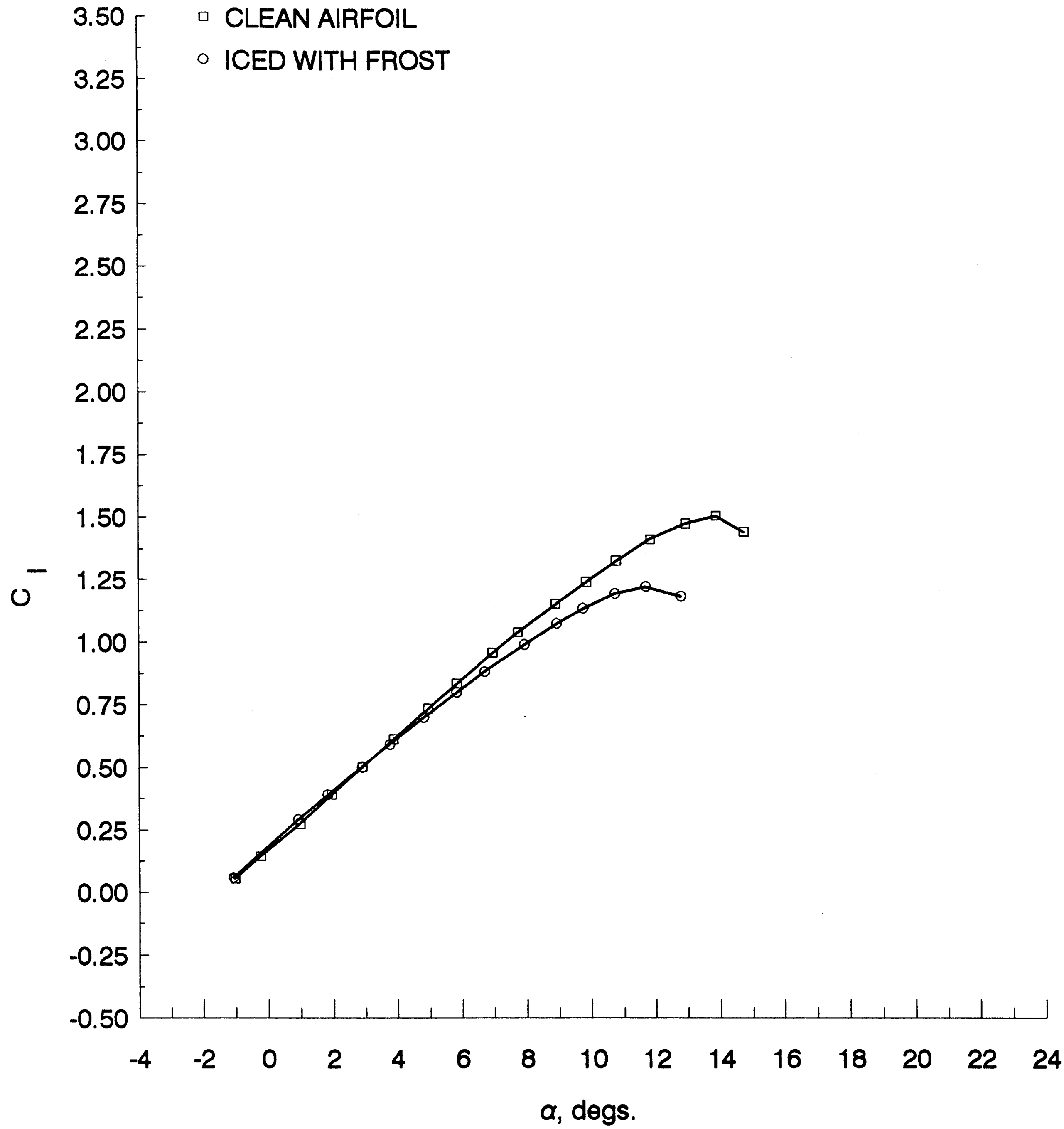
SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.073719	0.187756	0.049536	0.139282	0.053519	0.122296	0.039538	0.144330	0.057862	0.160139	0.032172	0.121163
0.047701	0.205968	0.009121	0.123423	0.003443	0.100004	0.013389	0.152579	0.015494	0.140493	−0.008043	0.111066
0.017603	0.216196	−0.031328	0.103513	−0.034630	0.085782	−0.029125	0.132836	−0.026790	0.128883	−0.028150	0.098950
−0.018586	0.218455	−0.069712	0.089662	−0.070707	0.073572	−0.067655	0.107033	−0.099270	0.109556	−0.058311	0.107027
−0.046801	0.210642	−0.106065	0.077820	−0.102732	0.055385	−0.120334	0.077327	−0.155648	0.094077	−0.084450	0.109047
−0.097226	0.190967	−0.148442	0.068055	−0.156894	0.045070	−0.160881	0.051540	−0.224113	0.074706	−0.108579	0.105008
−0.141588	0.175256	−0.178667	0.066288	−0.199066	0.044825	−0.213560	0.021835	−0.274532	0.053136	−0.144772	0.102989
−0.191913	0.169602	−0.213023	0.052403	−0.231103	0.028638	−0.256040	0.006109	−0.324867	0.039602	−0.154826	0.096931
−0.220170	0.155780	−0.231389	0.024200	−0.263140	0.012451	−0.328919	−0.027451	−0.373321	0.013992	−0.168901	0.078756
−0.248528	0.127937	−0.273955	−0.007846	−0.305230	−0.001794	−0.379515	−0.049137	−0.413576	0.004371	−0.199062	0.068659
−0.296884	0.116260	−0.314422	−0.029782	−0.349410	−0.002051	−0.436310	−0.088855	−0.457888	−0.009226	−0.233244	0.060582
−0.357323	0.102665	−0.352874	−0.051735	−0.385521	−0.008261	−0.484973	−0.120603	−0.490198	−0.026970	−0.275469	0.054523
−0.397605	0.094938	−0.377281	−0.079886	−0.413612	−0.012424	−0.523503	−0.146406	−0.514563	−0.052834	−0.301609	0.042407
−0.454107	0.069296	−0.399640	−0.104003	−0.451685	−0.026646	−0.549966	−0.176326	−0.530856	−0.074765	−0.339812	0.030291
−0.514787	0.021651	−0.431982	−0.117905	−0.481679	−0.048822	−0.572330	−0.198243	−0.549135	−0.094666	−0.357909	0.020194
−0.555198	−0.004104	−0.456390	−0.146056	−0.523734	−0.069067	−0.586661	−0.224244	−0.557525	−0.128737	−0.394102	0.018174
−0.583470	−0.019929	−0.436698	−0.198895	−0.555771	−0.085254	−0.574876	−0.262512	−0.543833	−0.163041	−0.426273	0.018174
−0.636021	−0.055614	−0.424838	−0.225331	−0.581784	−0.101406	−0.546908	−0.294886	−0.516132	−0.201512	−0.466488	0.000000
−0.648445	−0.105603	−0.404922	−0.251837	−0.603768	−0.119535	−0.512841	−0.321282	−0.480274	−0.228014	−0.496649	−0.010097
−0.650699	−0.139640	−0.397005	−0.268111	−0.615700	−0.139606	−0.490873	−0.347579	−0.450332	−0.244405	−0.532842	−0.020194
−0.642896	−0.173748	−0.403253	−0.292366	−0.611450	−0.179584	−0.505105	−0.361526	−0.426433	−0.262743	−0.589142	−0.028271
−0.612955	−0.206009	−0.407521	−0.320690	−0.607247	−0.211562	−0.527469	−0.383443	−0.404711	−0.297132	−0.615281	−0.032310
−0.574870	−0.224306	−0.411772	−0.346988	−0.607071	−0.241563	−0.541850	−0.415471	−0.399007	−0.327333	−0.645442	−0.040388
−0.550848	−0.240501	−0.393750	−0.359297	−0.596889	−0.265505	−0.529932	−0.437668	−0.348906	−0.335900	−0.661528	−0.052504
−0.520865	−0.266753	−0.355607	−0.373805	−0.576644	−0.293390	−0.487534	−0.431987	−0.300727	−0.336409	−0.663539	−0.078756
−0.513076	−0.302864	−0.329358	−0.365927	−0.548413	−0.313228	−0.445103	−0.422288	−0.258571	−0.336855	−0.657507	−0.129241
−0.503191	−0.326971	−0.283005	−0.362274	−0.516189	−0.329042	−0.404656	−0.408555	−0.202362	−0.337449	−0.647453	−0.165590
−0.477187	−0.347185	−0.240730	−0.364662	−0.540181	−0.347182	−0.366324	−0.406859	−0.146111	−0.334025	−0.629356	−0.197900
−0.449101	−0.357399	−0.190487	−0.377248	−0.556130	−0.367276	−0.322009	−0.413248	−0.112112	−0.346440	−0.607238	−0.222132
−0.418875	−0.349600	−0.148299	−0.389765	−0.555966	−0.395277	−0.275545	−0.403582	−0.063827	−0.336904	−0.577078	−0.244346
−0.370504	−0.335921	−0.102066	−0.400290	−0.529719	−0.419127	−0.235262	−0.409937	−0.003646	−0.341559	−0.554960	−0.254443
−0.330307	−0.340211	−0.029635	−0.409015	−0.453350	−0.428684	−0.189013	−0.426388	0.024373	−0.349893	−0.516756	−0.256462
−0.288099	−0.344515	0.034860	−0.403491	−0.417262	−0.418474	−0.160913	−0.442690	0.054188	−0.378340	−0.490617	−0.256462

TABLE 31 - RUN 8 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.251867	−0.340765	0.079252	−0.393744	−0.379189	−0.404252	−0.118631	−0.451071	0.082059	−0.400737	−0.458445	−0.256462
−0.217704	−0.345012	0.117566	−0.387995	−0.347058	−0.404066	−0.035885	−0.443711	0.101900	−0.423050	−0.442359	−0.266559
−0.175553	−0.357329	0.145847	−0.378109	−0.308891	−0.405844	0.010431	−0.452125	0.141901	−0.437539	−0.458445	−0.280695
−0.129322	−0.361662	0.174299	−0.347967	−0.266626	−0.421600	0.042481	−0.478504	0.194222	−0.426035	−0.480563	−0.296850
−0.103304	−0.379874	0.188447	−0.342011	−0.218383	−0.429321	0.090714	−0.498989	0.248550	−0.414553	−0.502681	−0.308966
−0.055176	−0.400245	0.220790	−0.328109	−0.158103	−0.434972	0.157344	−0.489488	0.296877	−0.400998	−0.522788	−0.323102
−0.035206	−0.420417	0.242977	−0.324248	−0.121921	−0.440762	0.224057	−0.469942	0.339245	−0.381352	−0.516756	−0.345315
−0.015193	−0.434580	0.269036	−0.338652	−0.083719	−0.448541	0.260488	−0.454166	0.371597	−0.359591	−0.498659	−0.363489
0.012851	−0.450803	0.313239	−0.351186	−0.019469	−0.446168	0.288869	−0.436316	0.407901	−0.343899	−0.460456	−0.369543
0.065101	−0.457181	0.337336	−0.359496	0.046718	−0.431783	0.327250	−0.428594	0.453923	−0.358452	−0.430295	−0.363489
0.123514	−0.445575	0.355392	−0.367754	0.090793	−0.413526	0.381681	−0.431047	0.485979	−0.364819	−0.392091	−0.355412
0.169902	−0.427875	0.385738	−0.351808	0.132871	−0.397281	0.456377	−0.421611	0.548189	−0.367486	−0.363941	−0.351373
0.244519	−0.400359	0.411969	−0.345956	0.172917	−0.377047	0.515040	−0.399990	0.596558	−0.349912	−0.335791	−0.347334
0.290835	−0.392674	0.440146	−0.348224	0.237015	−0.348673	0.569587	−0.388382	0.662995	−0.332530	−0.317694	−0.351373
0.343271	−0.373013	0.470355	−0.348483	0.283086	−0.328404	0.622167	−0.370729	0.701264	−0.320878	−0.291555	−0.361470
0.401798	−0.345384	0.500597	−0.344691	0.343166	−0.300054	0.680846	−0.347100	0.767615	−0.311532	−0.275469	−0.375606
0.448214	−0.323677	0.536932	−0.334874	0.371187	−0.283890	0.745691	−0.309457	0.805862	−0.301890	−0.239276	−0.405897
0.492562	−0.309969	0.577347	−0.319016	0.397492	−0.317740	0.790321	−0.277676	0.858204	−0.288377	−0.209115	−0.407916
0.532760	−0.314259	0.599431	−0.327308	0.415765	−0.351636					−0.170912	−0.418013
0.574868	−0.332585	0.619484	−0.337609	0.432029	−0.385544					−0.140751	−0.432149
0.631084	−0.347004	0.655734	−0.337920	0.452274	−0.413429					−0.112601	−0.440226
0.707527	−0.345541	0.689952	−0.340240	0.482455	−0.423255					−0.072386	−0.436187
0.731876	−0.315666	0.726236	−0.336499	0.530593	−0.412974					−0.046247	−0.422052
0.774341	−0.283917	0.742416	−0.328535	0.584708	−0.394659					−0.020107	−0.409935
		0.768545	−0.334837	0.610744	−0.382507					0.008043	−0.399838
		0.804829	−0.331097	0.642782	−0.366320					0.038204	−0.411955
		0.833057	−0.327288	0.674807	−0.348133					0.076407	−0.415993
		0.877345	−0.329694	0.727043	−0.351830					0.098525	−0.422052
		0.899498	−0.329884	0.777340	−0.367540					0.136729	−0.415993
		0.957969	−0.322283	0.817457	−0.359306					0.195040	−0.403877
		1.000260	−0.322646	0.853522	−0.345096					0.231233	−0.393780
		1.042586	−0.318958	0.893697	−0.346863					0.289544	−0.377625
		1.074808	−0.319234	0.959931	−0.340478					0.341823	−0.363489
		1.135276	−0.313676	1.006025	−0.324210					0.376005	−0.349354

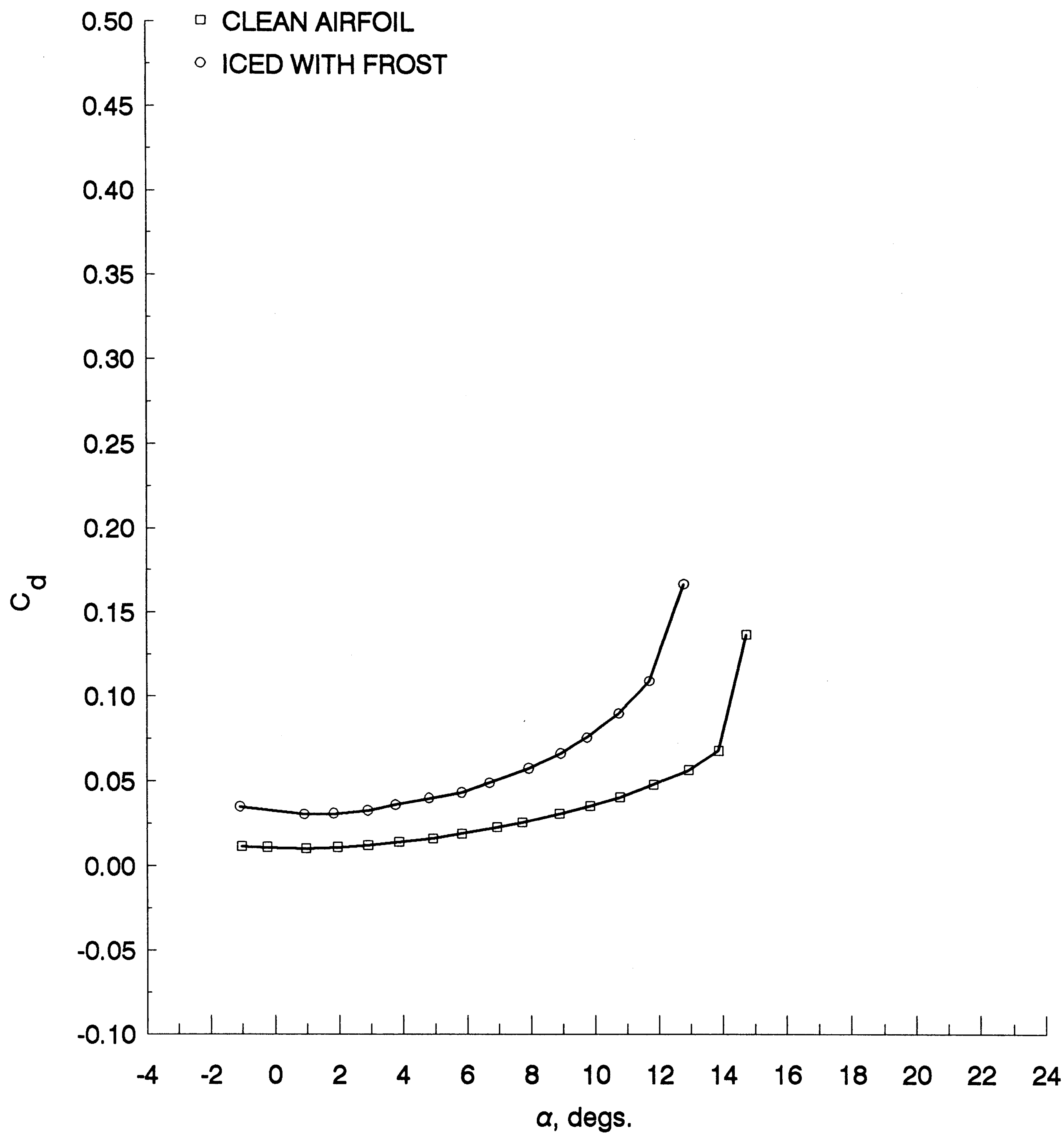
TABLE 31 - RUN 8 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
										0.436327	−0.343296
										0.478552	−0.339257
										0.510724	−0.327141
										0.550938	−0.315024
										0.601206	−0.298869
										0.635389	−0.284733
										0.693700	−0.280695
										0.739946	−0.274636
										0.796247	−0.274636



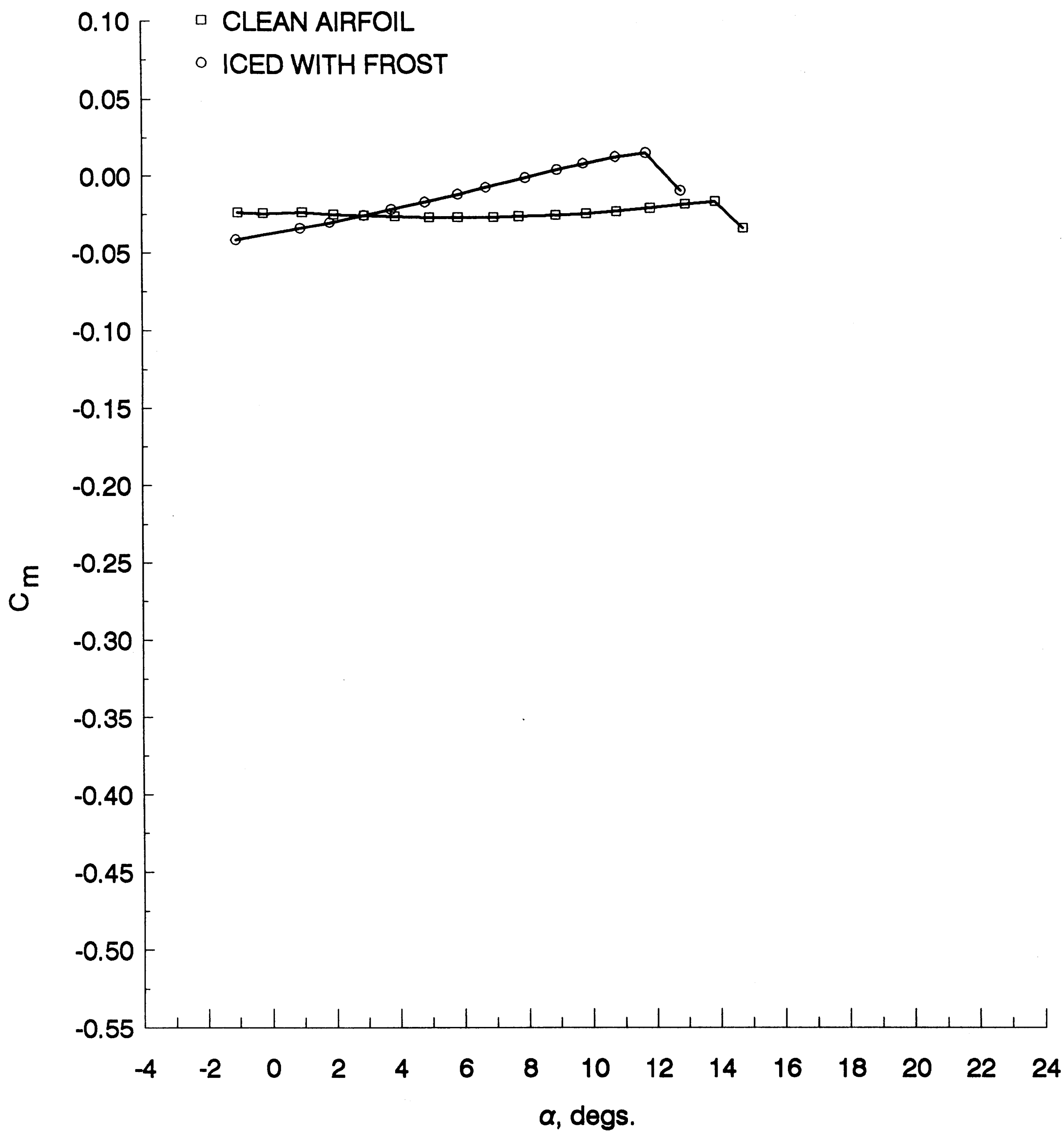
(A) C_l VERSUS α

FIGURE 21 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 8.



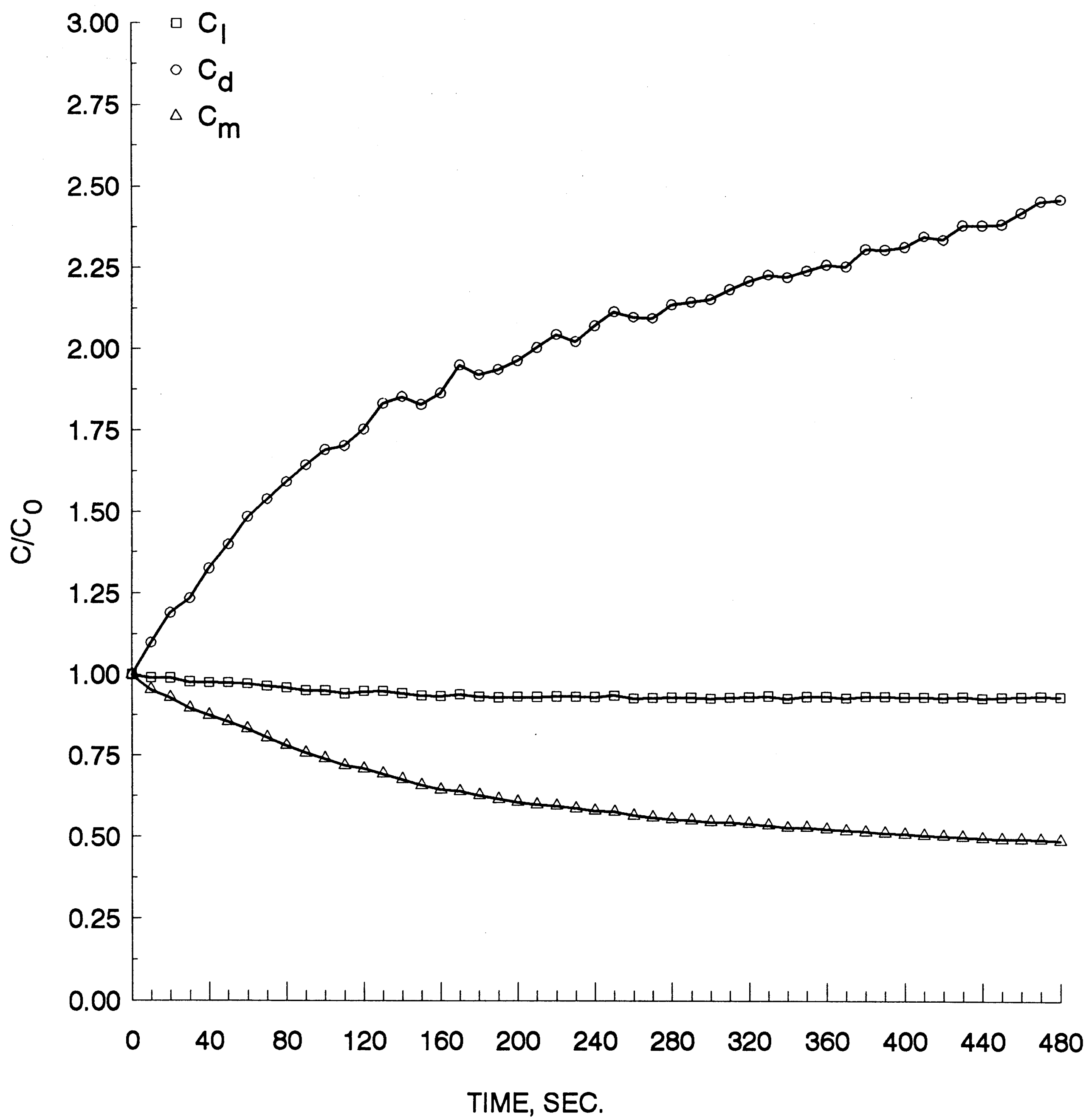
(B) C_d VERSUS α

FIGURE 21 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 8 (con't).



(C) C_m VERSUS α

FIGURE 21 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 8 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 21 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 8 (con't).

TABLE 32 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 8.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0273	0.0560	0.0115	−0.0235
−0.2439	0.1449	0.0111	−0.0239
0.9720	0.2748	0.0103	−0.0232
1.9482	0.3919	0.0111	−0.0245
2.9017	0.5012	0.0123	−0.0253
3.8735	0.6117	0.0141	−0.0259
4.9425	0.7338	0.0162	−0.0266
5.8408	0.8338	0.0190	−0.0267
6.9524	0.9564	0.0229	−0.0266
7.7398	1.0378	0.0256	−0.0261
8.8951	1.1517	0.0309	−0.0253
9.8490	1.2389	0.0352	−0.0241
10.7813	1.3250	0.0404	−0.0227
11.8453	1.4100	0.0478	−0.0205
12.9383	1.4732	0.0562	−0.0178
13.8818	1.5039	0.0676	−0.0163
14.7527	1.4393	0.1366	−0.0337

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.0831	0.0598	0.0350	−0.0413
0.9104	0.2922	0.0306	−0.0335
1.8268	0.3917	0.0310	−0.0299
2.8924	0.5021	0.0328	−0.0253
3.7632	0.5921	0.0361	−0.0214
4.8110	0.6993	0.0399	−0.0167
5.8357	0.7988	0.0433	−0.0118
6.7084	0.8818	0.0488	−0.0073
7.9375	0.9890	0.0573	−0.0009
8.9287	1.0734	0.0660	0.0043
9.7500	1.1336	0.0753	0.0084
10.7441	1.1917	0.0897	0.0129
11.7009	1.2209	0.1089	0.0154
12.7955	1.1823	0.1664	−0.0093

TABLE 33 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 8.

TIME SEC.	C_l/C_{l_0}	C_d/C_{d_0}	C_m/C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9904	1.0980	0.9532
20	0.9898	1.1893	0.9294
30	0.9777	1.2335	0.8962
40	0.9757	1.3254	0.8751
50	0.9749	1.3990	0.8546
60	0.9715	1.4843	0.8317
70	0.9649	1.5390	0.8051
80	0.9604	1.5916	0.7807
90	0.9521	1.6439	0.7585
100	0.9522	1.6910	0.7402
110	0.9425	1.7031	0.7187
120	0.9494	1.7538	0.7089
130	0.9498	1.8321	0.6937
140	0.9435	1.8536	0.6772
150	0.9364	1.8289	0.6587
160	0.9347	1.8645	0.6453
170	0.9397	1.9507	0.6401
180	0.9335	1.9210	0.6279
190	0.9306	1.9379	0.6162
200	0.9327	1.9647	0.6075
210	0.9322	2.0047	0.5997
220	0.9338	2.0457	0.5948
230	0.9336	2.0239	0.5871
240	0.9322	2.0721	0.5802
250	0.9369	2.1167	0.5768
260	0.9281	2.1003	0.5655
270	0.9302	2.0969	0.5593
280	0.9307	2.1381	0.5547
290	0.9306	2.1474	0.5508
300	0.9282	2.1550	0.5472
310	0.9317	2.1862	0.5461
320	0.9334	2.2111	0.5407
330	0.9357	2.2308	0.5359
340	0.9280	2.2234	0.5288
350	0.9341	2.2435	0.5295

TIME SEC.	C_l/C_{l_0}	C_d/C_{d_0}	C_m/C_{m_0}
360	0.9339	2.2618	0.5239
370	0.9296	2.2571	0.5200
380	0.9347	2.3110	0.5168
390	0.9342	2.3095	0.5121
400	0.9334	2.3171	0.5097
410	0.9335	2.3509	0.5060
420	0.9314	2.3404	0.5034
430	0.9344	2.3853	0.5010
440	0.9291	2.3856	0.4966
450	0.9330	2.3882	0.4940
460	0.9340	2.4246	0.4940
470	0.9365	2.4598	0.4933
480	0.9347	2.4658	0.4903

TABLE 34 - TEST CONDITIONS FOR RUN NUMBER 8.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 8	Configuration Cruise Wing		Date 05-03-88
P_{air} 43 psig	ΔP_W 8.8 psid	T_{avg} 15° F	V_∞ 150 mph
Spray Duration 8 min	Ice Accretion Type Mixed		A.O.A. 5°
LWC 0.8 g/m³	MVD 14 μm		

Remarks

- Ice accretion approximately 1/2" to 9/16" thick
- Rime on the outside with a glaze core
- Uniform across the span

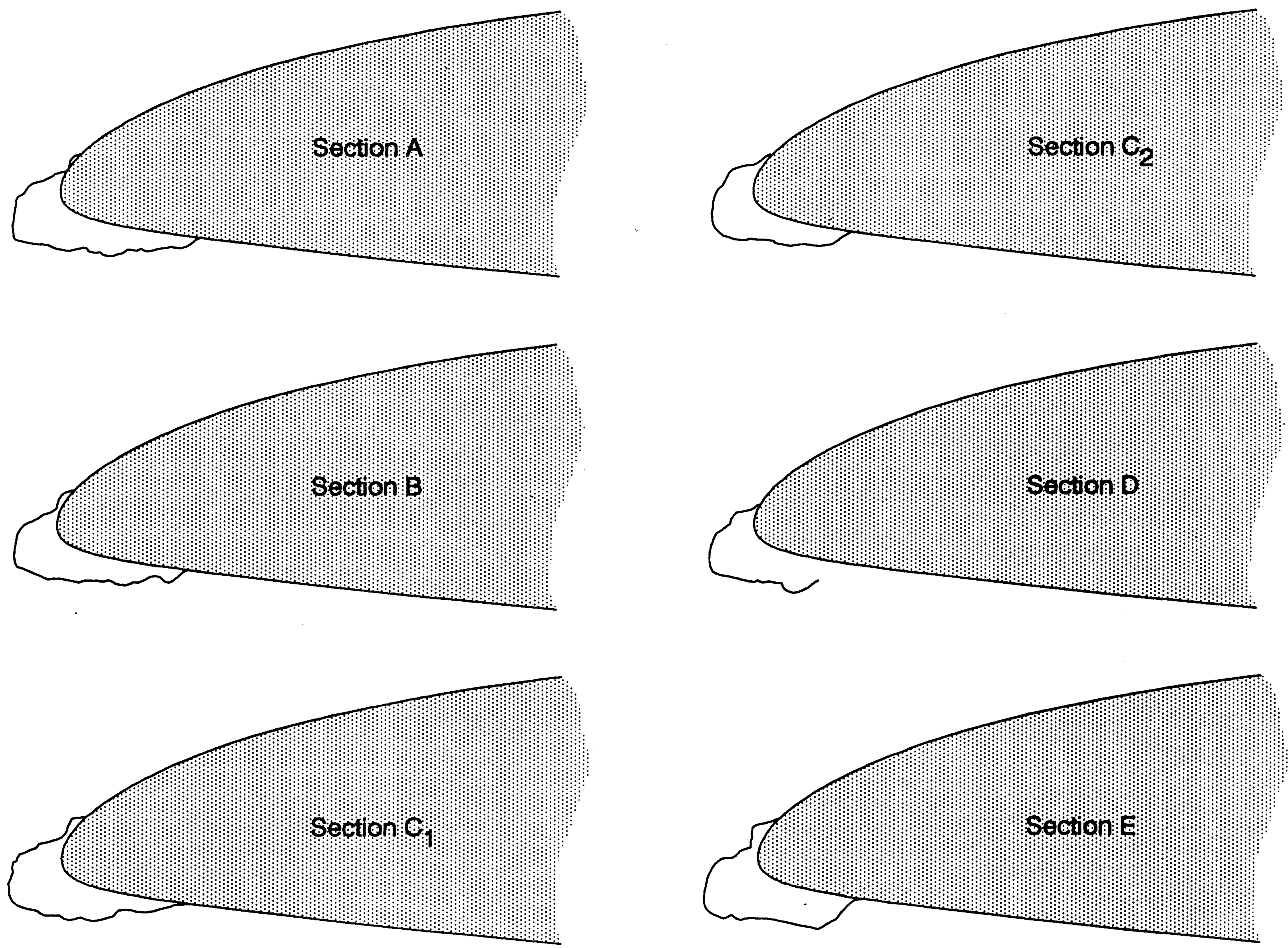


FIGURE 22 - RUN 9 ICE SHAPE TRACINGS FOR SECTIONS A - E.

TABLE 35 - RUN 9 ICE SHAPE COORDINATES FOR SECTIONS A - E.

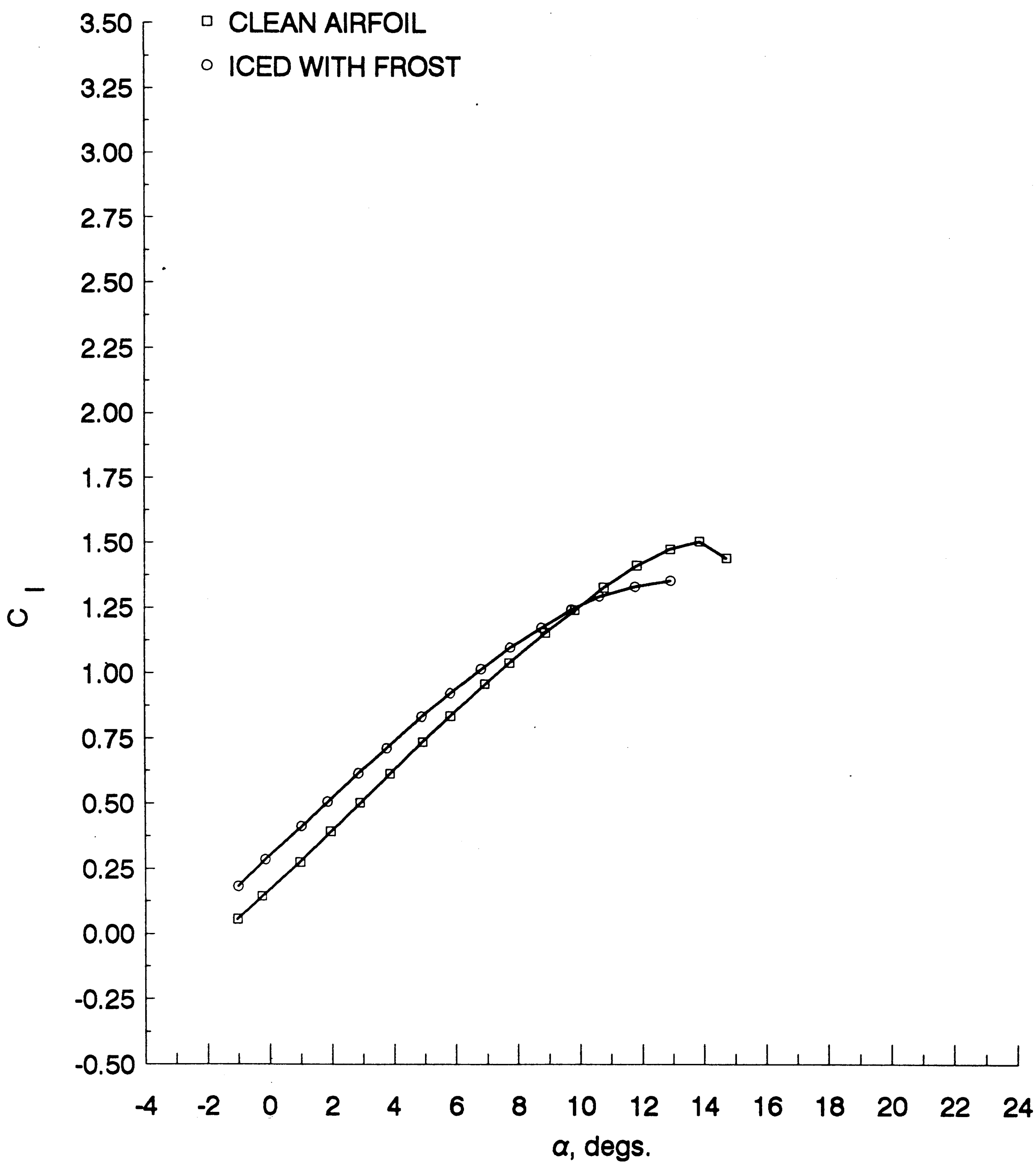
SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.142637	0.247205	0.107024	0.225585	0.146278	0.269758	0.110100	0.236053	0.042228	0.127358	0.093736	0.233107
0.108428	0.239466	0.084851	0.221802	0.118053	0.263876	0.075780	0.216209	0.020138	0.123694	0.051509	0.221723
0.092312	0.233585	0.056558	0.210059	0.087841	0.264012	0.053566	0.202308	0.003871	0.107935	0.013348	0.214287
0.076131	0.219692	0.030235	0.194284	0.065659	0.258103	0.029289	0.180395	-0.022377	0.094329	-0.018838	0.204754
0.061927	0.201777	0.009781	0.162400	0.051450	0.234131	0.003065	0.168524	-0.062614	0.082938	-0.037131	0.186987
0.057717	0.177772	0.001420	0.132398	0.039228	0.204141	-0.039198	0.164782	-0.114775	0.077731	-0.041748	0.146955
0.053523	0.155771	-0.000863	0.106345	0.031053	0.178139	-0.069405	0.158956	-0.147430	0.038212	-0.038111	0.122638
0.049361	0.137776	-0.043386	0.080708	0.016854	0.156170	-0.103662	0.149143	-0.160027	0.000386	-0.048306	0.110963
0.033229	0.129892	-0.089808	0.067147	-0.001356	0.138224	-0.131896	0.137286	-0.188371	-0.019191	-0.048704	0.084902
-0.011023	0.122232	-0.120217	0.045396	-0.039697	0.122373	-0.160209	0.113393	-0.220811	-0.044708	-0.048918	0.070869
-0.035189	0.114412	-0.160666	0.025755	-0.071968	0.112504	-0.172444	0.087390	-0.245027	-0.056343	-0.047038	0.062820
-0.049345	0.102507	-0.186946	0.013992	-0.096165	0.106604	-0.188727	0.057401	-0.265635	-0.094047	-0.075159	0.057235
-0.075569	0.088694	-0.211236	0.000202	-0.146564	0.096817	-0.198924	0.035398	-0.282391	-0.141814	-0.097304	0.049553
-0.109858	0.070939	-0.237663	-0.025602	-0.170852	0.070887	-0.227237	0.011504	-0.293140	-0.189673	-0.117477	0.039837
-0.138041	0.063151	-0.256126	-0.059512	-0.209193	0.055036	-0.239433	-0.008480	-0.293783	-0.231683	-0.135802	0.020066
-0.166209	0.057367	-0.266833	-0.121585	-0.241483	0.041160	-0.253730	-0.042494	-0.288357	-0.269784	-0.148028	0.006217
-0.190392	0.047543	-0.273204	-0.153614	-0.273764	0.029288	-0.264043	-0.082551	-0.270915	-0.308069	-0.168171	-0.001495
-0.210637	0.027674	-0.275759	-0.205742	-0.291991	0.007337	-0.266248	-0.112630	-0.221125	-0.326838	-0.212247	-0.002825
-0.226882	0.005769	-0.270099	-0.241908	-0.292083	-0.012693	-0.270502	-0.148713	-0.165204	-0.337697	-0.240398	-0.010415
-0.239094	-0.014166	-0.256286	-0.268128	-0.316289	-0.020596	-0.264879	-0.212947	-0.097359	-0.354741	-0.274830	-0.035954
-0.273367	-0.029917	-0.222187	-0.278510	-0.320463	-0.052626	-0.244959	-0.243166	-0.047477	-0.367509	-0.295279	-0.063713
-0.281482	-0.039868	-0.176100	-0.297041	-0.318596	-0.084682	-0.224974	-0.263355	-0.001508	-0.374215	-0.311724	-0.091534
-0.291669	-0.057816	-0.148078	-0.311372	-0.330854	-0.122685	-0.194959	-0.287621	0.022677	-0.364579	-0.328261	-0.125368
-0.287748	-0.069866	-0.114000	-0.323760	-0.349127	-0.154650	-0.160832	-0.297870	0.054505	-0.379072	-0.334757	-0.157351
-0.291974	-0.095873	-0.085979	-0.338092	-0.339194	-0.184741	-0.118672	-0.310175	0.098685	-0.371743	-0.343317	-0.193313
-0.296248	-0.127889	-0.051901	-0.350480	-0.339386	-0.226803	-0.078485	-0.316450	0.138616	-0.380357	-0.349751	-0.221286
-0.302531	-0.159890	-0.019647	-0.344796	-0.323447	-0.264933	-0.050327	-0.316629	0.176635	-0.382939	-0.352641	-0.279391
-0.304812	-0.193925	0.016590	-0.343165	-0.293363	-0.293111	-0.022105	-0.306778	0.188223	-0.411130	-0.350976	-0.301473
-0.309070	-0.223939	0.050710	-0.351542	-0.259187	-0.307287	0.034173	-0.313155	0.211948	-0.431502	-0.337360	-0.327749
-0.307239	-0.245988	0.086863	-0.357934	-0.216936	-0.317493	0.070363	-0.315392	0.251786	-0.446117	-0.315644	-0.348133
-0.305503	-0.280055	0.114968	-0.364243	-0.186743	-0.321635	0.098508	-0.317577	0.281918	-0.440575	-0.289893	-0.366574
-0.297694	-0.308162	0.141040	-0.372536	-0.156577	-0.331786	0.132674	-0.321807	0.316177	-0.427091	-0.264020	-0.376996

TABLE 35 - RUN 9 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.271663	−0.318385	0.169312	−0.362799	−0.140529	−0.345880	0.144639	−0.337933	0.350498	−0.409607	−0.224224	−0.393646
−0.225548	−0.328769	0.191506	−0.357011	−0.114400	−0.358016	0.174783	−0.342138	0.389008	−0.380181	−0.204081	−0.385934
−0.173391	−0.337197	0.225689	−0.359370	−0.058014	−0.360274	0.204926	−0.346342	0.413284	−0.364545	−0.173775	−0.368352
−0.127227	−0.341572	0.257901	−0.357698	−0.011680	−0.358480	0.239067	−0.354584			−0.161854	−0.374550
−0.083056	−0.343928	0.278000	−0.359912	0.012398	−0.378619	0.279344	−0.346817			−0.140077	−0.390925
−0.051048	−0.360208	0.300069	−0.366158	0.044578	−0.388779	0.301481	−0.344951			−0.112202	−0.401378
−0.008965	−0.372563	0.316206	−0.362313	0.078836	−0.384928	0.329664	−0.341118			−0.084020	−0.391783
0.021114	−0.378812	0.332385	−0.354457	0.107070	−0.377043	0.351763	−0.345272			−0.043918	−0.388387
0.057220	−0.385110	0.354455	−0.360703	0.125225	−0.371116	0.393961	−0.351559			0.004101	−0.391128
0.085403	−0.377322	0.380443	−0.377019	0.157386	−0.385283	0.430151	−0.353796			0.054121	−0.393899
0.111562	−0.371521	0.408548	−0.383328	0.203665	−0.395507	0.466393	−0.348008			0.100107	−0.398614
0.133688	−0.367691	0.442689	−0.389699	0.248002	−0.389698	0.506657	−0.342246			0.140025	−0.407246
0.151813	−0.361826	0.466916	−0.381926	0.294391	−0.375886	0.532932	−0.322352			0.193927	−0.418097
0.173858	−0.368012	0.499254	−0.368219	0.328686	−0.364023	0.575362	−0.292530			0.245765	−0.432927
0.185749	−0.388138	0.525389	−0.370495	0.363081	−0.330127	0.605621	−0.278680			0.291690	−0.441651
0.209819	−0.392336	0.557705	−0.358794	0.399363	−0.324281	0.631884	−0.260791			0.331669	−0.446274
0.227879	−0.394483	0.584007	−0.345025	0.451730	−0.324518					0.361577	−0.454752
0.260032	−0.392737	0.610309	−0.331256	0.483910	−0.334679					0.389545	−0.459191
0.275971	−0.408889	0.632461	−0.329479	0.546329	−0.338966					0.411751	−0.447500
0.304058	−0.413120	0.668656	−0.331860	0.596718	−0.331182					0.440024	−0.431892
0.344228	−0.413440	0.684585	−0.348072	0.651163	−0.317407					0.468298	−0.416283
0.366386	−0.405604	0.702526	−0.364305	0.699557	−0.305607					0.506673	−0.394815
0.390537	−0.399787	0.730631	−0.370614	0.737889	−0.291759					0.537347	−0.353176
0.414719	−0.389964	0.760977	−0.354880							0.567898	−0.319557
0.432924	−0.374084	0.791407	−0.331124							0.592290	−0.295868
0.455003	−0.376264	0.821880	−0.303356							0.624690	−0.272303
0.495141	−0.380590	0.850214	−0.287602								
0.521364	−0.366777										
0.541369	−0.376953										
0.565407	−0.385157										
0.607650	−0.377481										
0.629808	−0.369646										
0.664001	−0.363909										

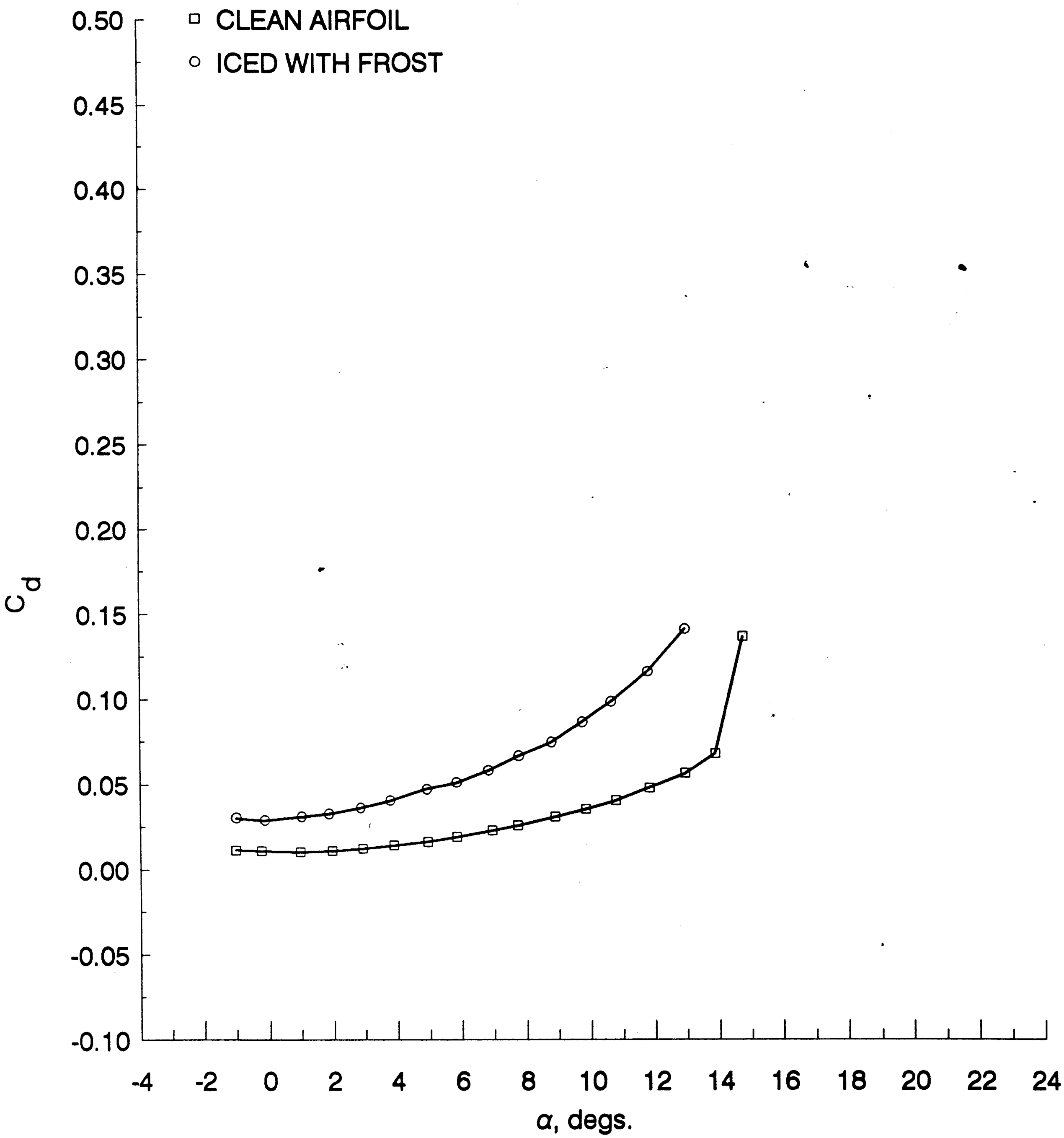
TABLE 35 - RUN 9 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.700170	−0.362194										
0.718311	−0.354326										
0.748375	−0.362578										
0.784528	−0.362867										
0.818737	−0.355127										
0.853043	−0.335369										
0.879346	−0.311541										
0.915644	−0.293802										



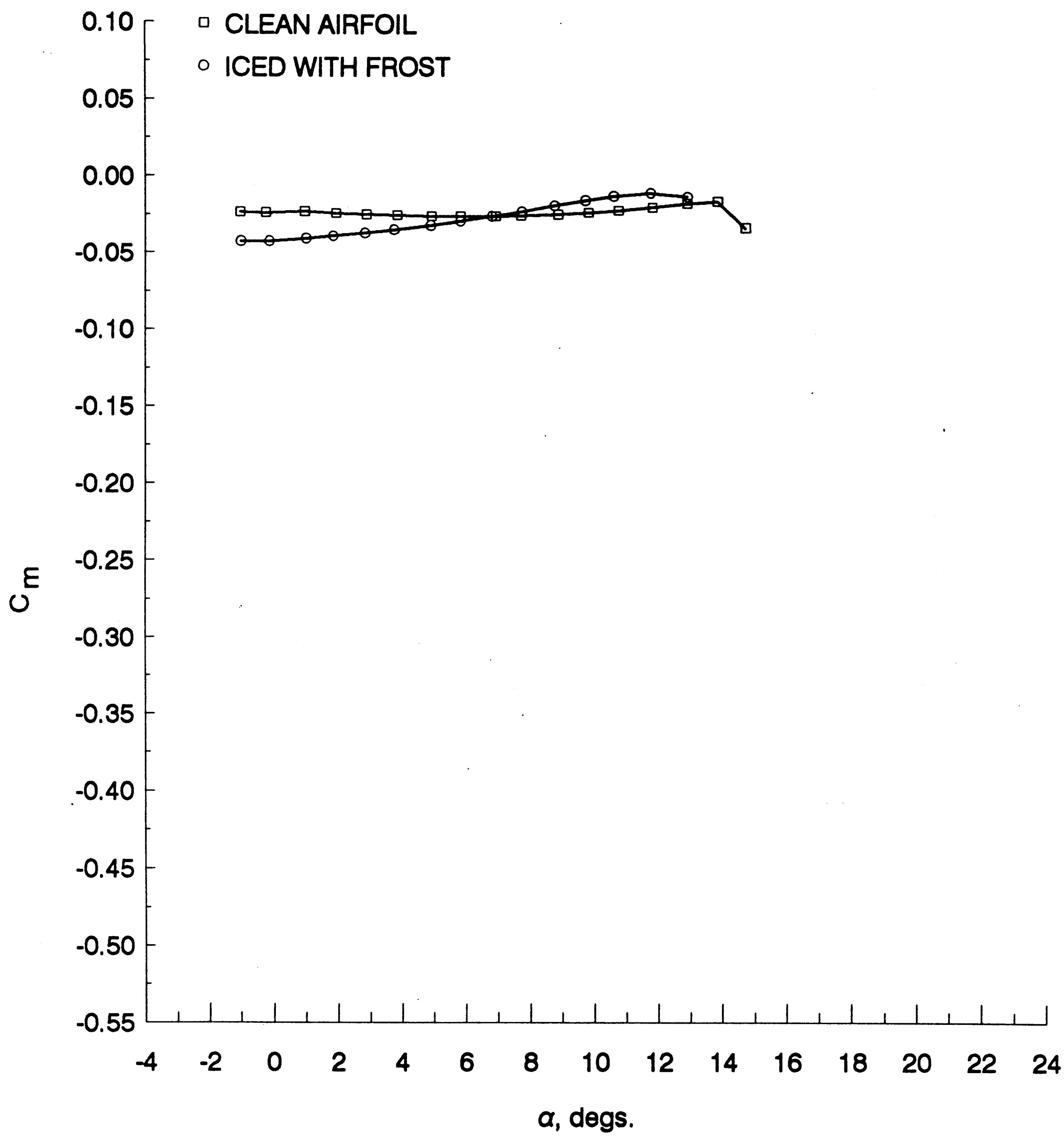
(A) C_l VERSUS α

FIGURE 23 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 9.



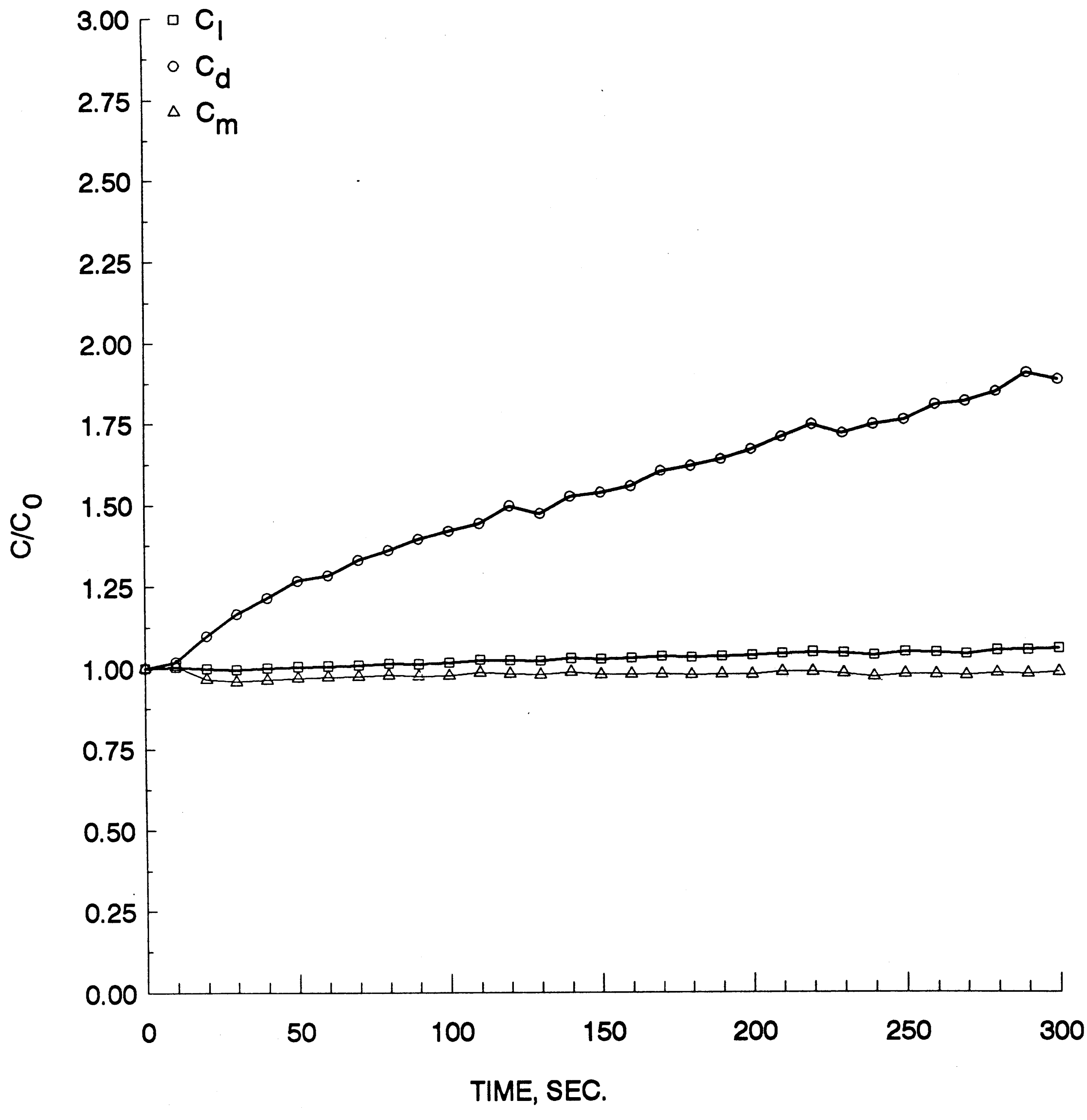
(B) C_d VERSUS α

FIGURE 23 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 9 (con't).



(C) C_m VERSUS α

FIGURE 23 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 9 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 23 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 9 (con't).

TABLE 36 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 9.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0273	0.0560	0.0115	−0.0235
−0.2439	0.1449	0.0111	−0.0239
0.9720	0.2748	0.0103	−0.0232
1.9482	0.3919	0.0111	−0.0245
2.9017	0.5012	0.0123	−0.0253
3.8735	0.6117	0.0141	−0.0259
4.9425	0.7338	0.0162	−0.0266
5.8408	0.8338	0.0190	−0.0267
6.9524	0.9564	0.0229	−0.0266
7.7398	1.0378	0.0256	−0.0261
8.8951	1.1517	0.0309	−0.0253
9.8490	1.2389	0.0352	−0.0241
10.7813	1.3250	0.0404	−0.0227
11.8453	1.4100	0.0478	−0.0205
12.9383	1.4732	0.0562	−0.0178
13.8818	1.5039	0.0676	−0.0163
14.7527	1.4393	0.1366	−0.0337

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.0103	0.1832	0.0304	−0.0427
−0.1333	0.2849	0.0290	−0.0426
1.0093	0.4128	0.0311	−0.0408
1.8559	0.5060	0.0327	−0.0393
2.8478	0.6135	0.0362	−0.0374
3.7713	0.7101	0.0405	−0.0353
4.9127	0.8318	0.0471	−0.0325
5.8390	0.9213	0.0510	−0.0297
6.8305	1.0133	0.0580	−0.0266
7.7649	1.0957	0.0664	−0.0234
8.7800	1.1706	0.0745	−0.0194
9.7434	1.2415	0.0863	−0.0160
10.6353	1.2915	0.0983	−0.0132
11.7896	1.3284	0.1160	−0.0110
12.9446	1.3517	0.1410	−0.0134

TABLE 37 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 9.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	1.0034	1.0192	1.0062
20	0.9983	1.0985	0.9650
30	0.9957	1.1652	0.9573
40	1.0002	1.2143	0.9623
50	1.0044	1.2671	0.9684
60	1.0062	1.2837	0.9721
70	1.0082	1.3300	0.9732
80	1.0139	1.3609	0.9772
90	1.0113	1.3949	0.9738
100	1.0156	1.4190	0.9747
110	1.0237	1.4421	0.9844
120	1.0218	1.4962	0.9808
130	1.0210	1.4717	0.9780
140	1.0279	1.5246	0.9850
150	1.0253	1.5359	0.9772
160	1.0288	1.5558	0.9794
170	1.0335	1.6028	0.9795
180	1.0310	1.6179	0.9764
190	1.0334	1.6383	0.9782
200	1.0369	1.6701	0.9777
210	1.0429	1.7086	0.9859
220	1.0467	1.7460	0.9859
230	1.0445	1.7192	0.9806
240	1.0376	1.7468	0.9702
250	1.0471	1.7610	0.9789
260	1.0456	1.8082	0.9774
270	1.0412	1.8175	0.9743
280	1.0516	1.8473	0.9815
290	1.0531	1.9055	0.9788
300	1.0572	1.8844	0.9846

TABLE 38 - TEST CONDITIONS FOR RUN NUMBER 9.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 9	Configuration Cruise Wing	Date 05-03-88	
P_{air} 22 psig	ΔP_w 6.3 psid	T_{avg} -22° F	V_∞ 100 mph
Spray Duration 5 min	Ice Accretion Type Rime	A.O.A. 5°	
LWC 0.87 g/m³	MVD 17.1 μm		

Remarks

- Ice accretion approximately 3/8" thick
- Uniform across span
- Frost to trailing edge on lower surface

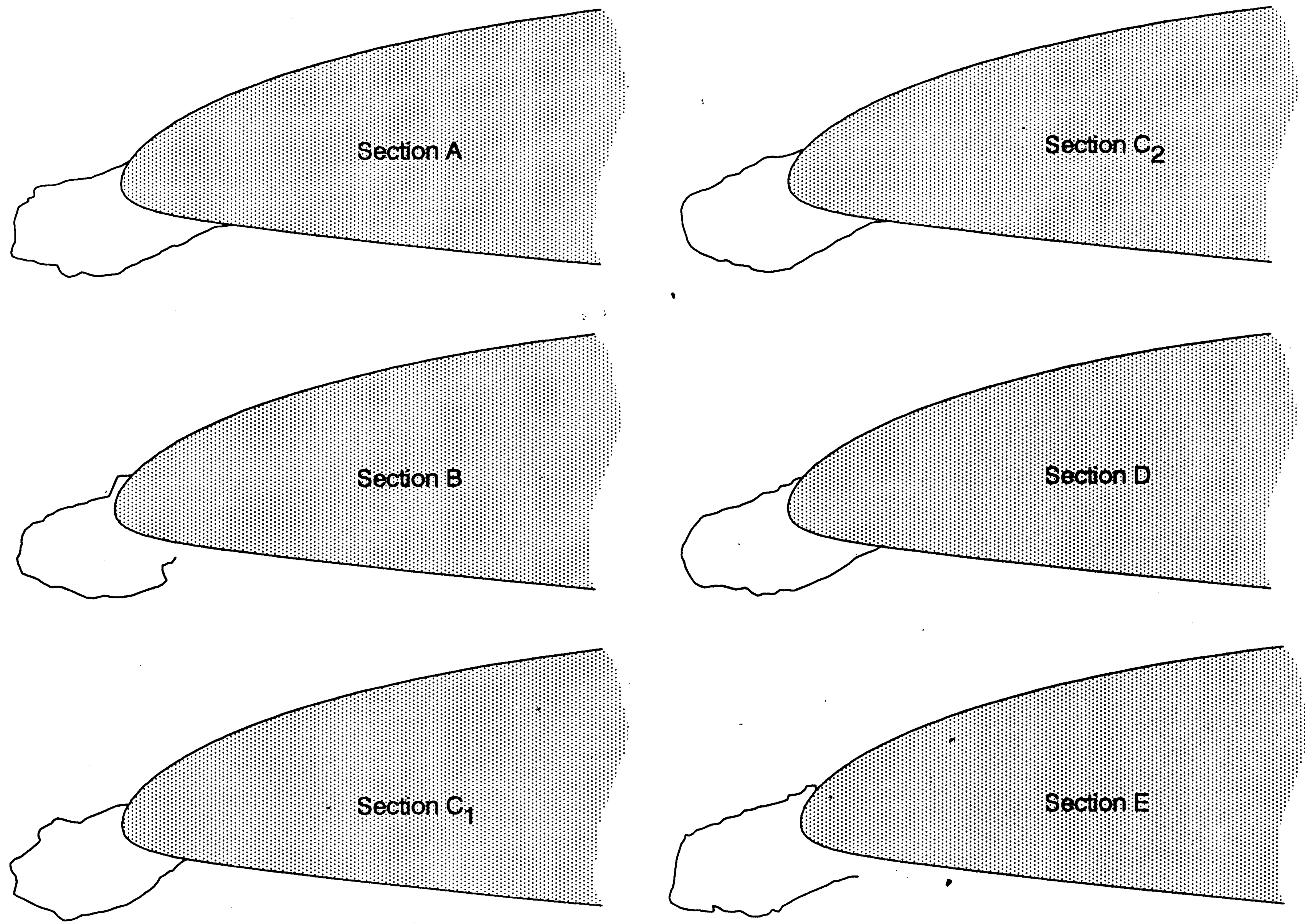


FIGURE 24 - RUN 10 ICE SHAPE TRACINGS FOR SECTIONS A - E.

TABLE 39 - RUN 10 ICE SHAPE COORDINATES FOR SECTIONS A - E.

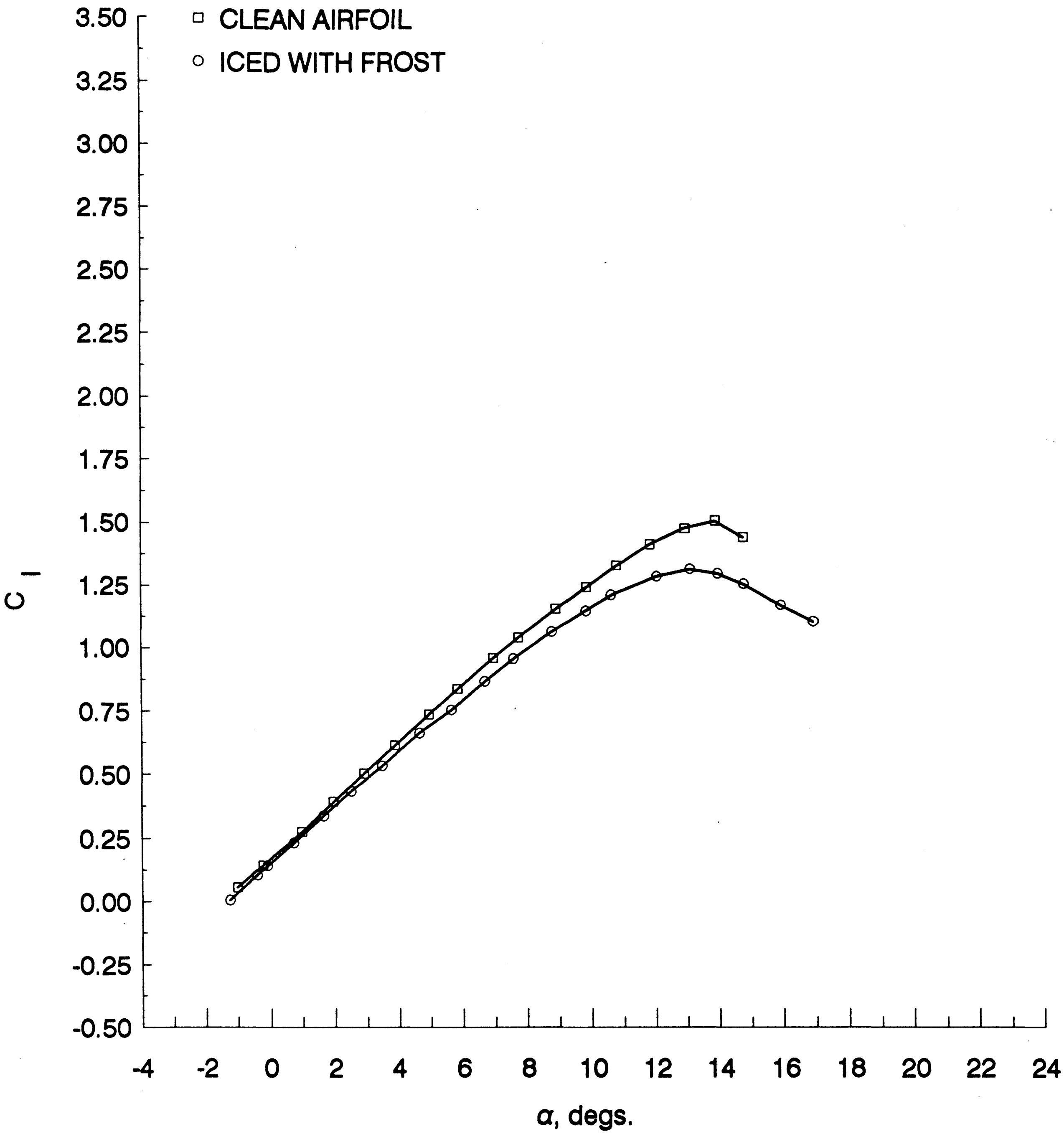
SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.058778	0.161095	0.119110	0.232466	0.042747	0.138693	0.092990	0.216497	0.101798	0.209394	0.099778	0.248390
0.030531	0.139262	0.085161	0.226930	0.008573	0.132797	0.058556	0.199076	0.073600	0.205841	0.041695	0.243238
0.000282	0.123404	0.049281	0.225466	−0.031611	0.130953	0.028239	0.189520	0.057430	0.200116	0.027330	0.219273
−0.040029	0.111549	0.021337	0.221858	−0.063810	0.116999	0.001949	0.179920	0.037178	0.190473	0.000967	0.195493
−0.080353	0.093723	−0.040454	0.087428	−0.118139	0.095087	−0.040450	0.170497	0.026883	0.174709	−0.043149	0.188111
−0.122696	0.073910	−0.106422	0.072286	−0.148330	0.081124	−0.082759	0.168982	0.002551	0.161148	−0.083234	0.182682
−0.171068	0.060082	−0.168377	0.059102	−0.184546	0.067186	−0.106923	0.169245	−0.031707	0.155697	−0.089661	0.154564
−0.205345	0.044233	−0.192520	0.043310	−0.224772	0.055278	−0.139164	0.167620	−0.049887	0.150002	−0.129869	0.141074
−0.249672	0.038358	−0.256436	0.032178	−0.248936	0.041291	−0.163395	0.161953	−0.062161	0.136259	−0.182106	0.125755
−0.271833	0.036415	−0.280549	0.018406	−0.281169	0.019285	−0.195860	0.140556	−0.072394	0.124474	−0.236281	0.114497
−0.310107	0.034507	−0.320413	0.017004	−0.315309	0.021441	−0.230339	0.119182	−0.102725	0.112993	−0.284427	0.105162
−0.344358	0.030601	−0.384450	−0.002210	−0.341407	0.025576	−0.262714	0.105693	−0.134942	0.109501	−0.316636	0.091549
−0.374584	0.024695	−0.426732	−0.031865	−0.383548	0.035817	−0.305248	0.084407	−0.163141	0.105948	−0.346723	0.085966
−0.414909	0.006869	−0.450693	−0.035534	−0.413646	0.043994	−0.331717	0.058990	−0.183392	0.096305	−0.382779	0.082490
−0.465295	−0.006955	−0.470822	−0.049368	−0.439743	0.048129	−0.355992	0.049368	−0.201757	0.078674	−0.411203	0.054711
−0.487447	−0.004917	−0.489174	−0.077373	−0.463899	0.036153	−0.406446	0.040033	−0.244361	0.053450	−0.451380	0.043237
−0.535798	−0.008794	−0.519170	−0.084991	−0.480062	0.014080	−0.434772	0.028478	−0.272652	0.043929	−0.501525	0.033932
−0.568043	−0.016685	−0.561117	−0.092423	−0.504226	0.000092	−0.453186	0.002973	−0.309043	0.030550	−0.525675	0.024227
−0.586193	−0.026598	−0.579377	−0.114367	−0.536408	−0.009836	−0.499814	−0.024201	−0.341414	0.017110	−0.552068	−0.001569
−0.594276	−0.038523	−0.615623	−0.140075	−0.560597	−0.029862	−0.550425	−0.047377	−0.381701	0.011750	−0.602213	−0.010874
−0.590345	−0.082320	−0.632104	−0.176192	−0.570725	−0.049947	−0.582755	−0.056911	−0.413981	0.004279	−0.638422	−0.024424
−0.604462	−0.090251	−0.636575	−0.208455	−0.572835	−0.074091	−0.619135	−0.068378	−0.450341	−0.007110	−0.664601	−0.036114
−0.634693	−0.098147	−0.634918	−0.230709	−0.558874	−0.098303	−0.663660	−0.087665	−0.476714	−0.022631	−0.704779	−0.047588
−0.632719	−0.116065	−0.643281	−0.256848	−0.579063	−0.122372	−0.686057	−0.109172	−0.521143	−0.035887	−0.716930	−0.057478
−0.656911	−0.125965	−0.647843	−0.295172	−0.609295	−0.146398	−0.712571	−0.138543	−0.569562	−0.047093	−0.733172	−0.073352
−0.673047	−0.135882	−0.666286	−0.329238	−0.637502	−0.166408	−0.727271	−0.191772	−0.598037	−0.068552	−0.759321	−0.083027
−0.701290	−0.155725	−0.660829	−0.363675	−0.659683	−0.186442	−0.721768	−0.239290	−0.614453	−0.090193	−0.781257	−0.078658
−0.711450	−0.195511	−0.649336	−0.394165	−0.689898	−0.206443	−0.718234	−0.282831	−0.636991	−0.117711	−0.783409	−0.088703
−0.721578	−0.221364	−0.633920	−0.428757	−0.732158	−0.224380	−0.706644	−0.326461	−0.657519	−0.145259	−0.787714	−0.108792
−0.729710	−0.255184	−0.600245	−0.441403	−0.762424	−0.256457	−0.692930	−0.360226	−0.680241	−0.184714	−0.810170	−0.138679
−0.725748	−0.285048	−0.548706	−0.458369	−0.758541	−0.288678	−0.681274	−0.397924	−0.696842	−0.218291	−0.828993	−0.192808
−0.723826	−0.326850	−0.515091	−0.475056	−0.746589	−0.312881	−0.657513	−0.433777	−0.711279	−0.241952	−0.845847	−0.248983
−0.723897	−0.358697	−0.477676	−0.503927	−0.726611	−0.339131	−0.633551	−0.451835	−0.721850	−0.275621	−0.852794	−0.311358

TABLE 39 - RUN 10 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.721953	−0.390547	−0.436126	−0.522758	−0.718718	−0.373380	−0.595582	−0.477956	−0.722526	−0.319390	−0.859680	−0.369703
−0.736092	−0.408430	−0.390257	−0.519428	−0.728939	−0.415606	−0.565489	−0.488172	−0.704992	−0.355474	−0.866505	−0.424018
−0.742192	−0.434292	−0.358451	−0.523963	−0.741160	−0.455809	−0.529378	−0.500431	−0.693518	−0.393457	−0.880992	−0.456043
−0.748279	−0.454183	−0.293092	−0.549226	−0.717113	−0.469999	−0.497338	−0.516600	−0.674096	−0.437530	−0.893633	−0.498174
−0.742298	−0.482062	−0.241675	−0.574273	−0.687040	−0.484215	−0.473287	−0.526750	−0.646636	−0.481724	−0.882093	−0.528585
−0.714130	−0.496055	−0.188235	−0.597330	−0.658968	−0.496409	−0.453172	−0.528947	−0.628886	−0.503882	−0.846466	−0.553321
−0.681919	−0.504086	−0.136483	−0.600153	−0.628895	−0.510624	−0.416882	−0.525389	−0.600965	−0.518234	−0.808686	−0.568012
−0.635606	−0.510158	−0.074467	−0.582929	−0.590813	−0.530912	−0.392830	−0.535539	−0.568962	−0.528669	−0.756816	−0.576874
−0.599349	−0.510236	−0.006903	−0.594081	−0.548704	−0.549203	−0.378869	−0.547555	−0.522645	−0.523400	−0.708885	−0.581643
−0.575210	−0.524221	0.054868	−0.593018	−0.502553	−0.561473	−0.358799	−0.553707	−0.484368	−0.518010	−0.660953	−0.586413
−0.543004	−0.534243	0.122828	−0.577907	−0.464445	−0.575722	−0.322598	−0.558057	−0.444172	−0.518618	−0.625020	−0.590998
−0.496685	−0.538324	0.180921	−0.556580	−0.440441	−0.599976	−0.284383	−0.562429	−0.416128	−0.525013	−0.597055	−0.593445
−0.462453	−0.542379	0.228965	−0.541160	−0.424438	−0.616145	−0.260264	−0.566648	−0.382116	−0.535477	−0.588934	−0.585508
−0.434253	−0.542440	0.287027	−0.521853	−0.398383	−0.630343	−0.248361	−0.582597	−0.352061	−0.541902	−0.596412	−0.551128
−0.420220	−0.572326	0.323121	−0.506247	−0.352173	−0.628524	−0.204195	−0.594944	−0.323863	−0.538349	−0.572538	−0.559558
−0.404154	−0.594255	0.347416	−0.480355	−0.315973	−0.618612	−0.149894	−0.601470	−0.293624	−0.532837	−0.548665	−0.567988
−0.375995	−0.612230	0.333993	−0.445794	−0.275714	−0.598653	−0.115661	−0.601844	−0.271640	−0.541130	−0.526943	−0.586463
−0.351846	−0.622234	0.322531	−0.413285	−0.231496	−0.592800	−0.081384	−0.598263	−0.247830	−0.561390	−0.483011	−0.591171
−0.311540	−0.612369	0.323018	−0.380960	−0.173191	−0.580969	−0.030931	−0.588927	−0.233916	−0.571550	−0.453016	−0.591633
−0.295413	−0.606433	0.341034	−0.375177	−0.126956	−0.573111	0.017487	−0.581547	−0.205994	−0.585902	−0.414899	−0.584159
−0.265164	−0.590575	0.359111	−0.365354	−0.090756	−0.563199	0.049997	−0.556196	−0.187845	−0.582197	−0.383149	−0.600773
−0.247040	−0.592605	0.387025	−0.363767	−0.040478	−0.549321	0.094544	−0.534931	−0.165584	−0.572585	−0.355428	−0.619340
−0.212829	−0.606611	0.411473	−0.327772	0.021869	−0.531467	0.145288	−0.499893	−0.137447	−0.573011	−0.333523	−0.625724
−0.176595	−0.616642			0.062129	−0.511508	0.183794	−0.478562	−0.111351	−0.575396	−0.285531	−0.626464
−0.138321	−0.614734			0.114483	−0.481537	0.236396	−0.457385	−0.085162	−0.571813	−0.243384	−0.617036
−0.091980	−0.608863			0.150750	−0.455523	0.291146	−0.424368	−0.058697	−0.550324	−0.217235	−0.607361
−0.045644	−0.604982			0.187017	−0.429509	0.335782	−0.395194	−0.014482	−0.550994	−0.192811	−0.579520
−0.005338	−0.595118			0.217241	−0.407496	0.384379	−0.371996	0.041760	−0.553835	−0.170937	−0.587919
0.024933	−0.569308			0.243489	−0.375402	0.414719	−0.360464	0.078151	−0.540456	−0.149001	−0.592288
0.063247	−0.549487			0.253634	−0.351291	0.465486	−0.323448	0.114542	−0.527078	−0.132759	−0.576414
0.107592	−0.535650			0.283841	−0.333303	0.507974	−0.306115	0.161104	−0.505893	−0.120455	−0.556448
0.139872	−0.511835			0.320100	−0.309302	0.562701	−0.275075	0.201607	−0.486607	−0.092215	−0.540759
0.180183	−0.499979			0.344230	−0.303365			0.254199	−0.465514	−0.031734	−0.509443

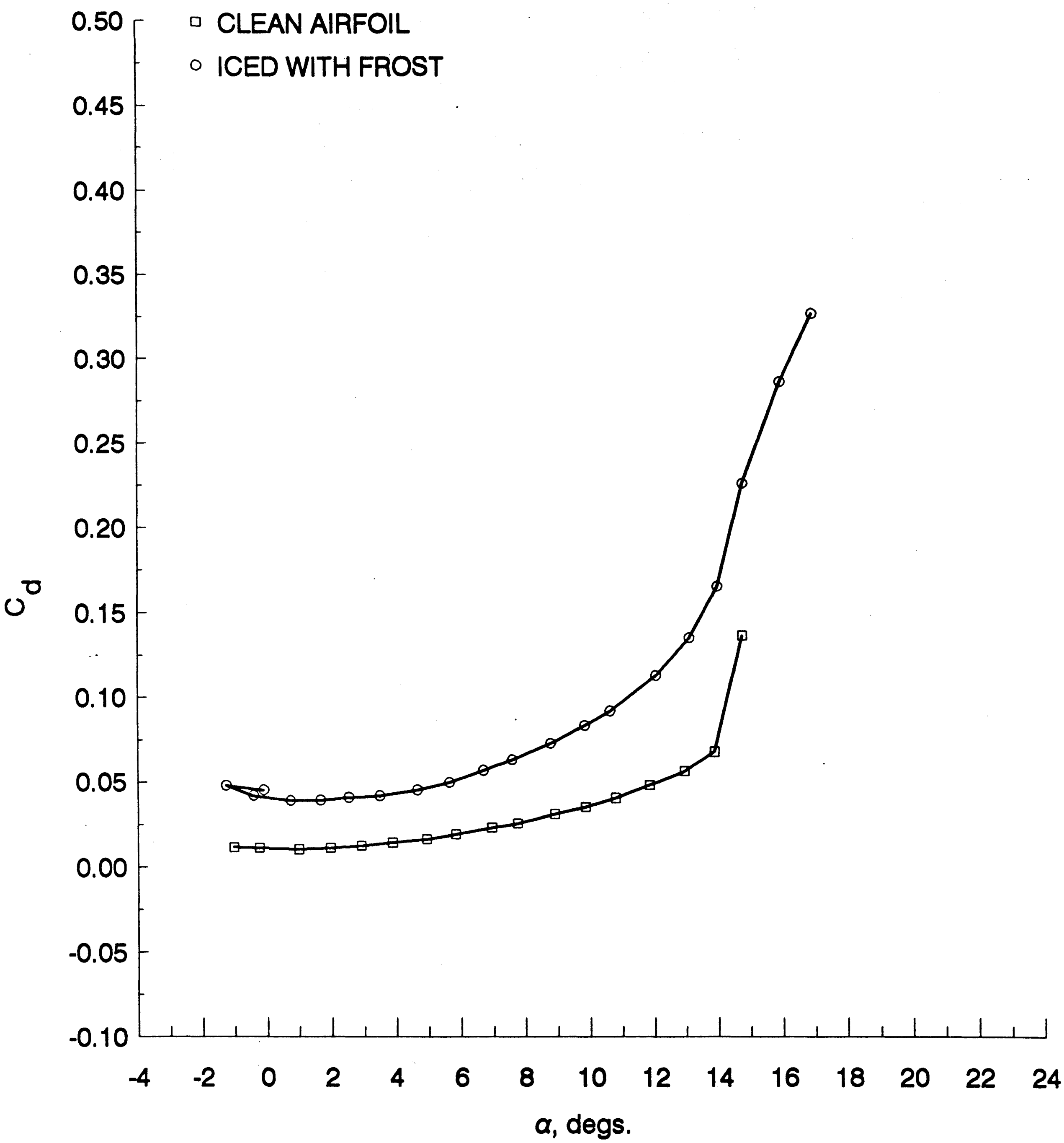
TABLE 39 - RUN 10 ICE SHAPE COORDINATES FOR SECTIONS A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.214460	−0.484130			0.366428	−0.279305			0.314983	−0.434595	0.010565	−0.489940
0.252766	−0.468290			0.398686	−0.251261			0.351497	−0.413259	0.070984	−0.462653
0.274962	−0.450424			0.430910	−0.231269			0.410426	−0.372362	0.107193	−0.449102
0.301173	−0.438539							0.457265	−0.333272	0.139402	−0.435490
0.327394	−0.422672							0.517958	−0.308322	0.175579	−0.423954
0.357633	−0.410795							0.556389	−0.292984	0.197821	−0.408173
0.381791	−0.416819							0.592780	−0.279606	0.224062	−0.392453
0.418078	−0.402965							0.629386	−0.252301	0.250058	−0.392854
0.454378	−0.383139									0.280206	−0.383240
0.482629	−0.359315									0.326474	−0.365814
0.514892	−0.343462									0.356531	−0.362246
0.549170	−0.327613									0.388556	−0.360724
0.571348	−0.317708										
0.637884	−0.287996										



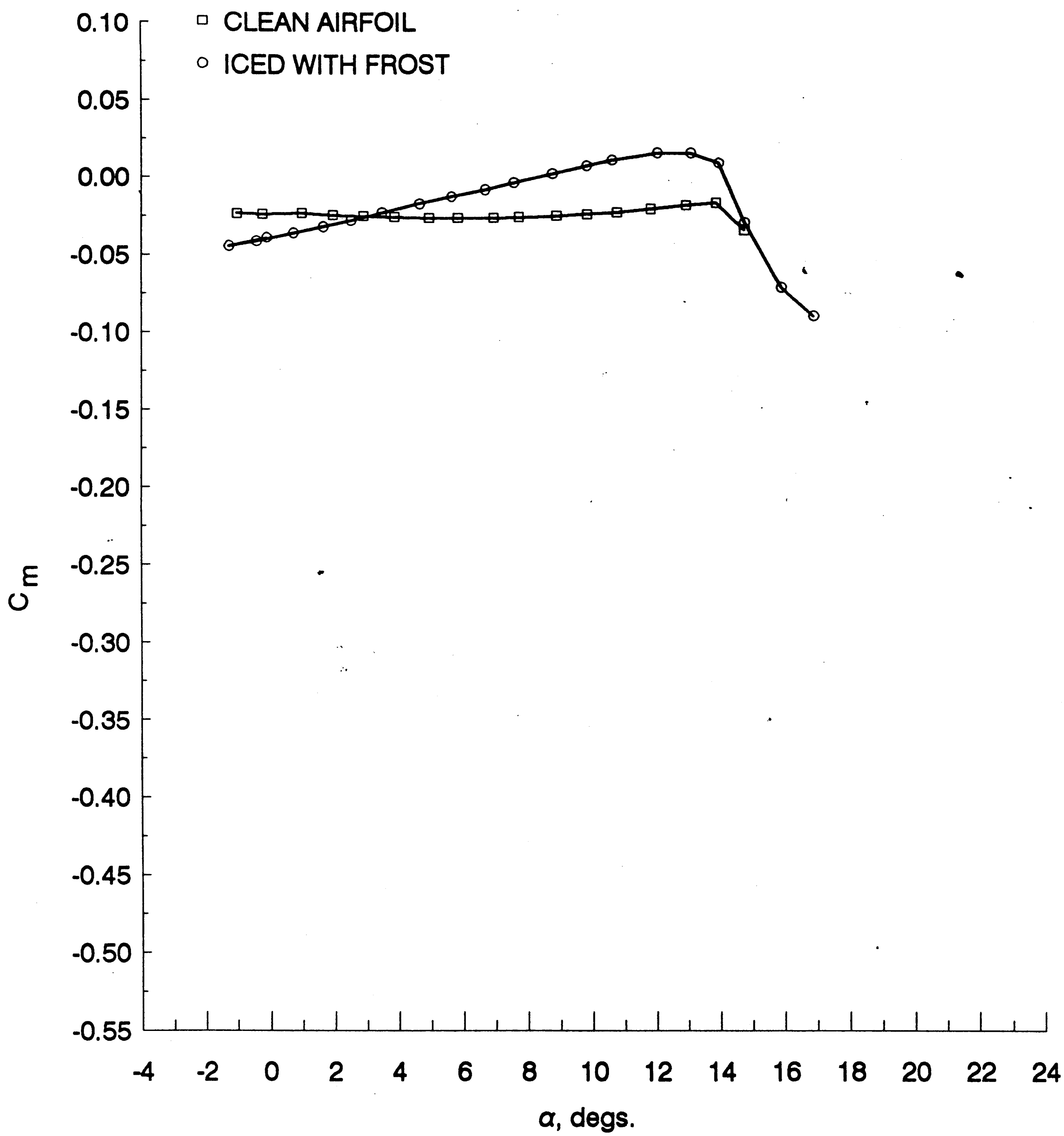
(A) C_l VERSUS α

FIGURE 25 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 10.



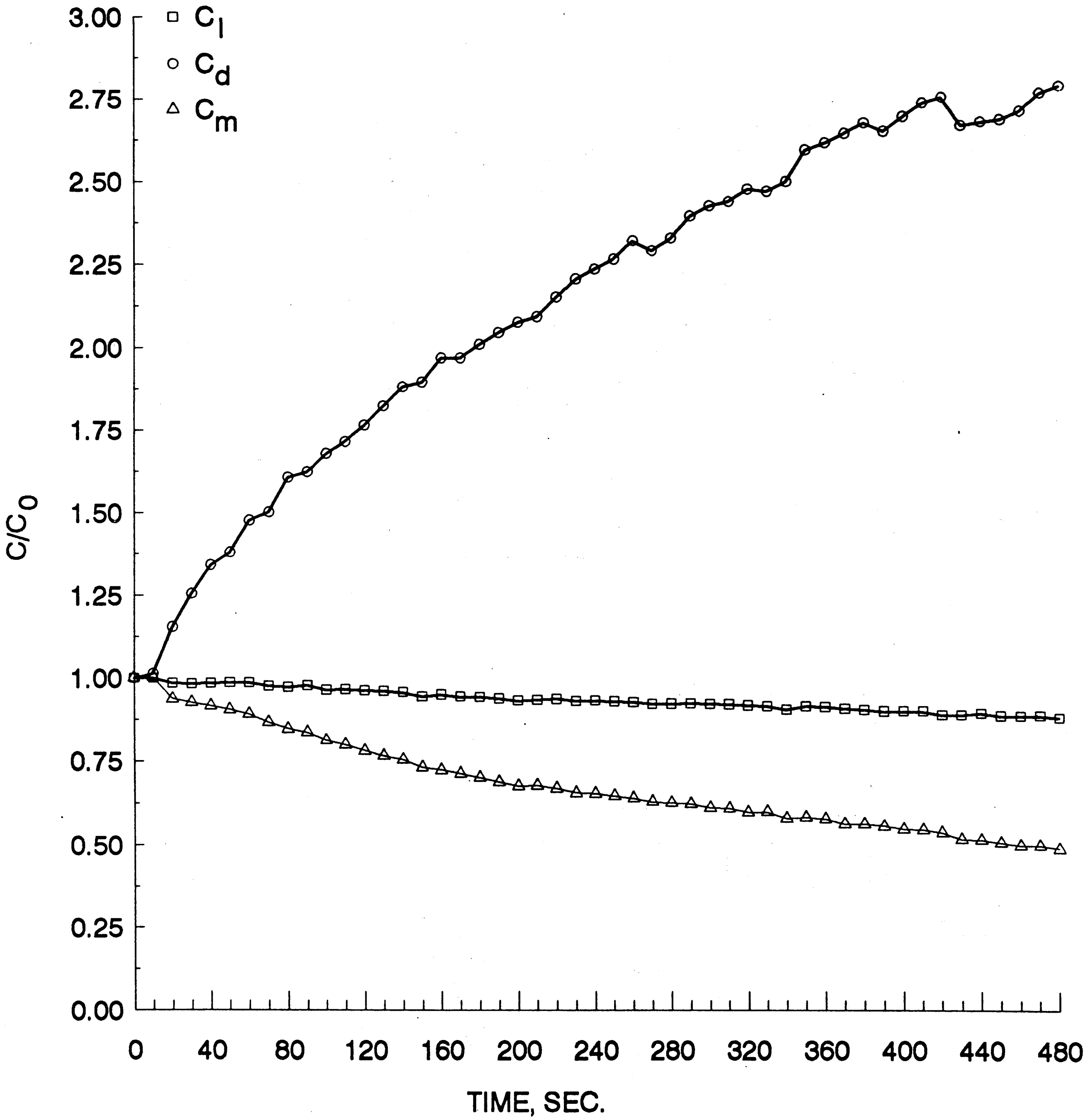
(B) C_d VERSUS α

FIGURE 25 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 10 (con't).



(C) C_m VERSUS α

FIGURE 25 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 10 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 25 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 10 (con't).

TABLE 40 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 10.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0273	0.0560	0.0115	−0.0235
−0.2439	0.1449	0.0111	−0.0239
0.9720	0.2748	0.0103	−0.0232
1.9482	0.3919	0.0111	−0.0245
2.9017	0.5012	0.0123	−0.0253
3.8735	0.6117	0.0141	−0.0259
4.9425	0.7338	0.0162	−0.0266
5.8408	0.8338	0.0190	−0.0267
6.9524	0.9564	0.0229	−0.0266
7.7398	1.0378	0.0256	−0.0261
8.8951	1.1517	0.0309	−0.0253
9.8490	1.2389	0.0352	−0.0241
10.7813	1.3250	0.0404	−0.0227
11.8453	1.4100	0.0478	−0.0205
12.9383	1.4732	0.0562	−0.0178
13.8818	1.5039	0.0676	−0.0163
14.7527	1.4393	0.1366	−0.0337

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−0.1120	0.1428	0.0452	−0.0389
−1.2695	0.0056	0.0480	−0.0444
−0.4209	0.1055	0.0420	−0.0412
0.7179	0.2326	0.0391	−0.0359
1.6446	0.3376	0.0393	−0.0320
2.5072	0.4329	0.0409	−0.0280
3.4818	0.5318	0.0418	−0.0231
4.6502	0.6604	0.0451	−0.0175
5.6433	0.7520	0.0494	−0.0129
6.6944	0.8650	0.0565	−0.0084
7.5836	0.9545	0.0629	−0.0040
8.7740	1.0612	0.0726	0.0019
9.8341	1.1430	0.0832	0.0072
10.6266	1.2084	0.0918	0.0109
12.0523	1.2820	0.1130	0.0159
13.0942	1.3117	0.1352	0.0159
13.9602	1.2936	0.1653	0.0094
14.7625	1.2525	0.2261	−0.0289
15.9132	1.1677	0.2862	−0.0708
16.9066	1.1023	0.3267	−0.0892

TABLE 41 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 10.

TIME SEC.	C_l/C_{l_0}	C_d/C_{d_0}	C_m/C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9998	1.0131	1.0014
20	0.9851	1.1550	0.9370
30	0.9835	1.2565	0.9263
40	0.9848	1.3426	0.9164
50	0.9865	1.3801	0.9054
60	0.9867	1.4777	0.8920
70	0.9764	1.5028	0.8668
80	0.9734	1.6089	0.8468
90	0.9775	1.6253	0.8370
100	0.9650	1.6797	0.8120
110	0.9661	1.7161	0.7990
120	0.9622	1.7656	0.7814
130	0.9606	1.8242	0.7655
140	0.9573	1.8818	0.7539
150	0.9446	1.8962	0.7314
160	0.9503	1.9697	0.7233
170	0.9439	1.9697	0.7126
180	0.9426	2.0108	0.7007
190	0.9387	2.0470	0.6880
200	0.9322	2.0778	0.6761
210	0.9344	2.0954	0.6769
220	0.9369	2.1543	0.6696
230	0.9306	2.2085	0.6563
240	0.9327	2.2386	0.6533
250	0.9304	2.2690	0.6468
260	0.9281	2.3247	0.6410
270	0.9228	2.2946	0.6299
280	0.9234	2.3331	0.6266
290	0.9245	2.4004	0.6233
300	0.9225	2.4316	0.6121
310	0.9218	2.4439	0.6100
320	0.9185	2.4813	0.5988
330	0.9159	2.4748	0.5999
340	0.9063	2.5043	0.5797
350	0.9155	2.5995	0.5840

TIME SEC.	C_l/C_{l_0}	C_d/C_{d_0}	C_m/C_{m_0}
360	0.9147	2.6213	0.5783
370	0.9089	2.6498	0.5632
380	0.9064	2.6824	0.5635
390	0.9019	2.6573	0.5574
400	0.9026	2.7024	0.5481
410	0.9030	2.7433	0.5466
420	0.8914	2.7612	0.5390
430	0.8914	2.6752	0.5186
440	0.8955	2.6863	0.5174
450	0.8884	2.6934	0.5086
460	0.8875	2.7196	0.5000
470	0.8889	2.7749	0.4999
480	0.8827	2.7966	0.4909

TABLE 42 - TEST CONDITIONS FOR RUN NUMBER 10.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 10	Configuration Cruise Wing	Date 05-03-88	
P_{air} 47 psig	ΔP_w 15.9 psid	T_{avg} -22° F	V_∞ 100 mph
Spray Duration 8 min	Ice Accretion Type Rime	A.O.A. 5°	
LWC 1.38 g/m³	MVD 16 μm		
Remarks • Ice accretion approximately 7/8" thick • Uniform accretion across the span • Ice fingers formed on the lower surface • Frost on the lower surface			

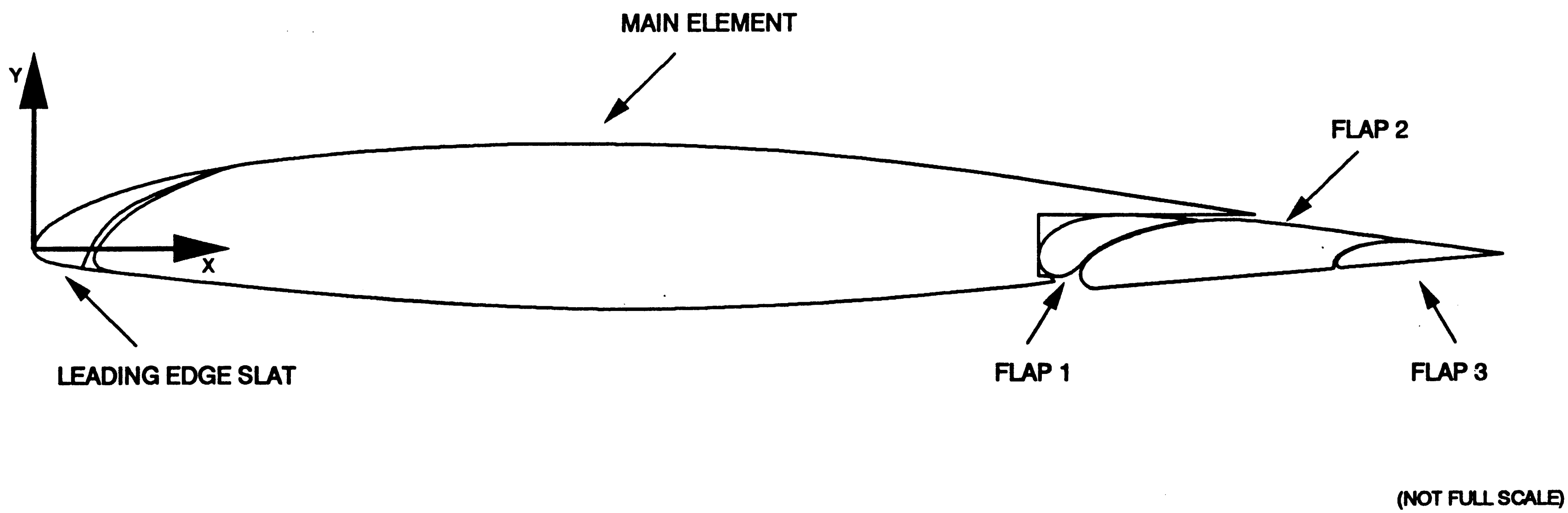
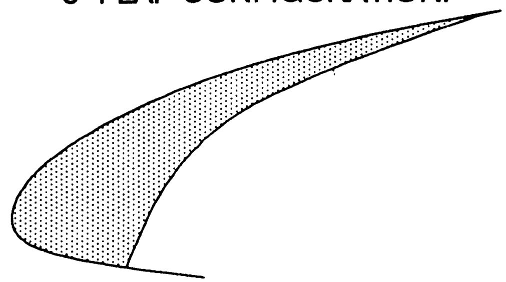


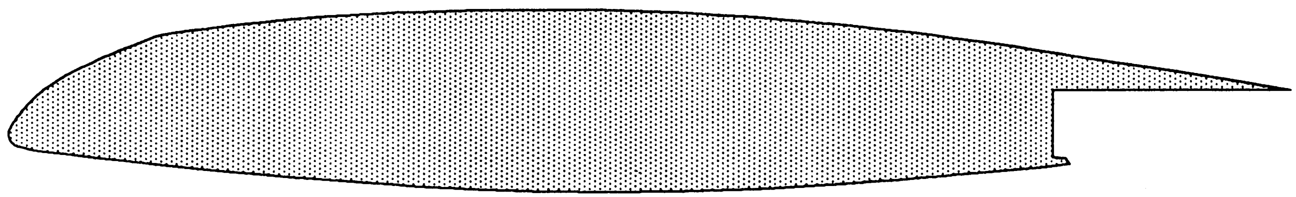
FIGURE 26 - BOEING 737-200 WING SECTION PROFILE - 0° FLAP CONFIGURATION.

TABLE 43 - BOEING 737-200 LEADING EDGE SLAT AIRFOIL COORDINATES - 0° FLAP CONFIGURATION.



X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
2.538000	1.068326	0.473233	0.479067	0.052285	0.149276	0.034586	−0.089179	0.546724	−0.245736	0.946400	0.344802
2.397212	1.045131	0.447092	0.464851	0.045660	0.139087	0.040062	−0.094775	0.598499	−0.253574	0.975028	0.373680
2.261350	1.021364	0.421109	0.450311	0.039322	0.128672	0.045772	−0.100083	0.682030	−0.265516	1.004598	0.401638
2.130410	0.997071	0.396773	0.436292	0.033735	0.118826	0.052397	−0.105698	0.765586	−0.276784	1.035131	0.428687
2.004375	0.972298	0.372604	0.421951	0.028446	0.108770	0.059236	−0.110997	0.849178	−0.287533	1.066646	0.454836
1.883221	0.947091	0.350046	0.408158	0.023830	0.099254	0.067200	−0.116647	1.002734	−0.306692	1.099166	0.480089
1.766913	0.921496	0.327662	0.394047	0.019521	0.089549	0.075355	−0.121958	1.002734	−0.306692	1.132714	0.504451
1.655407	0.895556	0.306847	0.380510	0.015813	0.080349	0.084885	−0.127661	0.849178	−0.287533	1.167334	0.527934
1.548651	0.869316	0.286213	0.366657	0.012420	0.070980	0.094586	−0.133006	0.765586	−0.276784	1.203060	0.550541
1.446584	0.842818	0.267095	0.353399	0.009560	0.062079	0.105958	−0.138780	0.682030	−0.265516	1.239921	0.572265
1.349138	0.816105	0.248169	0.339830	0.007021	0.053031	0.117480	−0.144181	0.598499	−0.253574	1.273785	0.590893
1.256237	0.789217	0.230698	0.326872	0.004955	0.044409	0.131032	−0.150050	0.597390	−0.253416	1.304527	0.606774
1.167799	0.762194	0.213428	0.313609	0.003216	0.035659	0.144716	−0.155534	0.619184	−0.202705	1.329406	0.618948
1.083736	0.735074	0.197549	0.300969	0.000907	0.018815	0.160873	−0.161530	0.654005	−0.121708	1.379290	0.641968
1.003953	0.707894	0.181880	0.288030	0.000013	0.002271	0.177147	−0.167132	0.672086	−0.079660	1.475943	0.685239
0.928353	0.680691	0.167530	0.275723	0.000000	0.000000	0.196331	−0.173263	0.690187	−0.038389	1.573302	0.727410
0.856832	0.653497	0.153400	0.263124	0.000000	0.000000	0.215618	−0.178994	0.709153	0.001827	1.670813	0.768195
0.789282	0.626454	0.140514	0.251161	0.000103	−0.005757	0.237844	−0.185150	0.728979	0.040887	1.768711	0.807709
0.720496	0.597535	0.127859	0.238914	0.000264	−0.009144	0.260156	−0.190922	0.749664	0.078819	1.867932	0.846370
0.685794	0.582365	0.116368	0.227303	0.001487	−0.021239	0.285112	−0.196973	0.771206	0.115653	1.971265	0.885275
0.651230	0.566840	0.105119	0.215416	0.003789	−0.033151	0.314053	−0.203540	0.793607	0.151416	2.080979	0.925243
0.619767	0.552322	0.094953	0.204163	0.007191	−0.044659	0.343065	−0.209717	0.816871	0.186134	2.199374	0.967046
0.588441	0.537477	0.085040	0.192643	0.011836	−0.056005	0.375664	−0.216252	0.841004	0.219829	2.329226	1.011585
0.558655	0.522978	0.076126	0.181747	0.017851	−0.067200	0.413791	−0.223442	0.866013	0.252524	2.416968	1.041036
0.529014	0.508151	0.067477	0.170597	0.025365	−0.078236	0.451977	−0.230236	0.891907	0.284240	2.538000	1.068326
0.501047	0.493772	0.059743	0.160057	0.029849	−0.083835	0.494999	−0.237486	0.918698	0.314994		

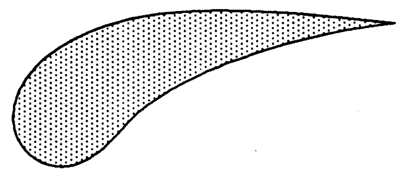
TABLE 44 - BOEING 737-200 MAIN AIRFOIL COORDINATES - 0° FLAP CONFIGURATION.



(NOT FULL SCALE)

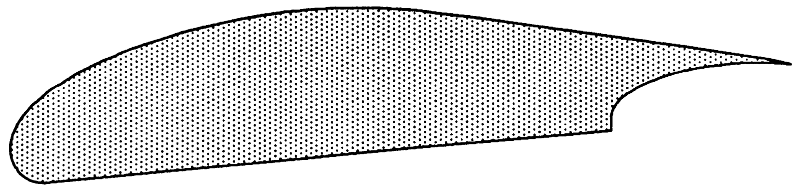
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
15.324045	0.410907	6.995781	1.345638	1.923554	0.836397	0.830213	0.055012	0.861431	−0.267474	7.890765	−0.803119
14.648516	0.527104	6.768388	1.346707	1.832961	0.795898	0.820329	0.039492	0.875249	−0.271370	8.009646	−0.801920
13.972987	0.633348	6.536183	1.346478	1.753596	0.759198	0.810736	0.023730	1.002734	−0.306692	8.128524	−0.800356
13.297457	0.739592	6.417366	1.345846	1.679141	0.723581	0.802329	0.009221	1.156326	−0.325565	8.354594	−0.796336
12.657597	0.840226	6.298552	1.344835	1.600593	0.684565	0.794230	−0.005536	1.449001	−0.360644	8.573961	−0.791076
12.393353	0.881785	6.070500	1.341814	1.562462	0.665015	0.787386	−0.018778	1.741943	−0.394516	8.789466	−0.784566
12.231850	0.906928	5.850569	1.337531	1.524492	0.645099	0.781454	−0.031006	2.049551	−0.428734	9.002593	−0.776801
11.981311	0.944878	5.633291	1.331943	1.490345	0.626769	0.775833	−0.043470	2.381133	−0.464182	9.216013	−0.767707
11.737519	0.980513	5.419407	1.325088	1.456362	0.608092	0.771176	−0.054697	2.660816	−0.493081	9.431372	−0.757215
11.499800	1.013963	5.208706	1.316981	1.425702	0.590830	0.767302	−0.064947	2.940559	−0.521232	9.650343	−0.745237
11.267522	1.045348	5.001403	1.307650	1.395209	0.573231	0.763757	−0.075438	3.321177	−0.558583	9.874675	−0.731660
11.040089	1.074776	4.797681	1.297124	1.367419	0.556779	0.761032	−0.084686	3.664380	−0.591408	10.106223	−0.716345
10.816936	1.102344	4.597713	1.285434	1.339801	0.539991	0.758658	−0.094302	3.984786	−0.620885	10.346993	−0.699122
10.597525	1.128140	4.401663	1.272615	1.314758	0.524347	0.757143	−0.102020	4.285215	−0.647312	10.599196	−0.679787
10.381342	1.152245	4.209681	1.258702	1.289895	0.508369	0.755993	−0.110105	4.568133	−0.670981	10.865304	−0.658096
10.167894	1.174728	4.021905	1.243733	1.267482	0.493536	0.755460	−0.116418	4.835714	−0.692141	11.148121	−0.633758
9.956702	1.195655	3.838461	1.227745	1.245257	0.478372	0.755469	−0.128965	5.089878	−0.711006	11.450870	−0.606423
9.747303	1.215082	3.659465	1.210782	1.225342	0.464344	0.755975	−0.136038	5.332339	−0.727761	11.476741	−0.604032
9.539243	1.233059	3.485017	1.192883	1.205625	0.449988	0.756845	−0.143270	5.564634	−0.742566	11.814344	−0.572771
9.332074	1.249629	3.315207	1.174092	1.170720	0.423189	0.759525	−0.157125	5.788152	−0.755555	12.455736	−0.513070
9.125355	1.264830	3.150112	1.154453	1.140450	0.398442	0.763443	−0.170538	6.004157	−0.766844	12.820953	−0.462577
8.918645	1.278693	2.989798	1.134012	1.108250	0.370640	0.768599	−0.183597	6.213814	−0.776529	12.765582	−0.395997
8.711505	1.291244	2.834316	1.112812	1.073276	0.338739	0.774965	−0.196196	6.418203	−0.784691	12.620649	−0.389820
8.503493	1.302504	2.683707	1.090902	1.038222	0.304959	0.782492	−0.208216	6.618246	−0.791393	12.620649	0.410907
8.294146	1.312488	2.538000	1.068326	1.003473	0.269605	0.791121	−0.219545	6.815015	−0.796690	15.218750	0.410907
8.082011	1.321242	2.416968	1.037299	0.969585	0.233194	0.800785	−0.230078	7.009721	−0.800625		
7.866345	1.328761	2.344526	1.009522	0.937115	0.196301	0.811403	−0.239710	7.175444	−0.802926		
7.649682	1.334943	2.230280	0.964635	0.906553	0.159493	0.822883	−0.247846	7.295949	−0.803985		
7.435693	1.339733	2.121968	0.920739	0.878330	0.123332	0.835124	−0.255904	7.416456	−0.804524		
7.218960	1.343290	2.019763	0.877982	0.852797	0.088346	0.848013	−0.262301	7.649682	−0.804482		

TABLE 45 - BOEING 737-200 FORE FLAP (FLAP 1) AIRFOIL COORDINATES - 0° FLAP CONFIGURATION.



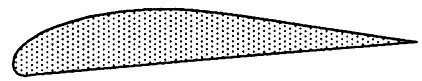
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
14.603322	0.343473	13.189961	0.359919	12.658661	0.013446	12.710750	−0.335441	13.072274	−0.311112	13.677853	0.117624
14.597971	0.344054	13.154261	0.350438	12.650242	−0.004440	12.723532	−0.345518	13.091106	−0.295116	13.724067	0.135961
14.438869	0.360966	13.119418	0.340142	12.642883	−0.022399	12.736954	−0.354738	13.111042	−0.276910	13.771429	0.153673
14.316456	0.373370	13.085129	0.328945	12.636601	−0.040460	12.750929	−0.363070	13.132346	−0.256115	13.821628	0.171457
14.210577	0.383361	13.050519	0.316497	12.631366	−0.058638	12.765398	−0.370501	13.155351	−0.232383	13.850595	0.181273
14.112275	0.391751	13.017917	0.303672	12.627164	−0.076902	12.780303	−0.376958	13.181890	−0.204128	13.879635	0.190813
14.024791	0.398295	12.986783	0.290380	12.624008	−0.095283	12.795587	−0.382454	13.205928	−0.177793	13.934370	0.207928
13.949450	0.403094	12.957016	0.276580	12.621885	−0.113795	12.811176	−0.386933	13.217837	−0.164560	13.989600	0.224113
13.882049	0.406584	12.928586	0.262300	12.620765	−0.133630	12.826983	−0.390380	13.229776	−0.151967	14.045528	0.239440
13.817876	0.409012	12.901509	0.247584	12.620649	−0.142369	12.842804	−0.392721	13.246078	−0.136029	14.102517	0.253968
13.754212	0.410452	12.875800	0.232475	12.620765	−0.149887	12.858320	−0.393972	13.258743	−0.124541	14.160815	0.267782
13.717436	0.410816	12.851427	0.216988	12.621885	−0.167207	12.873735	−0.394161	13.271468	−0.113358	14.220771	0.280928
13.680659	0.410859	12.828422	0.201195	12.624008	−0.183290	12.889222	−0.393346	13.293397	−0.095370	14.282603	0.293434
13.625197	0.410350	12.806726	0.185098	12.627164	−0.199213	12.904927	−0.391529	13.317231	−0.077120	14.346441	0.305300
13.572643	0.409085	12.786353	0.168738	12.631337	−0.214889	12.921606	−0.388591	13.343304	−0.058405	14.412330	0.316497
13.522663	0.406933	12.767274	0.152146	12.636529	−0.230274	12.938664	−0.384476	13.371893	−0.039166	14.480270	0.326982
13.474995	0.403908	12.749475	0.135336	12.642694	−0.245311	12.954936	−0.379459	13.402751	−0.019622	14.550143	0.336725
13.429435	0.400026	12.732926	0.118336	12.649805	−0.259925	12.971165	−0.373380	13.435892	0.000140	14.603322	0.343473
13.385766	0.395329	12.717614	0.101191	12.657861	−0.274045	12.987393	−0.366226	13.471243	0.020034		
13.343813	0.389832	12.703508	0.083887	12.666805	−0.287627	13.003680	−0.357937	13.508761	0.039956		
13.303416	0.383535	12.690581	0.066437	12.676606	−0.300613	13.020185	−0.348412	13.548314	0.059791		
13.264400	0.376453	12.678816	0.048885	12.687236	−0.312945	13.036995	−0.337535	13.589788	0.079422		
13.226635	0.368586	12.668186	0.031216	12.698622	−0.324578	13.054300	−0.325174	13.633035	0.098748		

TABLE 46 - BOEING 737-200 MID FLAP (FLAP 2) AIRFOIL COORDINATES - 0° FLAP CONFIGURATION.

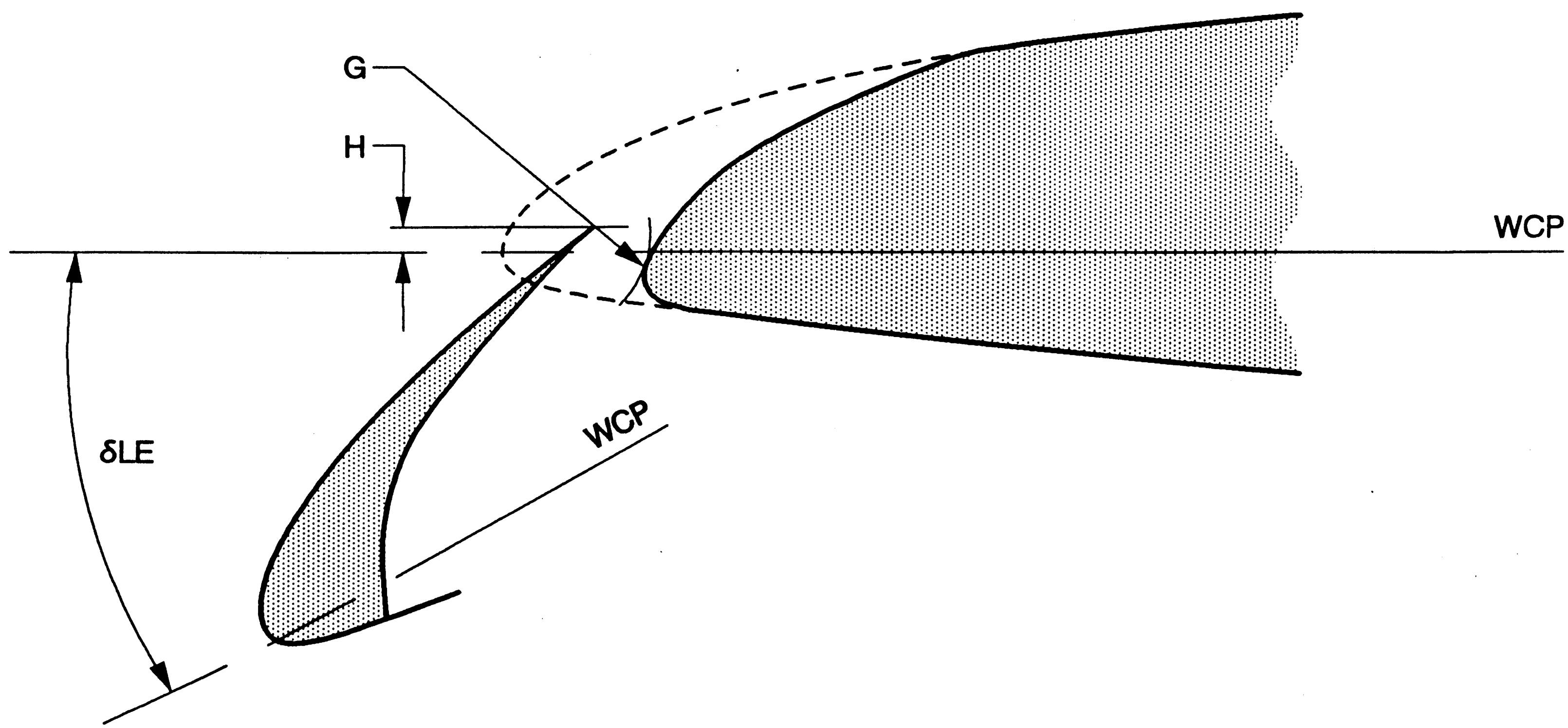


X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
17.269679	0.049394	14.670011	0.329687	13.414297	−0.035458	13.146277	−0.393783	14.447056	−0.455818	16.540229	−0.035821
17.145056	0.076616	14.608223	0.323478	13.384995	−0.054144	13.148415	−0.407117	14.997624	−0.408601	16.555381	−0.030092
17.074223	0.086940	14.545941	0.316148	13.357773	−0.072670	13.151556	−0.420292	15.548191	−0.361398	16.582167	−0.020698
16.852765	0.119151	14.483367	0.307700	13.332558	−0.090993	13.155729	−0.433234	16.098758	−0.314195	16.613171	−0.010868
16.697386	0.141327	14.420736	0.298189	13.309276	−0.109112	13.160892	−0.445857	16.320800	−0.292542	16.646588	−0.001328
16.541963	0.163125	14.358220	0.287617	13.287871	−0.126984	13.167028	−0.458072	16.320837	−0.228660	16.682608	0.007877
16.360162	0.188253	14.296010	0.276042	13.268268	−0.144594	13.174081	−0.469822	16.320938	−0.224211	16.720780	0.016587
16.178331	0.213062	14.234266	0.263493	13.250396	−0.161957	13.182035	−0.481019	16.322073	−0.213072	16.760814	0.024643
15.927049	0.246871	14.173147	0.249998	13.234182	−0.179044	13.190833	−0.491591	16.324196	−0.203052	16.802447	0.031943
15.675693	0.280128	14.112784	0.235616	13.219553	−0.195869	13.200416	−0.501479	16.327337	−0.193135	16.845287	0.038400
15.559577	0.295281	14.053337	0.220391	13.206422	−0.212403	13.210726	−0.510611	16.331539	−0.183232	16.889000	0.043911
15.468691	0.306943	13.994239	0.204162	13.194760	−0.228675	13.221705	−0.518944	16.336847	−0.173271	16.933148	0.048419
15.387838	0.316556	13.937046	0.187381	13.184464	−0.244685	13.233266	−0.526418	16.343333	−0.163222	16.977341	0.051851
15.314824	0.324350	13.882587	0.170381	13.175477	−0.260449	13.245380	−0.532977	16.351098	−0.153057	17.021126	0.054178
15.248819	0.330516	13.828899	0.152568	13.167741	−0.275965	13.257915	−0.538590	16.360230	−0.142747	17.064112	0.055385
15.188150	0.335285	13.777319	0.134376	13.161226	−0.291263	13.270828	−0.543214	16.370831	−0.132263	17.105861	0.055457
15.129111	0.338994	13.727964	0.115908	13.155846	−0.306372	13.284032	−0.546835	16.383046	−0.121604	17.145081	0.054454
15.072136	0.341582	13.680834	0.097207	13.151585	−0.321292	13.297454	−0.549423	16.396992	−0.110741	17.214300	0.052800
15.017211	0.343094	13.635972	0.078361	13.148415	−0.336052	13.310978	−0.550965	16.412799	−0.099689	17.269679	0.049394
14.963261	0.343603	13.593394	0.059384	13.146277	−0.350724	13.324545	−0.551459	16.430642	−0.088463		
14.907493	0.343094	13.553099	0.040363	13.145201	−0.365339	13.338069	−0.550892	16.450637	−0.077047		
14.850053	0.341451	13.515072	0.021328	13.145143	−0.367026	13.351462	−0.549758	16.472958	−0.065458		
14.791159	0.338688	13.479284	0.002307	13.145056	−0.373133	13.374889	−0.547737	16.497767	−0.053722		
14.731072	0.334762	13.445707	−0.016626	13.145157	−0.379270	13.896489	−0.503021	16.525193	−0.041856		

TABLE 47 - BOEING 737-200 AFT FLAP (FLAP 3) AIRFOIL COORDINATES - 0° FLAP CONFIGURATION.

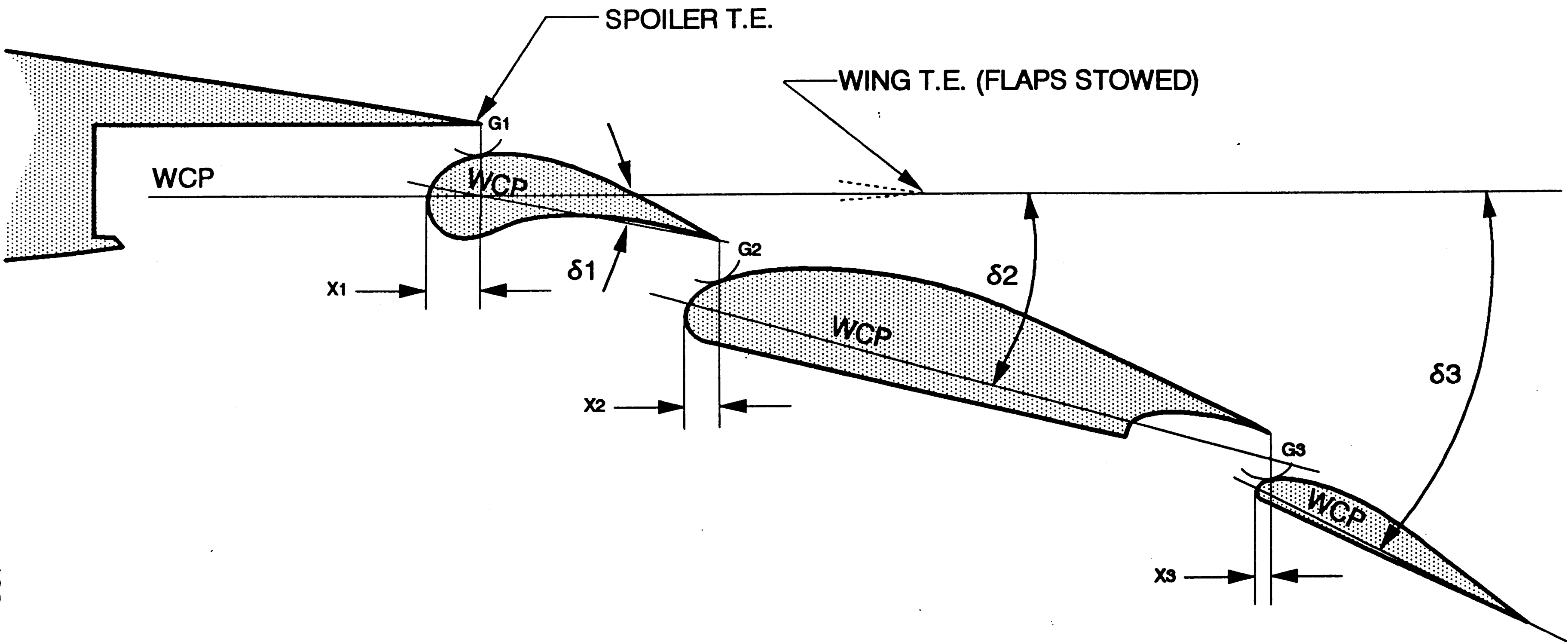


X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
18.446431	−0.112893	17.175681	0.054454	16.677188	−0.001328	16.413646	−0.121604	16.351524	−0.231569	16.416264	−0.286958
18.277353	−0.088274	17.136461	0.055457	16.643771	−0.010868	16.401431	−0.132263	16.352673	−0.240105	16.423506	−0.286333
17.730538	−0.008643	17.094712	0.055385	16.612767	−0.020698	16.390830	−0.142747	16.354781	−0.247434	16.452066	−0.283890
17.551717	0.017402	17.051726	0.054178	16.585981	−0.030092	16.381698	−0.153057	16.357908	−0.254559	17.002633	−0.236687
17.505038	0.024207	17.007941	0.051851	16.570829	−0.035821	16.373933	−0.163222	16.362023	−0.261350	17.553215	−0.189485
17.452222	0.031580	16.963748	0.048419	16.555793	−0.041856	16.367447	−0.173271	16.367040	−0.267632	18.103782	−0.142267
17.423139	0.035143	16.919600	0.043911	16.528367	−0.053722	16.362139	−0.183232	16.372871	−0.273260	18.446431	−0.112893
17.394011	0.038414	16.875887	0.038400	16.503558	−0.065458	16.357937	−0.193135	16.379386	−0.278073		
17.362499	0.041628	16.833047	0.031943	16.481237	−0.077047	16.354796	−0.203052	16.386439	−0.281971		
17.330944	0.044551	16.791414	0.024643	16.461242	−0.088463	16.352673	−0.213072	16.393841	−0.284850		
17.269679	0.049394	16.751380	0.016587	16.443399	−0.099689	16.351538	−0.224211	16.401417	−0.286638		
17.214318	0.052767	16.713208	0.007877	16.427592	−0.110741	16.351437	−0.228660	16.408964	−0.287322		



Flap Detent	δLE	G(in.)	H(in.)
1°, 5°	17.25°	0.000	0.446
15°	28.31°	0.200	-0.007

FIGURE 27 - LEADING EDGE SLAT ORIENTATION FOR 1°, 5° AND 15° FLAP CONFIGURATIONS.



	Fore Flap			Main Flap			Aft Flap		
Flap Detent	δ1	X1	G1	δ2	X2	G2	δ3	X3	G3
1°	-12.2°	2.610	.038	1.6°	1.608	.024	9.2°	.478	.043
5°	-7.2°	.720	.106	6.6°	1.634	.026	16.0°	.435	.051
15°	4.1°	.267	.241	14.7°	1.246	.043	30.0°	.265	.085

FIGURE 28 - TRIPLE SLOTTED FLAP ORIENTATION FOR 1°, 5° AND 15° FLAP CONFIGURATIONS.

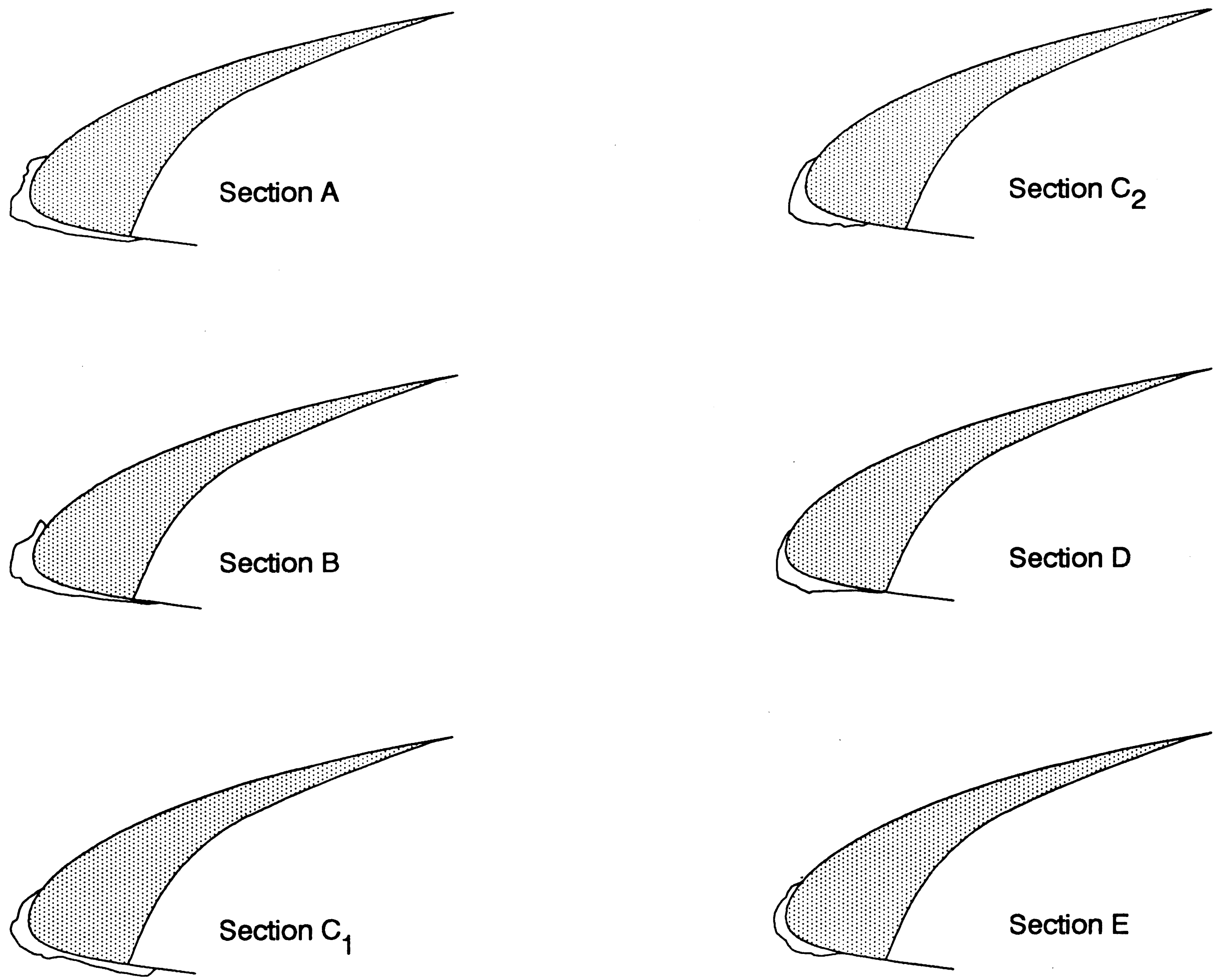


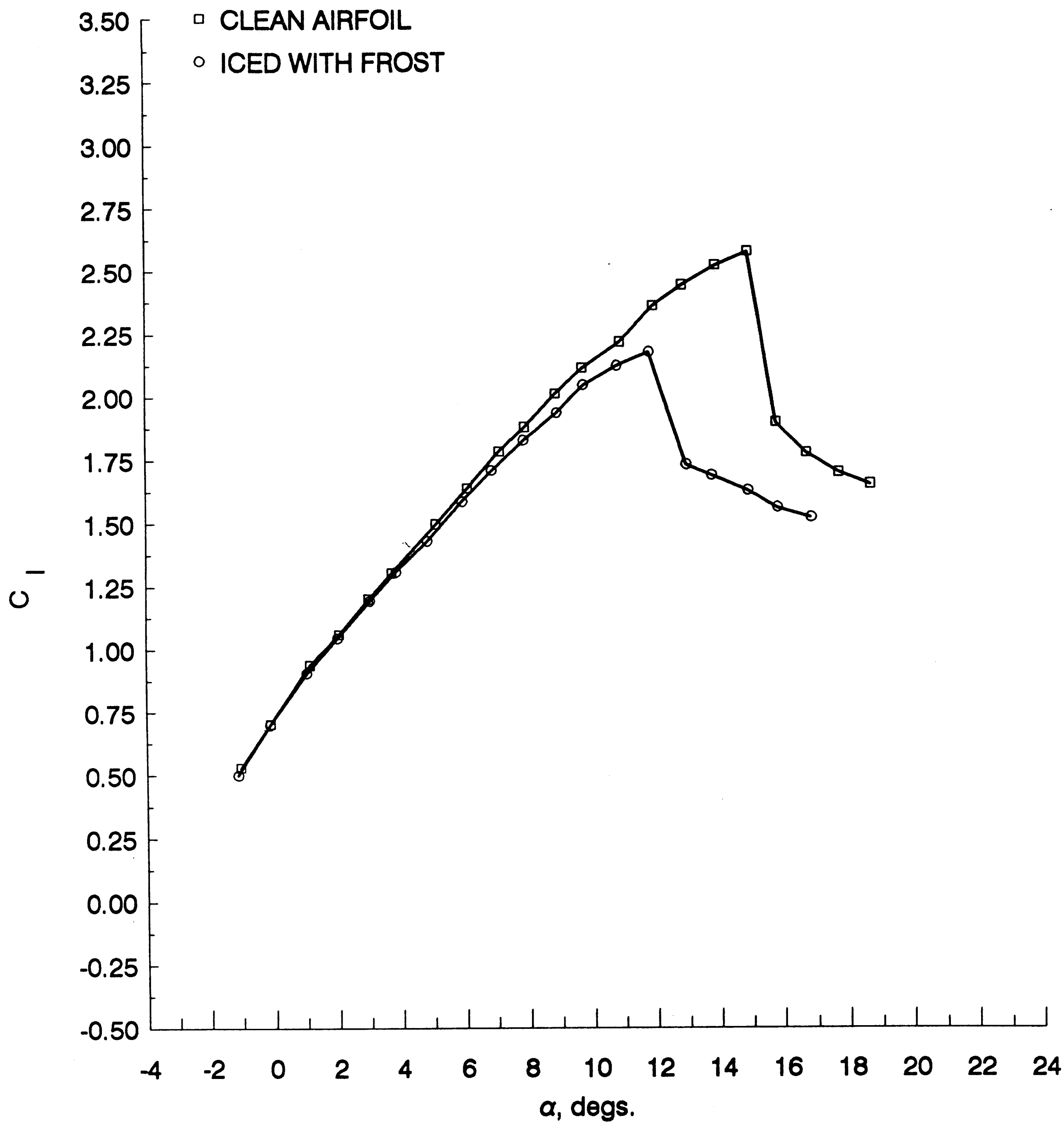
FIGURE 29 - RUN 11 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 48 - RUN 11 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTIONS A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.099417	0.223171	0.071997	0.179480	0.084581	0.186936	0.090846	0.184983	0.017685	0.112664	0.115322	0.220317
0.067431	0.217062	0.063874	0.205354	0.056255	0.174816	0.069038	0.172875	−0.004209	0.078423	0.087390	0.202244
0.041451	0.208962	0.043701	0.219246	0.034016	0.158696	0.041273	0.160752	−0.022101	0.042182	0.061435	0.192175
0.007475	0.198831	0.027651	0.197291	0.013798	0.144590	0.003602	0.140569	−0.030047	0.024064	0.035492	0.178106
−0.010473	0.178704	0.015623	0.177340	−0.008441	0.128470	−0.016189	0.116419	−0.043973	−0.000102	0.013582	0.150049
−0.020404	0.152575	−0.002398	0.139445	−0.024608	0.114375	−0.035975	0.090259	−0.055805	−0.060455	0.001675	0.118018
−0.010366	0.138546	−0.030508	0.109491	−0.038755	0.102292	−0.049778	0.054076	−0.055673	−0.110723	−0.020261	0.099960
−0.020309	0.116432	−0.070726	0.089465	−0.054873	0.070128	−0.063598	0.023917	−0.047541	−0.162980	−0.046163	0.069892
−0.038278	0.104337	−0.100897	0.077434	−0.060875	0.042005	−0.079376	−0.016289	−0.023511	−0.181013	−0.068025	0.023835
−0.032214	0.080258	−0.112920	0.055490	−0.064862	0.017903	−0.091162	−0.064516	0.004506	−0.195013	−0.071921	−0.014174
−0.044172	0.064163	−0.120905	0.029573	−0.076983	0.005826	−0.099004	−0.102692	0.032512	−0.204992	−0.069822	−0.052168
−0.056067	0.023973	−0.124847	−0.002309	−0.091135	−0.004250	−0.098878	−0.150887	0.062516	−0.214966	−0.059723	−0.092140
−0.076009	0.001832	−0.134829	−0.034207	−0.103240	−0.022350	−0.080977	−0.162888	0.082544	−0.230998	−0.031685	−0.114066
−0.099958	−0.018310	−0.138734	−0.080033	−0.109253	−0.046457	−0.055098	−0.188924	0.104554	−0.240993	0.000350	−0.135980
−0.111900	−0.040429	−0.128591	−0.107895	−0.101080	−0.072534	−0.005414	−0.206864	0.138572	−0.256988	0.016412	−0.163937
−0.113794	−0.080593	−0.112440	−0.123789	−0.088879	−0.090571	0.044248	−0.216772	0.164526	−0.246865	0.036461	−0.187884
−0.117672	−0.126786	−0.078209	−0.123699	−0.070584	−0.114614	0.101842	−0.222642	0.208494	−0.246748	0.060476	−0.199819
−0.073596	−0.154779	−0.064044	−0.149558	−0.050247	−0.144675	0.141572	−0.230568	0.238467	−0.244657	0.100478	−0.211713
−0.023572	−0.162678	−0.039839	−0.165430	−0.025898	−0.160672	0.173313	−0.220442	0.260451	−0.244598	0.134448	−0.209623
0.024505	−0.190660	0.010538	−0.179242	−0.005615	−0.170657	0.203095	−0.220362	0.286437	−0.246540	0.152435	−0.209575
0.072529	−0.198564	0.046803	−0.187115	0.026843	−0.188640	0.224961	−0.230344	0.326403	−0.244423	0.168460	−0.223532
0.114558	−0.208492	0.079053	−0.198982	0.049141	−0.194605	0.234904	−0.236342	0.370371	−0.244305	0.208442	−0.227426
0.172593	−0.220385	0.103237	−0.206887	0.071422	−0.194546	0.304369	−0.226115	0.432325	−0.244140	0.250400	−0.223315
0.220637	−0.236321	0.139513	−0.218744	0.077509	−0.198545	0.348059	−0.230014	0.472307	−0.248055	0.286358	−0.217220
0.286673	−0.248193	0.177781	−0.222628	0.083613	−0.208567			0.504294	−0.251991	0.318325	−0.213135
0.332686	−0.252086	0.234183	−0.230448	0.114019	−0.216518			0.550276	−0.257900	0.350306	−0.215050
0.398716	−0.261950	0.282514	−0.232313	0.140340	−0.212433						
0.454729	−0.265817	0.316750	−0.234215	0.174759	−0.206320						
0.524760	−0.275670	0.363089	−0.244054	0.203123	−0.208253						
0.592785	−0.283521	0.423523	−0.253855	0.231503	−0.216209						
		0.471859	−0.257713	0.259877	−0.222157						
		0.536309	−0.263519	0.298385	−0.230087						
		0.586659	−0.267372	0.328795	−0.240045						

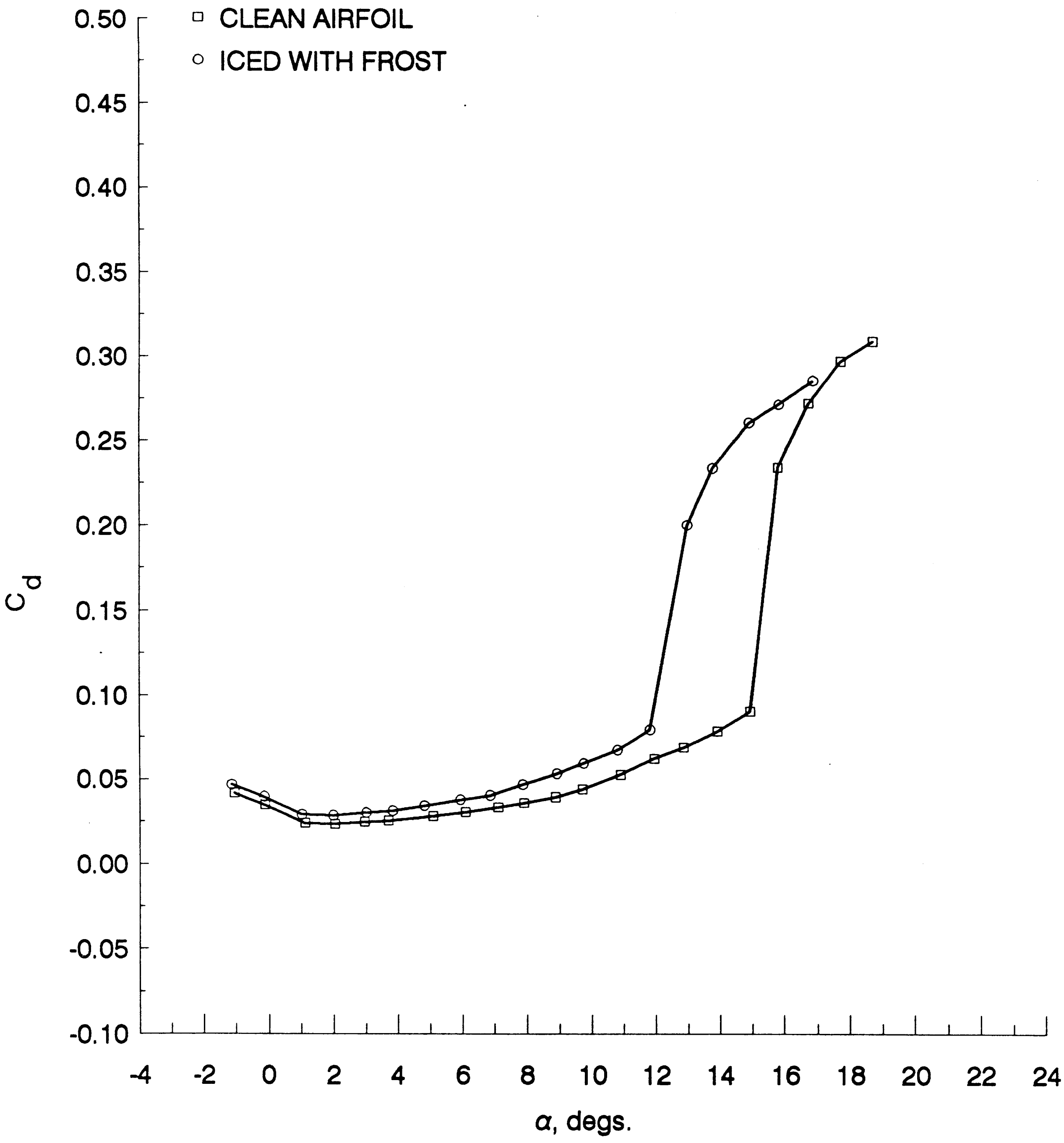
TABLE 48 - RUN 11 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
		0.653134	−0.277156	0.371381	−0.258002						
		0.687375	−0.281051	0.415965	−0.265915						
		0.701465	−0.279022	0.458530	−0.275841						
				0.490960	−0.283786						
				0.549746	−0.299693						
				0.590268	−0.303602						
				0.640935	−0.313506						
				0.681463	−0.319423						
				0.717928	−0.321335						



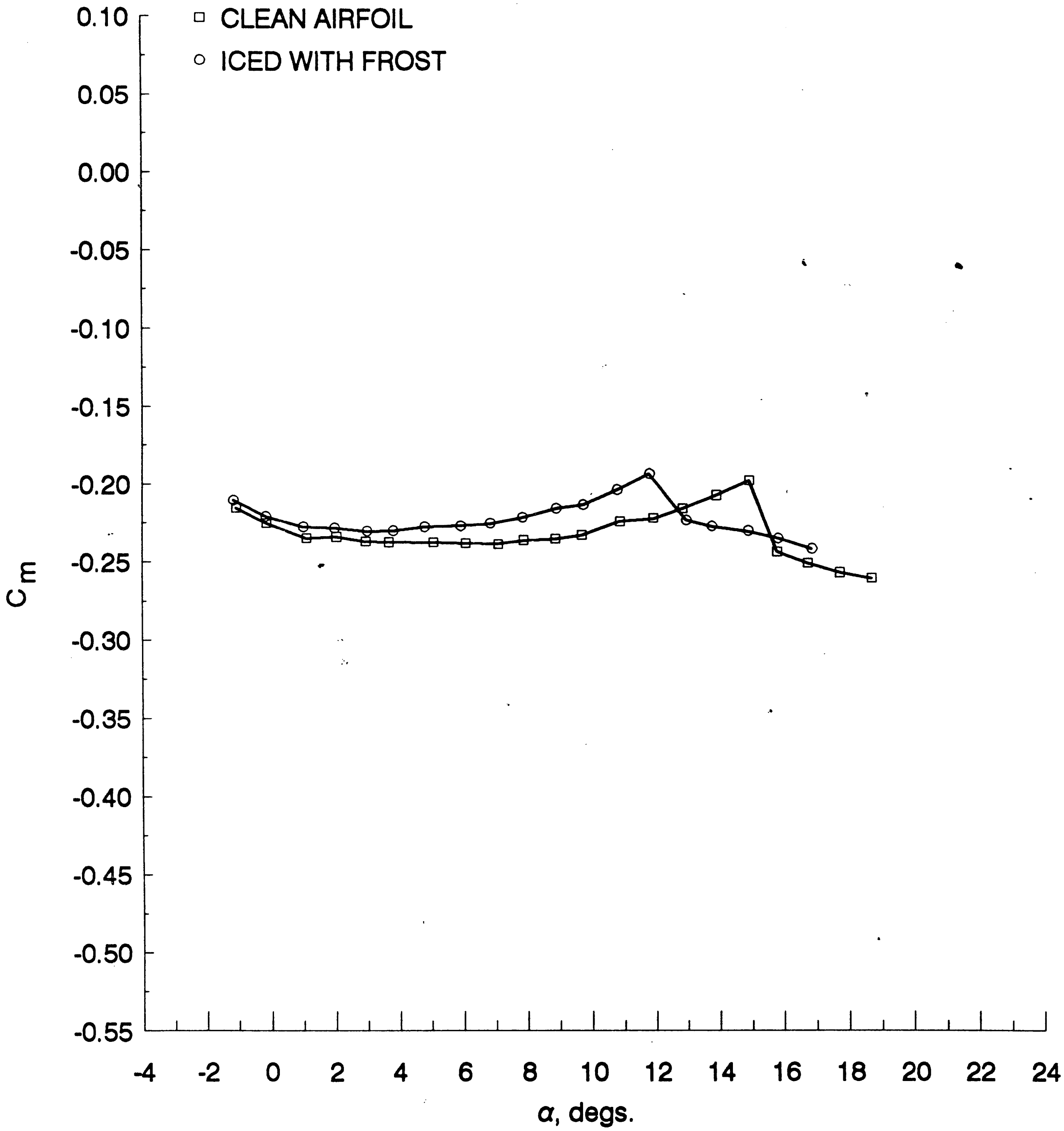
(A) C_l VERSUS α

FIGURE 30 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 11.



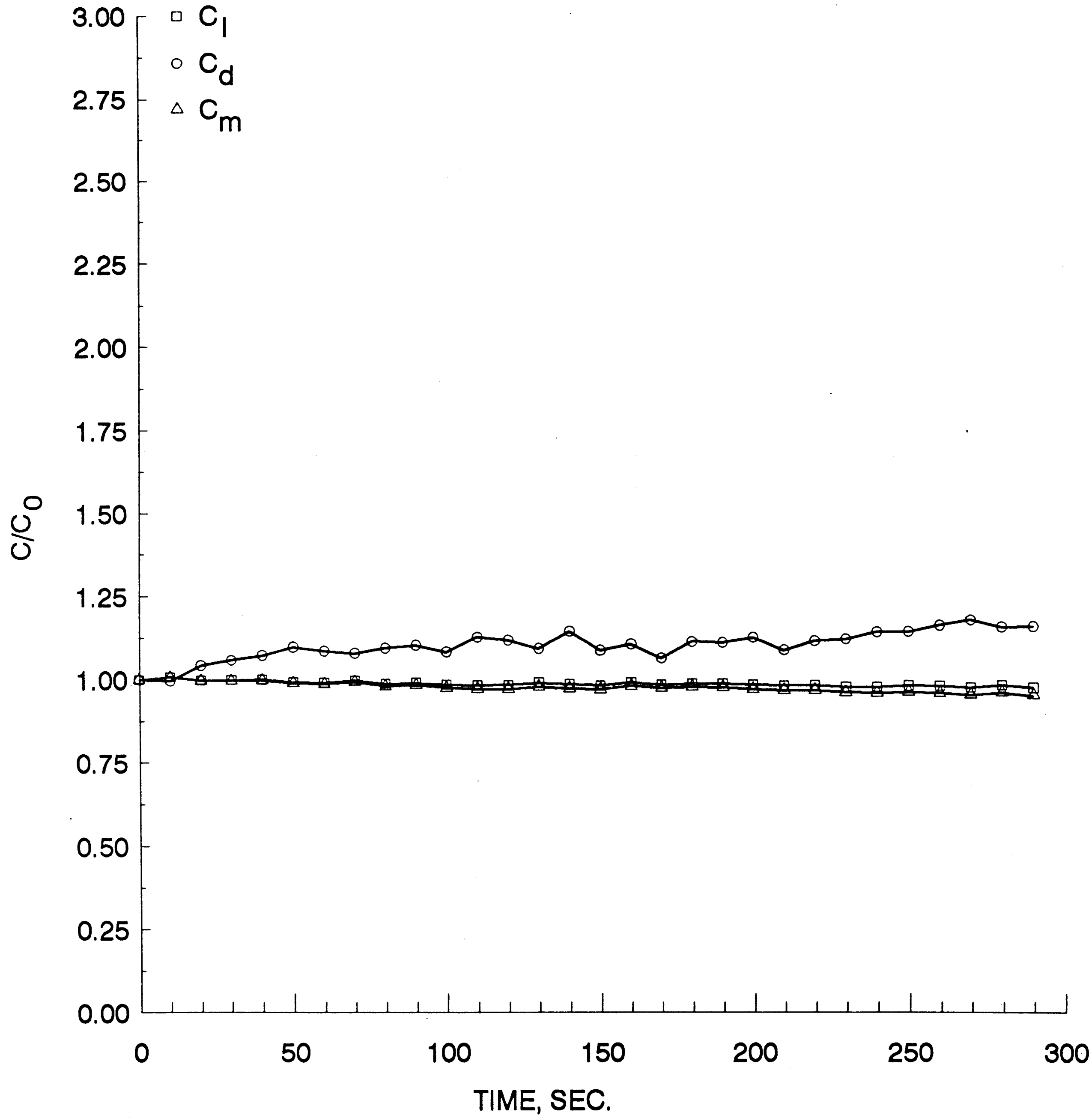
(B) C_d VERSUS α

FIGURE 30 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 11 (con't).



(C) C_m VERSUS α

FIGURE 30 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 11 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 30 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 11 (con't).

TABLE 49 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 11.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0614	0.5300	0.0417	−0.2152
−0.1236	0.7026	0.0348	−0.2254
1.1138	0.9371	0.0242	−0.2350
2.0407	1.0597	0.0236	−0.2341
2.9615	1.2005	0.0247	−0.2369
3.6951	1.3029	0.0255	−0.2375
5.0813	1.4961	0.0280	−0.2378
6.0842	1.6375	0.0302	−0.2385
7.1007	1.7828	0.0332	−0.2390
7.8945	1.8786	0.0358	−0.2365
8.8743	2.0122	0.0391	−0.2356
9.7030	2.1131	0.0438	−0.2332
10.8920	2.2166	0.0525	−0.2244
11.9468	2.3605	0.0621	−0.2223
12.8584	2.4441	0.0688	−0.2159
13.9103	2.5237	0.0784	−0.2075
14.9360	2.5788	0.0903	−0.1980
15.7987	1.8982	0.2342	−0.2438
16.7396	1.7775	0.2724	−0.2512
17.7307	1.7005	0.2973	−0.2572
18.7026	1.6535	0.3092	−0.2609

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.1451	0.4996	0.0467	−0.2103
−0.1477	0.6980	0.0397	−0.2209
1.0139	0.9052	0.0291	−0.2277
1.9843	1.0445	0.0286	−0.2284
3.0041	1.1937	0.0301	−0.2303
3.8268	1.3068	0.0311	−0.2302
4.8106	1.4298	0.0342	−0.2276
5.9294	1.5852	0.0377	−0.2272
6.8552	1.7070	0.0402	−0.2256
7.8619	1.8260	0.0466	−0.2218
8.9110	1.9354	0.0531	−0.2159
9.7458	2.0466	0.0592	−0.2136
10.8016	2.1217	0.0672	−0.2040
11.8184	2.1773	0.0793	−0.1937
12.9730	1.7317	0.2004	−0.2236
13.7741	1.6889	0.2338	−0.2275
14.9087	1.6294	0.2610	−0.2304
15.8320	1.5621	0.2717	−0.2352
16.8704	1.5220	0.2858	−0.2419

TABLE 50 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 11.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	1.0076	0.9957	1.0075
20	0.9982	1.0434	0.9971
30	0.9989	1.0586	0.9973
40	1.0004	1.0731	0.9980
50	0.9934	1.0975	0.9907
60	0.9910	1.0866	0.9872
70	0.9984	1.0797	0.9932
80	0.9880	1.0949	0.9808
90	0.9909	1.1027	0.9828
100	0.9847	1.0834	0.9757
110	0.9820	1.1267	0.9714
120	0.9834	1.1179	0.9718
130	0.9908	1.0933	0.9780
140	0.9863	1.1446	0.9739
150	0.9816	1.0877	0.9696
160	0.9911	1.1066	0.9805
170	0.9839	1.0645	0.9746
180	0.9872	1.1137	0.9778
190	0.9875	1.1106	0.9769
200	0.9840	1.1259	0.9717
210	0.9812	1.0889	0.9680
220	0.9830	1.1160	0.9682
230	0.9778	1.1217	0.9619
240	0.9782	1.1434	0.9608
250	0.9819	1.1447	0.9638
260	0.9808	1.1632	0.9607
270	0.9759	1.1787	0.9547
280	0.9831	1.1582	0.9612
290	0.9752	1.1593	0.9526

TABLE 51 - TEST CONDITIONS FOR RUN NUMBER 11.

NASA LEWIS ICING RESEARCH TUNNEL		
Run No. 11	Configuration 5° Flap	Date 05-04-88
P_{air} 25 psig	ΔP_w 20 psid	T_{avg} 25° F
V_∞ 100 mph		
Spray Duration 2 min + 2 min	Ice Accretion Type Mixed	A.O.A. 5°
LWC 0.48 g/m³	MVD 13.4 μm	

Remarks

- This run was to simulate an intermittant icing condition. The spray was run for 2 minutes then turned off. A picture was taken at this time. The spray was then turned on for another 2 minutes. Tracings were made after the 4 minute mark. There was frost on the lower surface behind the slat and on the last trailing edge flap lower surface. No force balance measurements taken with frost removed.
- Uniform across span
- Ice accretion on Leading Edge Slat approximately 1/8" thick

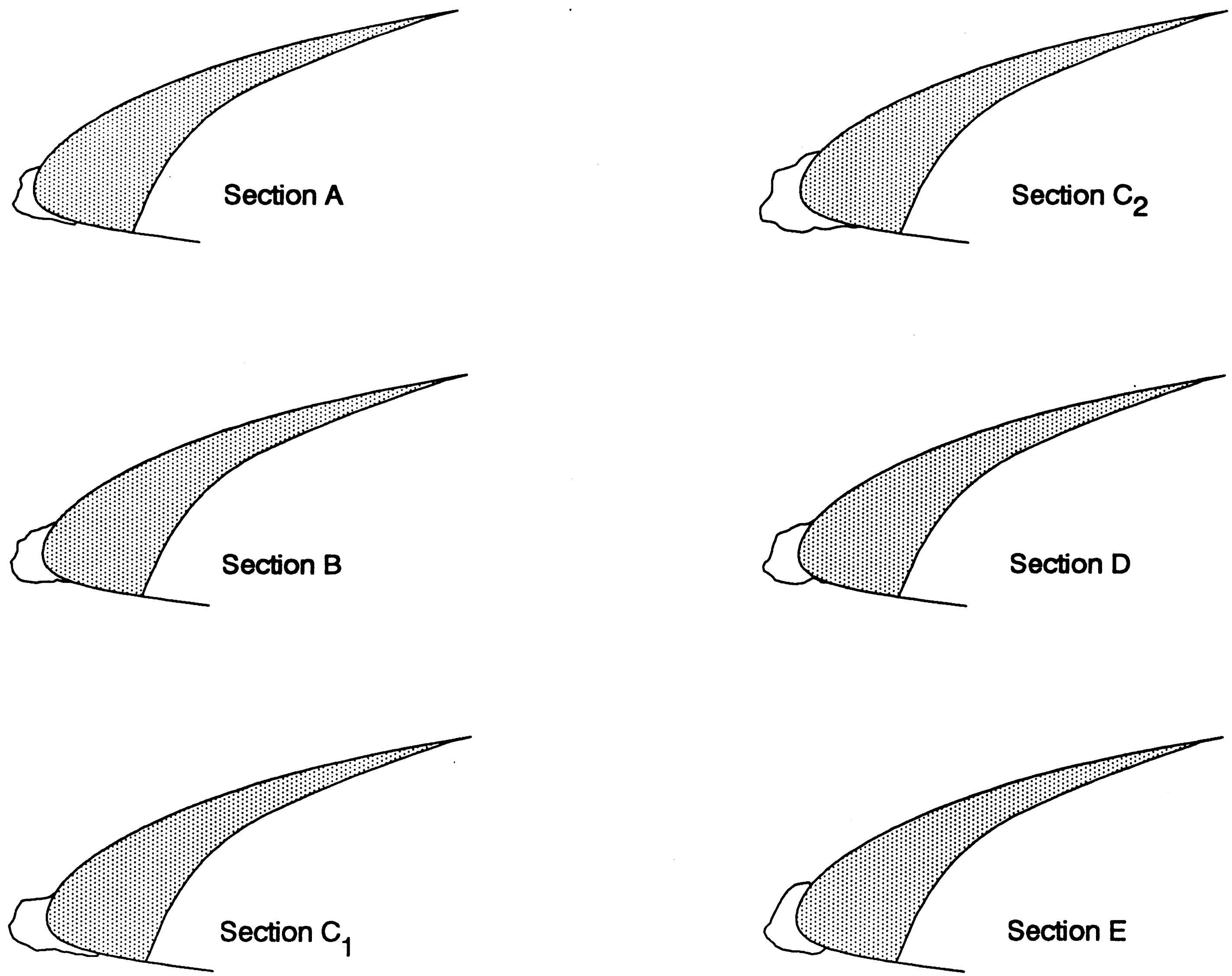


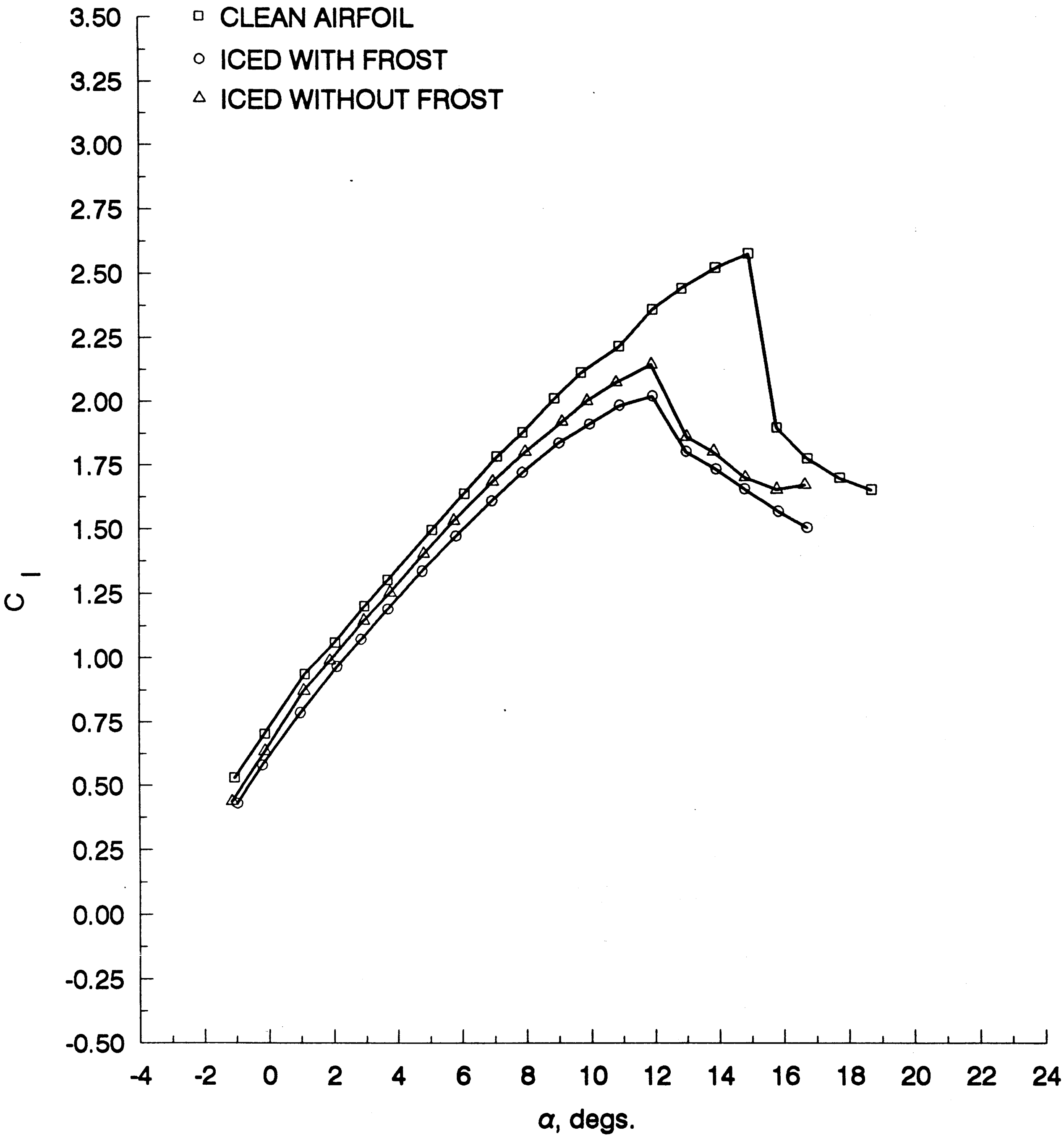
FIGURE 31 - RUN 12 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 52 - RUN 12 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTIONS A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.031859	0.130601	0.069275	0.187167	0.046349	0.144494	0.107507	0.232326	0.088210	0.200516	0.077764	0.211070
0.011734	0.126531	0.053349	0.179168	0.019978	0.126379	0.029488	0.210118	0.074112	0.192468	0.049655	0.206979
-0.000336	0.122484	0.041404	0.173168	-0.012512	0.116269	-0.004476	0.184026	0.060014	0.184420	0.007486	0.202851
-0.024483	0.116396	0.027470	0.165174	-0.042979	0.110174	-0.032414	0.149950	0.039854	0.180362	-0.014587	0.194760
-0.044586	0.104294	0.015525	0.159175	-0.083619	0.108062	-0.066416	0.137859	0.009599	0.180282	-0.052659	0.160522
-0.060662	0.092203	-0.000418	0.157143	-0.108001	0.105994	-0.106424	0.125753	-0.014585	0.172207	-0.086682	0.114246
-0.070693	0.078121	-0.012363	0.151143	-0.132388	0.105930	-0.138435	0.117667	-0.048826	0.154093	-0.112692	0.076024
-0.082731	0.062025	-0.034270	0.143128	-0.152689	0.097856	-0.156405	0.099619	-0.068965	0.142023	-0.130663	0.035815
-0.078661	0.045972	-0.056188	0.139092	-0.185070	0.047644	-0.168316	0.061585	-0.091131	0.133954	-0.146630	-0.002381
-0.072578	0.029923	-0.072125	0.135071	-0.191097	0.021562	-0.166255	0.039589	-0.115319	0.127882	-0.154606	-0.024491
-0.076546	0.007825	-0.086032	0.117131	-0.197124	-0.004521	-0.168199	0.017582	-0.131418	0.113820	-0.166625	-0.036571
-0.092606	-0.010290	-0.093980	0.107163	-0.209269	-0.022598	-0.168135	-0.006419	-0.153435	0.049675	-0.186663	-0.054697
-0.096570	-0.034397	-0.105904	0.093207	-0.227500	-0.044702	-0.178076	-0.032447	-0.161401	0.011602	-0.192625	-0.078810
-0.102562	-0.052486	-0.115850	0.085223	-0.219268	-0.082777	-0.194044	-0.050490	-0.173397	-0.028485	-0.176476	-0.108888
-0.114601	-0.068581	-0.127800	0.081213	-0.202919	-0.116821	-0.212009	-0.070539	-0.189501	-0.040543	-0.152315	-0.130913
-0.124620	-0.086680	-0.149707	0.073198	-0.168306	-0.140793	-0.239957	-0.100615	-0.201582	-0.048586	-0.136209	-0.144927
-0.118532	-0.104736	-0.153652	0.057273	-0.131693	-0.152727	-0.239878	-0.130617	-0.211608	-0.070643	-0.122101	-0.162962
-0.096319	-0.128774	-0.153610	0.041358	-0.103198	-0.168693	-0.233781	-0.164602	-0.209516	-0.098676	-0.081882	-0.180928
-0.070111	-0.140753	-0.153552	0.019476	-0.062494	-0.190643	-0.221722	-0.182571	-0.185280	-0.110629	-0.053752	-0.184870
-0.031827	-0.150692	-0.159495	0.005536	-0.027951	-0.188547	-0.179669	-0.186460	-0.159005	-0.130586	-0.019590	-0.190803
-0.003600	-0.164674	-0.167416	-0.014379	0.014716	-0.184425	-0.145614	-0.194370	-0.138770	-0.154566	0.010538	-0.190723
0.016546	-0.168636	-0.175353	-0.028325	0.049259	-0.182330	-0.119514	-0.222303	-0.104453	-0.164489	0.058765	-0.198628
0.042733	-0.172583	-0.185294	-0.038297	0.098076	-0.198243	-0.089447	-0.236224	-0.068125	-0.172405	0.092932	-0.206570
0.076968	-0.174501	-0.191248	-0.048259	0.126528	-0.198169	-0.033376	-0.242076	-0.019700	-0.178285	0.141121	-0.200418
0.105158	-0.174426	-0.187219	-0.064163	0.148899	-0.204126	0.014688	-0.247949	0.032727	-0.172139	0.171191	-0.178249
0.135377	-0.180370	-0.185178	-0.082061	0.181437	-0.212061	0.050708	-0.241853	0.064941	-0.150024		
0.165612	-0.192338	-0.183137	-0.099959	0.213953	-0.211976	0.088687	-0.219752	0.089125	-0.141950		
0.195836	-0.200290	-0.177120	-0.113869	0.248523	-0.219906	0.128748	-0.227646	0.117390	-0.151889		
0.228063	-0.204221	-0.161124	-0.131730	0.303399	-0.221767	0.172797	-0.229529	0.141637	-0.167847		
0.246196	-0.208189	-0.145128	-0.149592			0.210803	-0.217428	0.175933	-0.169760		
		-0.133141	-0.159507			0.248825	-0.211327				
		-0.111197	-0.165417			0.284866	-0.213231				
		-0.085276	-0.167337			0.318916	-0.219142				

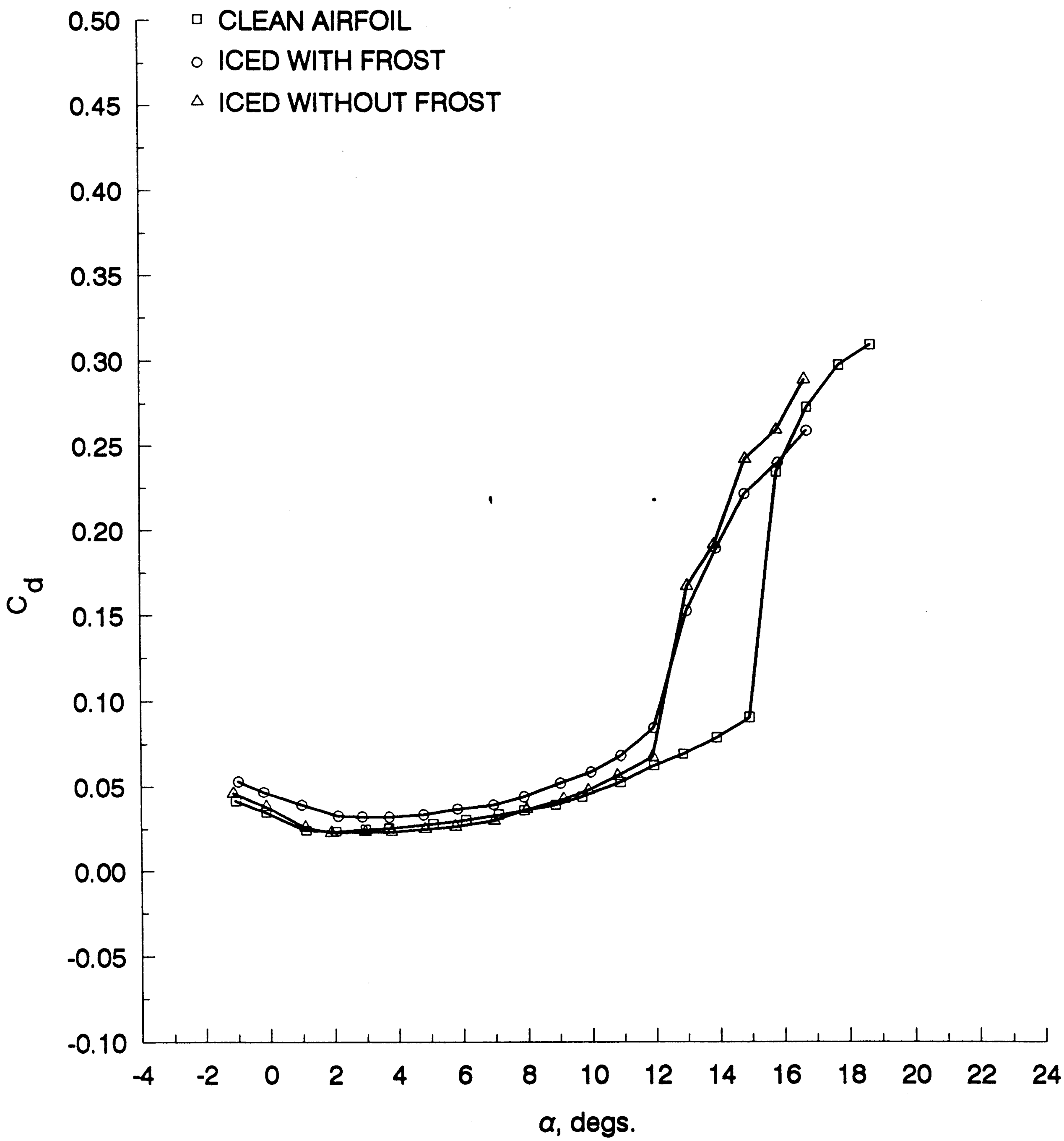
TABLE 52 - RUN 12 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
		−0.061344	−0.171252			0.356948	−0.217041				
		−0.037411	−0.175168			0.384971	−0.214966				
		−0.009524	−0.167137								
		0.016392	−0.167068								
		0.046294	−0.166989								
		0.064236	−0.166942								
		0.084139	−0.154953								
		0.102096	−0.160873								
		0.130026	−0.168757								
		0.153948	−0.168693								
		0.177865	−0.166641								



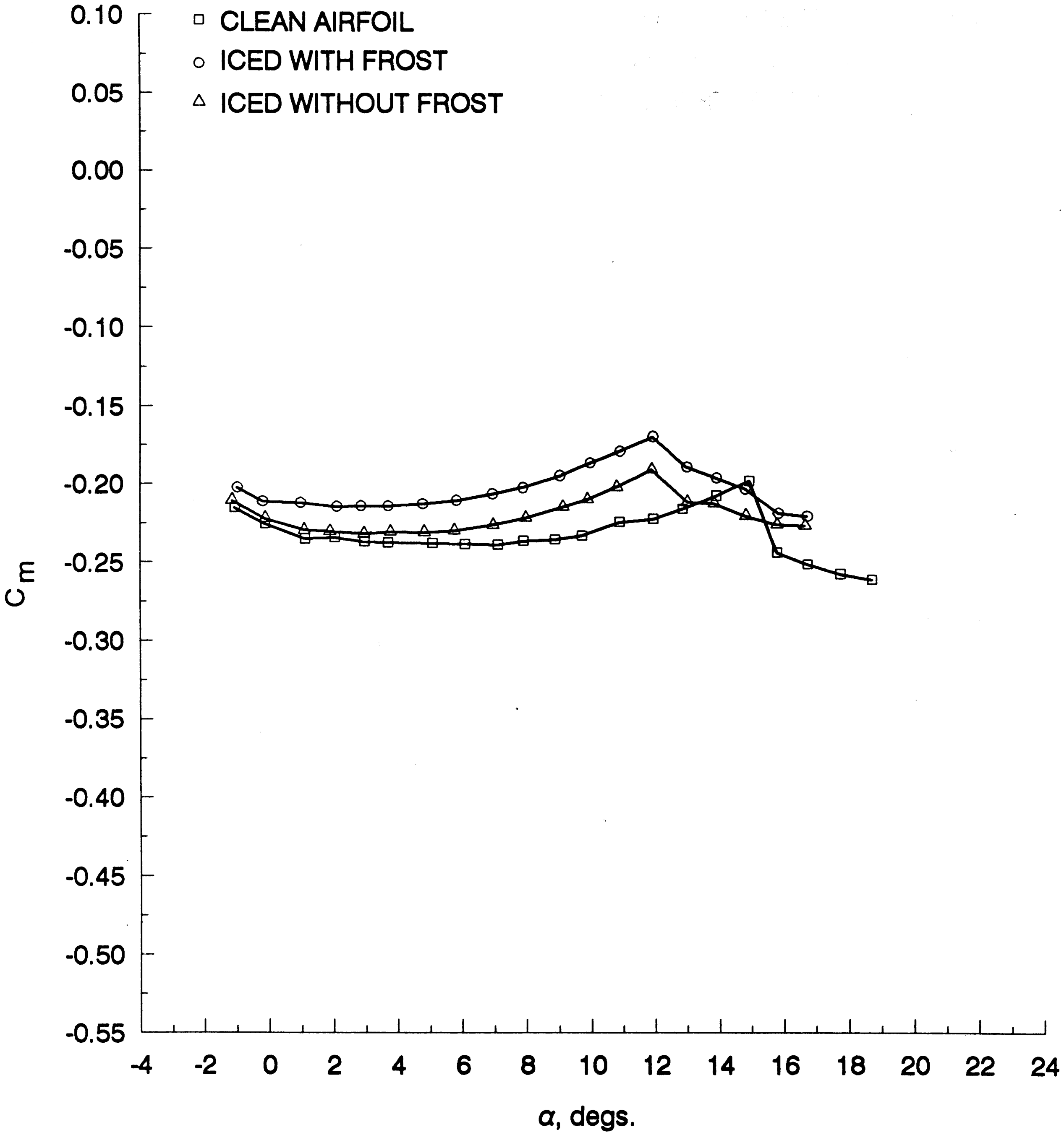
(A) C_l VERSUS α

FIGURE 32 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 12.



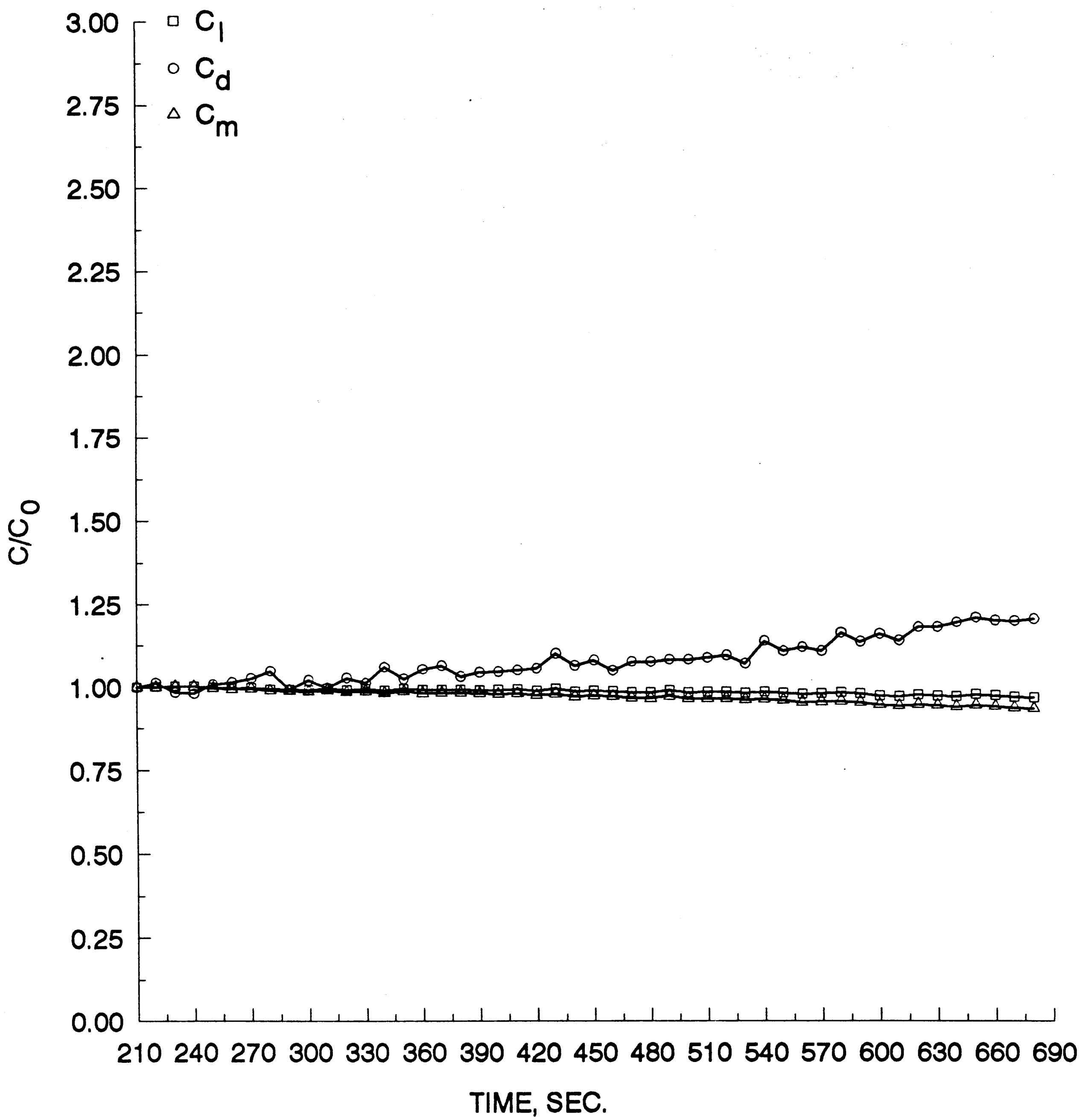
(B) C_d VERSUS α

FIGURE 32 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 12 (con't).



(C) C_m VERSUS α

FIGURE 32 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 12 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 32 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 12 (con't).

TABLE 53 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 12.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0614	0.5300	0.0417	−0.2152
−0.1236	0.7026	0.0348	−0.2254
1.1138	0.9371	0.0242	−0.2350
2.0407	1.0597	0.0236	−0.2341
2.9615	1.2005	0.0247	−0.2369
3.6951	1.3029	0.0255	−0.2375
5.0813	1.4961	0.0280	−0.2378
6.0842	1.6375	0.0302	−0.2385
7.1007	1.7828	0.0332	−0.2390
7.8945	1.8786	0.0358	−0.2365
8.8743	2.0122	0.0391	−0.2356
9.7030	2.1131	0.0438	−0.2332
10.8920	2.2166	0.0525	−0.2244
11.9468	2.3605	0.0621	−0.2223
12.8584	2.4441	0.0688	−0.2159
13.9103	2.5237	0.0784	−0.2075
14.9360	2.5788	0.0903	−0.1980
15.7987	1.8982	0.2342	−0.2438
16.7396	1.7775	0.2724	−0.2512
17.7307	1.7005	0.2973	−0.2572
18.7026	1.6535	0.3092	−0.2609

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−0.9769	0.4288	0.0530	−0.2023
−0.1980	0.5790	0.0468	−0.2110
0.9781	0.7862	0.0393	−0.2120
2.1013	0.9662	0.0327	−0.2144
2.8532	1.0719	0.0322	−0.2141
3.7019	1.1895	0.0320	−0.2141
4.7726	1.3367	0.0333	−0.2128
5.8232	1.4730	0.0366	−0.2106
6.9418	1.6092	0.0392	−0.2066
7.8884	1.7213	0.0438	−0.2026
9.0226	1.8364	0.0518	−0.1950
9.9697	1.9110	0.0582	−0.1867
10.8994	1.9844	0.0678	−0.1793
11.9378	2.0219	0.0842	−0.1697
12.9906	1.8046	0.1524	−0.1892
13.9140	1.7355	0.1889	−0.1962
14.8071	1.6577	0.2214	−0.2032
15.8444	1.5696	0.2397	−0.2186
16.7320	1.5068	0.2586	−0.2204

(C). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
−1.1369	0.4369	0.0460	−0.2104
−0.1185	0.6347	0.0381	−0.2219
1.0850	0.8716	0.0261	−0.2294
1.8867	0.9891	0.0228	−0.2304
2.9455	1.1444	0.0233	−0.2319
3.7723	1.2538	0.0233	−0.2307
4.8193	1.4040	0.0249	−0.2309
5.7567	1.5323	0.0263	−0.2299
6.9614	1.6844	0.0299	−0.2264
7.9706	1.8013	0.0364	−0.2217
9.1182	1.9206	0.0424	−0.2148
9.8856	2.0020	0.0476	−0.2099
10.7999	2.0751	0.0560	−0.2021
11.8996	2.1456	0.0672	−0.1909
13.0048	1.8619	0.1669	−0.2114
13.8424	1.8047	0.1912	−0.2123
14.8283	1.7022	0.2419	−0.2201
15.7992	1.6546	0.2591	−0.2259
16.6630	1.6729	0.2888	−0.2266

TABLE 54 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 12.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
210	1.0000	1.0000	1.0000
220	1.0008	1.0133	1.0006
230	1.0022	0.9841	1.0018
240	1.0034	0.9804	1.0019
250	0.9995	1.0079	0.9965
260	0.9964	1.0146	0.9936
270	0.9986	1.0270	0.9952
280	0.9935	1.0486	0.9893
290	0.9932	0.9932	0.9884
300	0.9911	1.0212	0.9860
310	0.9963	0.9985	0.9905
320	0.9920	1.0282	0.9848
330	0.9949	1.0125	0.9875
340	0.9891	1.0605	0.9811
350	0.9948	1.0248	0.9863
360	0.9908	1.0536	0.9805
370	0.9911	1.0644	0.9810
380	0.9916	1.0308	0.9816
390	0.9903	1.0443	0.9793
400	0.9906	1.0464	0.9782
410	0.9924	1.0507	0.9798
420	0.9876	1.0560	0.9748
430	0.9941	1.1005	0.9789
440	0.9855	1.0645	0.9709
450	0.9875	1.0808	0.9730
460	0.9866	1.0498	0.9711
470	0.9834	1.0766	0.9663
480	0.9828	1.0763	0.9659
490	0.9904	1.0834	0.9723
500	0.9830	1.0833	0.9653
510	0.9842	1.0884	0.9654
520	0.9846	1.0959	0.9653
530	0.9821	1.0712	0.9613
540	0.9842	1.1397	0.9628
550	0.9812	1.1087	0.9595
560	0.9775	1.1206	0.9537

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
570	0.9798	1.1088	0.9560
580	0.9825	1.1642	0.9573
590	0.9795	1.1375	0.9542
600	0.9737	1.1606	0.9467
610	0.9711	1.1412	0.9432
620	0.9760	1.1816	0.9471
630	0.9738	1.1823	0.9447
640	0.9715	1.1961	0.9405
650	0.9774	1.2107	0.9452
660	0.9740	1.2022	0.9415
670	0.9699	1.2007	0.9372
680	0.9689	1.2068	0.9348

TABLE 55 - TEST CONDITIONS FOR RUN NUMBER 12.

<table>
<tr><th colspan="4">NASA LEWIS ICING RESEARCH TUNNEL</th></tr>
<tr><td>Run No. 12</td><td colspan="2">Configuration 5° Flap</td><td>Date 05-04-88</td></tr>
<tr><td>P_{air} 39 psig</td><td>ΔP_w 18 psid</td><td>T_{avg} 25° F</td><td>V_∞ 100 mph</td></tr>
<tr><td>Spray Duration 11 min</td><td colspan="2">Ice Accretion Type Mixed</td><td>A.O.A. 5°</td></tr>
<tr><td colspan="2">LWC 0.46 g/m³</td><td colspan="2">MVD 12 μm</td></tr>
<tr><td colspan="4">Remarks
• Ice accretion on Leading Edge Slat approximately 1/4" thick
• Ice accretion on leading edge of Flaps 1 & 2 approximately 1/8" thick, too small to trace
• From on lower surface behind leading edge of Main Wing Section and heavy frost on lower surface of Flap 3.
• Pitch pause taken with all this ice on model.
• Frost and ice on flap leading edges removed and a second pitch pause was taken.
• Data system screen blanked out during second pitch pause. System reset and pitch pause was repeated.
• This problem caused the first 30 seconds of the ice accretion data to be lost.</td></tr>
</table>

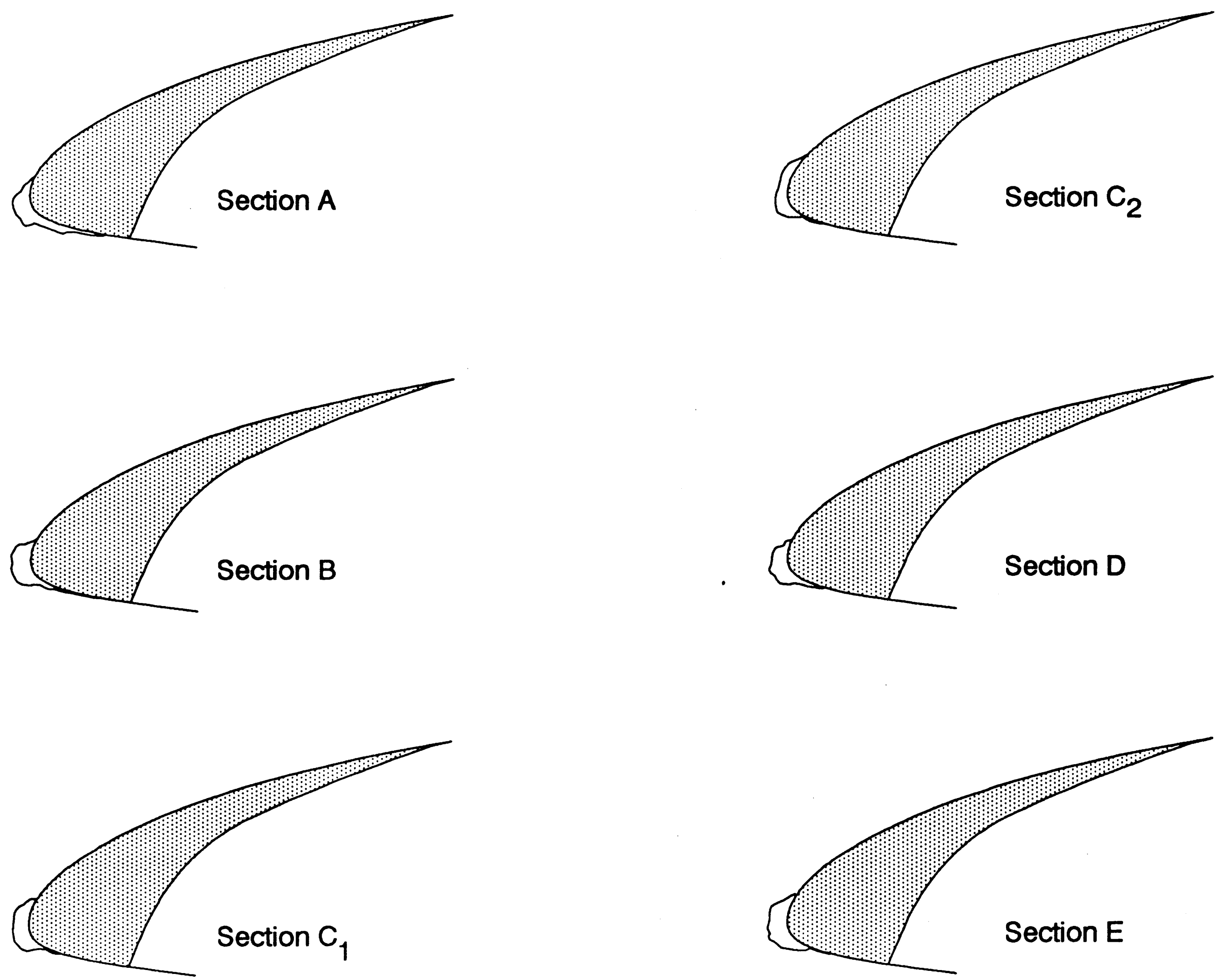
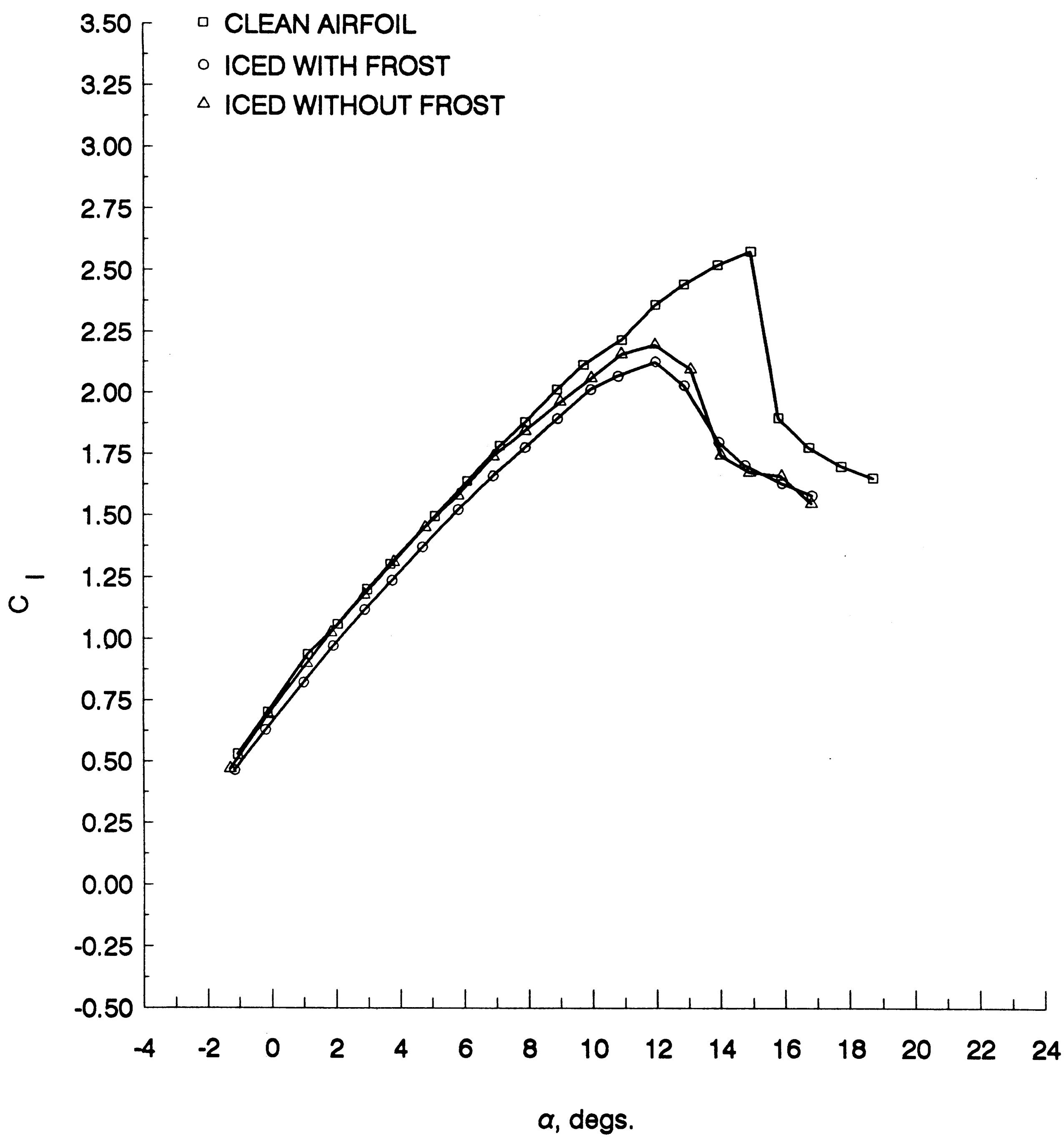


FIGURE 33 - RUN 13 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

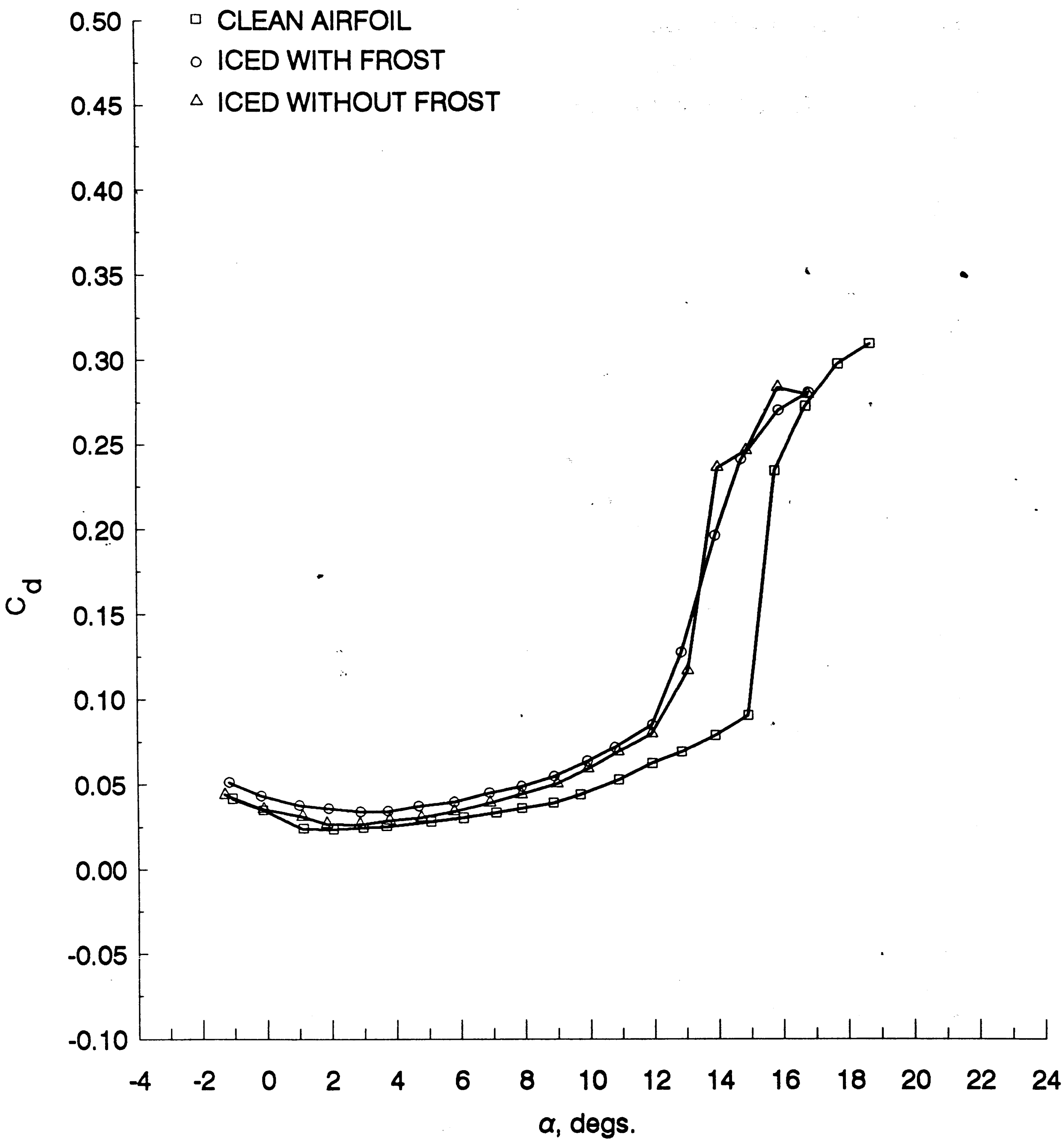
TABLE 56 - RUN 13 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTIONS A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.031565	0.115778	0.033675	0.123606	0.059191	0.149366	0.124777	0.233272	0.037465	0.107804	0.045730	0.159260
0.011672	0.105752	0.007693	0.115569	0.033367	0.147309	0.100537	0.221160	0.019589	0.105761	0.021681	0.147262
-0.010171	0.079762	-0.012288	0.107548	0.011511	0.147250	0.074280	0.207034	0.001718	0.101725	-0.016389	0.125280
-0.030049	0.063751	-0.036269	0.099517	-0.012290	0.131273	0.041950	0.194901	-0.012168	0.093710	-0.048460	0.111271
-0.045937	0.045757	-0.064267	0.097451	-0.028144	0.115317	0.011648	0.180765	-0.024042	0.075728	-0.080536	0.099251
-0.051865	0.027788	-0.076252	0.091443	-0.053942	0.103312	-0.012549	0.152588	-0.031973	0.069723	-0.100556	0.081295
-0.063791	0.017783	-0.088227	0.081451	-0.073764	0.085356	-0.022619	0.136498	-0.055804	0.065671	-0.106491	0.049452
-0.085660	0.001767	-0.102160	0.055518	-0.083656	0.069415	-0.036719	0.114372	-0.075646	0.055646	-0.108402	0.013640
-0.097559	-0.018212	-0.114103	0.033574	-0.087546	0.037575	-0.042706	0.084235	-0.089474	0.025691	-0.112341	-0.014220
-0.103482	-0.038175	-0.112033	0.007683	-0.089433	-0.000227	-0.050727	0.058110	-0.093363	-0.006232	-0.120299	-0.040101
-0.097432	-0.066085	-0.109975	-0.014224	-0.091319	-0.038028	-0.056720	0.029982	-0.095271	-0.036155	-0.110217	-0.057978
-0.081380	-0.109927	-0.111938	-0.028174	-0.089264	-0.063884	-0.068759	-0.006195	-0.109089	-0.070098	-0.104160	-0.071886
-0.053430	-0.133790	-0.115901	-0.042128	-0.083209	-0.099676	-0.074747	-0.036331	-0.101084	-0.092016	-0.112149	-0.085832
-0.043417	-0.153710	-0.109816	-0.073985	-0.061300	-0.119511	-0.072644	-0.066446	-0.075208	-0.109898	-0.106076	-0.105709
-0.039391	-0.169658	-0.093734	-0.103823	-0.041367	-0.143330	-0.066490	-0.098558	-0.061238	-0.133795	-0.075937	-0.119554
-0.025420	-0.179594	-0.081680	-0.123712	-0.009540	-0.157170	-0.060374	-0.116615	-0.047277	-0.153703	-0.059841	-0.135426
-0.001533	-0.173546	-0.067652	-0.133635	0.034146	-0.147107	-0.030002	-0.128583	-0.025407	-0.159629	-0.035712	-0.153266
0.010404	-0.167531	-0.043618	-0.145524	0.057984	-0.145055	0.006438	-0.140535	0.012347	-0.161522	0.008458	-0.161107
0.030307	-0.161493	-0.005608	-0.147415	0.103689	-0.146922	0.042851	-0.142448	0.036173	-0.155475	0.042594	-0.168974
0.056229	-0.171398	0.014389	-0.145371	0.121613	-0.162789	0.069146	-0.142379	0.065980	-0.157391	0.078726	-0.172858
0.098103	-0.187245	0.032391	-0.145323	0.141504	-0.170694	0.089367	-0.140317	0.093811	-0.163300	0.106815	-0.170795
0.134001	-0.203108	0.056393	-0.145260	0.169331	-0.174599	0.109626	-0.152312	0.121652	-0.173199	0.136885	-0.158780
0.157931	-0.213018	0.072421	-0.155178	0.199135	-0.174520	0.133940	-0.168312	0.157430	-0.179087	0.181081	-0.176567
0.189824	-0.220912	0.088450	-0.165095	0.215030	-0.174477	0.166324	-0.176259	0.189230	-0.182991	0.221248	-0.188397
0.197802	-0.224880	0.112468	-0.171008			0.192635	-0.182214	0.211084	-0.182933	0.251365	-0.194286
0.221685	-0.216838	0.140477	-0.172926			0.216907	-0.182151				
0.241599	-0.214790	0.174501	-0.180804								
0.271479	-0.214711	0.208532	-0.190674								
0.333267	-0.228511	0.250552	-0.196539								
0.369138	-0.234399	0.288588	-0.208391								
0.432892	-0.238220	0.330608	-0.214257								
0.448822	-0.236183	0.358627	-0.220159								
		0.388641	-0.224064								
		0.408649	-0.226003								
		0.438657	-0.227915								



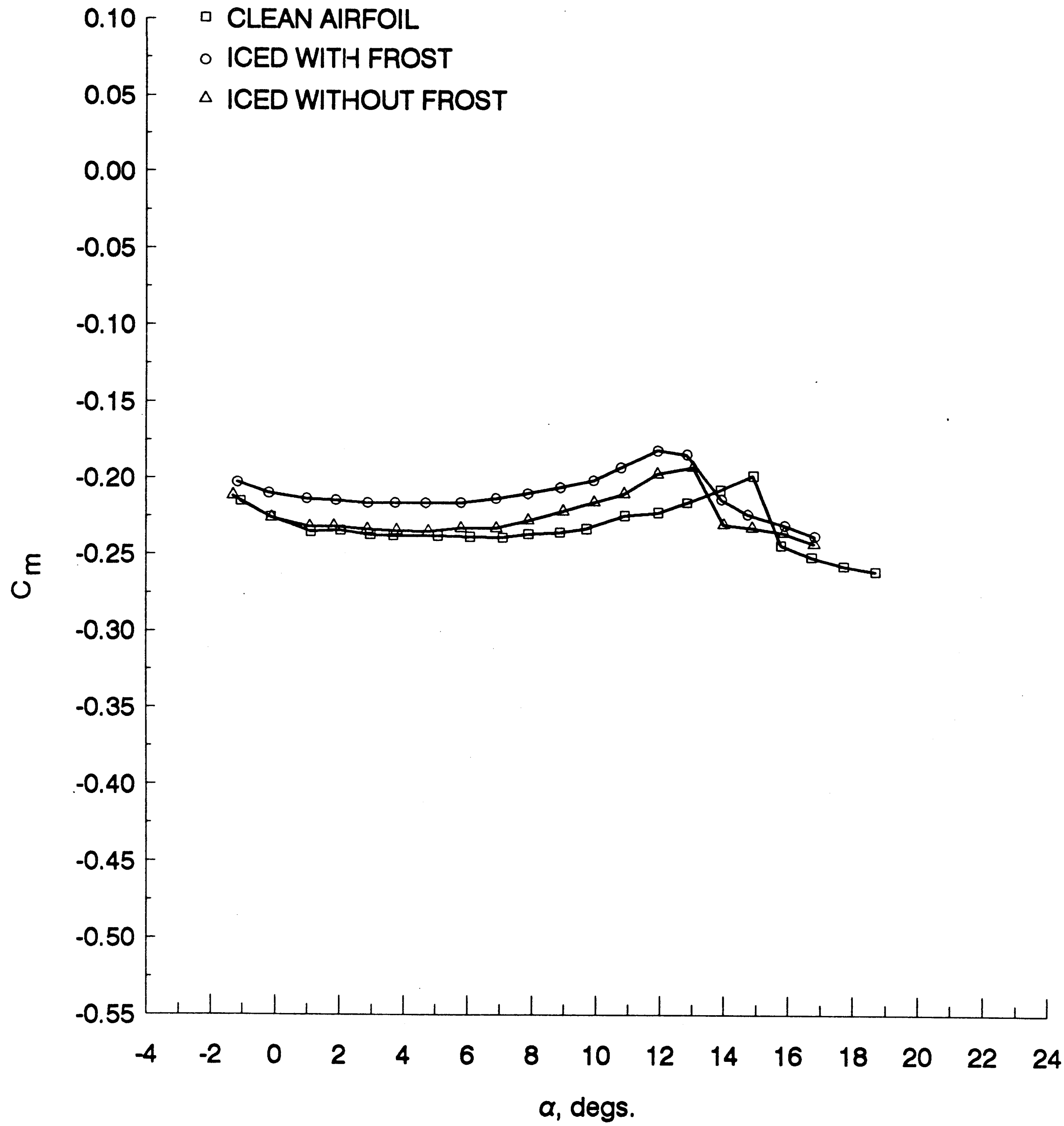
(A) C_l VERSUS α

FIGURE 34 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 13.



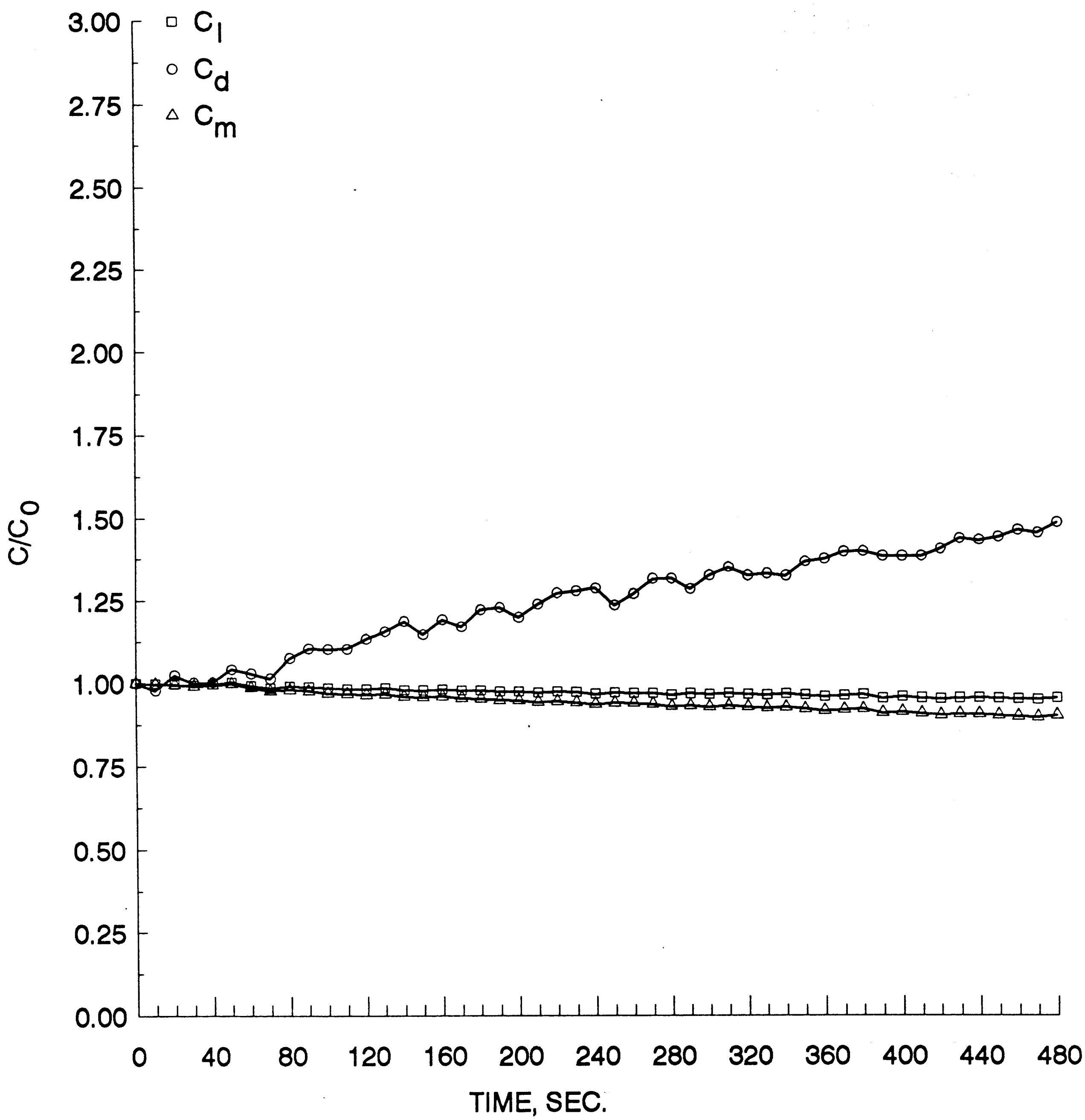
(B) C_d VERSUS α

FIGURE 36 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 13 (con't).



(C) C_m VERSUS α

FIGURE 34 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 13 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 34 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 13 (con't).

TABLE 57 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 13.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0614	0.5300	0.0417	−0.2152
−0.1236	0.7026	0.0348	−0.2254
1.1138	0.9371	0.0242	−0.2350
2.0407	1.0597	0.0236	−0.2341
2.9615	1.2005	0.0247	−0.2369
3.6951	1.3029	0.0255	−0.2375
5.0813	1.4961	0.0280	−0.2378
6.0842	1.6375	0.0302	−0.2385
7.1007	1.7828	0.0332	−0.2390
7.8945	1.8786	0.0358	−0.2365
8.8743	2.0122	0.0391	−0.2356
9.7030	2.1131	0.0438	−0.2332
10.8920	2.2166	0.0525	−0.2244
11.9468	2.3605	0.0621	−0.2223
12.8584	2.4441	0.0688	−0.2159
13.9103	2.5237	0.0784	−0.2075
14.9360	2.5788	0.0903	−0.1980
15.7987	1.8982	0.2342	−0.2438
16.7396	1.7775	0.2724	−0.2512
17.7307	1.7005	0.2973	−0.2572
18.7026	1.6535	0.3092	−0.2609

(B) ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.1595	0.4643	0.0513	−0.2027
−0.1858	0.6297	0.0433	−0.2098
0.9901	0.8231	0.0377	−0.2134
1.8939	0.9709	0.0357	−0.2145
2.8805	1.1185	0.0338	−0.2162
3.7412	1.2366	0.0341	−0.2162
4.6969	1.3705	0.0371	−0.2163
5.8024	1.5220	0.0395	−0.2161
6.8914	1.6592	0.0449	−0.2134
7.8864	1.7753	0.0485	−0.2100
8.8933	1.8934	0.0545	−0.2061
9.9272	2.0125	0.0634	−0.2015
10.7857	2.0678	0.0714	−0.1930
11.9501	2.1276	0.0846	−0.1816
12.8604	2.0296	0.1274	−0.1840
13.9369	1.7996	0.1962	−0.2135
14.7533	1.7060	0.2410	−0.2233
15.9089	1.6317	0.2700	−0.2306
16.8324	1.5815	0.2806	−0.2375

(C). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
−1.2870	0.4698	0.0439	−0.2115
−0.1113	0.6921	0.0356	−0.2258
1.0861	0.8995	0.0311	−0.2317
1.8380	1.0256	0.0269	−0.2316
2.8684	1.1785	0.0266	−0.2337
3.7888	1.3095	0.0288	−0.2344
4.7773	1.4502	0.0303	−0.2349
5.7910	1.5802	0.0341	−0.2329
6.9017	1.7397	0.0392	−0.2330
7.8832	1.8433	0.0439	−0.2275
8.9810	1.9622	0.0502	−0.2217
9.9440	2.0586	0.0590	−0.2155
10.8765	2.1571	0.0688	−0.2102
11.9349	2.1965	0.0795	−0.1969
13.0565	2.0965	0.1165	−0.1926
14.0141	1.7453	0.2360	−0.2302
14.9002	1.6763	0.2462	−0.2322
15.8893	1.6603	0.2835	−0.2354
16.8115	1.5497	0.2792	−0.2428

TABLE 58 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 13.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9988	0.9786	0.9981
20	0.9969	1.0241	0.9958
30	0.9934	1.0014	0.9915
40	0.9970	1.0027	0.9939
50	1.0025	1.0408	0.9982
60	0.9921	1.0282	0.9856
70	0.9845	1.0132	0.9758
80	0.9901	1.0746	0.9796
90	0.9892	1.1037	0.9764
100	0.9845	1.1013	0.9687
110	0.9823	1.1022	0.9669
120	0.9814	1.1326	0.9646
130	0.9849	1.1556	0.9666
140	0.9787	1.1862	0.9587
150	0.9779	1.1460	0.9574
160	0.9806	1.1914	0.9589
170	0.9774	1.1699	0.9537
180	0.9774	1.2215	0.9525
190	0.9737	1.2281	0.9475
200	0.9730	1.1979	0.9467
210	0.9698	1.2383	0.9418
220	0.9737	1.2723	0.9446
230	0.9718	1.2783	0.9412
240	0.9664	1.2870	0.9354
250	0.9700	1.2352	0.9397
260	0.9692	1.2695	0.9389
270	0.9692	1.3160	0.9357
280	0.9639	1.3171	0.9285
290	0.9676	1.2849	0.9312
300	0.9654	1.3258	0.9278
310	0.9685	1.3508	0.9310
320	0.9657	1.3256	0.9270
330	0.9639	1.3310	0.9240
340	0.9670	1.3248	0.9264
350	0.9630	1.3674	0.9211
	-		

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
360	0.9584	1.3766	0.9161
370	0.9625	1.3980	0.9190
380	0.9653	1.3989	0.9207
390	0.9539	1.3849	0.9091
400	0.9581	1.3848	0.9119
410	0.9544	1.3853	0.9071
420	0.9515	1.4065	0.9032
430	0.9546	1.4386	0.9055
440	0.9552	1.4338	0.9052
450	0.9537	1.4435	0.9027
460	0.9517	1.4651	0.8998
470	0.9506	1.4567	0.8972
480	0.9557	1.4883	0.9024

TABLE 59 - TEST CONDITIONS FOR RUN NUMBER 13.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 13	Configuration 5° Flap	Date 05-04-88	
P_{air} 70 psig	ΔP_w 15.1 psid	T_{avg} 17° F	V_∞ 100 mph
Spray Duration 4 min + 4 min	Ice Accretion Type Mixed		A.O.A. 5°
LWC 0.42 g/m³	MVD 13.4 μm		

Remarks

- This run was a 4 min + 4 min run as was done in run number 11.
- Frost was removed from the lower surface and the pitch pause was performed a second time as in run #12. The flap leading edge ice was left on for this run.
- The condition was mixed and the glaze portion was not transparent but not yet fully opaque.
- Ice accretion on Leading Edge Slat approximately 1/8" thick. Uniform across span, and effects covered approximately 1/2" at each wing wall juncture.
- Ice accretion on leading edge of Flaps 1 & 2 < 1/16" thick, too small to trace.
- Frost on entire lower surface of Main Element and Flap 3.

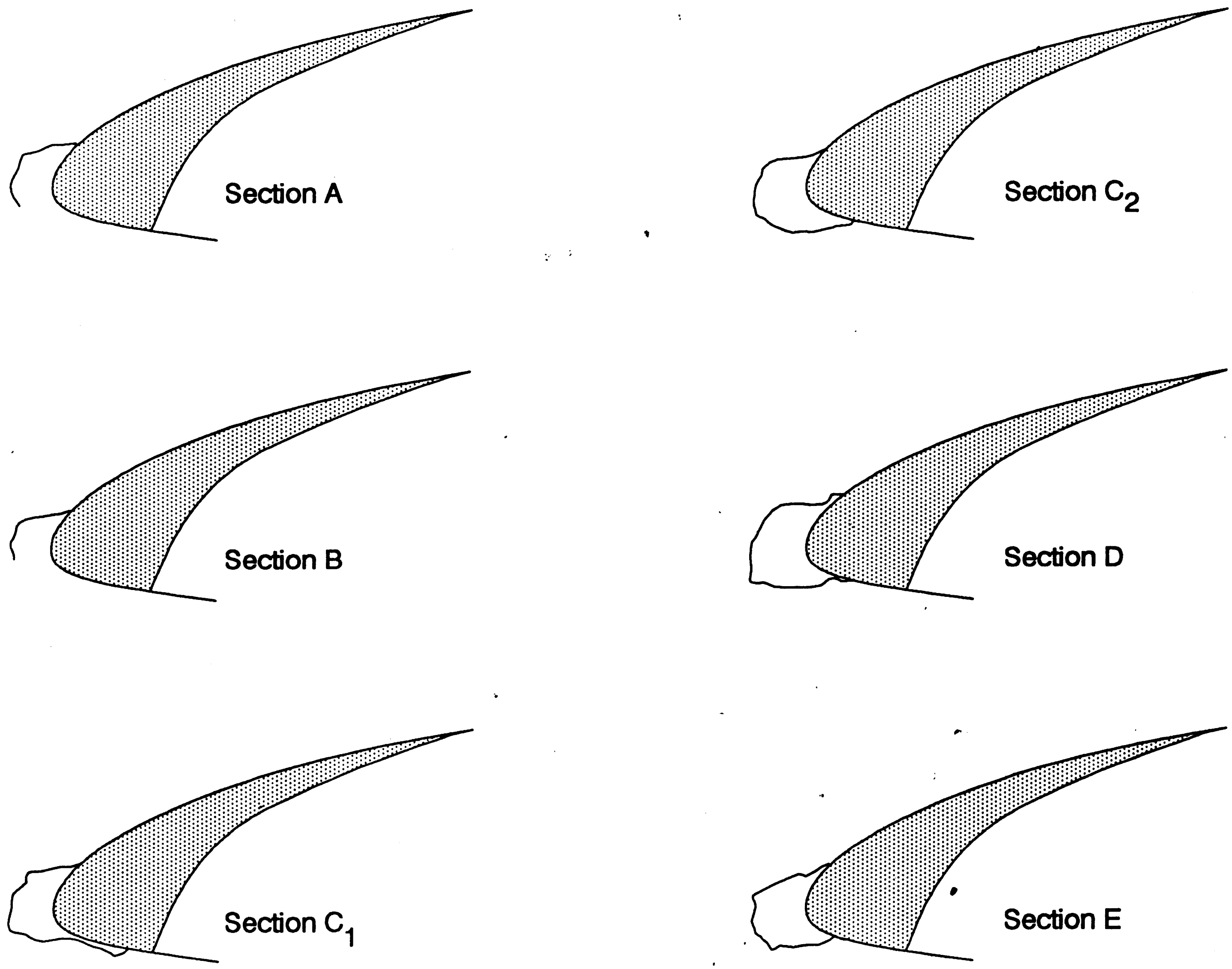


FIGURE 35 - RUN 14 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 60 - RUN 14 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTIONS A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.139292	0.270356	0.109608	0.234097	0.106693	0.255243	0.113258	0.226690	0.226774	0.325716	0.138745	0.262885
0.091305	0.264229	0.057562	0.218109	0.043068	0.255073	0.080754	0.212456	0.200821	0.323653	0.098946	0.246990
0.053308	0.262128	0.009497	0.212039	−0.018538	0.242862	0.042160	0.194163	0.170863	0.325568	0.055201	0.217268
−0.002689	0.259980	−0.054586	0.201963	−0.080138	0.228644	−0.006614	0.179886	0.150905	0.321526	0.021389	0.197441
−0.036654	0.245891	−0.108657	0.193896	−0.127857	0.228516	−0.073714	0.173646	0.135016	0.289571	−0.000497	0.187515
−0.086604	0.225759	−0.158710	0.181876	−0.151701	0.222429	−0.122520	0.171496	0.121080	0.273577	−0.022435	0.197326
−0.134569	0.211633	−0.190722	0.165940	−0.165556	0.198300	−0.171321	0.167325	0.093151	0.263531	−0.044363	0.203190
−0.160560	0.207564	−0.206690	0.144103	−0.165519	0.184247	−0.226180	0.146968	0.027262	0.261362	−0.098090	0.181337
−0.182535	0.197507	−0.214603	0.106435	−0.161495	0.166188	−0.254589	0.122639	−0.024671	0.267208	−0.179679	0.149542
−0.196451	0.165471	−0.228531	0.070732	−0.187290	0.146042	−0.268788	0.108453	−0.076594	0.269065	−0.253289	0.113820
−0.210319	0.115437	−0.242491	0.046918	−0.207131	0.129928	−0.272785	0.082167	−0.118516	0.264965	−0.285114	0.095972
−0.244157	0.053350	−0.242417	0.019179	−0.226972	0.113813	−0.274781	0.068013	−0.152457	0.262880	−0.303026	0.090004
−0.254072	0.021326	−0.232331	−0.006554	−0.246796	0.091676	−0.286946	0.053832	−0.204284	0.228835	−0.322904	0.074162
−0.251966	−0.018667	−0.226241	−0.036259	−0.252645	0.047492	−0.303136	0.023471	−0.258034	0.166861	−0.322857	0.056397
−0.235875	−0.052622	−0.226193	−0.054092	−0.252561	0.015369	−0.311190	−0.006867	−0.287832	0.108940	−0.312854	0.040633
−0.217816	−0.074574			−0.260425	−0.018783	−0.315177	−0.037196	−0.305698	0.069001	−0.306804	0.013016
−0.199735	−0.104524			−0.268288	−0.052934	−0.319142	−0.075610	−0.329585	0.041013	−0.312696	−0.018580
				−0.274158	−0.089088	−0.319056	−0.107949	−0.337451	−0.004883	−0.328479	−0.075862
				−0.264138	−0.119176	−0.310834	−0.140266	−0.339326	−0.050763	−0.312427	−0.119243
				−0.240246	−0.131158	−0.306708	−0.162489	−0.333161	−0.116568	−0.306371	−0.148834
				−0.202448	−0.139087	−0.284298	−0.176578	−0.333124	−0.130530	−0.290414	−0.156687
				−0.168631	−0.145020	−0.255803	−0.184588	−0.337038	−0.160458	−0.274446	−0.168487
				−0.148716	−0.157013	−0.237450	−0.202731	−0.340957	−0.188393	−0.258462	−0.186210
				−0.110886	−0.176988	−0.208917	−0.224889	−0.334925	−0.204334	−0.236497	−0.205890
				−0.061152	−0.186893	−0.176344	−0.236930	−0.300957	−0.212222	−0.208508	−0.243319
				−0.013449	−0.180743	−0.129507	−0.259040	−0.257038	−0.208116	−0.188598	−0.239319
				0.040214	−0.172568	−0.084730	−0.271049	−0.187081	−0.233861	−0.158771	−0.219503
				0.097875	−0.172414	−0.027799	−0.264836	−0.127161	−0.239686	−0.128875	−0.225346
				0.135663	−0.176328	0.041356	−0.266674	−0.055275	−0.239495	−0.073087	−0.229147
				0.173477	−0.190280	0.094203	−0.254408	0.024592	−0.237289	−0.019324	−0.221110
				0.199362	−0.204265	0.134852	−0.244195	0.086467	−0.227152	0.022498	−0.217052
				0.247123	−0.220198	0.157213	−0.240094	0.114369	−0.207133	0.076283	−0.216911
				0.288909	−0.232132	0.181598	−0.231945	0.138278	−0.187124	0.126036	−0.199017

TABLE 60 - RUN 14 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
				0.320759	−0.246101	0.226331	−0.227784	0.168225	−0.185050	0.147917	−0.187116
				0.346644	−0.260085	0.262923	−0.221624	0.194199	−0.190965	0.165798	−0.169305
				0.368552	−0.274080			0.208203	−0.200901	0.195689	−0.173174
				0.384448	−0.270022			0.276090	−0.198726	0.209660	−0.183006
				0.424182	−0.257870					0.229596	−0.188875
										0.259465	−0.184849

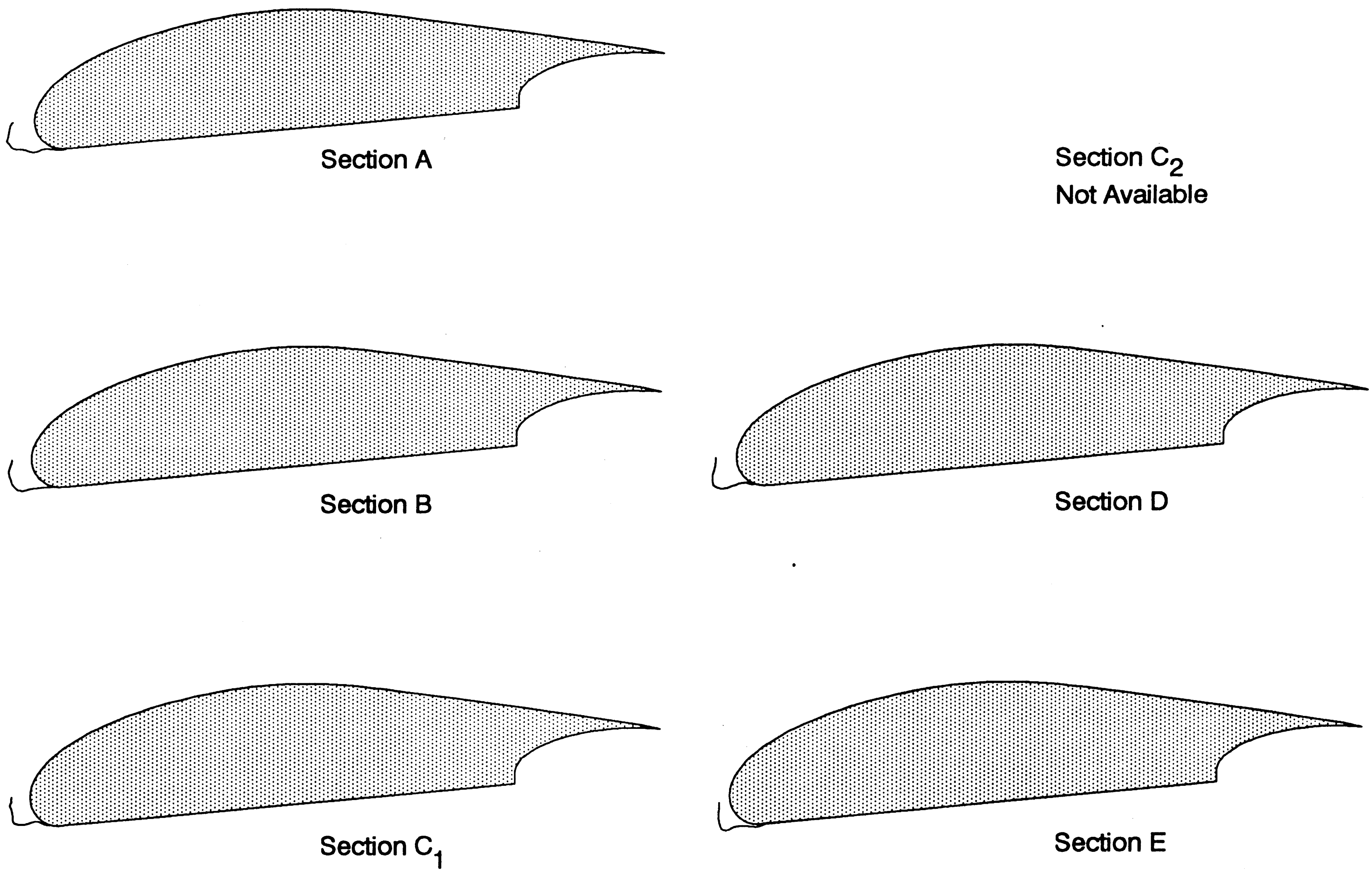
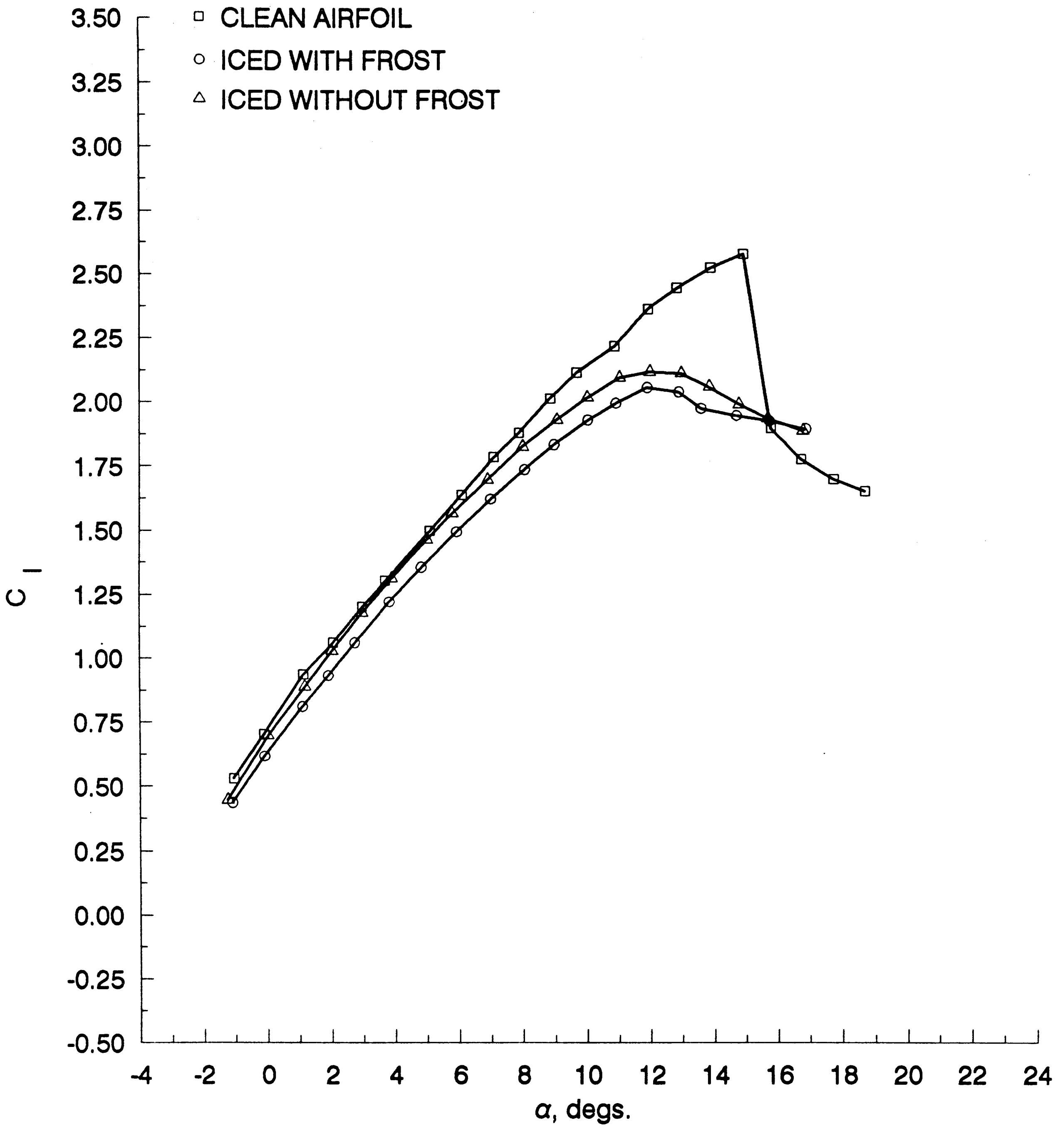


FIGURE 36 - RUN 14 ICE SHAPE TRACINGS FOR MID FLAP (FLAP 2), SECTIONS A - E.

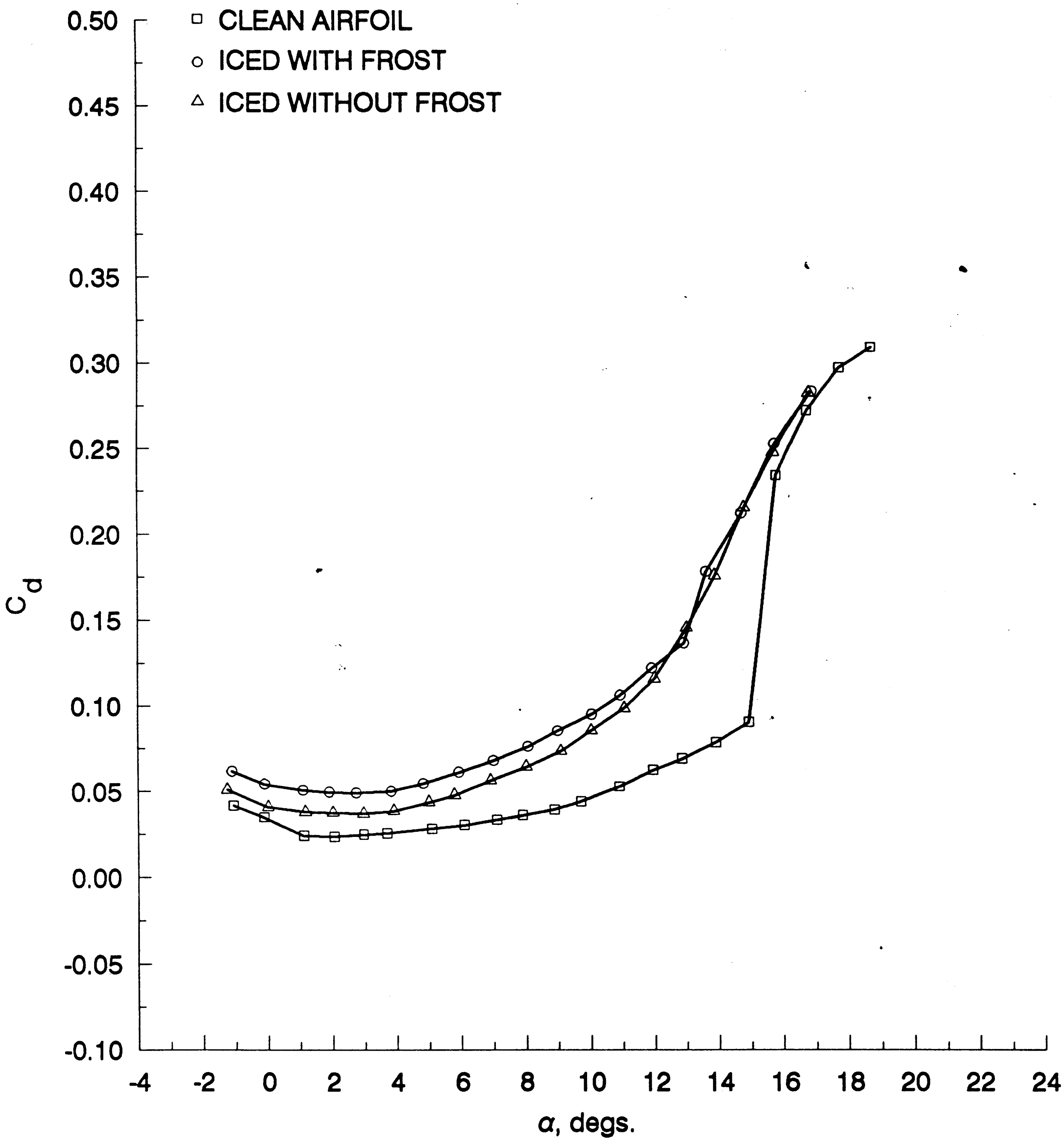
TABLE 61 - RUN 14 ICE SHAPE COORDINATES FOR MID FLAP (FLAP 2), SECTIONS A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
13.005713	−0.381746	13.017804	−0.380186	13.025830	−0.372747			13.011794	−0.377673	13.076468	−0.416380
12.995643	−0.389685	13.013823	−0.398018	13.021841	−0.388537			13.009834	−0.399548	13.074541	−0.449948
12.983598	−0.413456	13.007825	−0.415855	13.023895	−0.402338			13.005861	−0.423416	13.072606	−0.481542
12.979605	−0.429292	13.001812	−0.427752	13.017867	−0.410243			13.001885	−0.447283	13.072686	−0.511157
12.975627	−0.451064	12.997820	−0.441623	13.009856	−0.429987			12.995877	−0.465193	13.074769	−0.534844
12.973662	−0.470852	12.993826	−0.455495	13.021985	−0.441790			12.987869	−0.491059	13.078846	−0.548654
12.967672	−0.494607	12.997900	−0.471325	13.028097	−0.465443			12.987943	−0.518893	13.084974	−0.574305
12.963662	−0.504509	13.001972	−0.487156	13.030194	−0.495023			12.994087	−0.550687	13.097120	−0.586120
12.977833	−0.520299	13.010091	−0.508916	13.032274	−0.518685			13.014311	−0.562563	13.121373	−0.593954
12.992008	−0.538066	13.016185	−0.526721	13.042402	−0.536410			13.044626	−0.572424	13.145587	−0.587968
13.008191	−0.551872	13.026303	−0.542536	13.072665	−0.544221			13.082981	−0.568348	13.165742	−0.574096
13.030407	−0.557749	13.038425	−0.554386	13.104918	−0.542165			13.117275	−0.556330	13.187932	−0.566140
13.058662	−0.557676	13.052568	−0.568210	13.133126	−0.536175			13.139470	−0.550307	13.220229	−0.562108
13.084903	−0.559586	13.064669	−0.572139	13.163347	−0.528207			13.163669	−0.538316	13.250522	−0.564004
13.105112	−0.569425	13.082809	−0.574072	13.177448	−0.524225			13.204042	−0.534234	13.288892	−0.565879
13.137426	−0.577254	13.102955	−0.572039	13.195588	−0.522206			13.234357	−0.544095	13.321210	−0.569744
13.163640	−0.569273	13.125104	−0.566041	13.215781	−0.533988			13.254555	−0.546031	13.347444	−0.563753
13.191857	−0.555351	13.141219	−0.564019	13.235963	−0.541825					13.383753	−0.549838
13.224139	−0.551311	13.165389	−0.559996	13.260167	−0.545707						
13.256444	−0.557162	13.191579	−0.557947	13.282344	−0.545650						
13.290765	−0.561029	13.221794	−0.553908								
13.319020	−0.560956	13.254029	−0.551844								
13.351294	−0.554937	13.274174	−0.549811								
		13.286266	−0.549780								



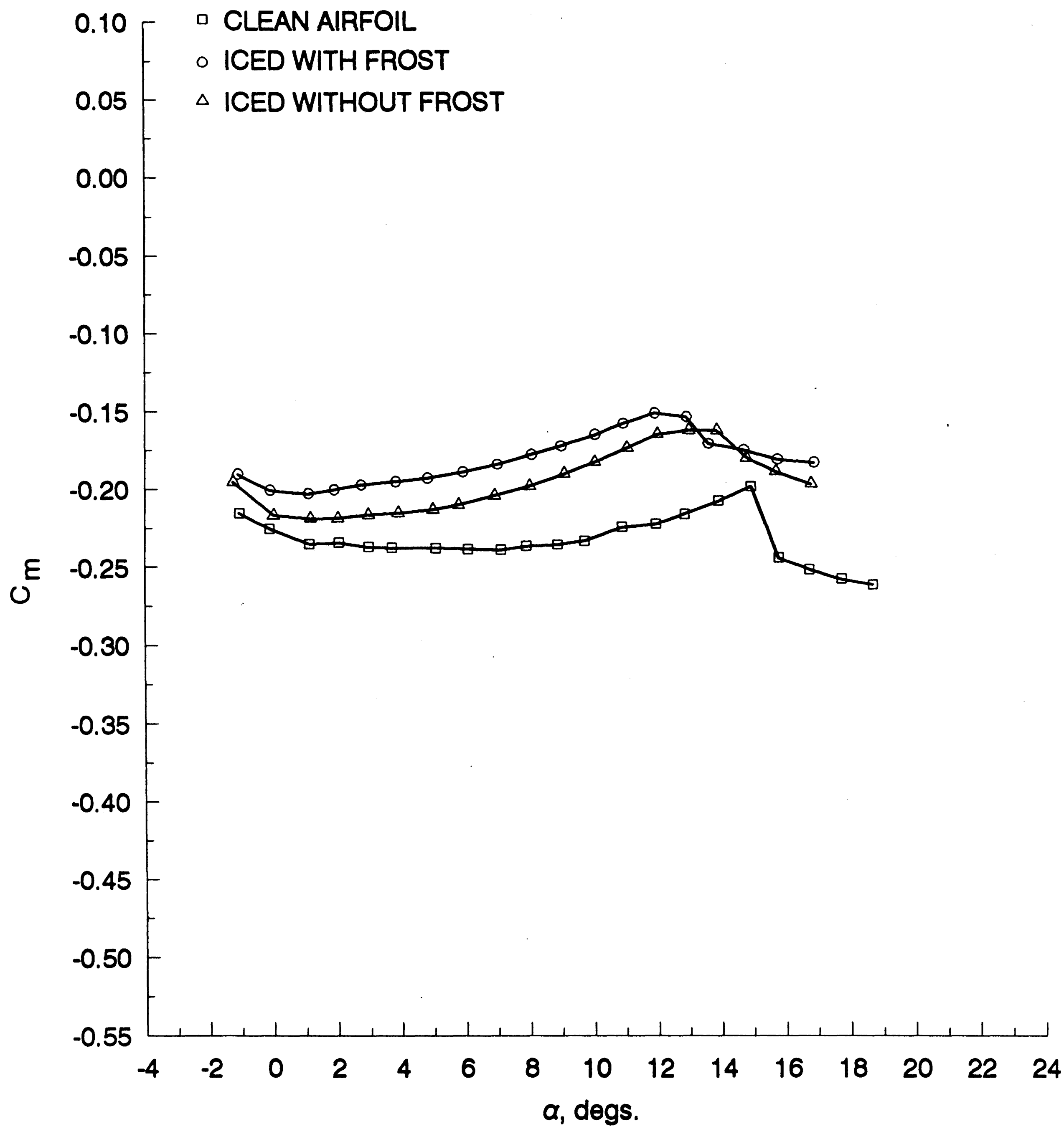
(A) C_l VERSUS α

FIGURE 37 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 14.



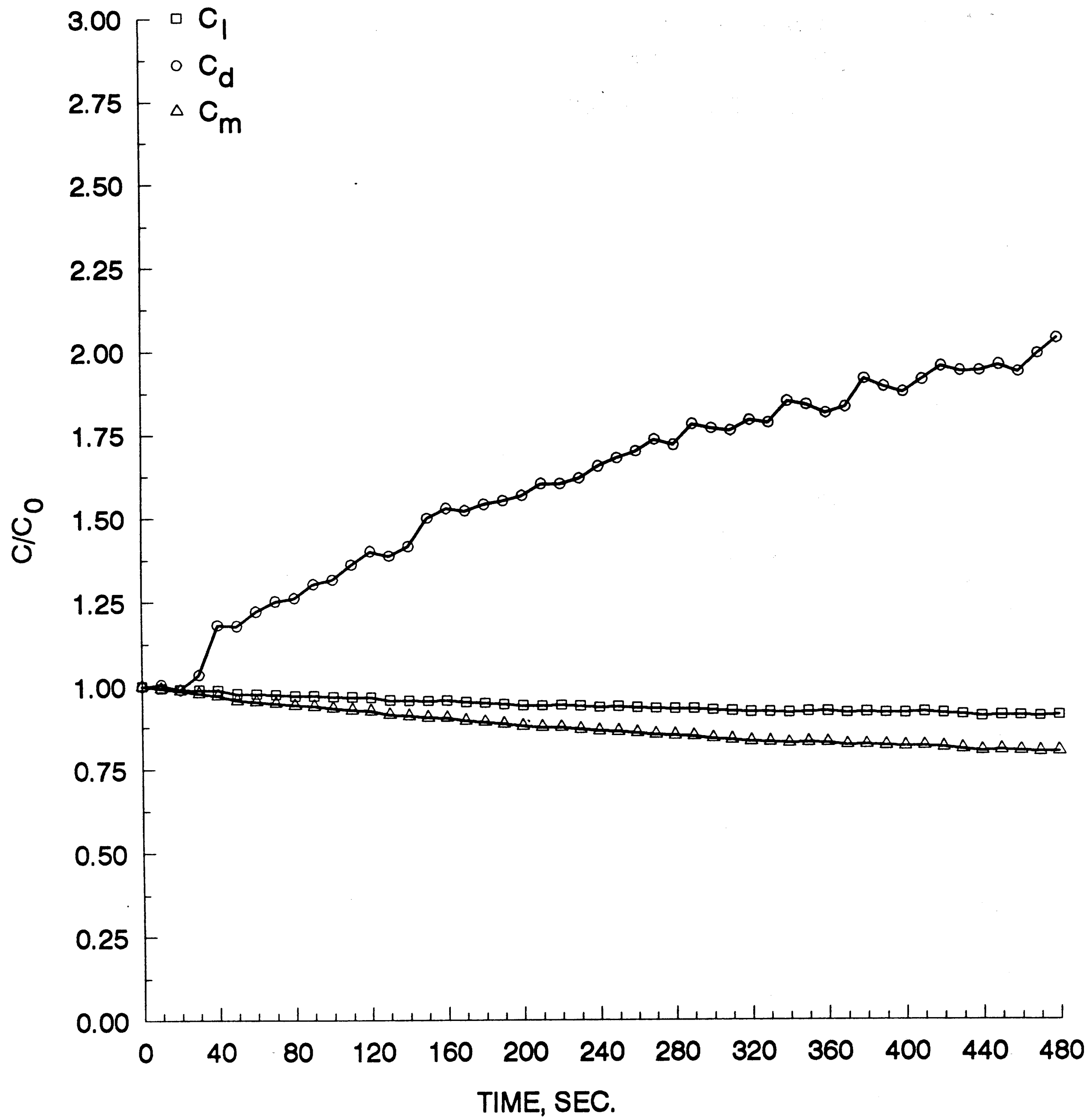
(B) C_d VERSUS α

FIGURE 37 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 14 (con't).



(C) C_m VERSUS α

FIGURE 37 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 14 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 37 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 14 (con't).

TABLE 62 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 14.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0614	0.5300	0.0417	−0.2152
−0.1236	0.7026	0.0348	−0.2254
1.1138	0.9371	0.0242	−0.2350
2.0407	1.0597	0.0236	−0.2341
2.9615	1.2005	0.0247	−0.2369
3.6951	1.3029	0.0255	−0.2375
5.0813	1.4961	0.0280	−0.2378
6.0842	1.6375	0.0302	−0.2385
7.1007	1.7828	0.0332	−0.2390
7.8945	1.8786	0.0358	−0.2365
8.8743	2.0122	0.0391	−0.2356
9.7030	2.1131	0.0438	−0.2332
10.8920	2.2166	0.0525	−0.2244
11.9468	2.3605	0.0621	−0.2223
12.8584	2.4441	0.0688	−0.2159
13.9103	2.5237	0.0784	−0.2075
14.9360	2.5788	0.0903	−0.1980
15.7987	1.8982	0.2342	−0.2438
16.7396	1.7775	0.2724	−0.2512
17.7307	1.7005	0.2973	−0.2572
18.7026	1.6535	0.3092	−0.2609

(B) ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.1022	0.4348	0.0616	−0.1901
−0.1036	0.6163	0.0542	−0.2005
1.0799	0.8110	0.0506	−0.2025
1.8932	0.9316	0.0495	−0.2000
2.7259	1.0596	0.0490	−0.1969
3.8204	1.2207	0.0499	−0.1949
4.8204	1.3557	0.0544	−0.1928
5.9224	1.4930	0.0609	−0.1889
6.9979	1.6210	0.0677	−0.1840
8.0654	1.7351	0.0759	−0.1777
8.9888	1.8318	0.0851	−0.1722
10.0456	1.9286	0.0948	−0.1648
10.9277	1.9948	0.1061	−0.1577
11.9136	2.0563	0.1220	−0.1510
12.9143	2.0397	0.1365	−0.1533
13.6100	1.9756	0.1782	−0.1705
14.7160	1.9476	0.2121	−0.1746
15.7560	1.9266	0.2528	−0.1805
16.8908	1.8962	0.2836	−0.1825

(C). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
−1.2433	0.4461	0.0509	−0.1952
0.0060	0.6965	0.0408	−0.2166
1.1540	0.8873	0.0379	−0.2186
2.0106	1.0277	0.0374	−0.2185
2.9538	1.1775	0.0370	−0.2164
3.9003	1.3124	0.0384	−0.2153
4.9893	1.4628	0.0435	−0.2131
5.7877	1.5648	0.0476	−0.2100
6.9051	1.6959	0.0561	−0.2041
8.0050	1.8238	0.0641	−0.1980
9.0793	1.9288	0.0732	−0.1901
10.0299	2.0164	0.0852	−0.1825
11.0522	2.0940	0.0984	−0.1736
12.0008	2.1179	0.1158	−0.1646
12.9993	2.1122	0.1453	−0.1619
13.8730	2.0606	0.1758	−0.1619
14.7985	1.9912	0.2154	−0.1795
15.7087	1.9373	0.2477	−0.1884
16.8025	1.8885	0.2826	−0.1963

TABLE 63 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 14.

TIME SEC.	C_l/C_{l_0}	C_d/C_{d_0}	C_m/C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9944	1.0053	0.9931
20	0.9902	0.9894	0.9867
30	0.9886	1.0351	0.9784
40	0.9878	1.1818	0.9717
50	0.9769	1.1795	0.9576
60	0.9762	1.2224	0.9534
70	0.9749	1.2524	0.9491
80	0.9711	1.2622	0.9423
90	0.9711	1.3036	0.9394
100	0.9682	1.3166	0.9333
110	0.9668	1.3611	0.9282
120	0.9660	1.4015	0.9250
130	0.9573	1.3879	0.9140
140	0.9560	1.4159	0.9098
150	0.9547	1.5006	0.9051
160	0.9562	1.5299	0.9037
170	0.9508	1.5226	0.8949
180	0.9482	1.5410	0.8902
190	0.9444	1.5521	0.8848
200	0.9407	1.5672	0.8784
210	0.9402	1.6021	0.8746
220	0.9417	1.6018	0.8741
230	0.9390	1.6187	0.8683
240	0.9351	1.6539	0.8634
250	0.9373	1.6786	0.8617
260	0.9342	1.6996	0.8575
270	0.9314	1.7348	0.8525
280	0.9309	1.7183	0.8500
290	0.9306	1.7814	0.8473
300	0.9267	1.7691	0.8410
310	0.9239	1.7619	0.8368
320	0.9210	1.7936	0.8321
330	0.9206	1.7859	0.8301
340	0.9190	1.8508	0.8263
350	0.9221	1.8401	0.8284
360	0.9228	1.8151	0.8274
370	0.9183	1.8332	0.8207
380	0.9204	1.9185	0.8212
390	0.9186	1.8957	0.8184
400	0.9179	1.8791	0.8169
410	0.9206	1.9158	0.8176
420	0.9171	1.9560	0.8137
430	0.9134	1.9423	0.8083
440	0.9077	1.9432	0.8028
450	0.9107	1.9605	0.8052
460	0.9101	1.9396	0.8027
470	0.9085	1.9947	0.7999
480	0.9119	2.0407	0.8016

TABLE 64 - TEST CONDITIONS FOR RUN NUMBER 14.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 14	Configuration 5° Flap	Date 05-04-88	
P_{air} 80 psig	ΔP_w 66 psid	T_{avg} -10° F	V_∞ 100 mph
Spray Duration 8 min	Ice Accretion Type Rime	A.O.A. 5°	
LWC 0.9 g/m³	MVD 14 μm		

Remarks

- Frost on entire lower surface except in region behind slat and in front of main wing leading edge. The frost was quite heavy. Frost also appeared on the upper surface of the trailing edge flaps.
- Ice accretion on leading edge of Slat approximately 5/16" thick.
- The ice was uniform across the span.
- Ice shape tracing for Flap 2, Section C_2 not available.

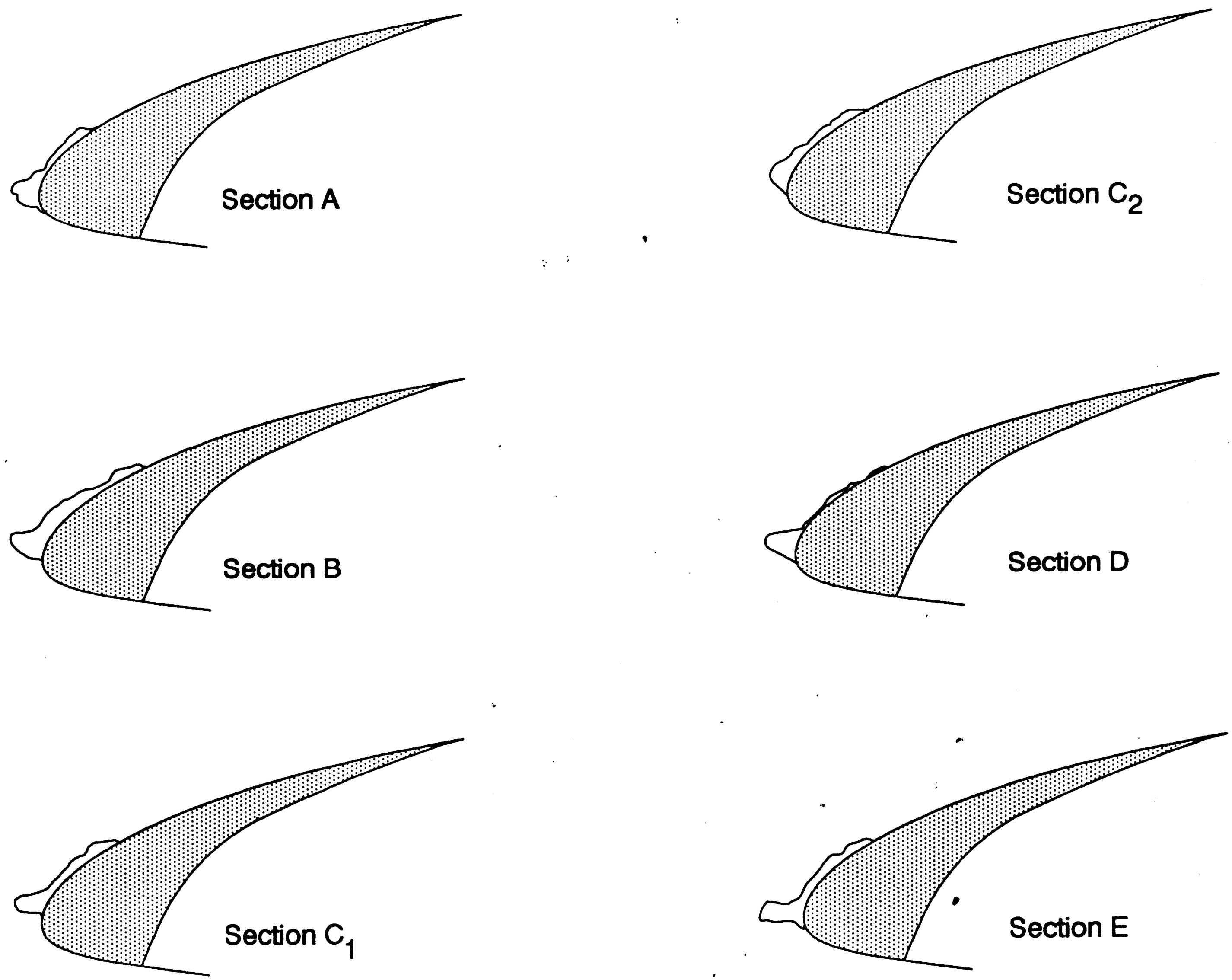


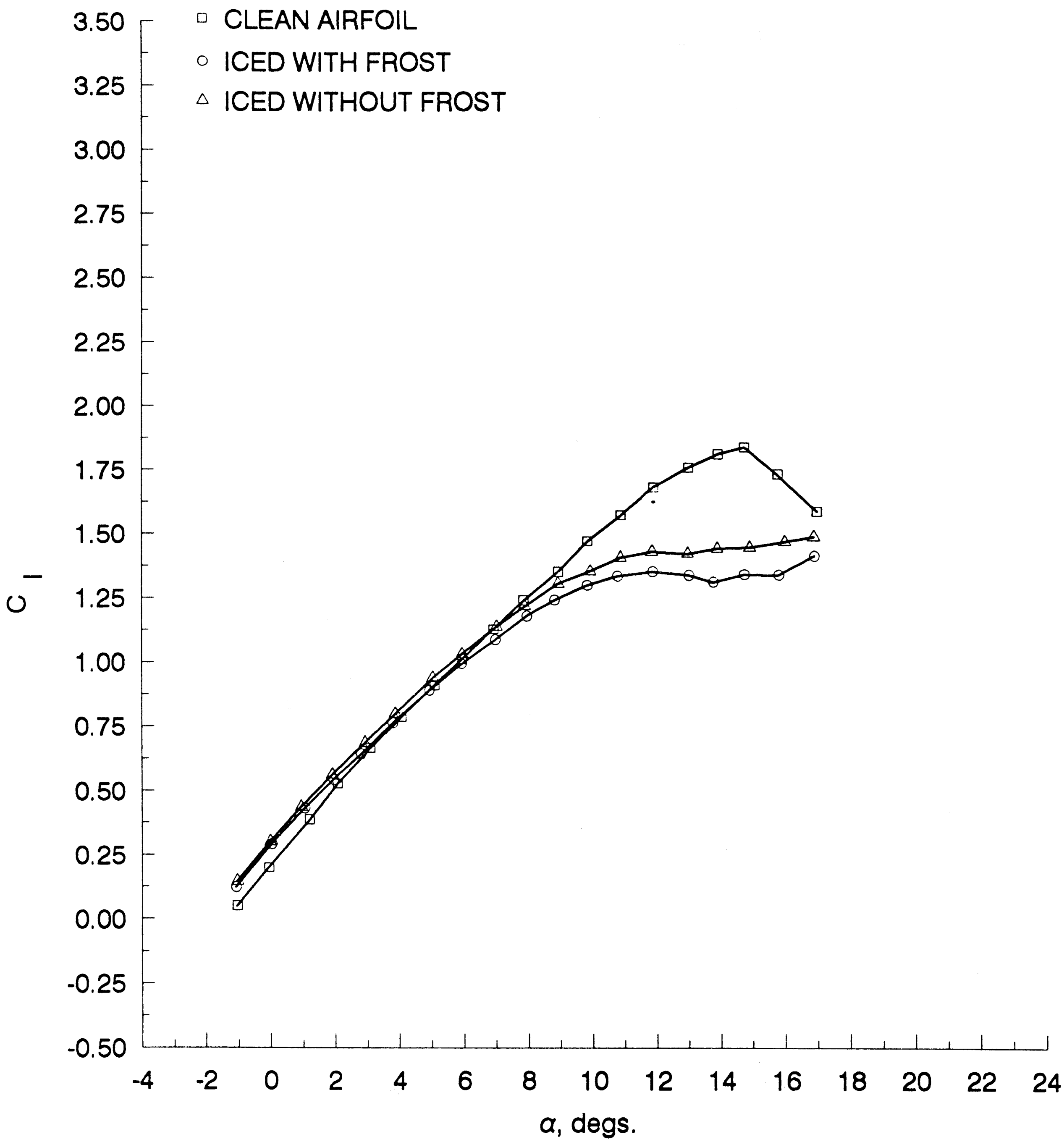
FIGURE 38 - RUN 15 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTION A - E.

TABLE 65 - RUN 15 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.365782	0.409313	0.615334	0.557596	0.469242	0.478681	0.491120	0.484597	0.559828	0.518579	0.400815	0.459893
0.349739	0.411263	0.597146	0.559560	0.441300	0.490543	0.467101	0.484533	0.531549	0.524510	0.380669	0.463825
0.337716	0.409239	0.582978	0.569583	0.409413	0.486480	0.433074	0.484442	0.515403	0.522466	0.356519	0.459777
0.319690	0.403216	0.566817	0.569540	0.369556	0.480407	0.397046	0.484347	0.491210	0.510390	0.320314	0.445737
0.297655	0.397182	0.546625	0.565463	0.339658	0.478338	0.371025	0.484278	0.469030	0.500322	0.298187	0.437711
0.279597	0.403110	0.538560	0.559405	0.315735	0.478275	0.345037	0.472176	0.450909	0.482256	0.278063	0.433674
0.257529	0.409028	0.516360	0.551298	0.293847	0.462301	0.323056	0.458080	0.436809	0.470208	0.261987	0.421680
0.231490	0.400991	0.482032	0.545171	0.277941	0.446344	0.309088	0.442000	0.420712	0.450146	0.247941	0.403715
0.205493	0.377019	0.459821	0.541089	0.270030	0.422450	0.285101	0.429905	0.402570	0.440089	0.239936	0.385765
0.171488	0.349043	0.433585	0.530959	0.260094	0.410488	0.267113	0.419830	0.376347	0.432012	0.227881	0.375773
0.151521	0.319111	0.417472	0.512807	0.256133	0.400530	0.259139	0.407777	0.352132	0.427944	0.203731	0.371725
0.133527	0.301136	0.405404	0.492654	0.234214	0.396493	0.257169	0.395740	0.327917	0.423877	0.181588	0.369675
0.107529	0.277164	0.395351	0.474519	0.208323	0.386478	0.237164	0.391676	0.309802	0.403809	0.155440	0.359646
0.089541	0.257197	0.379221	0.462403	0.188419	0.374489	0.213177	0.379580	0.293683	0.391755	0.141393	0.341681
0.071552	0.237230	0.355017	0.448255	0.170519	0.358527	0.189211	0.359462	0.271498	0.383689	0.119304	0.319710
0.051579	0.209291	0.326756	0.440132	0.156627	0.334617	0.171239	0.343372	0.253350	0.375633	0.097252	0.283795
0.041636	0.179385	0.302540	0.430008	0.140721	0.318660	0.153278	0.323270	0.233200	0.361566	0.073160	0.257835
0.035664	0.163434	0.270227	0.425898	0.120838	0.298713	0.131324	0.299147	0.213033	0.353505	0.055097	0.235875
0.015639	0.155413	0.241960	0.419787	0.094990	0.272782	0.119357	0.283073	0.192899	0.333433	0.035017	0.215902
−0.002393	0.151382	0.223795	0.413703	0.069142	0.246852	0.089365	0.270961	0.174815	0.301354	0.020965	0.199928
−0.026438	0.147335	0.209681	0.403605	0.051252	0.226911	0.069365	0.264892	0.156699	0.281287	0.004921	0.175981
−0.040428	0.131362	0.189521	0.387455	0.039343	0.206985	0.045373	0.254801	0.136559	0.263216	−0.005082	0.152050
−0.048405	0.115406	0.159261	0.371279	0.017435	0.198970	0.031404	0.238721	0.116430	0.241141	−0.019112	0.128109
−0.068414	0.101409	0.126965	0.361133	−0.010449	0.188949	0.023440	0.222657	0.092259	0.221058	−0.033158	0.110143
−0.094459	0.095365	0.110835	0.349017	−0.064234	0.172891	0.007470	0.206572	0.072124	0.200985	−0.055285	0.102117
−0.132527	0.087296	0.098746	0.336913	−0.094127	0.168834	−0.018508	0.190460	0.060033	0.192946	−0.073390	0.096093
−0.150531	0.073305	0.084632	0.326815	−0.122027	0.164781	−0.048489	0.174338	0.049976	0.178905	−0.091474	0.082101
−0.162517	0.057339	0.058406	0.312661	−0.145919	0.152781	−0.074478	0.162236	0.037911	0.160856	−0.131743	0.081995
−0.166463	0.033425	0.038252	0.294499	−0.161830	0.138813	−0.086445	0.146162	0.023796	0.154813	−0.176060	0.089848
−0.160411	0.019497	0.022134	0.278360	−0.163787	0.124882	−0.098412	0.130087	0.005632	0.152763	−0.200232	0.093768
−0.130320	0.011608	0.010066	0.258207	−0.161756	0.110962	−0.102367	0.112029	−0.014556	0.152711	−0.220367	0.093716
−0.130261	−0.010303	−0.010055	0.227972	−0.149747	0.093089	−0.106328	0.095975	−0.056924	0.142589	−0.236432	0.077737
−0.126210	−0.026228	−0.020108	0.209837	−0.137749	0.079196	−0.102288	0.081948	−0.091233	0.138495	−0.250473	0.057779

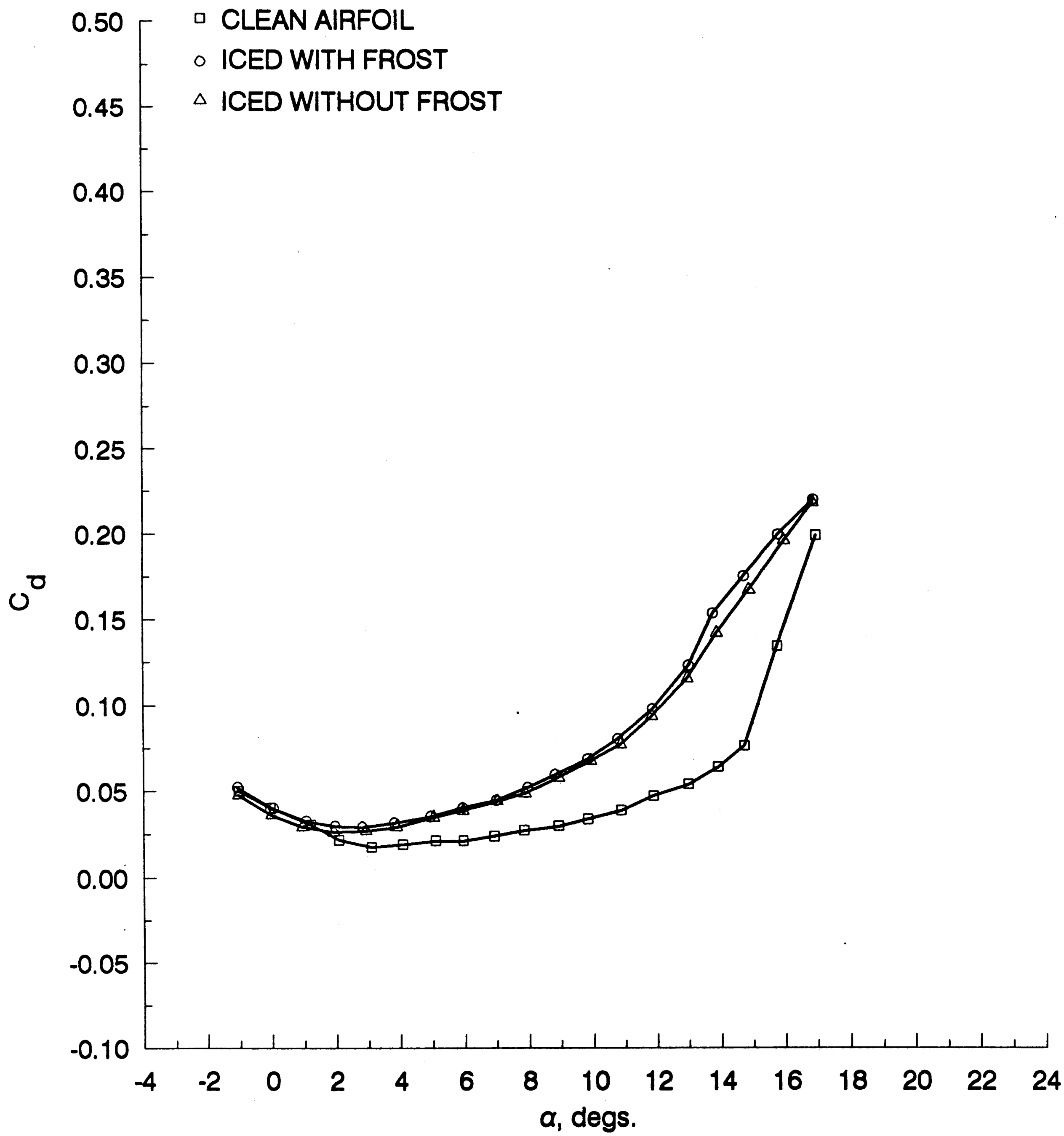
TABLE 65 - RUN 15 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.088052	−0.052023	−0.044303	0.191664	−0.119785	0.071285	−0.096251	0.069932	−0.115453	0.136430	−0.260465	0.029864
−0.053951	−0.059901	−0.064478	0.181550	−0.099839	0.067359	−0.088202	0.053911	−0.145719	0.130344	−0.266431	0.001959
−0.033899	−0.061840	−0.088704	0.175450	−0.073917	0.065439	−0.074165	0.043921	−0.163862	0.120286	−0.260343	−0.015953
−0.011847	−0.061782	−0.121006	0.167317	−0.044007	0.063528	−0.060111	0.027915	−0.177945	0.102231	−0.246254	−0.013924
0.008268	−0.087623	−0.149294	0.169254	−0.022083	0.065576	−0.044067	0.015926	−0.181934	0.084203	−0.222098	−0.011868
0.038370	−0.099496	−0.167465	0.165182	−0.004130	0.061644	−0.028017	0.001931	−0.175803	0.056192	−0.199934	−0.017787
		−0.187651	0.159093			−0.013969	−0.012069	−0.155573	0.040229	−0.169716	−0.023683
		−0.193674	0.144992			0.002076	−0.024059	−0.127277	0.028292	−0.145560	−0.021628
		−0.193632	0.128895					−0.107057	0.016333	−0.111336	−0.019546
		−0.189532	0.106773					−0.072694	0.000408	−0.079126	−0.017469
		−0.177363	0.088696					−0.048426	−0.015544	−0.054943	−0.025374
		−0.161158	0.072642					−0.026198	−0.023493	−0.028709	−0.047219
		−0.138888	0.054592					−0.007986	−0.039461	−0.010551	−0.061115
		−0.110551	0.034545					0.014242	−0.047411	0.001551	−0.069052
		−0.086272	0.020526								
		−0.055947	0.012557								
		−0.019573	0.008629								



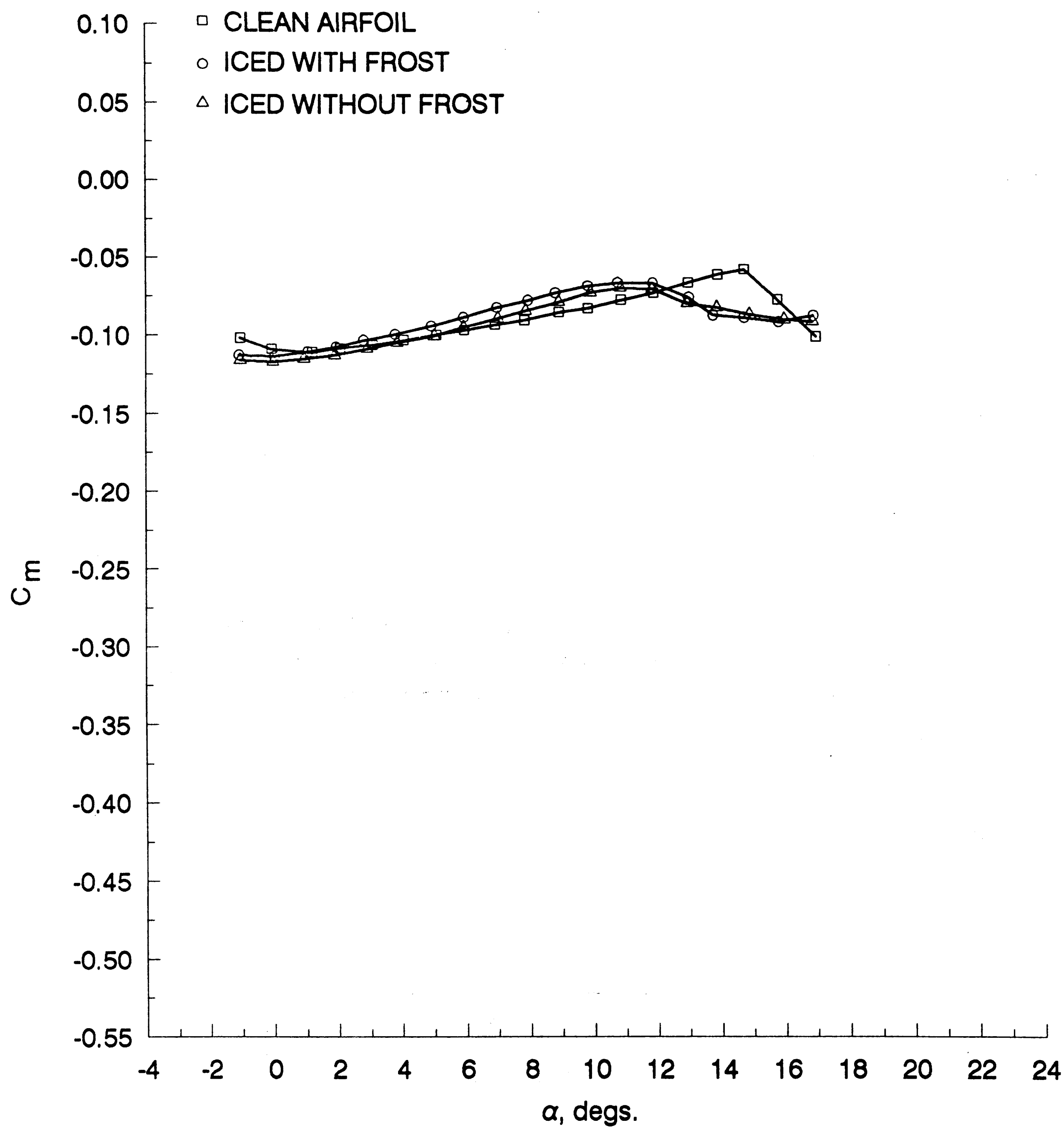
(A) C_l VERSUS α

FIGURE 39 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 15.



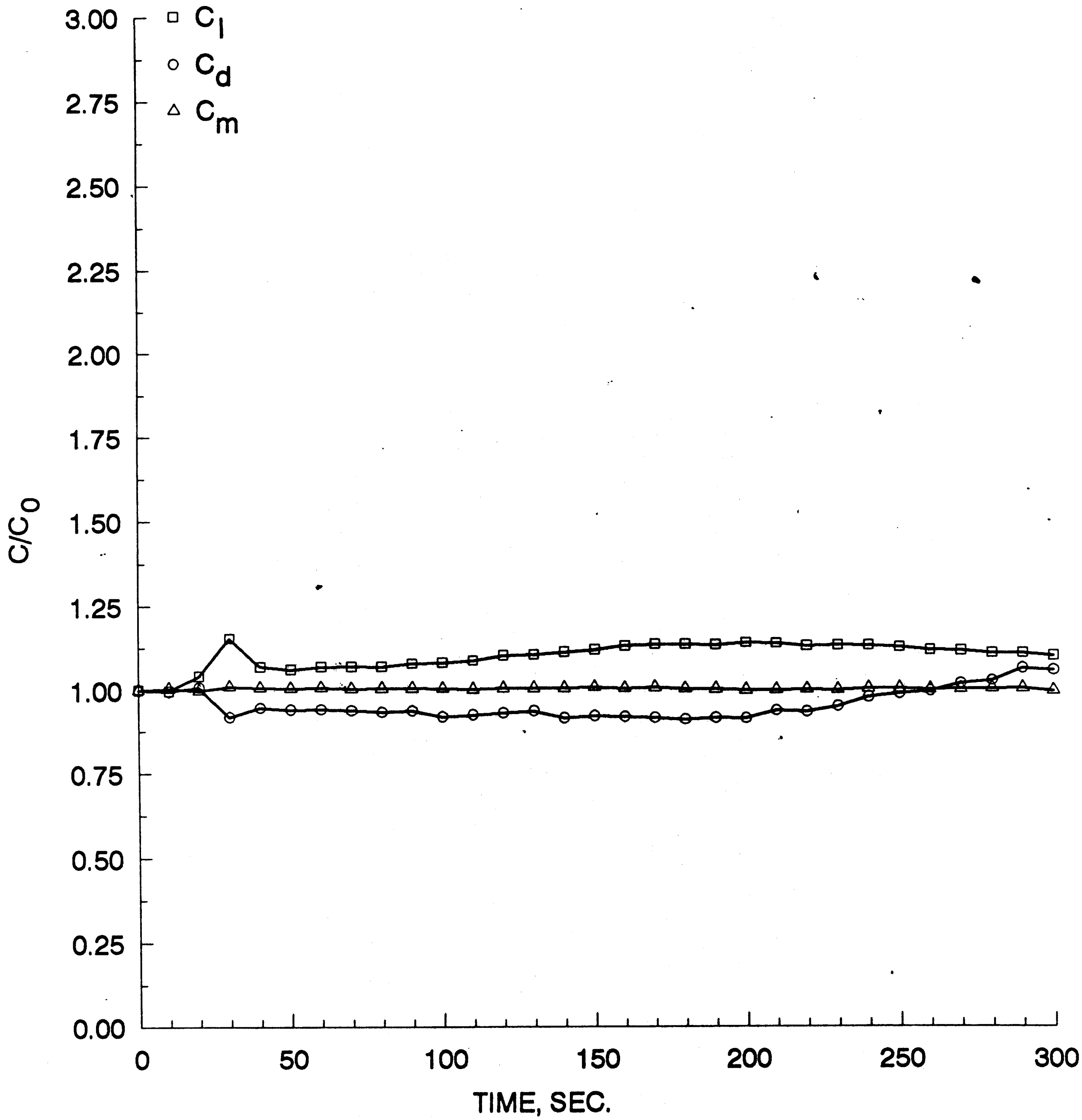
(B) C_d VERSUS α

FIGURE 39 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 15 (con't).



(C) C_m VERSUS α

FIGURE 39 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 15 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 39 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 15 (con't).

TABLE 66 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 15.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0428	0.0505	0.0503	−0.1018
−0.0673	0.2006	0.0404	−0.1088
1.1940	0.3877	0.0307	−0.1109
2.0687	0.5286	0.0217	−0.1083
3.0958	0.6669	0.0178	−0.1062
4.0676	0.7870	0.0193	−0.1032
5.0847	0.9116	0.0214	−0.1001
5.9550	1.0126	0.0214	−0.0970
6.9221	1.1277	0.0241	−0.0937
7.8462	1.2403	0.0274	−0.0906
8.9252	1.3516	0.0299	−0.0856
9.8322	1.4706	0.0338	−0.0830
10.8715	1.5725	0.0388	−0.0777
11.8892	1.6817	0.0472	−0.0731
12.9877	1.7597	0.0539	−0.0665
13.9101	1.8129	0.0640	−0.0612
14.7358	1.8409	0.0765	−0.0579
15.7684	1.7343	0.1345	−0.0771
16.9663	1.5883	0.1993	−0.1008

(B) ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.0755	0.1234	0.0524	−0.1128
0.0323	0.2923	0.0401	−0.1134
1.0530	0.4324	0.0327	−0.1108
1.9446	0.5446	0.0297	−0.1075
2.8025	0.6436	0.0293	−0.1033
3.8021	0.7644	0.0318	−0.0996
4.9341	0.8911	0.0353	−0.0944
5.9353	0.9949	0.0404	−0.0889
6.9790	1.0873	0.0446	−0.0826
7.9551	1.1791	0.0521	−0.0780
8.8114	1.2421	0.0596	−0.0732
9.8291	1.2993	0.0687	−0.0687
10.7679	1.3347	0.0803	−0.0666
11.8674	1.3525	0.0978	−0.0668
13.0031	1.3386	0.1232	−0.0759
13.7666	1.3127	0.1536	−0.0873
14.7325	1.3413	0.1754	−0.0887
15.8068	1.3400	0.1997	−0.0914
16.8895	1.4143	0.2202	−0.0875

(C). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
−1.0424	0.1466	0.0477	−0.1160
−0.0226	0.3021	0.0362	−0.1169
0.9411	0.4370	0.0295	−0.1151
1.9009	0.5633	0.0263	−0.1127
2.9144	0.6873	0.0271	−0.1088
3.8697	0.7995	0.0294	−0.1049
5.0282	0.9392	0.0349	−0.1006
5.9449	1.0309	0.0385	−0.0952
7.0088	1.1383	0.0442	−0.0896
7.8830	1.2169	0.0487	−0.0847
8.9155	1.3048	0.0579	−0.0790
9.9134	1.3528	0.0677	−0.0729
10.8574	1.4062	0.0772	−0.0700
11.8451	1.4305	0.0936	−0.0707
12.9577	1.4223	0.1157	−0.0798
13.8852	1.4427	0.1422	−0.0823
14.8976	1.4472	0.1674	−0.0868
15.9907	1.4692	0.1962	−0.0899
16.8668	1.4895	0.2185	−0.0912

TABLE 67 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 15.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9970	0.9955	1.0040
20	1.0412	1.0074	0.9977
30	1.1541	0.9189	1.0093
40	1.0698	0.9462	1.0067
50	1.0606	0.9407	1.0049
60	1.0688	0.9416	1.0060
70	1.0698	0.9381	1.0032
80	1.0688	0.9331	1.0037
90	1.0781	0.9371	1.0039
100	1.0803	0.9191	1.0030
110	1.0864	0.9244	1.0004
120	1.1023	0.9302	1.0037
130	1.1047	0.9360	1.0035
140	1.1119	0.9146	1.0035
150	1.1188	0.9208	1.0061
160	1.1301	0.9180	1.0028
170	1.1350	0.9151	1.0057
180	1.1351	0.9099	1.0014
190	1.1334	0.9145	1.0007
200	1.1394	0.9133	0.9971
210	1.1375	0.9364	0.9984
220	1.1298	0.9329	0.9998
230	1.1323	0.9491	0.9978
240	1.1321	0.9771	1.0025
250	1.1262	0.9870	1.0019
260	1.1174	0.9949	0.9990
270	1.1159	1.0175	1.0007
280	1.1082	1.0253	1.0013
290	1.1078	1.0623	1.0019
300	1.1003	1.0571	0.9947

TABLE 68 - TEST CONDITIONS FOR RUN NUMBER 15.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 15	Configuration 1° Flap	Date 05-05-88	
P_{air} 80 psig	ΔP_W 72.5 psid	T_{avg} 25° F	V_∞ 100 mph
Spray Duration 5 min	Ice Accretion Type Mixed	A.O.A. 5°	
LWC 0.92 g/m³	MVD 14.4 μm		

Remarks

- Light frost on lower surface.
- Region near center was clear bounded by opaque regions. Very granular appearance. Seemed to be less ice near section A.
- The opaque regions were actually mixed and not the milky white rime ice seen at lower temperatures.
- Ice accretion on leading edge of Slat approximately 3/16" thick.
- Ice accretion on leading edge of Flap 2 < 1/16" thick, too small to trace.

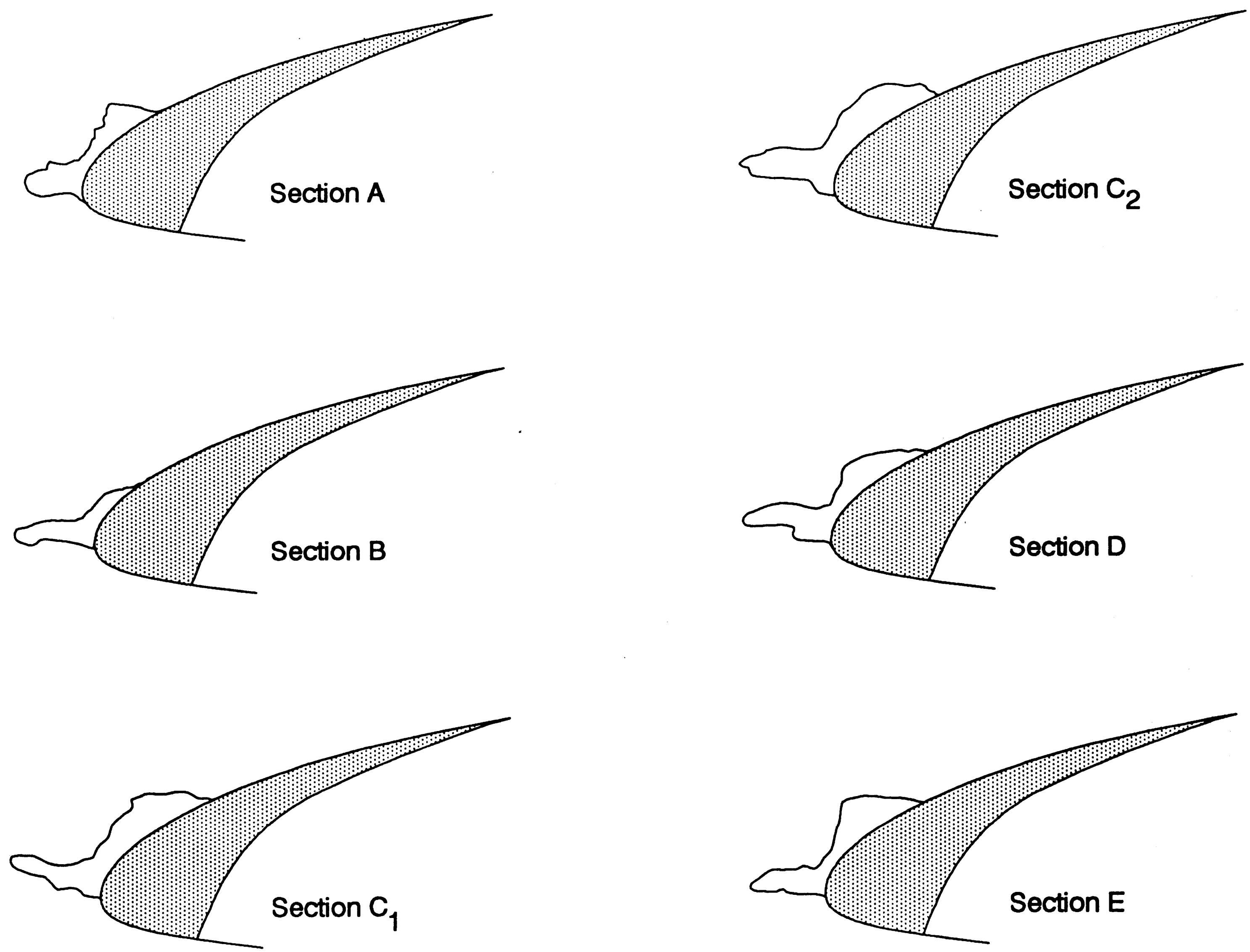


FIGURE 40 - RUN 16 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 69 - RUN 16 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E.

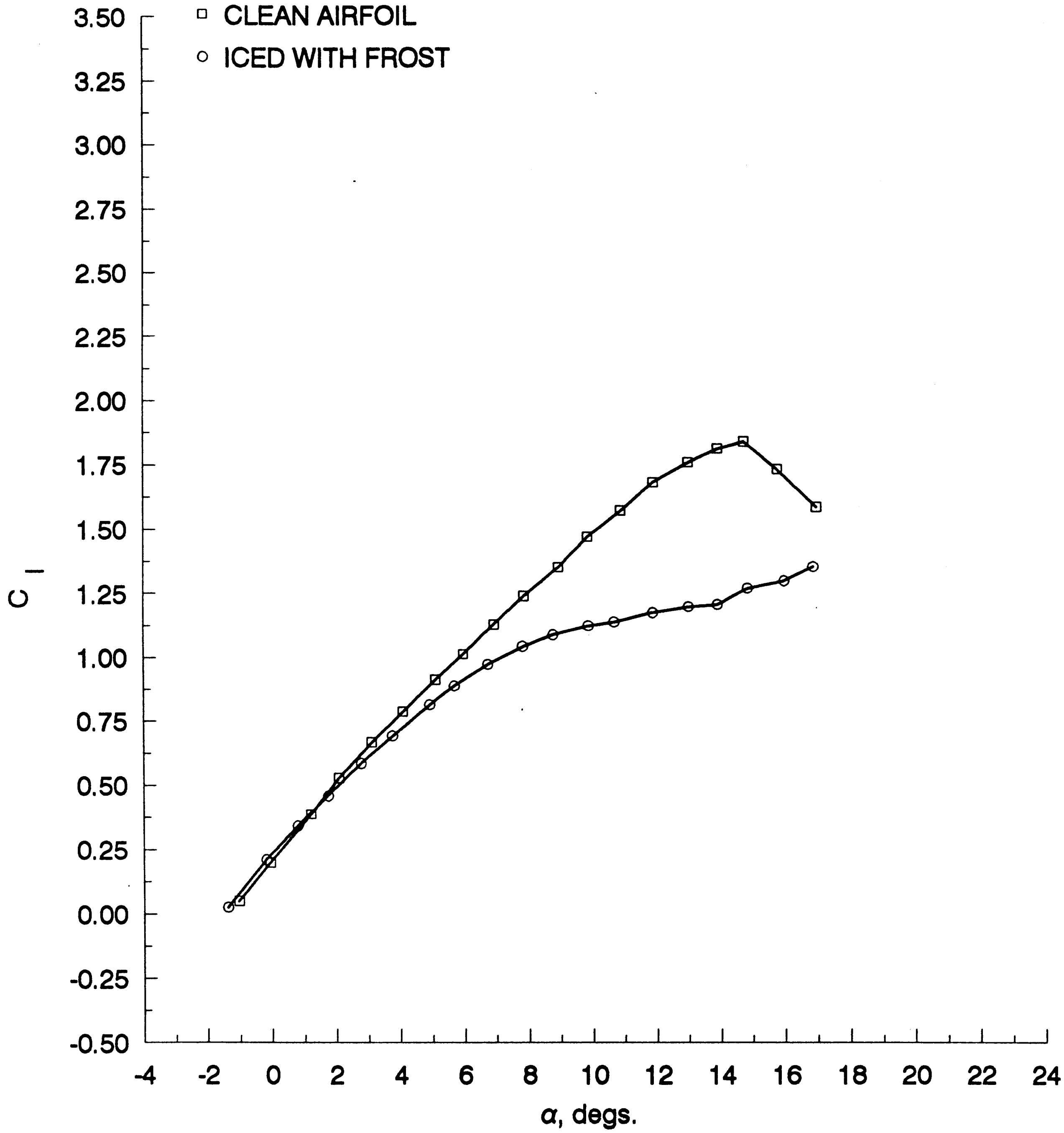
SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.478302	0.489990	0.374936	0.418200	0.687455	0.586875	0.629456	0.560918	0.583769	0.542469	0.628174	0.550373
0.452334	0.485948	0.360767	0.414195	0.667281	0.596762	0.607180	0.580740	0.559592	0.548387	0.601971	0.548319
0.420350	0.489838	0.346599	0.410190	0.651163	0.596720	0.586967	0.584664	0.537435	0.552316	0.575757	0.550236
0.386352	0.499681	0.328395	0.400222	0.622956	0.596646	0.566722	0.600516	0.517290	0.556252	0.557602	0.554161
0.356340	0.513509	0.320330	0.386313	0.608847	0.598597	0.556584	0.614406	0.503202	0.554221	0.537425	0.560066
0.314359	0.519359	0.302127	0.376345	0.588684	0.604508	0.542410	0.626297	0.473033	0.542178	0.513217	0.565961
0.280371	0.525229	0.285932	0.372334	0.568499	0.618372	0.522198	0.630220	0.452889	0.546113	0.489008	0.571856
0.242398	0.527116	0.269738	0.368325	0.544290	0.630237	0.479796	0.622158	0.426699	0.552026	0.446660	0.575718
0.208416	0.531000	0.257606	0.360356	0.522107	0.638131	0.449503	0.618102	0.382411	0.549915	0.410377	0.573637
0.186423	0.534916	0.241423	0.352378	0.491885	0.638052	0.429302	0.618050	0.348199	0.543844	0.366019	0.575507
0.166451	0.530889	0.221172	0.350342	0.467713	0.636001	0.409083	0.623961	0.316001	0.537778	0.333751	0.579395
0.148540	0.503028	0.204973	0.348315	0.435494	0.629952	0.384825	0.629862	0.281785	0.533700	0.303499	0.583288
0.148598	0.481174	0.188779	0.344305	0.407303	0.623914	0.356537	0.631776	0.245560	0.527623	0.279302	0.585211
0.144649	0.463283	0.176647	0.336337	0.379091	0.625829	0.338356	0.631729	0.221415	0.521577	0.247039	0.587113
0.132691	0.451331	0.158422	0.334306	0.348870	0.625750	0.312093	0.631660	0.191236	0.513522	0.222852	0.585064
0.128747	0.431454	0.132094	0.332253	0.320658	0.627664	0.289887	0.625638	0.161073	0.499485	0.192633	0.577041
0.134795	0.411603	0.109828	0.326243	0.292452	0.627590	0.267681	0.619616	0.124875	0.483439	0.166440	0.571014
0.132839	0.395704	0.091614	0.320244	0.276339	0.625560	0.233380	0.603622	0.100757	0.467424	0.146291	0.566989
0.110884	0.385712	0.073399	0.314245	0.248170	0.611570	0.201095	0.589621	0.086701	0.453429	0.124135	0.558987
0.096906	0.381701	0.057227	0.302298	0.226029	0.603560	0.178921	0.571671	0.076671	0.439445	0.106023	0.547023
0.074946	0.373697	0.041065	0.286383	0.209927	0.597554	0.162802	0.555724	0.066663	0.417485	0.102033	0.531124
0.073006	0.351838	0.026934	0.268490	0.191810	0.591542	0.144680	0.533808	0.064757	0.377601	0.098049	0.513239
0.073043	0.337931	0.008757	0.248602	0.195909	0.565708	0.118482	0.509883	0.060799	0.351669	0.096098	0.489402
0.073091	0.320050	−0.005379	0.232692	0.195957	0.547817	0.096318	0.487957	0.050780	0.333697	0.092162	0.453643
0.061111	0.316045	−0.023556	0.212804	0.181907	0.527899	0.078169	0.475981	0.036740	0.313720	0.084188	0.419859
0.055143	0.306096	−0.039734	0.202842	0.147715	0.505941	0.049929	0.460003	0.018695	0.285757	0.072162	0.394009
0.047218	0.280248	−0.055891	0.184943	0.121582	0.484005	0.035857	0.434121	0.010716	0.257821	0.062178	0.358234
0.045252	0.268322	−0.074062	0.163071	0.095444	0.464056	0.021791	0.406251	0.004729	0.237865	0.056204	0.330413
0.033304	0.252397	−0.094297	0.155082	0.077360	0.446116	0.009760	0.372423	−0.001274	0.223892	0.050220	0.306565
0.021351	0.238458	−0.116557	0.147088	0.065314	0.430181	−0.014380	0.334587	−0.009311	0.217889	0.044242	0.280731
0.009409	0.220546	−0.146936	0.145025	0.055352	0.388406	−0.030461	0.304724	−0.033456	0.211844	0.036236	0.258863
−0.004548	0.208589	−0.167192	0.144973	0.047368	0.360553	−0.046558	0.280825	−0.051560	0.205814	0.020161	0.238961
−0.012515	0.198634	−0.183397	0.144931	0.029278	0.344601	−0.060641	0.258919	−0.065632	0.197801	0.006092	0.223036

TABLE 69 - RUN 16 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.022469	0.184701	−0.201638	0.148851	0.013198	0.330643	−0.072719	0.242983	−0.093809	0.193740	−0.007978	0.207111
−0.044451	0.184643	−0.213781	0.144852	−0.008922	0.314680	−0.090879	0.234984	−0.128047	0.197638	−0.018021	0.193182
−0.068410	0.176633	−0.223909	0.144825	−0.022961	0.290787	−0.129247	0.228919	−0.158269	0.205534	−0.028048	0.173295
−0.098348	0.162647	−0.254309	0.150699	−0.032976	0.268893	−0.155509	0.228851	−0.190515	0.217413	−0.040123	0.165319
−0.122327	0.162584	−0.288734	0.146641	−0.049019	0.241019	−0.191873	0.228756	−0.218718	0.223321	−0.054197	0.151380
−0.150310	0.164497	−0.315056	0.142604	−0.069146	0.233014	−0.222186	0.232653	−0.246916	0.227235	−0.068294	0.145385
−0.182304	0.172359	−0.347444	0.134584	−0.103380	0.226960	−0.248454	0.234573	−0.285175	0.229128	−0.088465	0.149304
−0.202303	0.178266	−0.365659	0.128585	−0.135579	0.212960	−0.274733	0.240468	−0.313362	0.229054	−0.112679	0.157186
−0.212258	0.164333	−0.385888	0.118612	−0.157720	0.204949	−0.296960	0.242398	−0.371729	0.220925	−0.136882	0.161095
−0.216212	0.148429	−0.410174	0.110612	−0.181881	0.198922	−0.323223	0.242330	−0.403916	0.210871	−0.152995	0.155094
−0.216170	0.132535	−0.434465	0.104597	−0.222160	0.192852	−0.359575	0.238259	−0.440119	0.196818	−0.169096	0.145122
−0.236148	0.130496	−0.462813	0.100555	−0.252381	0.192774	−0.381781	0.232237	−0.488387	0.176752	−0.187230	0.141102
−0.268105	0.124452	−0.479002	0.094560	−0.282618	0.198658	−0.406008	0.226209	−0.504484	0.172722	−0.211428	0.143025
−0.286074	0.118444	−0.493122	0.072699	−0.318905	0.206516	−0.418129	0.226177	−0.522577	0.162704	−0.237637	0.142957
−0.298048	0.112452	−0.491037	0.050879	−0.361274	0.228274	−0.424158	0.214234	−0.536639	0.150703	−0.259802	0.138927
−0.316017	0.106445	−0.480855	0.031065	−0.387503	0.242121	−0.432222	0.208248	−0.544665	0.140713	−0.296097	0.140818
−0.337973	0.096453	−0.460556	0.015245	−0.405657	0.250026	−0.458458	0.198240	−0.546625	0.120768	−0.324327	0.142730
−0.347917	0.078546	−0.430145	0.005404	−0.429850	0.255926	−0.472594	0.196215	−0.538529	0.104838	−0.346482	0.134728
−0.353843	0.052703	−0.403791	−0.002464	−0.454022	0.253875	−0.494805	0.192181	−0.520377	0.092921	−0.376674	0.116775
−0.345775	0.024910	−0.381504	−0.004390	−0.474169	0.253822	−0.517022	0.190135	−0.486139	0.089024	−0.394776	0.100839
−0.335725	0.003083	−0.355208	0.009567	−0.492313	0.257751	−0.535171	0.178159	−0.441850	0.091134	−0.416910	0.084893
−0.315694	−0.014745	−0.343087	0.021503	−0.528573	0.255668	−0.555347	0.168166	−0.399574	0.093239	−0.439049	0.070933
−0.289695	−0.022623	−0.330955	0.029470	−0.550714	0.247658	−0.569461	0.158189	−0.359307	0.093345	−0.457161	0.058969
−0.253698	−0.032462	−0.304633	0.033507	−0.556683	0.219810	−0.581561	0.150205	−0.310991	0.095465	−0.465188	0.045046
−0.207742	−0.030354	−0.268161	0.029634	−0.542510	0.194002	−0.587600	0.142237	−0.278772	0.093556	−0.467172	0.033125
−0.163800	−0.022291	−0.219530	0.023807	−0.524335	0.178146	−0.563315	0.126396	−0.252582	0.087643	−0.448990	0.019269
−0.129844	−0.016242	−0.181033	0.019939	−0.479962	0.160370	−0.541082	0.122478	−0.240491	0.083687	−0.418728	0.011404
−0.101878	−0.012194	−0.146576	0.012092	−0.429540	0.140621	−0.528950	0.118533	−0.230403	0.075737	−0.386471	0.011488
−0.077893	−0.014118	−0.116176	0.006219	−0.383180	0.132791	−0.522836	0.098668	−0.230361	0.059786	−0.354209	0.009587
−0.055890	−0.022007	−0.085770	−0.001638	−0.342863	0.124944	−0.514712	0.082785	−0.236374	0.049800	−0.305824	0.009713
−0.029874	−0.035845	−0.059416	−0.009506	−0.308522	0.091237	−0.506605	0.072866	−0.238334	0.029855	−0.279637	0.017726
−0.011842	−0.053678	−0.031030	−0.019353	−0.278210	0.057520	−0.476281	0.064993	−0.228230	0.015924	−0.255455	0.021761

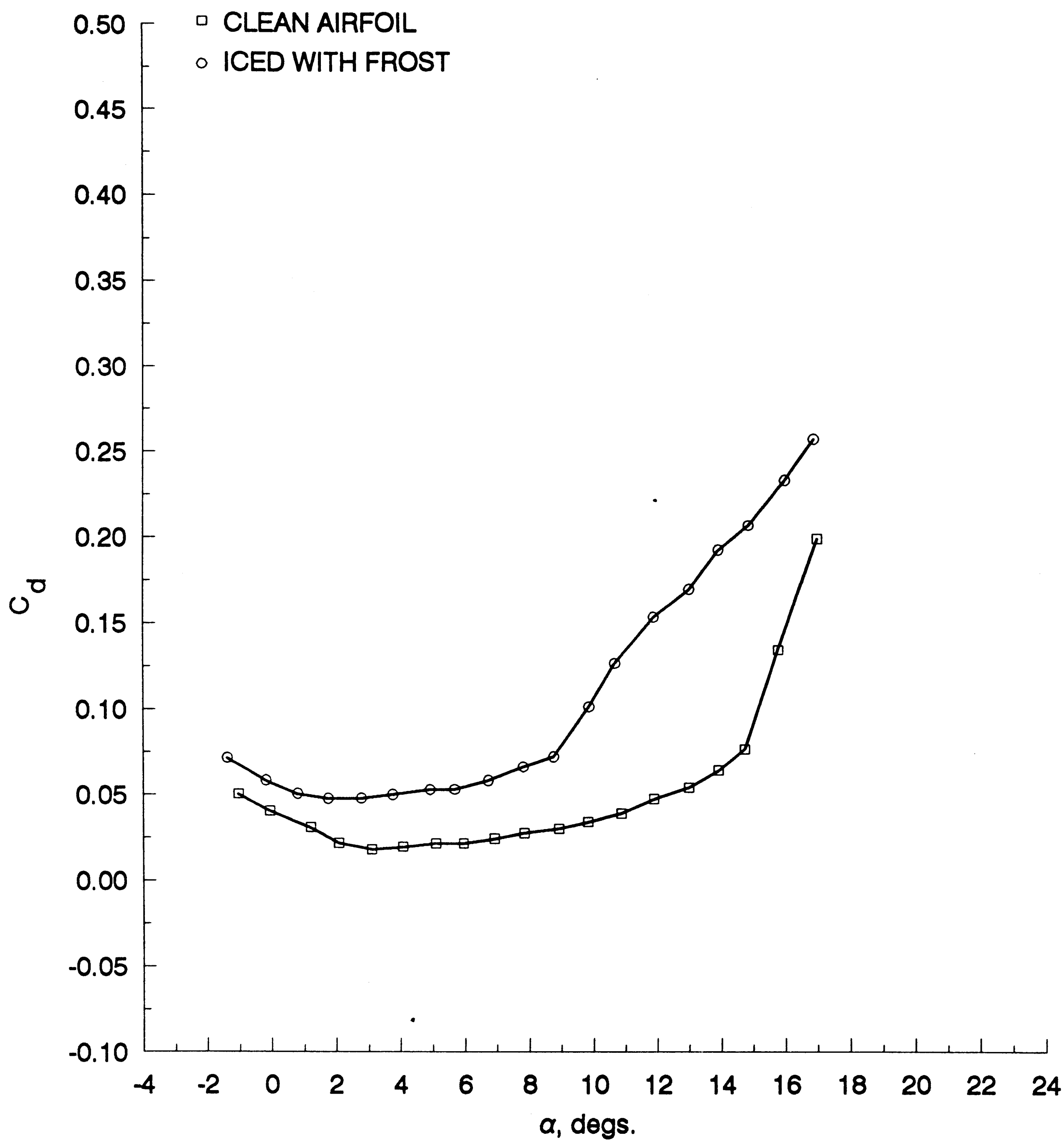
TABLE 69 - RUN 16 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.012186	−0.071496	−0.006701	−0.027226	−0.264085	0.049604	−0.437886	0.061117	−0.208064	0.004013	−0.239278	0.003929
				−0.213732	0.055700	−0.381310	0.057288	−0.181879	0.000094	−0.209022	−0.001950
				−0.187546	0.057757	−0.326760	0.055443	−0.133548	−0.003767	−0.162637	−0.007788
				−0.153284	0.053870	−0.247956	0.049684	−0.097302	−0.005666	−0.108203	−0.007645
				−0.123010	0.034069	−0.195426	0.047833	−0.063074	−0.005576	−0.065866	−0.007535
				−0.104829	0.016225	−0.159052	0.043952	−0.042940	−0.005523	−0.025529	−0.013387
				−0.066517	0.004396	−0.138802	0.026112	−0.030850	−0.009479	−0.007363	−0.021284
				−0.030241	0.000515	−0.122565	−0.001678	−0.012713	−0.015413	0.008792	−0.031172
				0.002006	−0.003376	−0.108370	−0.021522				
						−0.092171	−0.035396				
						−0.057806	−0.043259				
						−0.025462	−0.051127				
						0.002832	−0.055029				



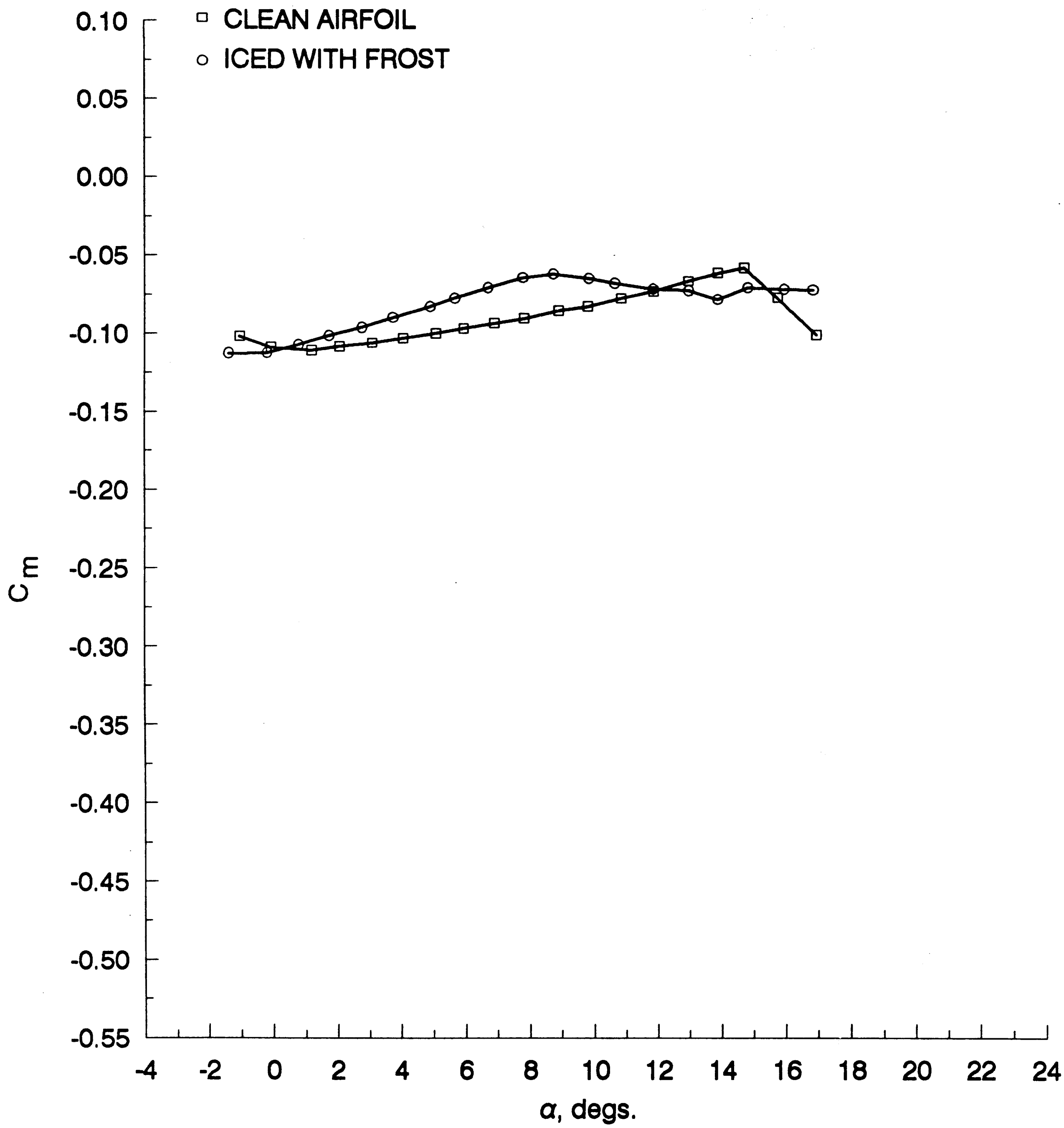
(A) C_l VERSUS α

FIGURE 41 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 16.



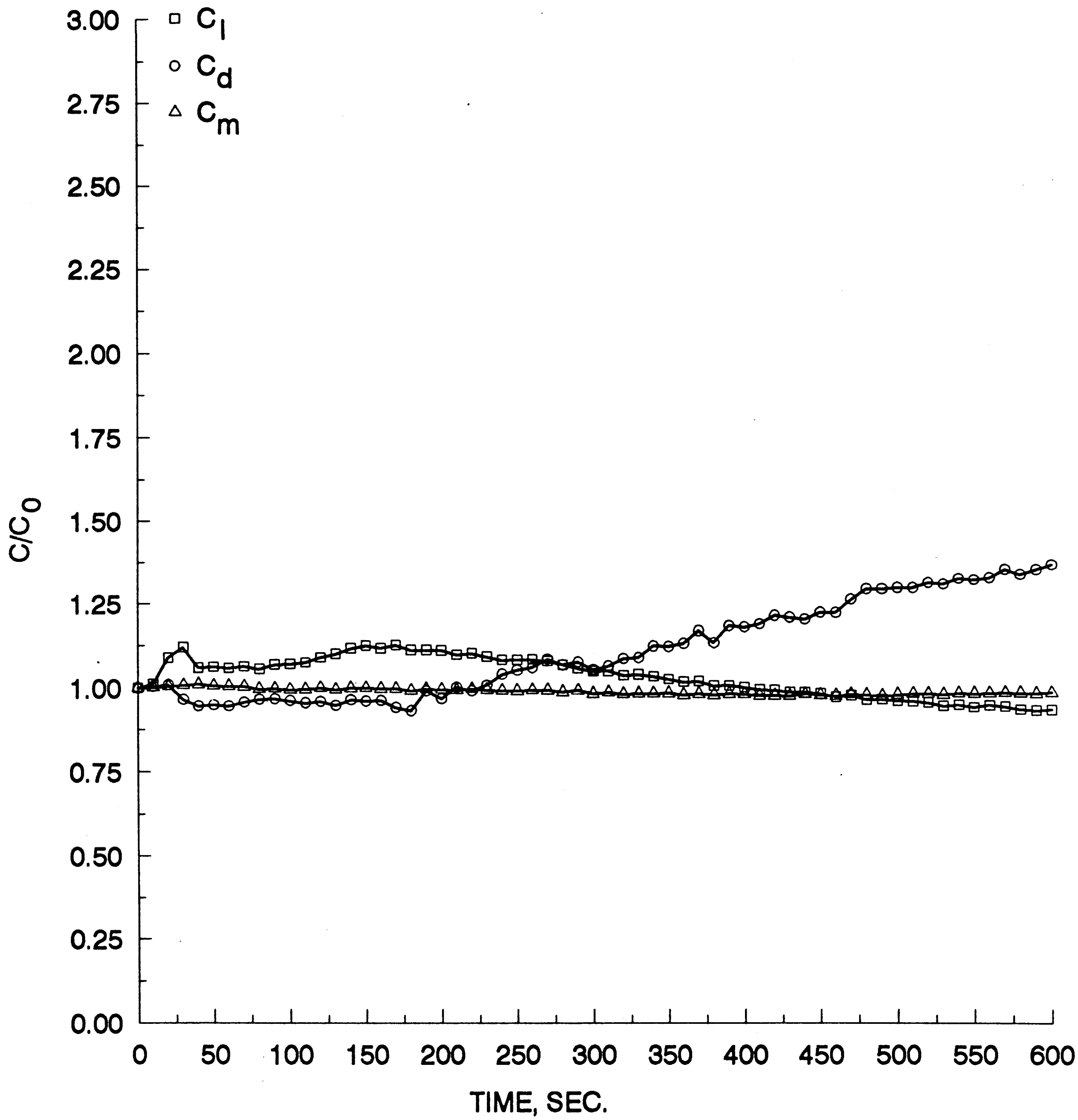
(B) C_d VERSUS α

FIGURE 41 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 16 (con't).



(C) C_m VERSUS α

FIGURE 41 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 16 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 41 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 16 (con't).

TABLE 70 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 16.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0428	0.0505	0.0503	−0.1018
−0.0673	0.2006	0.0404	−0.1088
1.1940	0.3877	0.0307	−0.1109
2.0687	0.5286	0.0217	−0.1083
3.0958	0.6669	0.0178	−0.1062
4.0676	0.7870	0.0193	−0.1032
5.0847	0.9116	0.0214	−0.1001
5.9550	1.0126	0.0214	−0.0970
6.9221	1.1277	0.0241	−0.0937
7.8462	1.2403	0.0274	−0.0906
8.9252	1.3516	0.0299	−0.0856
9.8322	1.4706	0.0338	−0.0830
10.8715	1.5725	0.0388	−0.0777
11.8892	1.6817	0.0472	−0.0731
12.9877	1.7597	0.0539	−0.0665
13.9101	1.8129	0.0640	−0.0612
14.7358	1.8409	0.0765	−0.0579
15.7684	1.7343	0.1345	−0.0771
16.9663	1.5883	0.1993	−0.1008

(B). ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.3817	0.0267	0.0715	−0.1126
−0.1886	0.2114	0.0583	−0.1123
0.7893	0.3428	0.0504	−0.1073
1.7356	0.4589	0.0476	−0.1015
2.7638	0.5846	0.0477	−0.0963
3.7474	0.6925	0.0498	−0.0900
4.9097	0.8144	0.0527	−0.0830
5.6775	0.8877	0.0528	−0.0777
6.7285	0.9727	0.0580	−0.0709
7.8140	1.0426	0.0660	−0.0644
8.7570	1.0873	0.0720	−0.0621
9.8597	1.1227	0.1012	−0.0649
10.6656	1.1372	0.1266	−0.0680
11.8801	1.1739	0.1535	−0.0716
12.9902	1.1981	0.1697	−0.0726
13.8976	1.2068	0.1926	−0.0782
14.8396	1.2704	0.2070	−0.0706
15.9796	1.2992	0.2334	−0.0716
16.8659	1.3551	0.2575	−0.0720

TABLE 71 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 16.

TIME SEC.	C_l/C_{l_0}	C_d/C_{d_0}	C_m/C_{m_0}
0	1.0000	1.0000	1.0000
10	1.0129	1.0045	1.0021
20	1.0898	1.0098	1.0049
30	1.1210	0.9661	1.0079
40	1.0603	0.9468	1.0108
50	1.0620	0.9500	1.0064
60	1.0592	0.9465	1.0056
70	1.0637	0.9583	1.0039
80	1.0567	0.9667	0.9971
90	1.0695	0.9684	0.9979
100	1.0709	0.9625	0.9946
110	1.0754	0.9558	0.9961
120	1.0901	0.9601	0.9998
130	1.1011	0.9483	0.9947
140	1.1173	0.9648	0.9992
150	1.1256	0.9610	0.9999
160	1.1179	0.9627	0.9975
170	1.1277	0.9420	0.9976
180	1.1124	0.9323	0.9916
190	1.1125	0.9915	0.9963
200	1.1112	0.9680	0.9948
210	1.0986	1.0015	0.9931
220	1.1026	0.9913	0.9964
230	1.0925	1.0078	0.9939
240	1.0828	1.0404	0.9912
250	1.0831	1.0524	0.9905
260	1.0842	1.0601	0.9931
270	1.0795	1.0857	0.9926
280	1.0682	1.0683	0.9877
290	1.0578	1.0769	0.9919
300	1.0495	1.0540	0.9825
310	1.0503	1.0651	0.9865
320	1.0373	1.0870	0.9816
330	1.0402	1.0898	0.9834
340	1.0343	1.1243	0.9835
350	1.0258	1.1229	0.9841

TIME SEC.	C_l/C_{l_0}	C_d/C_{d_0}	C_m/C_{m_0}
360	1.0181	1.1326	0.9792
370	1.0200	1.1705	0.9827
380	1.0067	1.1346	0.9790
390	1.0070	1.1858	0.9826
400	1.0022	1.1824	0.9818
410	0.9949	1.1912	0.9777
420	0.9931	1.2168	0.9779
430	0.9877	1.2116	0.9771
440	0.9873	1.2064	0.9819
450	0.9833	1.2263	0.9793
460	0.9742	1.2261	0.9772
470	0.9784	1.2662	0.9813
480	0.9659	1.2972	0.9803
490	0.9669	1.2972	0.9770
500	0.9626	1.3008	0.9807
510	0.9609	1.3009	0.9829
520	0.9568	1.3157	0.9829
530	0.9473	1.3117	0.9810
540	0.9502	1.3284	0.9854
550	0.9435	1.3254	0.9838
560	0.9491	1.3309	0.9854
570	0.9458	1.3567	0.9868
580	0.9367	1.3415	0.9855
590	0.9338	1.3564	0.9844
600	0.9361	1.3713	0.9869

TABLE 72 - TEST CONDITIONS FOR RUN NUMBER 16.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 16	Configuration 1° Flap		Date 05-05-88
P_{air} 80 psig	ΔP_w 72.5 psid	T_{avg} 25° F	V_∞ 100 mph
Spray Duration 10 min	Ice Accretion Type Glaze		A.O.A. 0°
LWC 0.92 g/m³	MVD 14.4 μm		

Remarks

- Ice growth started at leading edge and covered about 1" of upper surface followed by about 2" of fingers on upper surface
- Frost was on a portion of the main airfoil lower surface and on the flaps. There was about 1/8" on the leading edge of the second flap.
- Ice accretion on leading edge of Slat approximately 5/8" thick.
- Some ice was broken off the leading edge during photographing process. The second pitch-pause was not take due to this problem. Thus, no force balance data was obtained with the frost removed.

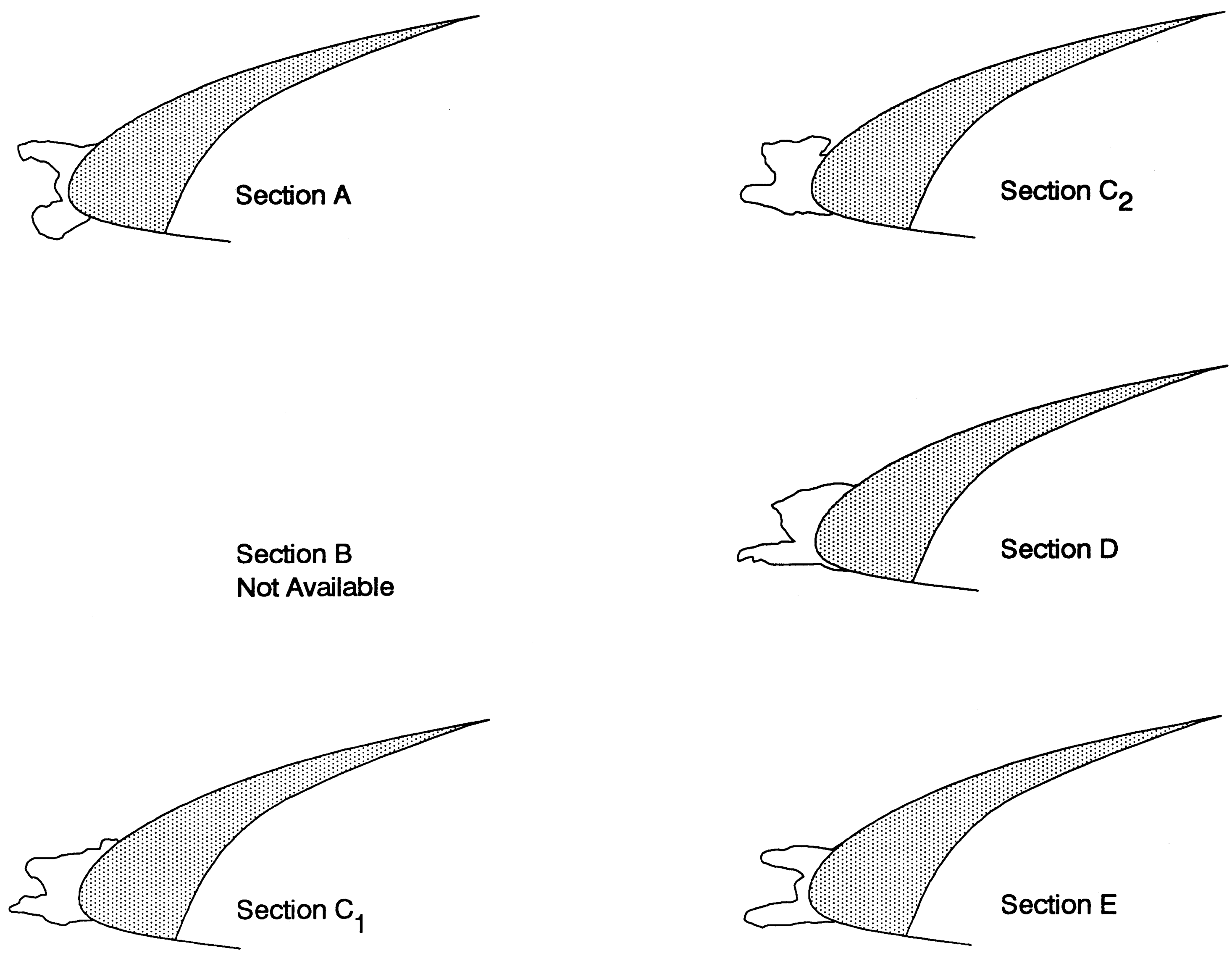


FIGURE 42 - RUN 17 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 73 - RUN 17 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.179731	0.291016			0.234789	0.356426	0.109037	0.211003	0.234654	0.342797	0.138258	0.267810
0.139474	0.286939			0.210616	0.354379	0.090999	0.206992	0.214553	0.350689	0.114061	0.275714
0.111297	0.282893			0.184419	0.356295	0.072957	0.204962	0.192449	0.356589	0.089874	0.279634
0.089181	0.270918			0.162256	0.356237	0.062935	0.202954	0.156295	0.360466	0.051579	0.285510
0.050905	0.278763			0.146148	0.352227	0.048898	0.202917	0.120152	0.360372	0.009266	0.287391
0.018659	0.290595			0.138116	0.342285	0.050888	0.208869	0.088040	0.354329	−0.027009	0.291280
−0.019606	0.294467			0.136144	0.326407	0.058866	0.224747	0.057937	0.348292	−0.059244	0.291195
−0.051836	0.300341			0.130153	0.306550	0.074893	0.230735	0.025836	0.338277	−0.085435	0.291127
−0.082043	0.302248			0.124130	0.298597	0.088888	0.246629	0.001762	0.330270	−0.105576	0.289082
−0.102188	0.306168			0.108016	0.296571	0.092867	0.258532	−0.022323	0.326235	−0.125691	0.277077
−0.128367	0.308085			0.091893	0.298513	0.106867	0.272444	−0.040379	0.320229	−0.139778	0.271065
−0.152517	0.304050			0.073759	0.298466	0.110851	0.282365	−0.054429	0.318207	−0.163949	0.269010
−0.180699	0.301990			0.053611	0.298413	0.110803	0.300204	−0.070498	0.320150	−0.196194	0.272909
−0.198836	0.307901			0.041544	0.290445	0.094755	0.302144	−0.094583	0.316115	−0.224389	0.268851
−0.229042	0.309808			0.025458	0.278498	0.076686	0.310026	−0.114636	0.306132	−0.256608	0.262791
−0.253182	0.301800			0.007346	0.270514	0.048595	0.315898	−0.130667	0.294174	−0.274713	0.252784
−0.269262	0.291828			−0.018847	0.270446	0.024531	0.315835	−0.152712	0.278228	−0.288795	0.244779
−0.297439	0.287782			−0.047043	0.266404	−0.001543	0.317749	−0.182800	0.266233	−0.294796	0.228827
−0.311506	0.277815			−0.065177	0.266356	−0.019575	0.311755	−0.204856	0.254258	−0.290703	0.204935
−0.313466	0.257949			−0.087329	0.262331	−0.035591	0.301802	−0.226927	0.248243	−0.276562	0.191028
−0.303319	0.228185			−0.105457	0.260299	−0.055629	0.295804	−0.242970	0.240256	−0.254390	0.187103
−0.291191	0.210342			−0.129608	0.250315	−0.069650	0.289821	−0.252994	0.234272	−0.238246	0.177185
−0.277054	0.194490			−0.151760	0.246289	−0.075655	0.285840	−0.269036	0.226286	−0.208005	0.169297
−0.252915	0.202498			−0.175937	0.246226	−0.091687	0.281834	−0.258953	0.210423	−0.173739	0.163411
−0.232813	0.214467			−0.206154	0.244163	−0.109740	0.283769	−0.238842	0.198560	−0.143503	0.157514
−0.218698	0.206560			−0.236381	0.246068	−0.125793	0.287691	−0.226757	0.184689	−0.121325	0.151597
−0.196518	0.194701			−0.260559	0.246005	−0.143857	0.293590	−0.214666	0.168833	−0.099158	0.149663
−0.170318	0.184839			−0.280702	0.243968	−0.165916	0.293532	−0.210587	0.145011	−0.076981	0.143745
−0.144143	0.184907			−0.306851	0.228027	−0.191980	0.291482	−0.208536	0.129128	−0.054787	0.131852
−0.119945	0.171068			−0.318903	0.214107	−0.208006	0.285493	−0.210485	0.107276	−0.042673	0.121924
−0.101777	0.153241			−0.324899	0.196234	−0.232044	0.275520	−0.200392	0.087442	−0.032562	0.108006
−0.083613	0.137400			−0.330906	0.182329	−0.252092	0.273485	−0.188307	0.073571	−0.050667	0.097999
−0.061407	0.115611			−0.320774	0.160530	−0.270145	0.275420	−0.170172	0.049786	−0.068767	0.086000

TABLE 73 - RUN 17 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.059335	0.093770			−0.306617	0.140725	−0.284182	0.275383	−0.156063	0.029963	−0.084842	0.070023
−0.075384	0.071882			−0.292481	0.128857	−0.298214	0.273364	−0.139957	0.014117	−0.088834	0.056069
−0.083378	0.050014			−0.270313	0.126930	−0.302203	0.265426	−0.127882	0.004219	−0.086761	0.034163
−0.085338	0.030148			−0.252158	0.119041	−0.306182	0.253522	−0.149959	0.000188	−0.080658	0.012267
−0.077221	0.006336			−0.238012	0.103205	−0.306113	0.227754	−0.178076	0.002100	−0.076564	−0.011625
−0.061055	−0.015468			−0.225880	0.087364	−0.304070	0.213885	−0.198156	0.002048	−0.074502	−0.029547
−0.046902	−0.037278			−0.215769	0.073502	−0.298033	0.205972	−0.212211	0.002011	−0.102659	−0.047549
−0.038806	−0.053145			−0.207635	0.045744	−0.289986	0.196082	−0.226235	−0.009942	−0.132879	−0.047628
−0.066988	−0.055205			−0.203562	0.029882	−0.285927	0.178254	−0.252339	−0.010010	−0.165108	−0.049704
−0.105216	−0.065235			−0.201526	0.021951	−0.283879	0.162402	−0.294495	−0.014093	−0.199347	−0.053778
−0.113227	−0.081145			−0.217645	0.021909	−0.281847	0.152497	−0.320599	−0.014161	−0.237610	−0.059854
−0.139380	−0.089158			−0.233758	0.019882	−0.269783	0.140635	−0.354713	−0.022195	−0.259750	−0.067880
−0.165570	−0.083268			−0.247840	0.011909	−0.253693	0.122839	−0.386813	−0.032210	−0.289955	−0.073935
−0.191717	−0.093266			−0.265952	0.003925	−0.245640	0.110967	−0.412901	−0.038236	−0.324177	−0.083984
−0.203750	−0.111173			−0.288131	0.009820	−0.229565	0.099116	−0.438988	−0.044263	−0.350347	−0.092021
−0.219809	−0.129089			−0.308290	0.013735	−0.225512	0.083270	−0.461055	−0.052265	−0.368458	−0.100036
−0.225790	−0.150952			−0.332472	0.015656	−0.223475	0.071382	−0.469049	−0.066188	−0.382534	−0.110032
−0.219665	−0.182713			−0.344545	0.009672	−0.225438	0.055520	−0.475025	−0.084078	−0.392564	−0.125994
−0.209544	−0.202547			−0.362641	−0.004264	−0.231411	0.039647	−0.474977	−0.101952	−0.394515	−0.149903
−0.197416	−0.220390			−0.370636	−0.028095	−0.239411	0.031697	−0.468916	−0.115839	−0.374331	−0.163793
−0.185282	−0.240219			−0.394782	−0.040063	−0.251422	0.023737	−0.450855	−0.111820	−0.356177	−0.171714
−0.177191	−0.254100			−0.414914	−0.046067	−0.267464	0.023695	−0.438829	−0.103843	−0.331974	−0.181610
−0.148982	−0.261971			−0.431011	−0.054046	−0.291528	0.023632	−0.422781	−0.097843	−0.315841	−0.187543
−0.130824	−0.275826			−0.428948	−0.071898	−0.315592	0.023569	−0.408741	−0.091848	−0.285594	−0.197424
−0.104629	−0.283702			−0.416838	−0.079803	−0.341661	0.023500	−0.394691	−0.089825	−0.263454	−0.189398
−0.070385	−0.289571			−0.394670	−0.081729	−0.361709	0.021466	−0.382632	−0.093766	−0.245338	−0.183375
−0.040205	−0.281547			−0.372501	−0.083655	−0.379752	0.019436	−0.380576	−0.111635	−0.199000	−0.183253
−0.028189	−0.257683			−0.346309	−0.083587	−0.407810	0.013416	−0.378547	−0.119574	−0.150643	−0.185118
−0.012114	−0.245724			−0.326150	−0.087503	−0.417800	−0.000485	−0.360486	−0.115554	−0.118408	−0.185034
0.005980	−0.235747			−0.301951	−0.095376	−0.427789	−0.014385	−0.334404	−0.107542	−0.094253	−0.177003
0.036133	−0.217793			−0.271719	−0.099265	−0.435757	−0.034228	−0.312295	−0.115428	−0.055985	−0.172918
0.060251	−0.201842			−0.247530	−0.103171	−0.431688	−0.056021	−0.292178	−0.129278	−0.005629	−0.168802
0.082377	−0.193839			−0.223342	−0.107076	−0.413587	−0.075795	−0.268051	−0.141130	0.032656	−0.170694

TABLE 73 - RUN 17 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.102484	−0.183856			−0.211226	−0.116965	−0.375464	−0.083624	−0.223881	−0.139029	0.070924	−0.166610
0.126602	−0.167904			−0.205155	−0.126870	−0.339353	−0.089475	−0.183722	−0.138923	0.105168	−0.164528
				−0.193040	−0.136759	−0.309252	−0.097325	−0.131515	−0.138786	0.141443	−0.168417
				−0.164806	−0.146606	−0.283161	−0.105185	−0.079308	−0.138649		
				−0.144647	−0.150522	−0.257076	−0.111063	−0.033120	−0.140515		
				−0.132547	−0.154458	−0.226970	−0.120895	0.011045	−0.136426		
				−0.110368	−0.160353	−0.198858	−0.134697	0.029122	−0.138365		
				−0.082161	−0.160280	−0.170746	−0.148498	0.059279	−0.152189		
				−0.058021	−0.146327	−0.146661	−0.156363	0.113547	−0.171907		
				−0.021770	−0.140280	−0.128603	−0.160280	0.155730	−0.177754		
				0.006426	−0.136238	−0.114565	−0.160243	0.191884	−0.181632		
				0.024554	−0.134207	−0.104565	−0.150306				
				0.050746	−0.134138	−0.092549	−0.144329				
				0.074929	−0.136059	−0.076496	−0.148251				
						−0.054416	−0.156121				
						−0.042400	−0.150143				
						−0.022357	−0.146127				
						0.005727	−0.150017				
						0.027802	−0.155906				
						0.057892	−0.159791				
						0.098010	−0.163651				
						0.124068	−0.159618				

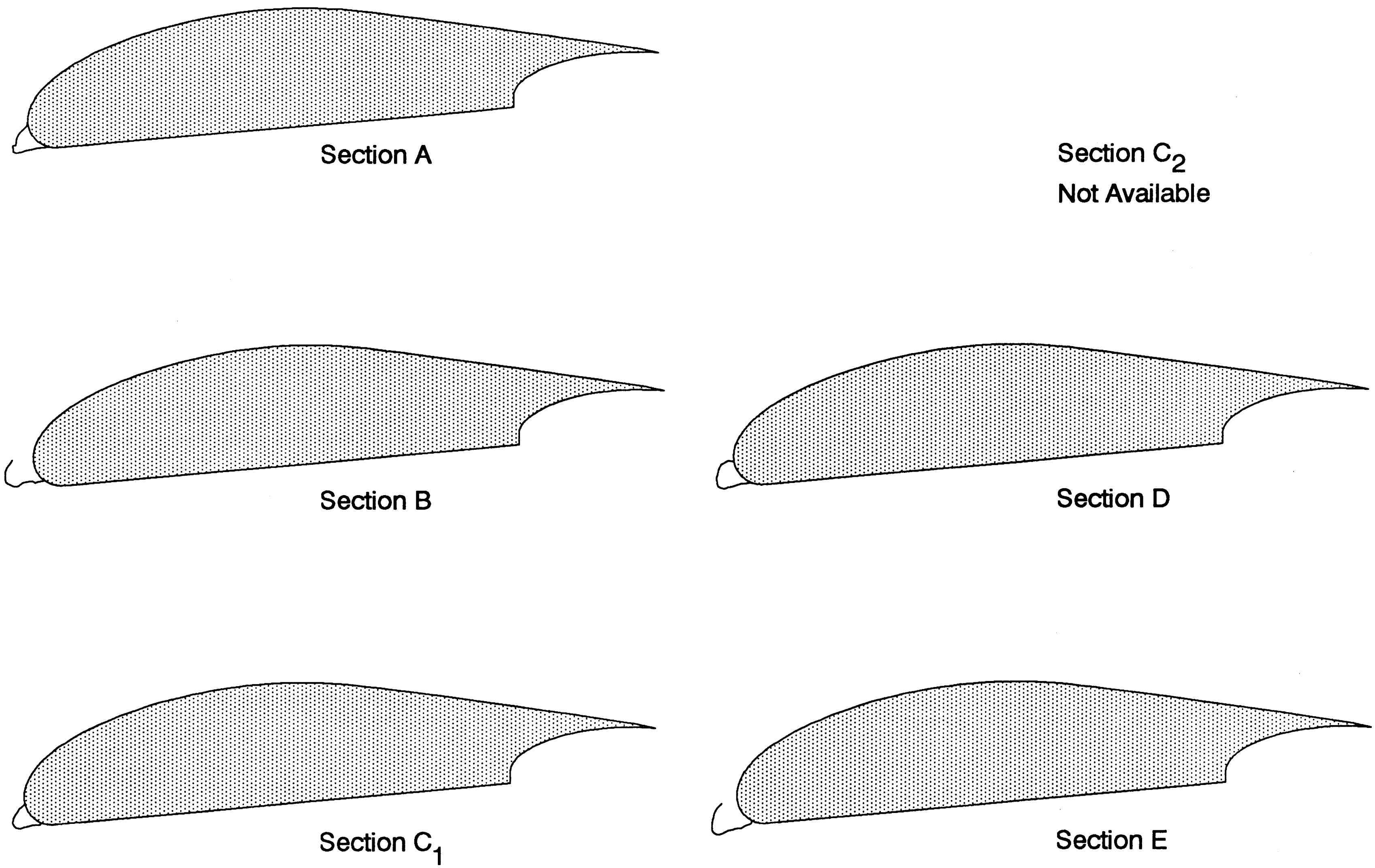
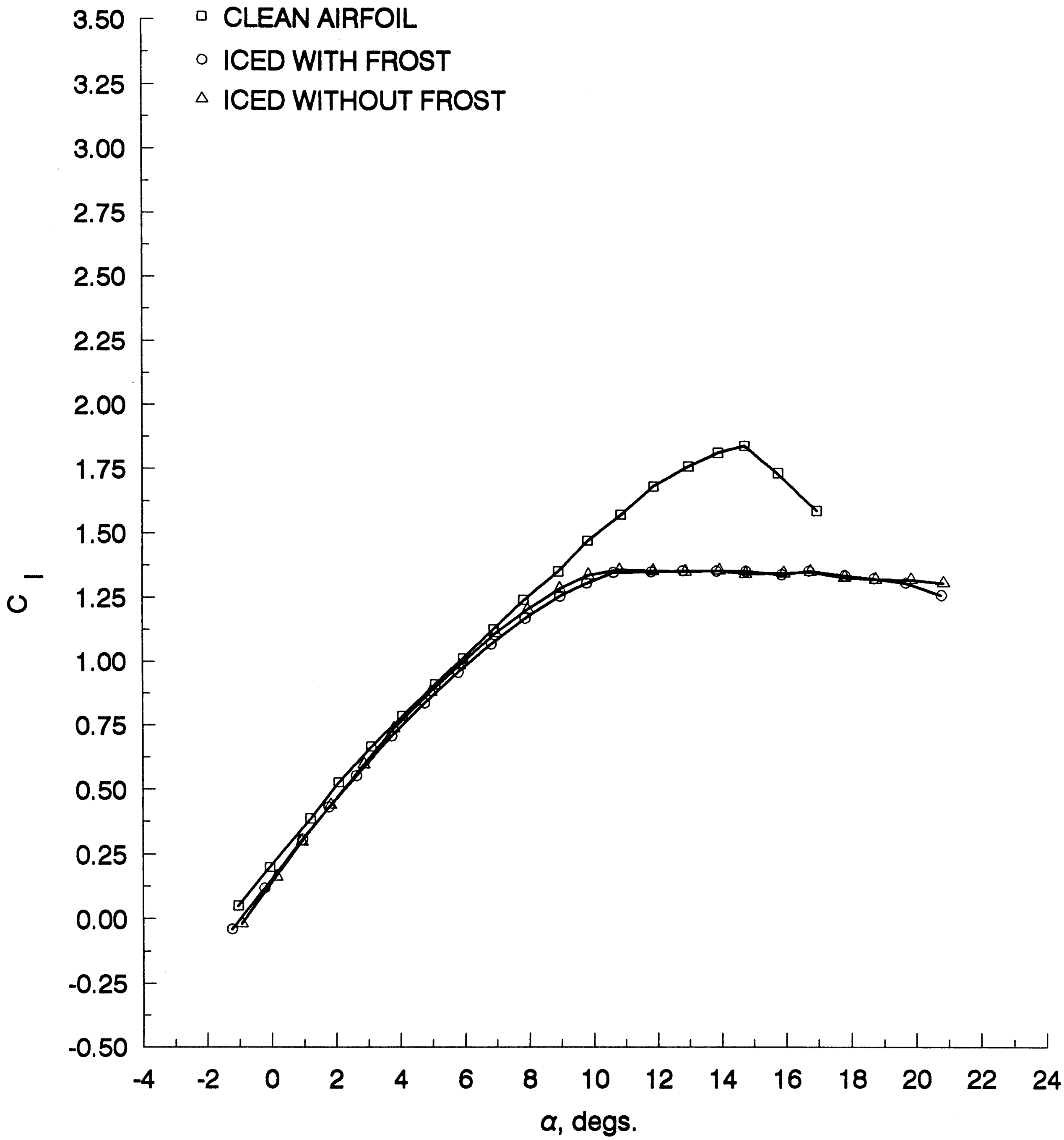


FIGURE 43 - RUN 17 ICE SHAPE TRACINGS FOR MID FLAP (FLAP 2), SECTIONS A - E.

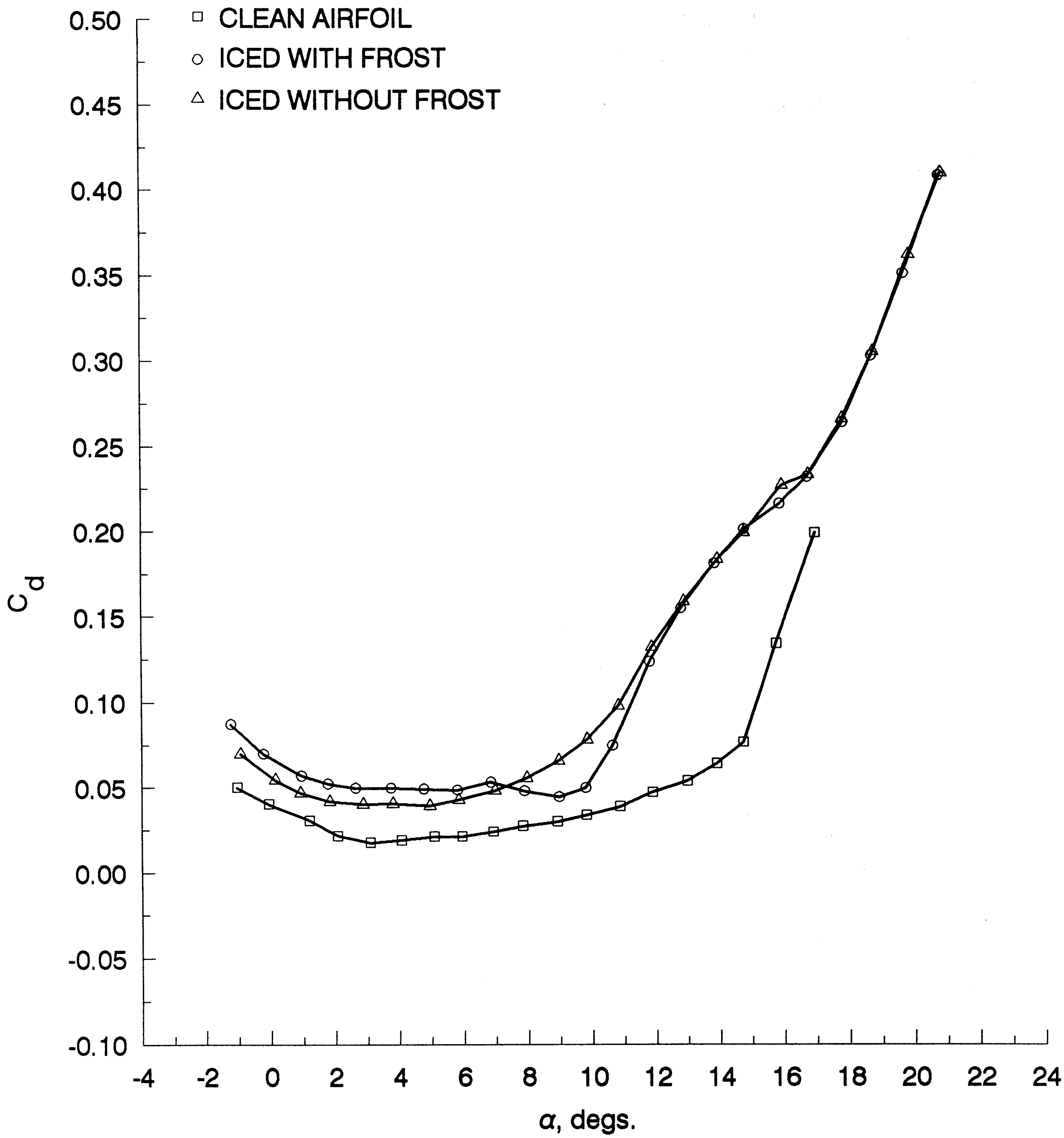
TABLE 74 - RUN 17 ICE SHAPE COORDINATES FOR MID FLAP (FLAP2), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
13.159699	−0.388904	13.007876	−0.388762	13.149323	−0.421299			13.108856	−0.400521	13.046299	−0.428240
13.139758	−0.410912	12.993674	−0.408839	13.131179	−0.435403			13.086667	−0.412604	13.022116	−0.450326
13.111827	−0.436933	12.975420	−0.436943	13.113040	−0.451515			13.062463	−0.426695	13.010038	−0.466374
13.095870	−0.452943	12.965302	−0.461017	13.098949	−0.469624			13.050391	−0.444763	12.999989	−0.486422
13.083913	−0.468942	12.965373	−0.487069	13.082847	−0.491755			13.044384	−0.464819	12.996008	−0.508455
13.073961	−0.486932	12.963401	−0.511122	13.074824	−0.513864			13.040409	−0.488877	12.987986	−0.530498
13.070025	−0.510893	12.965487	−0.529152	13.070864	−0.543995			13.034396	−0.506929	12.984009	−0.554534
13.068094	−0.536845	12.977728	−0.537136	13.078994	−0.562046			13.034434	−0.520957	12.984080	−0.580561
13.058099	−0.538868	13.000162	−0.549102	13.095182	−0.572044			13.038506	−0.532970	12.986131	−0.592568
13.048105	−0.540890	13.016476	−0.557075	13.121453	−0.575991			13.036522	−0.547003	12.990205	−0.604570
13.048157	−0.560849	13.042951	−0.557006	13.147693	−0.567889			13.044652	−0.565018	13.000333	−0.614553
13.050205	−0.578808	13.057192	−0.550957	13.169903	−0.563815			13.058815	−0.572997	13.016520	−0.624521
13.066215	−0.582757	13.077509	−0.532868	13.198158	−0.553700			13.081052	−0.578950	13.032683	−0.624479
13.100215	−0.582667	13.106005	−0.526782	13.222395	−0.551628			13.109307	−0.568856	13.052864	−0.616417
13.128187	−0.572613	13.124322	−0.522726	13.246636	−0.551564			13.135557	−0.564779	13.079093	−0.604336
13.162164	−0.564540	13.142652	−0.522678					13.165837	−0.556683	13.095239	−0.598287
13.208136	−0.554438	13.154892	−0.530662					13.194087	−0.544585	13.117451	−0.594225
13.244130	−0.552347	13.169150	−0.530625					13.220348	−0.544516	13.137636	−0.588165
13.274124	−0.550272	13.179321	−0.526591					13.246593	−0.538435	13.157827	−0.584108
		13.199677	−0.522529							13.171968	−0.584071
		13.213926	−0.520488							13.182059	−0.580040
										13.190125	−0.574013
										13.200209	−0.567980
										13.208279	−0.563955
										13.222410	−0.559914
										13.238555	−0.553865



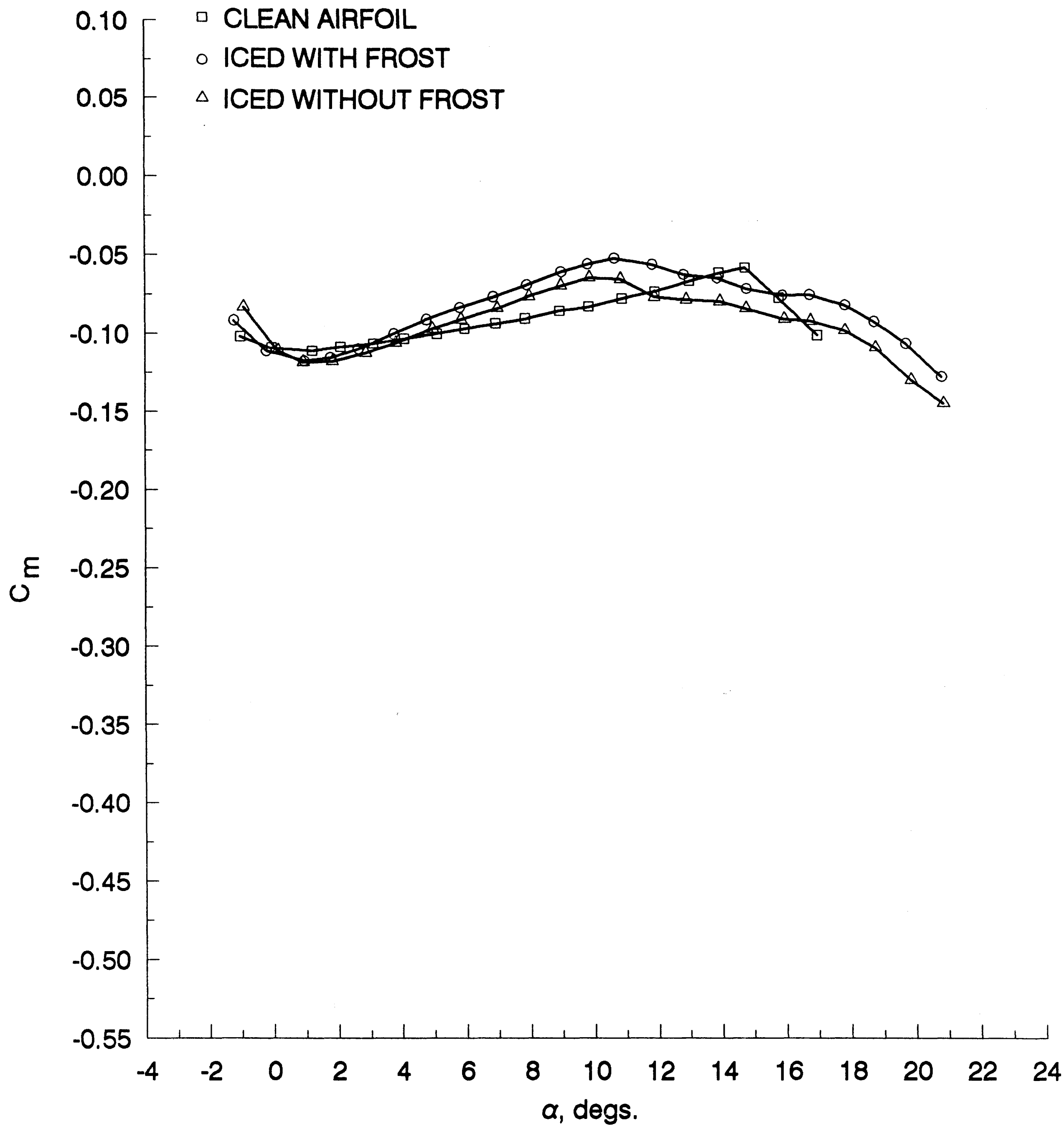
(A) C_l VERSUS α

FIGURE 44 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 17.



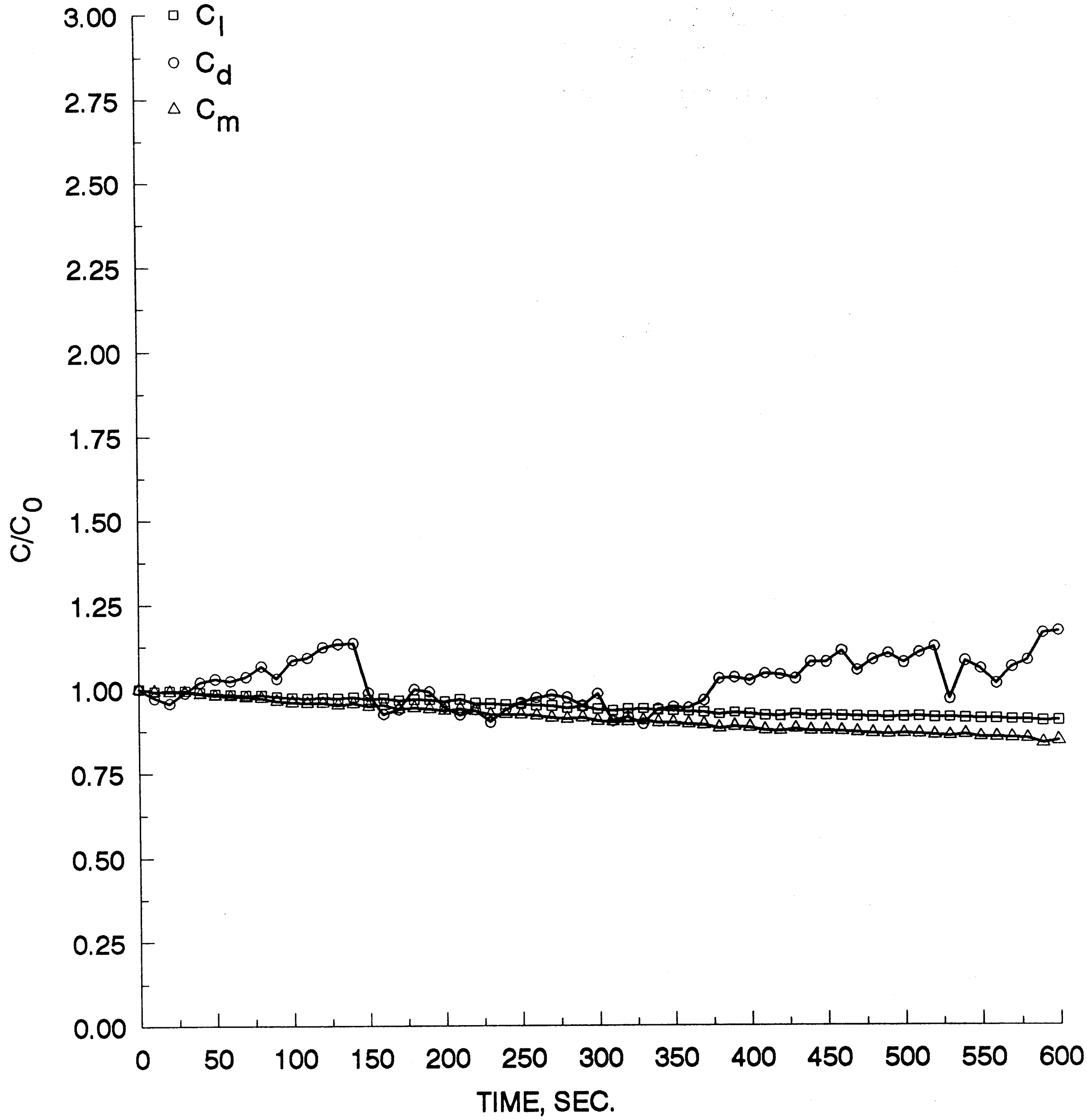
(B) C_d VERSUS α

FIGURE 44 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 17 (con't).



(C) C_m VERSUS α

FIGURE 44 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 17 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 44 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 17 (con't).

TABLE 75 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 17.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0428	0.0505	0.0503	−0.1018
−0.0673	0.2006	0.0404	−0.1088
1.1940	0.3877	0.0307	−0.1109
2.0687	0.5286	0.0217	−0.1083
3.0958	0.6669	0.0178	−0.1062
4.0676	0.7870	0.0193	−0.1032
5.0847	0.9116	0.0214	−0.1001
5.9550	1.0126	0.0214	−0.0970
6.9221	1.1277	0.0241	−0.0937
7.8462	1.2403	0.0274	−0.0906
8.9252	1.3516	0.0299	−0.0856
9.8322	1.4706	0.0338	−0.0830
10.8715	1.5725	0.0388	−0.0777
11.8892	1.6817	0.0472	−0.0731
12.9877	1.7597	0.0539	−0.0665
13.9101	1.8129	0.0640	−0.0612
14.7358	1.8409	0.0765	−0.0579
15.7684	1.7343	0.1345	−0.0771
16.9663	1.5883	0.1993	−0.1008

(B) ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.2315	−0.0389	0.0874	−0.0916
−0.2295	0.1194	0.0699	−0.1109
0.9474	0.3077	0.0570	−0.1171
1.7642	0.4320	0.0523	−0.1151
2.6241	0.5542	0.0499	−0.1095
3.7379	0.7090	0.0498	−0.1001
4.7616	0.8373	0.0493	−0.0912
5.8090	0.9574	0.0486	−0.0836
6.8460	1.0696	0.0531	−0.0767
7.8940	1.1694	0.0480	−0.0690
8.9729	1.2557	0.0445	−0.0607
9.8032	1.3057	0.0498	−0.0557
10.6378	1.3482	0.0746	−0.0520
11.8190	1.3499	0.1238	−0.0559
12.8037	1.3543	0.1551	−0.0624
13.8548	1.3529	0.1813	−0.0645
14.7723	1.3528	0.2014	−0.0713
15.8814	1.3399	0.2163	−0.0756
16.7345	1.3546	0.2320	−0.0750
17.8258	1.3364	0.2639	−0.0816
18.7193	1.3252	0.3032	−0.0921
19.6978	1.3082	0.3512	−0.1060
20.8059	1.2606	0.4085	−0.1272

(C). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
−0.9355	−0.0172	0.0697	−0.0831
0.1373	0.1635	0.0546	−0.1106
0.9247	0.2980	0.0468	−0.1181
1.8256	0.4398	0.0418	−0.1175
2.8611	0.5977	0.0402	−0.1121
3.8019	0.7380	0.0405	−0.1057
4.9538	0.8816	0.0393	−0.0970
5.8487	0.9846	0.0426	−0.0910
6.9728	1.1121	0.0482	−0.0840
7.9707	1.2028	0.0555	−0.0762
8.9598	1.2840	0.0657	−0.0694
9.8551	1.3371	0.0781	−0.0644
10.8268	1.3572	0.0980	−0.0653
11.8830	1.3539	0.1322	−0.0766
12.8938	1.3520	0.1590	−0.0783
13.9470	1.3552	0.1836	−0.0793
14.7667	1.3430	0.1994	−0.0839
15.9533	1.3454	0.2269	−0.0906
16.7702	1.3511	0.2334	−0.0917
17.8266	1.3298	0.2660	−0.0978
18.7688	1.3226	0.3054	−0.1085
19.8667	1.3206	0.3621	−0.1293
20.8768	1.3081	0.4099	−0.1444

TABLE 76 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 17.

TIME SEC.	C_l/C_{l_0}	C_d/C_{d_0}	C_m/C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9932	0.9737	0.9938
20	0.9955	0.9580	0.9921
30	0.9950	0.9882	0.9917
40	0.9898	1.0203	0.9852
50	0.9855	1.0296	0.9799
60	0.9846	1.0241	0.9781
70	0.9817	1.0362	0.9750
80	0.9826	1.0678	0.9736
90	0.9764	1.0311	0.9653
100	0.9739	1.0863	0.9607
110	0.9718	1.0932	0.9587
120	0.9747	1.1248	0.9587
130	0.9722	1.1340	0.9537
140	0.9761	1.1353	0.9571
150	0.9697	0.9897	0.9496
160	0.9731	0.9245	0.9531
170	0.9664	0.9391	0.9411
180	0.9690	0.9983	0.9446
190	0.9679	0.9916	0.9415
200	0.9626	0.9459	0.9362
210	0.9688	0.9222	0.9411
220	0.9567	0.9368	0.9339
230	0.9550	0.9008	0.9229
240	0.9531	0.9387	0.9235
250	0.9547	0.9582	0.9232
260	0.9504	0.9729	0.9200
270	0.9491	0.9810	0.9132
280	0.9425	0.9733	0.9097
290	0.9472	0.9492	0.9132
300	0.9386	0.9838	0.9036
310	0.9344	0.9032	0.9006
320	0.9388	0.9145	0.9018
330	0.9399	0.8942	0.9041
340	0.9355	0.9391	0.8984
350	0.9341	0.9447	0.8976
360	0.9319	0.9422	0.8940
370	0.9298	0.9641	0.8920
380	0.9233	1.0285	0.8816
390	0.9283	1.0317	0.8865
400	0.9244	1.0234	0.8831
410	0.9190	1.0431	0.8754
420	0.9176	1.0405	0.8731
430	0.9225	1.0282	0.8791
440	0.9187	1.0777	0.8734
450	0.9192	1.0776	0.8733
460	0.9176	1.1115	0.8718
470	0.9161	1.0532	0.8683
480	0.9140	1.0846	0.8653
490	0.9139	1.1028	0.8641
500	0.9143	1.0760	0.8645
510	0.9157	1.1059	0.8633
520	0.9133	1.1228	0.8608
530	0.9135	0.9688	0.8576
540	0.9108	1.0808	0.8622
550	0.9095	1.0573	0.8548
560	0.9100	1.0135	0.8542
570	0.9070	1.0628	0.8525
580	0.9070	1.0830	0.8499
590	0.9025	1.1636	0.8368
600	0.9043	1.1697	0.8439

TABLE 77 - TEST CONDITIONS FOR RUN NUMBER 17.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 17	Configuration 1° Flap	Date 05-05-88	
P_{air} 80 psig	ΔP_w 72.5 psid	T_{avg} 25° F	V_∞ 100 mph
Spray Duration 10 min	Ice Accretion Type Glaze	A.O.A. 5°	
LWC 0.92 g/m³	MVD 14.4 μm		

Remarks

- Frost on undersurface as in previous cases. No ice behind Slat and before leading edge of Main Airfoil surface. Frost on all flap lower surfaces. Very light frost on upper surface.
- Ice accretion on Leading Edge Slat approximately 1/2" thick.
- Horns developed on the Slat leading edge. Ice accretion on Leading Edge Slat approximately 1/2" thick. Almost all of this accretion was clear ice with a small amount of opaque ice at the edges on the upper surface.
- Ice accretion on leading edge of Flap 2 approximately 1/8" thick. The third flap had ice fingers starting just below the leading edge and extending to the trailing edge.
- Ice broke off from Section B during the cutting process and tracings were not taken.
- Ice shape tracings for the Leading Edge Slat, Section B and Flap 2, Section C_2 not available.

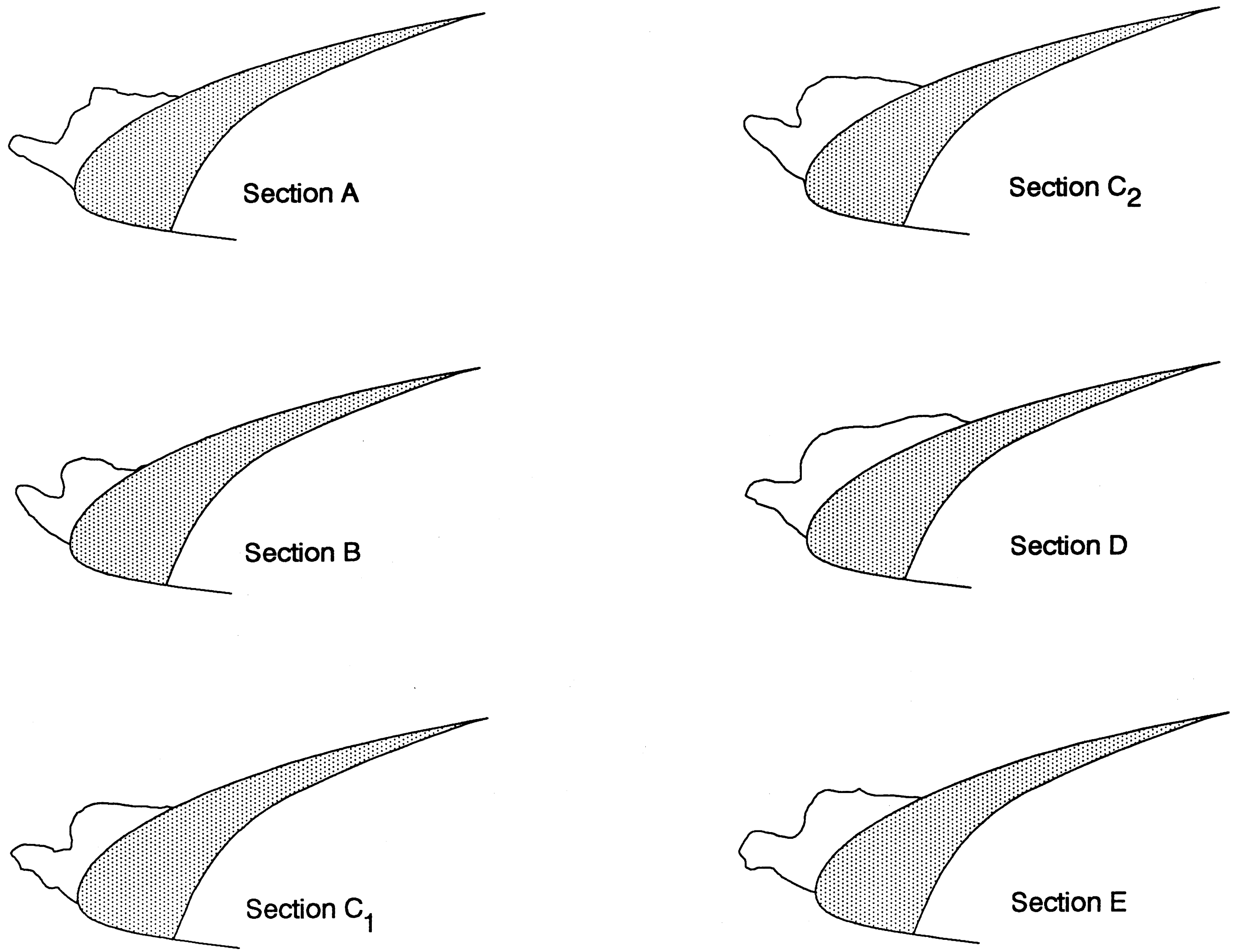


FIGURE 45 - RUN 18 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 78 - RUN 18 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.651007	0.573740	0.496712	0.488674	0.621021	0.542898	0.706428	0.602679	1.005709	0.709596	0.623518	0.573695
0.630986	0.575687	0.470734	0.480615	0.587094	0.546803	0.676406	0.610557	0.981660	0.713537	0.585571	0.575595
0.614973	0.575645	0.446739	0.478555	0.561143	0.552725	0.654390	0.616468	0.949583	0.723466	0.561613	0.573531
0.586950	0.575570	0.428776	0.464525	0.539213	0.546676	0.628368	0.624357	0.923495	0.741420	0.541634	0.577478
0.578922	0.583549	0.416797	0.456504	0.519268	0.544625	0.602357	0.628267	0.897433	0.749362	0.507676	0.581388
0.556873	0.595491	0.388797	0.456430	0.493322	0.548551	0.576346	0.632177	0.881381	0.759332	0.475720	0.583304
0.528866	0.589417	0.362792	0.458359	0.463397	0.548471	0.538334	0.636056	0.849326	0.761250	0.437773	0.585203
0.496877	0.575332	0.330781	0.462268	0.431465	0.552381	0.504328	0.637956	0.807276	0.755130	0.405823	0.585118
0.468859	0.573257	0.306781	0.462205	0.393554	0.554278	0.486317	0.641887	0.773239	0.749033	0.371876	0.585028
0.434826	0.575167	0.284776	0.464144	0.353653	0.554172	0.464301	0.647797	0.731162	0.752926	0.347907	0.586965
0.406788	0.581093	0.272744	0.476096	0.307746	0.562039	0.446285	0.653718	0.693108	0.750823	0.327922	0.592912
0.382752	0.587029	0.260701	0.492044	0.281805	0.563967	0.418279	0.655634	0.661057	0.750738	0.313928	0.598876
0.358738	0.584966	0.236680	0.499970	0.245873	0.571860	0.394268	0.659549	0.629018	0.746648	0.303928	0.604850
0.338733	0.580913	0.222654	0.509919	0.209962	0.571765	0.378268	0.659507	0.599003	0.734552	0.293927	0.610824
0.312690	0.588844	0.210632	0.517877	0.174041	0.575665	0.354267	0.659444	0.566979	0.724454	0.281925	0.618793
0.288665	0.590780	0.186622	0.521808	0.136140	0.573566	0.334267	0.659391	0.532952	0.714351	0.269922	0.626761
0.268633	0.596727	0.152616	0.523715	0.098250	0.567474	0.312282	0.653365	0.490908	0.706228	0.257957	0.620729
0.268622	0.600727	0.134616	0.523668	0.070346	0.557415	0.290277	0.655296	0.460887	0.696136	0.247988	0.614702
0.264593	0.610717	0.116611	0.525617	0.044447	0.543365	0.266266	0.659211	0.444878	0.690085	0.228035	0.608649
0.236549	0.618643	0.106605	0.527589	0.028524	0.529342	0.236260	0.661122	0.426855	0.688035	0.200083	0.606574
0.210522	0.620574	0.092595	0.531546	0.012590	0.519314	0.200254	0.663016	0.398816	0.685958	0.174124	0.606505
0.182494	0.622500	0.078590	0.533506	−0.003344	0.509285	0.176254	0.662953	0.364763	0.685868	0.142173	0.606420
0.158469	0.624436	0.070600	0.529490	−0.019251	0.489271	0.152253	0.662890	0.334705	0.689793	0.120191	0.612362
0.138453	0.624383	0.048621	0.521443	−0.027173	0.467280	0.136258	0.660858	0.302660	0.687706	0.102203	0.618315
0.122440	0.624341	0.024637	0.515387	−0.035111	0.451281	0.120273	0.654847	0.272619	0.685623	0.080232	0.620257
0.110478	0.606309	−0.007331	0.503318	−0.045044	0.435277	0.102300	0.644853	0.238571	0.683530	0.058266	0.620199
0.104516	0.590292	−0.021299	0.491297	−0.044986	0.413308	0.086331	0.632875	0.210537	0.679451	0.042312	0.612156
0.100581	0.564282	−0.035257	0.475281	−0.044912	0.385347	0.058378	0.614896	0.180506	0.673363	0.020372	0.602096
0.094619	0.548265	−0.045215	0.459275	−0.036879	0.365395	0.040394	0.608880	0.150491	0.661268	0.010414	0.592069
0.094661	0.532265	−0.053156	0.437283	−0.034831	0.345428	0.018420	0.598875	0.124482	0.649183	0.002453	0.582047
0.090690	0.520254	−0.053093	0.413315	−0.036778	0.327448	0.002468	0.580928	0.086444	0.641071	−0.007505	0.572019
0.076694	0.514217	−0.047045	0.395355	−0.038721	0.307471	−0.009480	0.561002	0.068463	0.623000	−0.017447	0.555992
0.062710	0.504180	−0.041002	0.379392	−0.048653	0.291466	−0.017437	0.545065	0.040472	0.602899	−0.025398	0.541970

TABLE 78 - RUN 18 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.040718	0.494122	−0.036944	0.357432	−0.064614	0.291424	−0.021395	0.529139	0.018507	0.576807	−0.033364	0.533947
0.022725	0.486074	−0.038902	0.341447	−0.080574	0.291382	−0.033369	0.519160	−0.005435	0.540696	−0.045319	0.523915
0.000733	0.476016	−0.040849	0.321468	−0.100519	0.289332	−0.043327	0.503219	−0.021375	0.508611	−0.051268	0.507898
−0.013235	0.459978	−0.042822	0.311476	−0.124439	0.281280	−0.051242	0.471367	−0.033330	0.484547	−0.059223	0.495876
−0.025187	0.437946	−0.048790	0.299476	−0.144384	0.279229	−0.047141	0.433579	−0.037241	0.448490	−0.065166	0.477858
−0.033135	0.415924	−0.054769	0.291471	−0.154407	0.297178	−0.035093	0.415705	−0.037166	0.420453	−0.069091	0.451846
−0.043058	0.383898	−0.068764	0.289436	−0.168383	0.301135	−0.029045	0.397816	−0.035089	0.392421	−0.069049	0.435844
−0.059002	0.357855	−0.088774	0.293378	−0.188354	0.309071	−0.029003	0.381901	−0.035057	0.380405	−0.072985	0.413832
−0.068957	0.337829	−0.108785	0.297320	−0.206320	0.313018	−0.030966	0.367970	−0.037034	0.370387	−0.080919	0.393809
−0.080914	0.317797	−0.120785	0.297288	−0.218291	0.312986	−0.040934	0.356007	−0.045025	0.362354	−0.088859	0.375787
−0.092887	0.303765	−0.144806	0.305214	−0.246232	0.316906	−0.062940	0.357938	−0.057028	0.356315	−0.104776	0.353742
−0.100867	0.293743	−0.160828	0.313161	−0.272178	0.320832	−0.082945	0.359875	−0.073037	0.350264	−0.122711	0.339694
−0.116853	0.283701	−0.180859	0.325093	−0.298119	0.322760	−0.106957	0.363790	−0.093074	0.352214	−0.132680	0.333666
−0.140883	0.287637	−0.196897	0.339032	−0.324060	0.324689	−0.128989	0.375669	−0.111107	0.354169	−0.146653	0.331629
−0.164913	0.291574	−0.210918	0.346984	−0.342005	0.320647	−0.143026	0.389558	−0.131133	0.352113	−0.166622	0.331576
−0.186947	0.297515	−0.226939	0.354931	−0.367914	0.310592	−0.159053	0.399463	−0.169193	0.352012	−0.192598	0.337508
−0.208970	0.299457	−0.248955	0.360865	−0.381853	0.300569	−0.175069	0.405389	−0.193231	0.351949	−0.218568	0.341439
−0.239021	0.309378	−0.268971	0.366804	−0.399776	0.288537	−0.199075	0.407315	−0.209277	0.359917	−0.234554	0.345397
−0.261060	0.317319	−0.294971	0.366735	−0.409715	0.274531	−0.231081	0.409220	−0.235334	0.365856	−0.262548	0.359324
−0.283089	0.321261	−0.318961	0.362677	−0.401687	0.256577	−0.253087	0.411152	−0.257374	0.367800	−0.280525	0.361277
−0.313129	0.327182	−0.322934	0.352680	−0.387690	0.244631	−0.285114	0.421014	−0.297415	0.359683	−0.306496	0.365208
−0.323148	0.331155	−0.330913	0.344669	−0.373682	0.228690	−0.305125	0.424940	−0.317436	0.355624	−0.320490	0.371171
−0.339172	0.335113	−0.330844	0.318703	−0.357669	0.208760	−0.329136	0.428856	−0.333434	0.345569	−0.342461	0.373113
−0.353183	0.335076	−0.316770	0.290777	−0.351641	0.192798	−0.349120	0.422835	−0.347419	0.331514	−0.366424	0.373050
−0.369191	0.333033	−0.306717	0.270831	−0.347609	0.176831	−0.365083	0.408867	−0.357398	0.317469	−0.392368	0.366980
−0.381174	0.323001	−0.294664	0.250889	−0.319668	0.172911	−0.373047	0.394920	−0.367344	0.291408	−0.412295	0.350926
−0.389143	0.308980	−0.280610	0.230952	−0.291726	0.168990	−0.372999	0.377015	−0.373300	0.271365	−0.420245	0.336903
−0.397107	0.292958	−0.270573	0.216997	−0.271760	0.163052	−0.370925	0.349169	−0.355241	0.259397	−0.438159	0.314854
−0.405071	0.276937	−0.258541	0.205044	−0.257747	0.145114	−0.358877	0.331295	−0.327170	0.249459	−0.448101	0.298826
−0.401020	0.258948	−0.248494	0.187095	−0.237749	0.127192	−0.338818	0.309464	−0.313127	0.241485	−0.460019	0.274792
−0.384965	0.242990	−0.222446	0.169187	−0.225736	0.111246	−0.320764	0.289617	−0.305066	0.223483	−0.467975	0.262770
−0.368909	0.227032	−0.212409	0.155232	−0.211713	0.089314	−0.296716	0.271776	−0.285014	0.215525	−0.471943	0.252758
−0.352870	0.217074	−0.190345	0.131323	−0.201706	0.077357	−0.276668	0.253924	−0.252937	0.205597	−0.467912	0.238768

TABLE 78 - RUN 18 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.336841	0.211117	−0.176303	0.115381	−0.193699	0.067392	−0.258631	0.240045	−0.226870	0.195653	−0.453886	0.220804
−0.312816	0.209181	−0.156260	0.099455	−0.171728	0.057464	−0.234593	0.226182	−0.196801	0.187722	−0.443880	0.212830
−0.294759	0.193228	−0.136218	0.083529	−0.153777	0.059509	−0.212550	0.210326	−0.172716	0.169762	−0.431867	0.200860
−0.258666	0.169323	−0.118181	0.069595	−0.135827	0.061554	−0.196492	0.188484	−0.152621	0.145784	−0.429838	0.188865
−0.218591	0.153429	−0.084138	0.053706	−0.119867	0.061596	−0.174438	0.168648	−0.140549	0.125789	−0.429796	0.172863
−0.186523	0.137514	−0.062090	0.035788	−0.103853	0.041666	−0.158380	0.146806	−0.124465	0.103802	−0.429764	0.160862
−0.160464	0.123582	−0.042059	0.023857	−0.085845	0.021742	−0.138305	0.119007	−0.110412	0.091824	−0.427751	0.154867
−0.130392	0.105662	−0.018021	0.009939	−0.065852	0.005817	−0.118241	0.095186	−0.088350	0.081869	−0.417745	0.146893
−0.102327	0.089736			−0.039875	−0.010091	−0.088193	0.077361	−0.060248	0.059914	−0.399763	0.142940
−0.076258	0.071805			−0.021882	−0.024025	−0.058139	0.057546	−0.042167	0.039936	−0.381791	0.142988
−0.046159	0.043884			−0.001900	−0.035955	−0.028101	0.043699	−0.022093	0.023968	−0.359846	0.151047
−0.030104	0.027926					−0.012080	0.035784	−0.004028	0.009998	−0.313917	0.151169
										−0.289954	0.151233
										−0.263983	0.147302
										−0.241954	0.123358
										−0.207932	0.095446
										−0.179928	0.077519
										−0.147935	0.061602
										−0.103940	0.037717
										−0.069950	0.021806
										−0.045961	0.011868
										−0.027973	0.005916

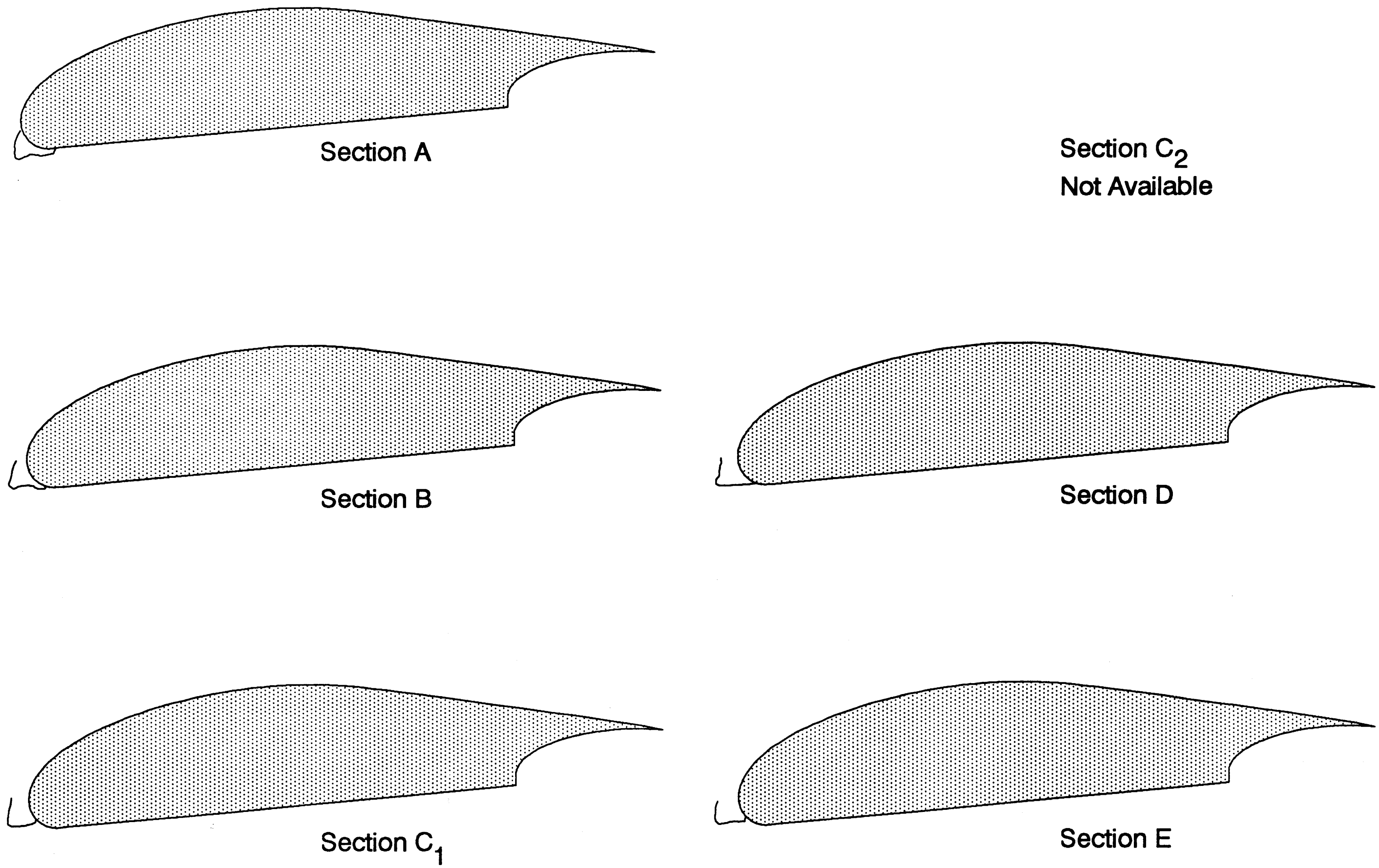
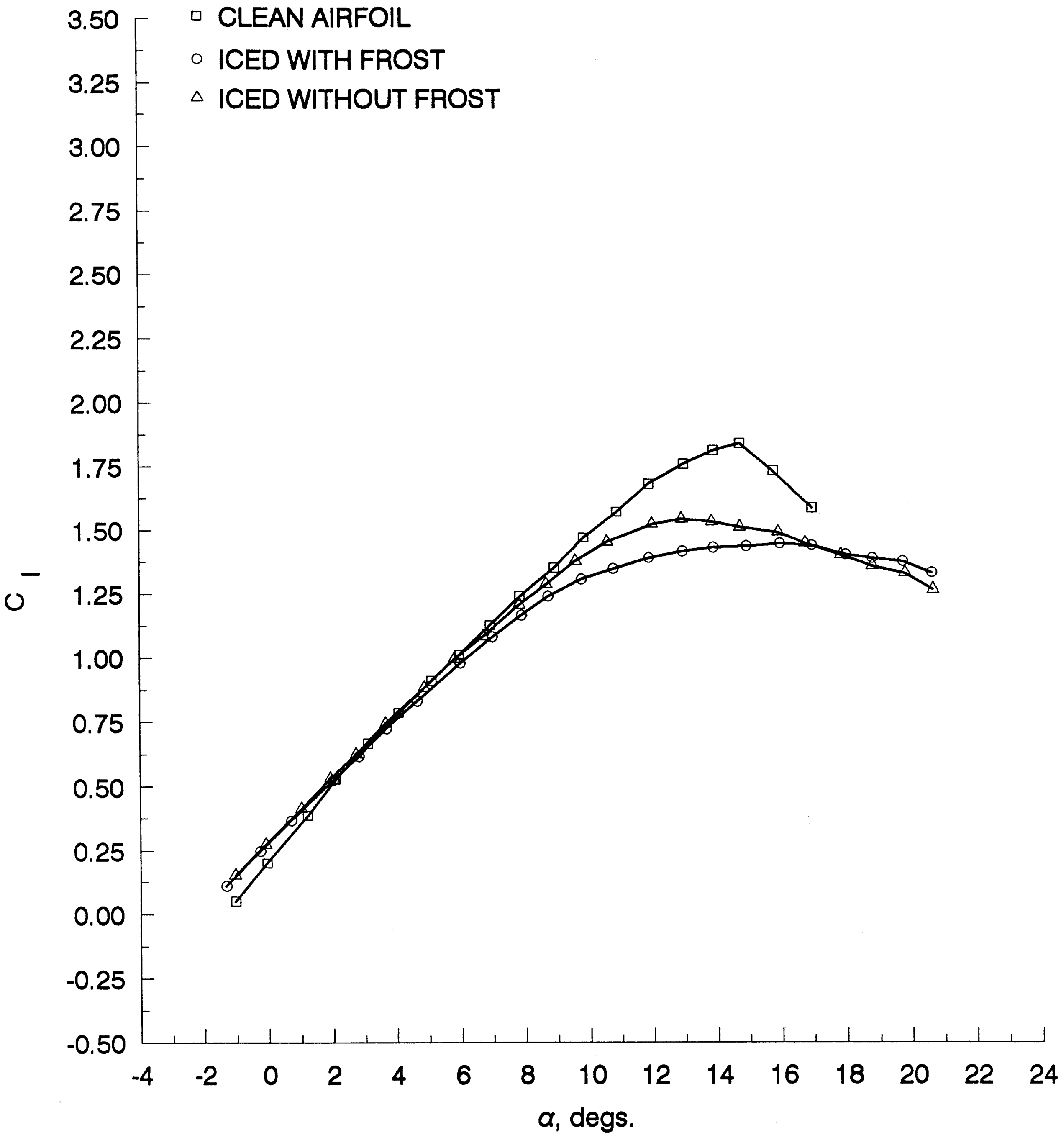


FIGURE 46 - RUN 18 ICE SHAPE TRACINGS FOR MID FLAP (FLAP 2), SECTIONS A - E.

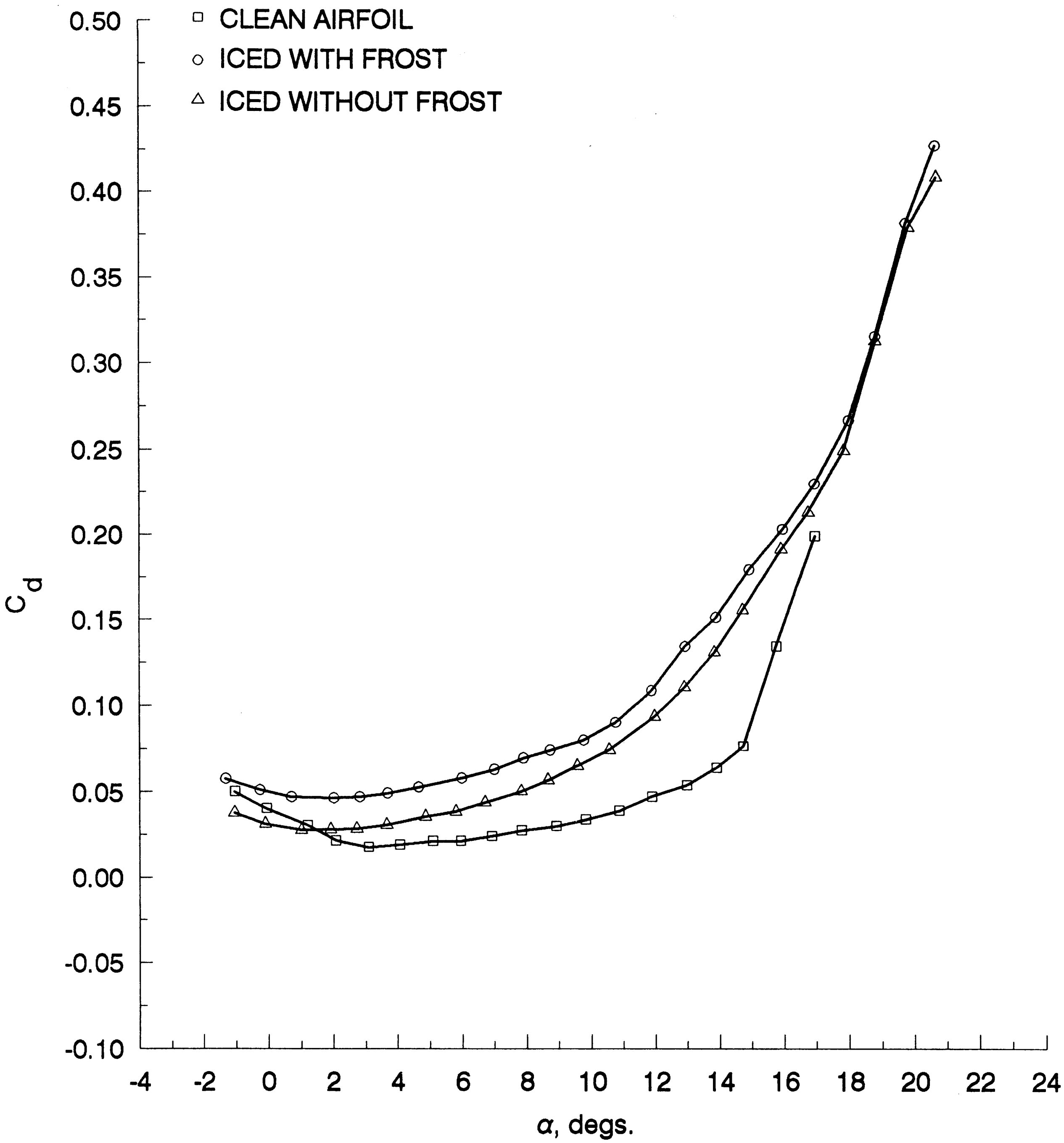
TABLE 79 - RUN 18 ICE SHAPE COORDINATES FOR MID FLAP (FLAP 2), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
13.140938	−0.435718	13.076982	−0.382868	13.031991	−0.362946			13.035941	−0.382596	13.007888	−0.401886
13.134841	−0.449733	13.064848	−0.405077	13.028020	−0.389036			13.035973	−0.394621	12.999812	−0.415979
13.122632	−0.471763	13.056772	−0.425260	13.024034	−0.409107			13.036010	−0.408649	12.997816	−0.428045
13.116536	−0.485779	13.050729	−0.445437	13.018032	−0.431190			13.028025	−0.432719	12.993786	−0.438106
13.110456	−0.505793	13.048729	−0.457539	13.014035	−0.447249			13.026051	−0.446754	12.995868	−0.458203
13.108482	−0.531796	13.046723	−0.467624	13.010048	−0.467320			13.024082	−0.462791	12.993878	−0.472279
13.110580	−0.551790	13.044739	−0.485775	13.008092	−0.491398			13.022102	−0.474822	12.991886	−0.486356
13.108590	−0.571794	13.038674	−0.497888	13.006114	−0.507452			13.022139	−0.488850	12.991930	−0.502438
13.108655	−0.595792	13.030610	−0.522102	13.008183	−0.525502			13.020143	−0.494868	12.996029	−0.518508
13.114827	−0.609776	13.028615	−0.536220	13.018306	−0.533500			13.018152	−0.502889	12.998080	−0.526543
13.131202	−0.615733	13.032691	−0.540242	13.030443	−0.539486			13.012126	−0.506914	13.004187	−0.534568
13.147549	−0.611691	13.042869	−0.546263	13.056710	−0.541423			13.008117	−0.512936	13.014349	−0.542582
13.165930	−0.603644	13.053052	−0.554301	13.080948	−0.539353			13.004121	−0.522967	13.026521	−0.542550
13.188401	−0.595586	13.061193	−0.558312	13.101145	−0.537294			13.002140	−0.534997	13.036657	−0.540513
13.202693	−0.587549	13.071343	−0.554253	13.121341	−0.535234			13.004184	−0.547017	13.048828	−0.540481
13.221089	−0.585502	13.085548	−0.546151	13.135471	−0.531185			13.010231	−0.551009	13.056937	−0.538450
13.229269	−0.585480	13.097738	−0.544103	13.143547	−0.529158			13.018285	−0.552992	13.067073	−0.536413
13.243594	−0.589443	13.111948	−0.538017	13.151623	−0.527130			13.028357	−0.556973	13.075177	−0.532371
13.257912	−0.591406	13.128207	−0.537975	13.163738	−0.525092			13.046464	−0.556925	13.087342	−0.530329
13.274286	−0.597363	13.144460	−0.535916	13.175843	−0.519042			13.060550	−0.556888	13.097485	−0.530302
13.296768	−0.593305	13.160719	−0.535873	13.187948	−0.512992			13.090726	−0.554804	13.115735	−0.528244
13.313121	−0.591263	13.168854	−0.537868					13.110841	−0.552747	13.131963	−0.528202
13.333559	−0.587210	13.179022	−0.539857					13.132973	−0.552689	13.146166	−0.530175
13.345816	−0.583178	13.191217	−0.539825					13.151082	−0.552641	13.160362	−0.528127
13.360123	−0.581141	13.199367	−0.547868					13.163156	−0.552609	13.172532	−0.528095
		13.209551	−0.555906					13.183264	−0.548548	13.186731	−0.528058
		13.221756	−0.559906					13.195338	−0.548516		
		13.238015	−0.559864					13.211441	−0.550477		
		13.250209	−0.559831								
		13.260371	−0.559804								



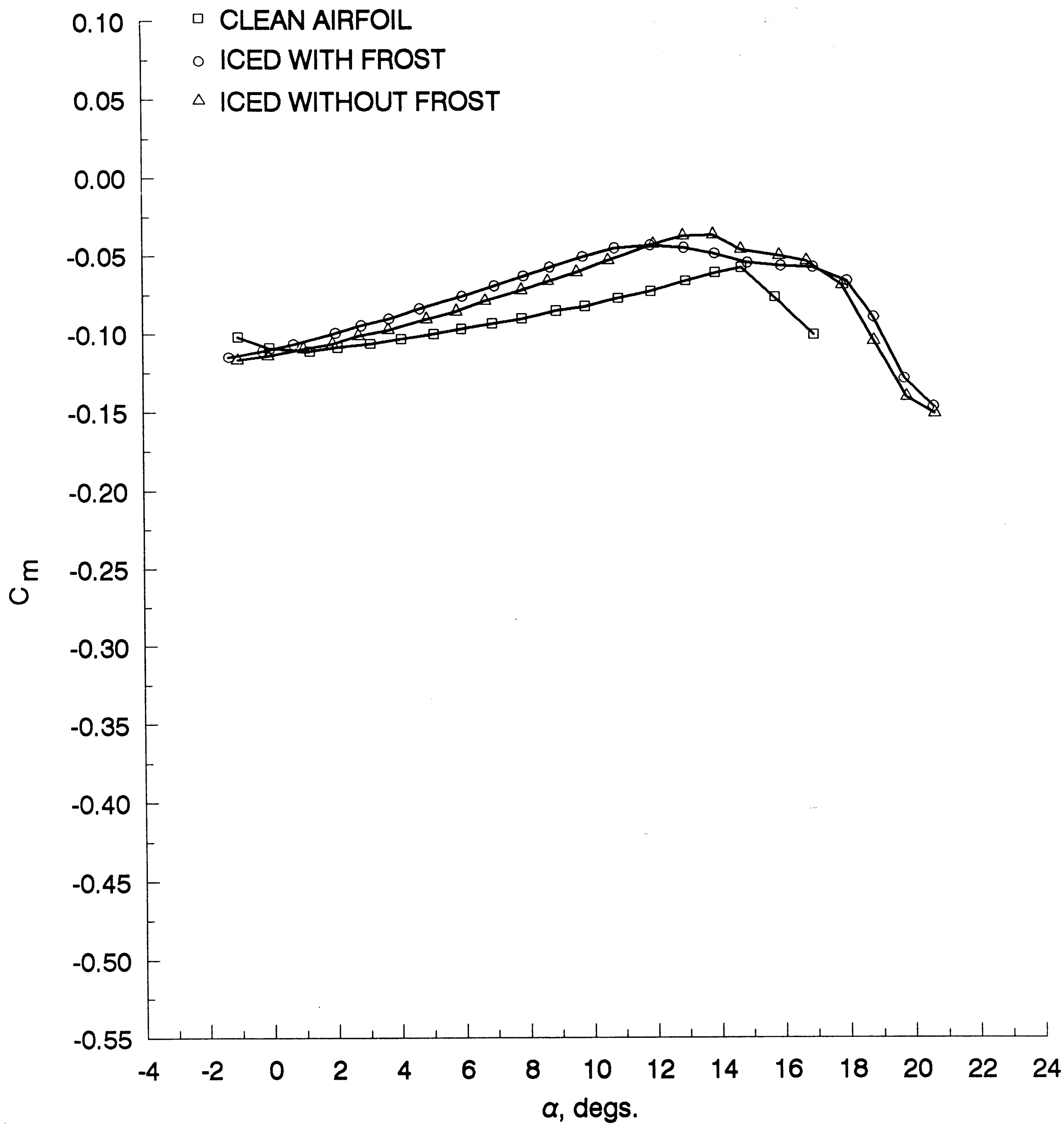
(A) C_l VERSUS α

FIGURE 47 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 18.



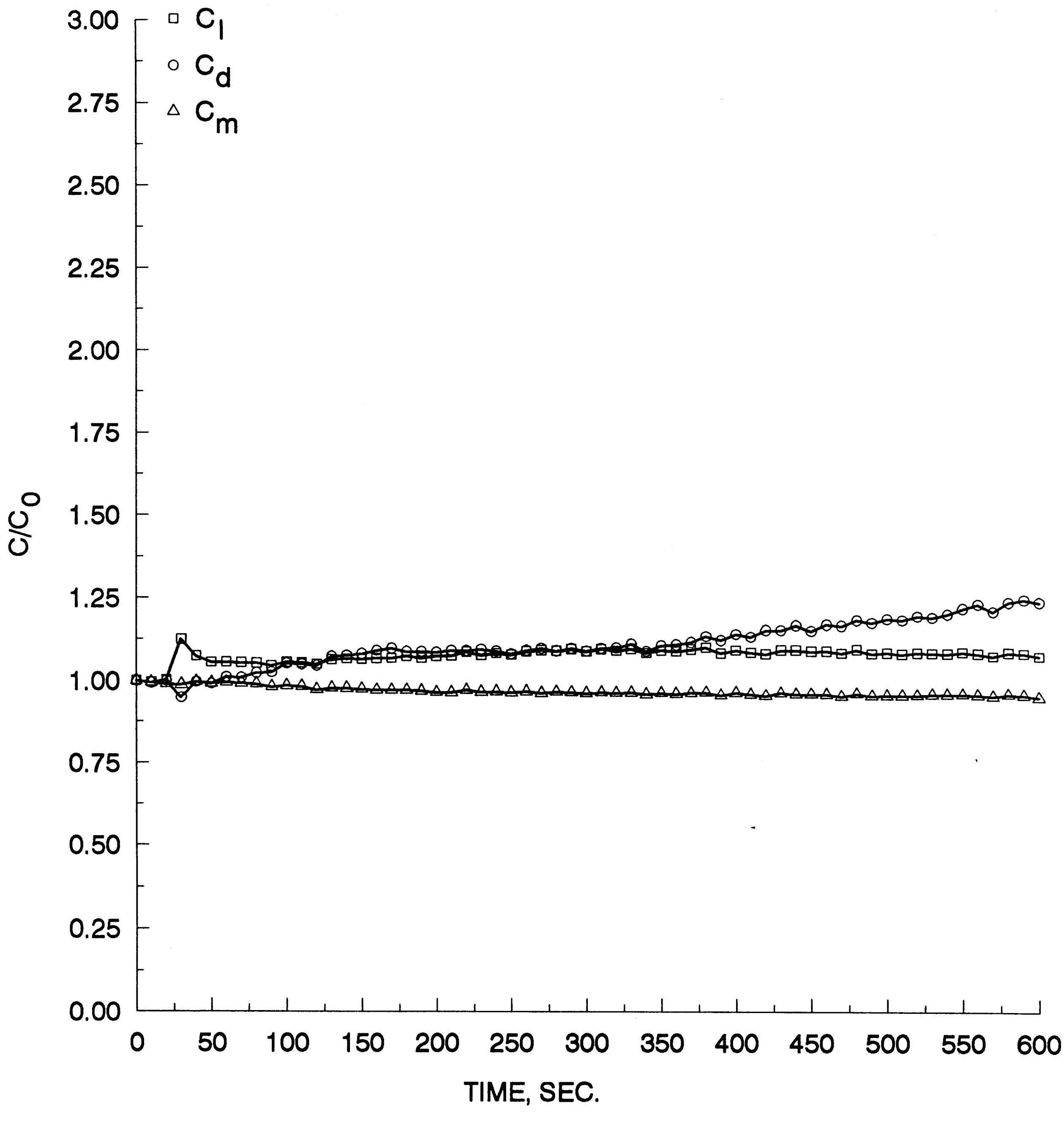
(B) C_d VERSUS α

FIGURE 47 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 18 (con't).



(C) C_m VERSUS α

FIGURE 47 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 18 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 47 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 18 (con't).

TABLE 80 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 18.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0428	0.0505	0.0503	−0.1018
−0.0673	0.2006	0.0404	−0.1088
1.1940	0.3877	0.0307	−0.1109
2.0687	0.5286	0.0217	−0.1083
3.0958	0.6669	0.0178	−0.1062
4.0676	0.7870	0.0193	−0.1032
5.0847	0.9116	0.0214	−0.1001
5.9550	1.0126	0.0214	−0.0970
6.9221	1.1277	0.0241	−0.0937
7.8462	1.2403	0.0274	−0.0906
8.9252	1.3516	0.0299	−0.0856
9.8322	1.4706	0.0338	−0.0830
10.8715	1.5725	0.0388	−0.0777
11.8892	1.6817	0.0472	−0.0731
12.9877	1.7597	0.0539	−0.0665
13.9101	1.8129	0.0640	−0.0612
14.7358	1.8409	0.0765	−0.0579
15.7684	1.7343	0.1345	−0.0771
16.9663	1.5883	0.1993	−0.1008

(B) ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.3261	0.1111	0.0577	−0.1148
−0.2717	0.2475	0.0512	−0.1108
0.6923	0.3671	0.0472	−0.1064
2.0026	0.5257	0.0466	−0.0993
2.8075	0.6188	0.0472	−0.0946
3.6837	0.7267	0.0494	−0.0903
4.6491	0.8326	0.0528	−0.0842
5.9858	0.9795	0.0580	−0.0763
6.9966	1.0828	0.0630	−0.0697
7.9070	1.1665	0.0696	−0.0634
8.7317	1.2403	0.0741	−0.0578
9.7655	1.3069	0.0799	−0.0510
10.7620	1.3481	0.0902	−0.0455
11.8867	1.3907	0.1087	−0.0436
12.9382	1.4170	0.1344	−0.0453
13.8952	1.4317	0.1512	−0.0489
14.9226	1.4376	0.1793	−0.0549
15.9655	1.4479	0.2032	−0.0569
16.9518	1.4411	0.2300	−0.0577
18.0005	1.4041	0.2671	−0.0665
18.8085	1.3898	0.3156	−0.0897
19.7413	1.3781	0.3819	−0.1288
20.6489	1.3329	0.4277	−0.1468

(C). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
−1.0518	0.1537	0.0377	−0.1166
−0.1040	0.2745	0.0314	−0.1138
0.9993	0.4147	0.0277	−0.1093
1.9113	0.5337	0.0281	−0.1062
2.7204	0.6261	0.0285	−0.1012
3.6597	0.7454	0.0308	−0.0975
4.8674	0.8845	0.0354	−0.0908
5.8069	0.9970	0.0384	−0.0859
6.7075	1.0847	0.0438	−0.0793
7.8308	1.2073	0.0502	−0.0725
8.6676	1.2871	0.0568	−0.0667
9.5706	1.3772	0.0651	−0.0610
10.5651	1.4537	0.0743	−0.0535
11.9831	1.5238	0.0935	−0.0430
12.9145	1.5444	0.1106	−0.0376
13.8522	1.5339	0.1309	−0.0370
14.7210	1.5121	0.1556	−0.0464
15.9233	1.4927	0.1913	−0.0504
16.7620	1.4493	0.2132	−0.0538
17.8548	1.4021	0.2495	−0.0693
18.8175	1.3590	0.3129	−0.1049
19.8169	1.3314	0.3793	−0.1408
20.6850	1.2668	0.4089	−0.1512

TABLE 81 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 18.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	0.9954	0.9937	0.9948
20	1.0029	0.9993	0.9904
30	1.1252	0.9486	0.9877
40	1.0752	0.9963	0.9967
50	1.0561	0.9911	0.9926
60	1.0565	1.0111	0.9947
70	1.0549	1.0101	0.9929
80	1.0538	1.0237	0.9897
90	1.0458	1.0261	0.9818
100	1.0572	1.0534	0.9853
110	1.0554	1.0505	0.9831
120	1.0512	1.0466	0.9737
130	1.0648	1.0748	0.9782
140	1.0676	1.0775	0.9780
150	1.0659	1.0831	0.9752
160	1.0687	1.0922	0.9720
170	1.0691	1.0989	0.9721
180	1.0756	1.0899	0.9720
190	1.0702	1.0892	0.9692
200	1.0753	1.0875	0.9656
210	1.0760	1.0923	0.9642
220	1.0889	1.0921	0.9721
230	1.0783	1.0956	0.9662
240	1.0843	1.0907	0.9675
250	1.0799	1.0821	0.9643
260	1.0896	1.0929	0.9676
270	1.0937	1.0991	0.9629
280	1.0915	1.0916	0.9670
290	1.0967	1.0991	0.9654
300	1.0895	1.0910	0.9624
310	1.0968	1.0990	0.9652
320	1.0925	1.1006	0.9635
330	1.0978	1.1119	0.9648
340	1.0858	1.0905	0.9595
350	1.0939	1.1077	0.9635
360	1.0908	1.1101	0.9608
370	1.0967	1.1180	0.9637
380	1.1024	1.1354	0.9650
390	1.0852	1.1235	0.9572
400	1.0944	1.1426	0.9643
410	1.0876	1.1340	0.9597
420	1.0833	1.1546	0.9556
430	1.0947	1.1541	0.9639
440	1.0946	1.1695	0.9604
450	1.0916	1.1523	0.9601
460	1.0921	1.1714	0.9593
470	1.0857	1.1680	0.9532
480	1.0967	1.1849	0.9621
490	1.0844	1.1774	0.9552
500	1.0870	1.1887	0.9562
510	1.0830	1.1852	0.9563
520	1.0872	1.1969	0.9567
530	1.0858	1.1938	0.9596
540	1.0847	1.2032	0.9596
550	1.0891	1.2210	0.9599
560	1.0845	1.2337	0.9581
570	1.0775	1.2122	0.9545
580	1.0878	1.2394	0.9602
590	1.0861	1.2482	0.9579
600	1.0778	1.2405	0.9510

TABLE 82 - TEST CONDITIONS FOR RUN NUMBER 18.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 18	Configuration 1° Flap		Date 05-05-88
P_{air} 78 psig	ΔP_W 70 psid	T_{avg} 17° F	V_∞ 100 mph
Spray Duration 10 min	Ice Accretion Type Mixed		A.O.A. 0°
LWC 0.90 g/m³	MVD 14.4 μm		

Remarks

- Ice accretion on Leading Edge Slat approximately 1/2" thick.
- Rime ice on the upper surface with a smaller mixed region near the leading edge. Ice was uniform across the span.
- Ice accretion on the leading edge of Flap 2 < 1/8" thick, too small to trace. There were ice fingers extending from just under the leading edge of the third flap to its trailing edge.
- Frost extended from approximately 30% chord position to the trailing edge.
- Ice shape tracing for Flap 2, Section C_2 not available

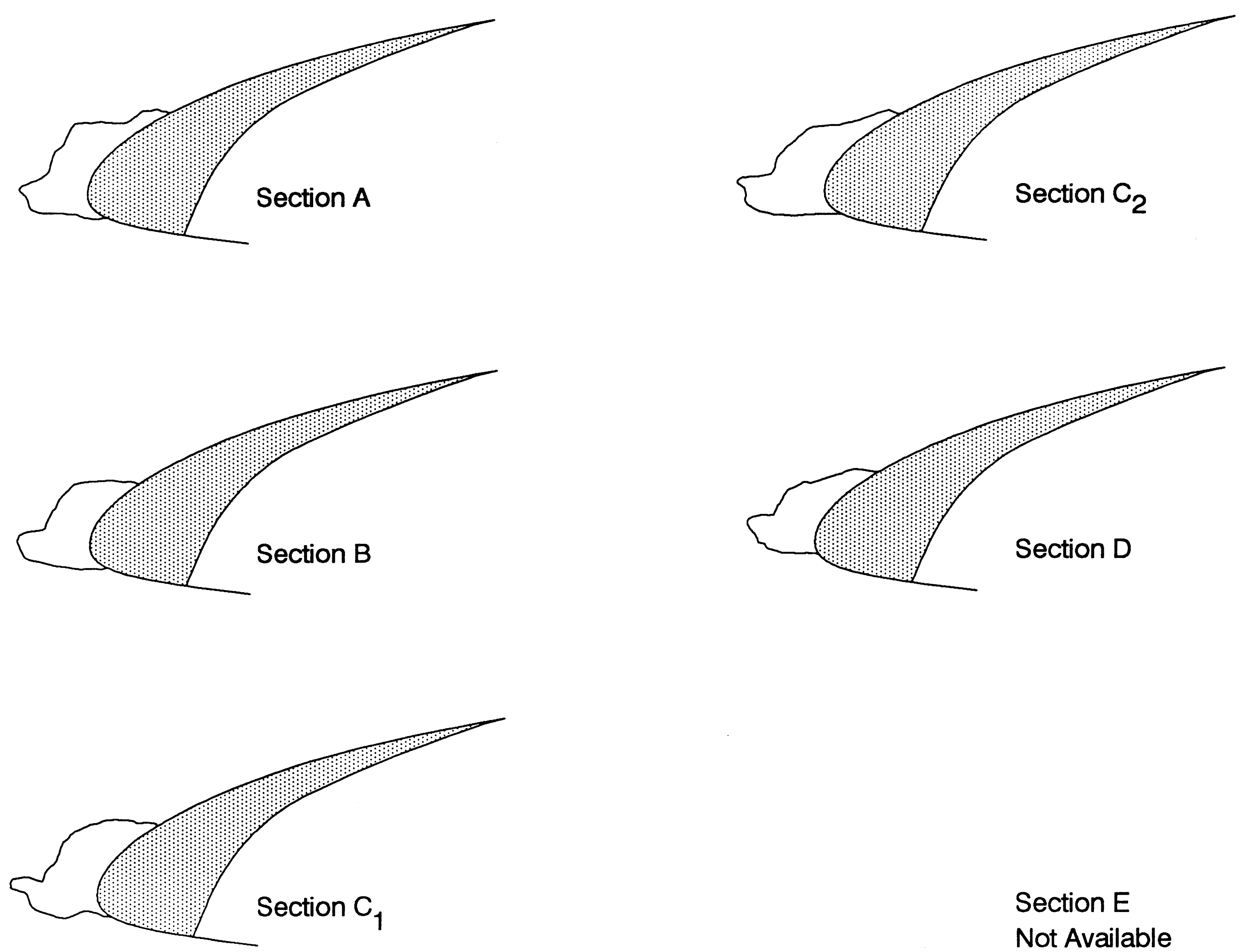


FIGURE 48 - RUN 19 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 83 - RUN 19 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.552651	0.508808	0.310245	0.380789	0.368857	0.437837	0.462683	0.479073	0.389903	0.434725		
0.526655	0.506742	0.288282	0.386700	0.344851	0.439769	0.448501	0.479035	0.371946	0.434678		
0.498655	0.506668	0.272305	0.392626	0.320840	0.443695	0.432271	0.487057	0.351983	0.438604		
0.482644	0.510620	0.248357	0.394551	0.292839	0.443621	0.420104	0.491058	0.326034	0.442514		
0.464639	0.512570	0.208459	0.392457	0.268843	0.441562	0.405906	0.497069	0.310067	0.444462		
0.450623	0.518525	0.186501	0.396378	0.248842	0.441510	0.393739	0.501069	0.290104	0.448387		
0.434606	0.524475	0.166538	0.400303	0.226810	0.453420	0.381593	0.497005	0.278127	0.450345		
0.420612	0.522440	0.142591	0.402230	0.210799	0.457367	0.361344	0.492919	0.258170	0.452282		
0.392627	0.516374	0.110668	0.402145	0.180787	0.461277	0.341099	0.486817	0.244203	0.452245		
0.372627	0.516321	0.082740	0.400082	0.142786	0.461177	0.324907	0.480726	0.220276	0.446213		
0.346631	0.514255	0.064784	0.400034	0.112779	0.463092	0.306694	0.472612	0.202330	0.442187		
0.324663	0.502212	0.034861	0.397966	0.084789	0.459029	0.278357	0.462456	0.184388	0.436172		
0.308705	0.486191	0.010924	0.395913	0.058788	0.458960	0.258113	0.456354	0.162472	0.424177		
0.290737	0.474159	−0.022984	0.391845	0.036798	0.454912	0.235848	0.448230	0.136545	0.420130		
0.270779	0.458127	−0.048911	0.387797	0.010834	0.440880	0.215609	0.440112	0.118603	0.414114		
0.248811	0.446084	−0.076833	0.383745	−0.009156	0.436838	0.197385	0.436031	0.094682	0.406093		
0.226826	0.440034	−0.098759	0.375729	−0.037147	0.432774	0.181188	0.431956	0.074745	0.400072		
0.200826	0.439965	−0.116673	0.359767	−0.075106	0.416715	0.169048	0.425875	0.058804	0.392072		
0.172831	0.437894	−0.130592	0.341825	−0.109070	0.402663	0.154866	0.425837	0.044848	0.388056		
0.138820	0.441798	−0.148512	0.327852	−0.139044	0.392610	0.136642	0.421757	0.028902	0.382046		
0.112819	0.441730	−0.166421	0.309900	−0.153008	0.378609	0.110320	0.415639	0.010961	0.376030		
0.088803	0.447658	−0.182330	0.289965	−0.164976	0.366609	0.090076	0.409537	−0.002995	0.372014		
0.064808	0.445597	−0.194258	0.274018	−0.174940	0.352619	0.069815	0.409483	−0.010971	0.370004		
0.042818	0.441544	−0.200196	0.256098	−0.186914	0.342613	0.037404	0.407381	−0.028917	0.365978		
0.024828	0.437502	−0.206140	0.240166	−0.198887	0.332608	0.011071	0.405296	−0.040894	0.367935		
−0.013183	0.441396	−0.214084	0.226220	−0.208872	0.326597	−0.011210	0.403221	−0.052876	0.371882		
−0.045178	0.439314	−0.226023	0.214252	−0.216830	0.310617	−0.031465	0.401151	−0.064853	0.373840		
−0.075173	0.437237	−0.239931	0.192332	−0.224772	0.288654	−0.049688	0.397070	−0.076809	0.367840		
−0.101094	0.407207	−0.247870	0.176396	−0.232708	0.264696	−0.069949	0.397017	−0.088759	0.359851		
−0.111041	0.387207	−0.259777	0.152491	−0.236671	0.250722	−0.084115	0.390931	−0.104699	0.351851		
−0.120983	0.365209	−0.269700	0.132571	−0.244629	0.234743	−0.104354	0.382812	−0.110675	0.347856		
−0.132919	0.341208	−0.275628	0.110672	−0.248576	0.214785	−0.118504	0.370677	−0.134591	0.337846		
−0.144856	0.317209	−0.291547	0.094715	−0.260540	0.200789	−0.134674	0.356521	−0.154522	0.329835		

TABLE 83 - RUN 19 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.150814	0.301213	−0.321469	0.092646	−0.270508	0.188794	−0.158938	0.338311	−0.166473	0.321847		
−0.162777	0.287200	−0.345401	0.088604	−0.286482	0.178778	−0.179140	0.316079	−0.174427	0.311879		
−0.186740	0.273155	−0.377314	0.084541	−0.306430	0.158778	−0.195310	0.301923	−0.184372	0.299916		
−0.200708	0.261133	−0.401246	0.080499	−0.324372	0.136787	−0.211481	0.287766	−0.194311	0.285963		
−0.204682	0.251136	−0.415196	0.074494	−0.328330	0.120819	−0.227662	0.277642	−0.198264	0.272027		
−0.210650	0.239136	−0.425162	0.070489	−0.330293	0.106850	−0.237766	0.267534	−0.206213	0.260069		
−0.218597	0.219140	−0.435122	0.064494	−0.336251	0.090877	−0.262013	0.243275	−0.212167	0.248117		
−0.222560	0.205148	−0.439096	0.058516	−0.340235	0.084882	−0.276153	0.227108	−0.220117	0.236159		
−0.226507	0.185164	−0.443055	0.046569	−0.358241	0.086829	−0.292307	0.206903	−0.228076	0.228181		
−0.230465	0.169174	−0.447003	0.030643	−0.378263	0.094755	−0.296311	0.188746	−0.232035	0.216234		
−0.234428	0.155182	−0.444971	0.016723	−0.396285	0.102686	−0.302341	0.170584	−0.237984	0.202292		
−0.242380	0.137184	−0.438948	0.002813	−0.410296	0.106639	−0.304313	0.150416	−0.245933	0.190334		
−0.250348	0.125178	−0.432915	−0.015076	−0.426312	0.112581	−0.310364	0.140319	−0.247907	0.182372		
−0.268311	0.111149	−0.428898	−0.025012	−0.444313	0.112533	−0.316399	0.124173	−0.251866	0.170425		
−0.292275	0.097104	−0.416874	−0.044874	−0.456308	0.110507	−0.320435	0.118113	−0.265827	0.168398		
−0.320238	0.083048	−0.406834	−0.068721	−0.472303	0.108470	−0.334585	0.105978	−0.279789	0.166372		
−0.344217	0.074995	−0.394831	−0.080625	−0.492293	0.104427	−0.354840	0.103909	−0.305738	0.170282		
−0.364196	0.066952	−0.370863	−0.090509	−0.512289	0.102380	−0.375090	0.099823	−0.317709	0.170251		
−0.378181	0.060923	−0.342914	−0.096403	−0.520289	0.102359	−0.409516	0.093683	−0.329680	0.170219		
−0.394165	0.054889	−0.320956	−0.100324	−0.532258	0.090358	−0.435849	0.091597	−0.343636	0.166203		
−0.406160	0.052860	−0.293008	−0.106218	−0.536221	0.076384	−0.460162	0.091533	−0.357593	0.162188		
−0.412144	0.046852	−0.271039	−0.114117	−0.534183	0.062426	−0.486489	0.087431	−0.373549	0.160156		
−0.420107	0.032849	−0.239101	−0.120001	−0.538147	0.048452	−0.500677	0.089410	−0.385510	0.156146		
−0.420086	0.024859	−0.221128	−0.125922	−0.532136	0.044478	−0.516869	0.083319	−0.397466	0.150145		
−0.410054	0.012902	−0.195185	−0.127843	−0.522119	0.038521	−0.531024	0.073200	−0.405436	0.146145		
−0.400033	0.004938	−0.161256	−0.131732	−0.502108	0.034584	−0.537086	0.067135	−0.417376	0.134177		
−0.396011	−0.003040	−0.139293	−0.137642	−0.484092	0.028647	−0.539086	0.057049	−0.417355	0.126220		
−0.388000	−0.007014	−0.119336	−0.139579	−0.464075	0.022716	−0.530955	0.046989	−0.417312	0.110304		
−0.381979	−0.014988	−0.083401	−0.147441	−0.456069	0.020742	−0.518777	0.038956	−0.411305	0.102362		
−0.377968	−0.018972	−0.055463	−0.149357	−0.444053	0.014789	−0.504573	0.030929	−0.401276	0.082495		
−0.373926	−0.034941	−0.029531	−0.147299	−0.434026	0.004842	−0.492390	0.020880	−0.391279	0.074563		
−0.369899	−0.044917	−0.007589	−0.145252	−0.427978	−0.013095	−0.490332	0.008788	−0.383271	0.064638		
−0.363857	−0.060881	0.014358	−0.145193	−0.419920	−0.035016	−0.488263	−0.007337	−0.369278	0.054727		

TABLE 83 - RUN 19 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.359804	−0.080844	0.024339	−0.147157	−0.413861	−0.056943	−0.486188	−0.025478	−0.363256	0.040818		
−0.351782	−0.088811	0.046286	−0.147098	−0.399823	−0.070869	−0.490192	−0.043635	−0.353221	0.018960		
−0.337756	−0.098761	0.064254	−0.151030	−0.375775	−0.088759	−0.490160	−0.055732	−0.351173	−0.000929		
−0.325740	−0.104722	0.076225	−0.150998	−0.339742	−0.100632	−0.482018	−0.069825	−0.347172	−0.004897		
−0.313724	−0.110682			−0.307709	−0.112516	−0.469824	−0.083905	−0.327214	−0.006833		
−0.297718	−0.112637			−0.271686	−0.120400	−0.451563	−0.093939	−0.309247	−0.010765		
−0.279707	−0.116584			−0.251659	−0.130321	−0.437354	−0.103983	−0.303224	−0.024675		
−0.257702	−0.118524			−0.225642	−0.136236	−0.419099	−0.111999	−0.289220	−0.038564		
−0.239701	−0.118476			−0.201636	−0.138168	−0.398811	−0.122027	−0.271247	−0.044485		
−0.219701	−0.118423			−0.183641	−0.136125	−0.358269	−0.129985	−0.253279	−0.048416		
−0.205701	−0.118386			−0.153666	−0.126072	−0.329889	−0.135959	−0.235312	−0.052348		
−0.177706	−0.116315			−0.141682	−0.120056	−0.309612	−0.141954	−0.219328	−0.060263		
−0.153705	−0.116251			−0.123702	−0.112029	−0.271118	−0.141853	−0.201355	−0.066184		
−0.135694	−0.120198			−0.101728	−0.101997	−0.234638	−0.145789	−0.177413	−0.066120		
−0.119689	−0.122153			−0.081743	−0.095960	−0.183977	−0.149688	−0.153470	−0.066057		
−0.103683	−0.124108			−0.059742	−0.095902	−0.147519	−0.145559	−0.135512	−0.066010		
−0.093683	−0.124081			−0.037731	−0.099833	−0.104978	−0.143431	−0.115555	−0.067946		
−0.077683	−0.124039			−0.017720	−0.103770	−0.072561	−0.143345	−0.097598	−0.067899		
−0.061677	−0.125994			0.002297	−0.109701	−0.048254	−0.141265	−0.071659	−0.067830		
−0.051661	−0.131960			0.018319	−0.117638	−0.017864	−0.141185	−0.051707	−0.067778		
−0.031640	−0.139897			0.038346	−0.127559	0.014548	−0.139083	−0.029754	−0.069709		
−0.019624	−0.145857			0.064347	−0.127490	0.042912	−0.139008	0.002175	−0.071614		
−0.001618	−0.147807			0.092359	−0.131406	0.067230	−0.140960	0.018147	−0.075551		
0.012393	−0.151764					0.097620	−0.140880	0.026139	−0.079508		
0.034398	−0.153703										
0.054399	−0.153651										
0.072399	−0.153603										
0.094383	−0.147553										
0.112384	−0.147505										

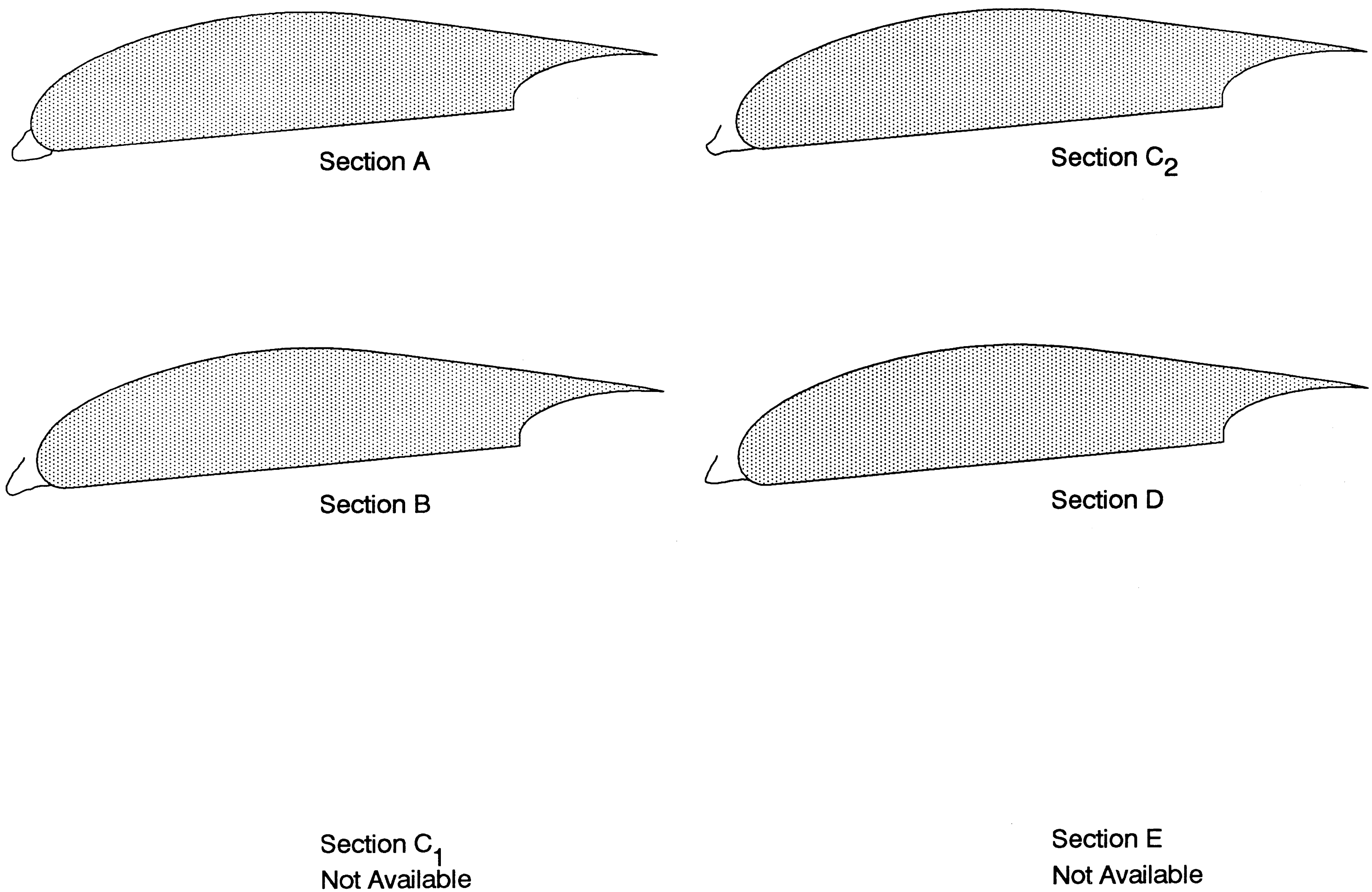
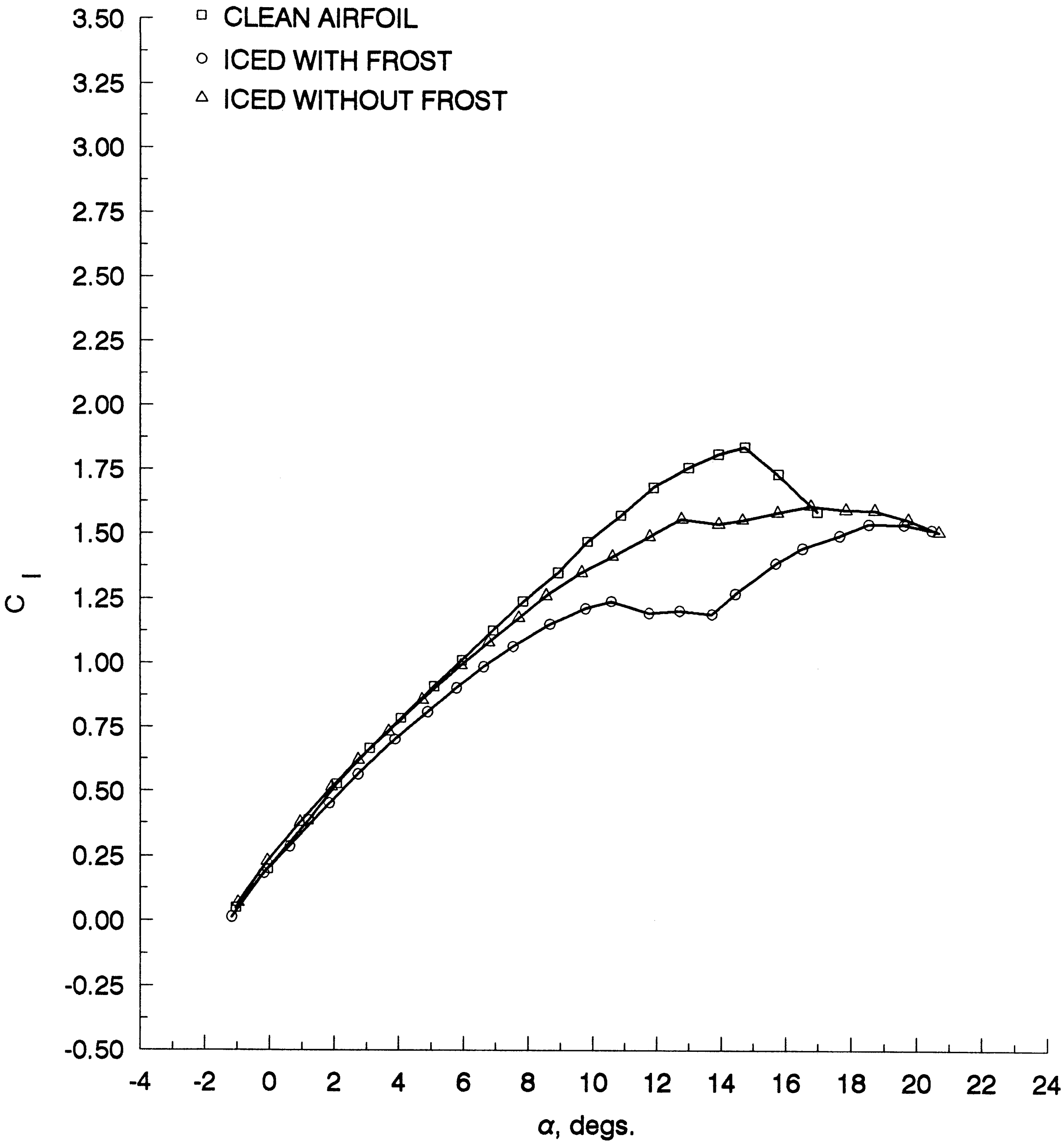


FIGURE 49 - RUN 19 ICE SHAPE TRACINGS FOR MID FLAP (FLAP 2), SECTIONS A - E.

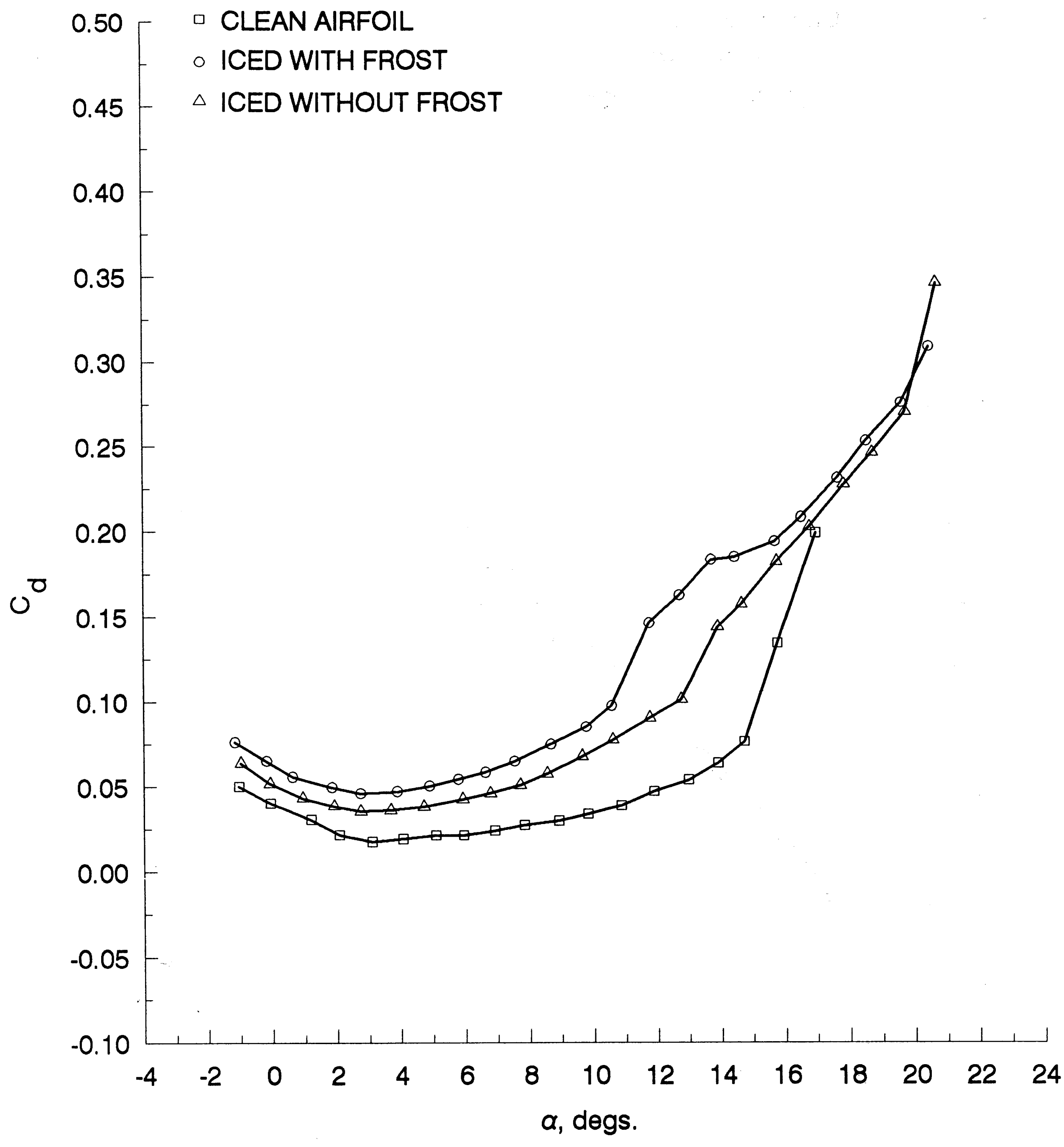
TABLE 84 - RUN 19 ICE SHAPE COORDINATES FOR MID FLAP (FLAP 2), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
13.150167	−0.404026	13.058600	−0.356788			13.040739	−0.399013	13.005820	−0.364786		
13.135977	−0.418077	13.056601	−0.368831			13.034640	−0.417085	13.001770	−0.376894		
13.113648	−0.428145	13.044443	−0.382906			13.026487	−0.433154	12.997722	−0.389002		
13.103513	−0.438181	13.028230	−0.401004			13.018323	−0.445212	12.989591	−0.401121		
13.097448	−0.450209	13.016095	−0.423104			13.010176	−0.463288	12.975358	−0.421321		
13.091394	−0.466241	13.001909	−0.439190			12.999984	−0.483376	12.967222	−0.431424		
13.083297	−0.478274	12.985687	−0.453276			12.977503	−0.505501	12.959113	−0.451607		
13.063021	−0.496345	12.975598	−0.481389			12.965235	−0.515563	12.948946	−0.465748		
13.048853	−0.518404	12.963441	−0.495464			12.955012	−0.523614	12.944903	−0.479872		
13.036686	−0.528445	12.951298	−0.515557			12.948875	−0.527642	12.938812	−0.491986		
13.022497	−0.542496	12.943228	−0.537646			12.948901	−0.537673	12.932722	−0.504099		
13.020519	−0.562521	12.943298	−0.563726			12.957136	−0.551694	12.928674	−0.516207		
13.022615	−0.586540	12.953515	−0.583761			12.965365	−0.563709	12.928706	−0.528305		
13.024674	−0.596544	12.965737	−0.593760			12.975649	−0.577725	12.940967	−0.534321		
13.038934	−0.608519	12.986068	−0.595713			13.004370	−0.589687	12.955265	−0.538317		
13.061301	−0.612464	13.018563	−0.585597			13.020753	−0.585632	12.973642	−0.542301		
13.091788	−0.612385	13.038862	−0.575513			13.047370	−0.577539	13.000173	−0.542232		
13.116171	−0.610319	13.053073	−0.569458			13.069895	−0.571462	13.024653	−0.538135		
13.138523	−0.608259	13.067281	−0.561396			13.092424	−0.567392	13.036887	−0.534070		
13.175095	−0.604159	13.079471	−0.559358			13.125200	−0.563294	13.051173	−0.534033		
13.205560	−0.596072	13.093699	−0.559320			13.164129	−0.561187	13.067488	−0.529958		
13.236013	−0.583980	13.111982	−0.555260			13.207151	−0.557063	13.079729	−0.527909		
13.264446	−0.575898	13.126187	−0.547198			13.235834	−0.554983	13.098086	−0.523829		
13.276629	−0.571862	13.152589	−0.539104			13.258359	−0.548906	13.118488	−0.521759		
		13.174943	−0.537040					13.136851	−0.519694		
		13.199334	−0.536976					13.155213	−0.517630		
								13.169493	−0.515577		



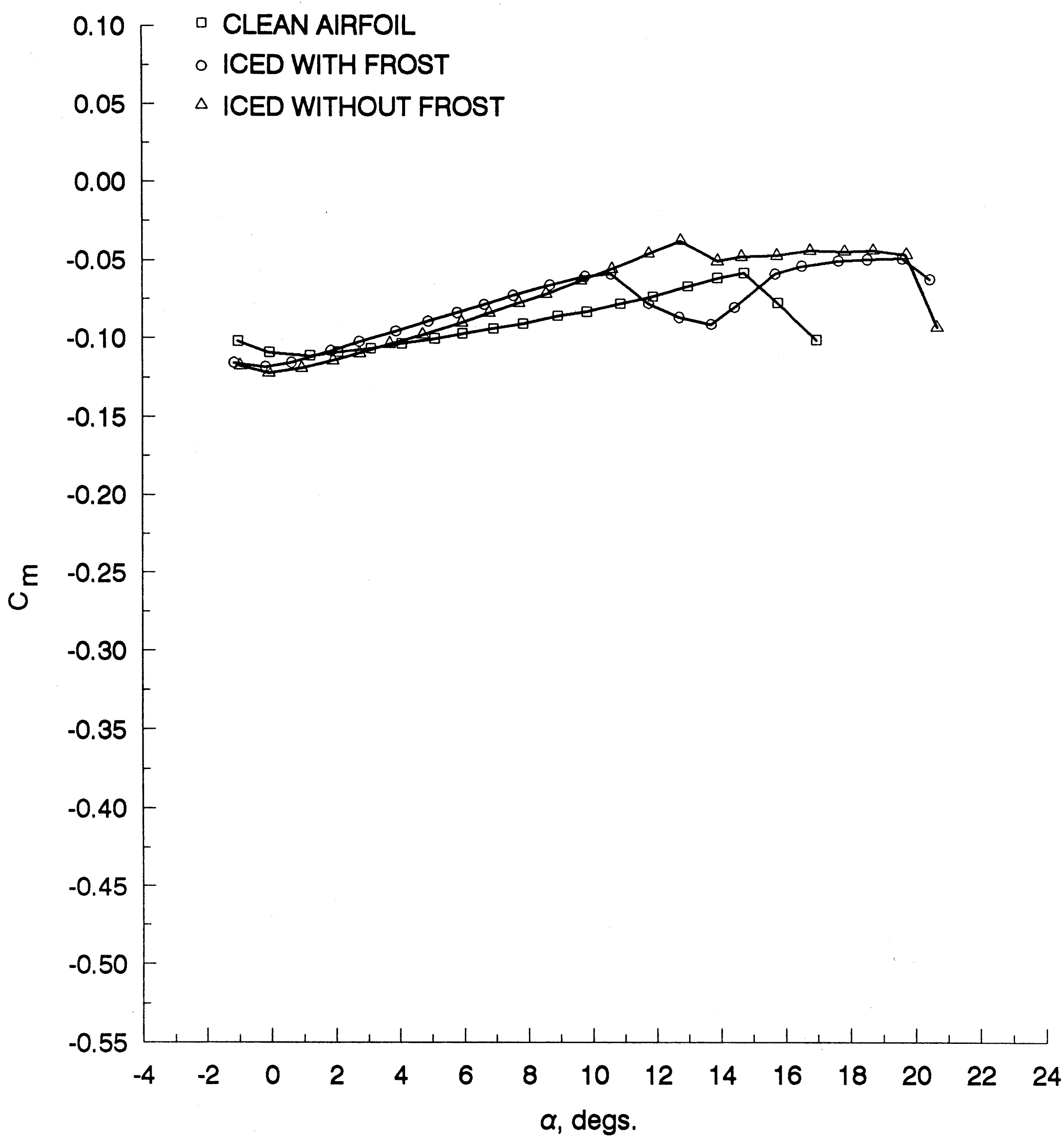
(A) C_l VERSUS α

FIGURE 50 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 19.



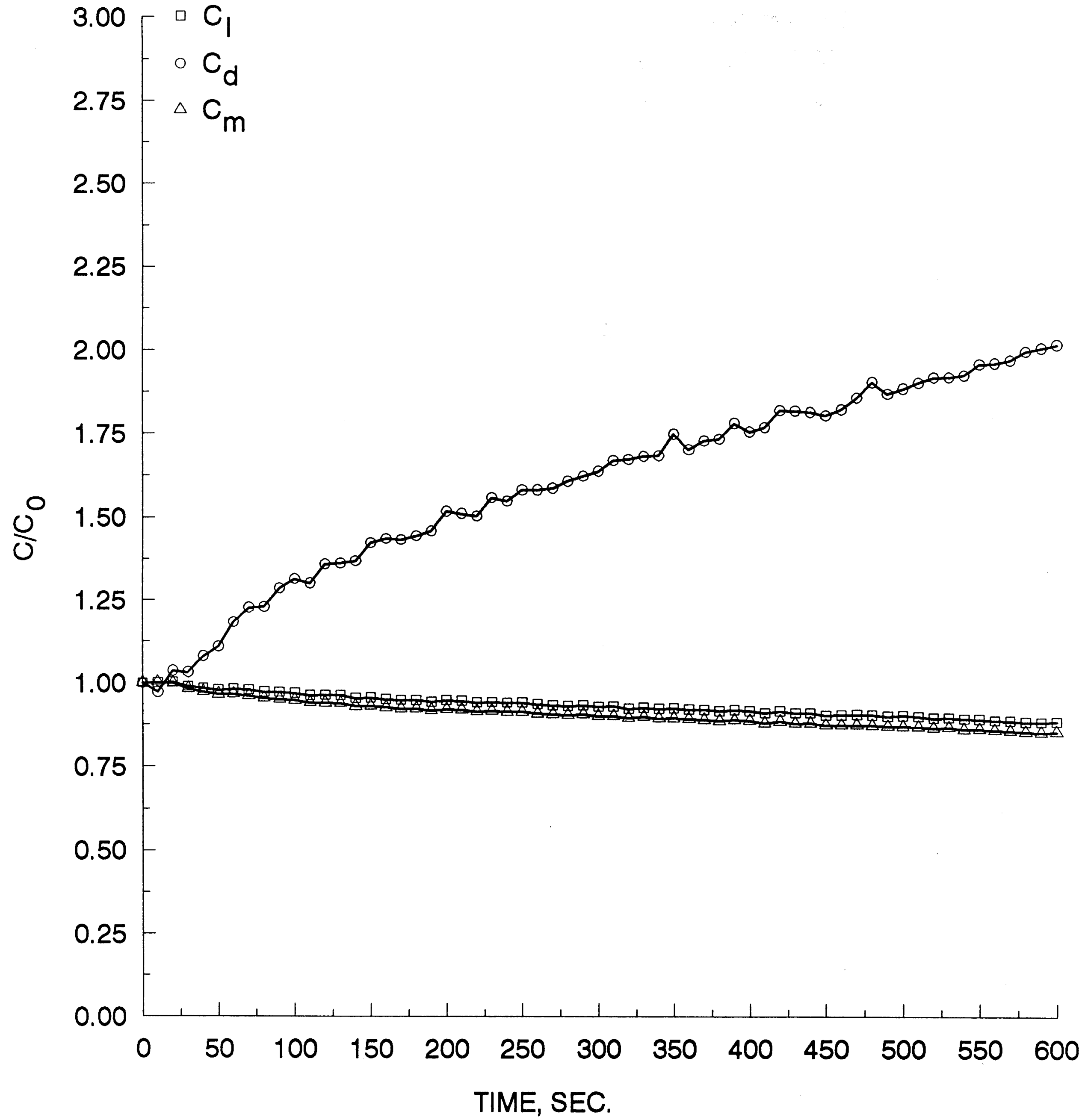
(B) C_d VERSUS α

FIGURE 50 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 19 (con't).



(C) C_m VERSUS α

FIGURE 50 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 19 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 50 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 19 (con't).

TABLE 85 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 19.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.0428	0.0505	0.0503	−0.1018
−0.0673	0.2006	0.0404	−0.1088
1.1940	0.3877	0.0307	−0.1109
2.0687	0.5286	0.0217	−0.1083
3.0958	0.6669	0.0178	−0.1062
4.0676	0.7870	0.0193	−0.1032
5.0847	0.9116	0.0214	−0.1001
5.9550	1.0126	0.0214	−0.0970
6.9221	1.1277	0.0241	−0.0937
7.8462	1.2403	0.0274	−0.0906
8.9252	1.3516	0.0299	−0.0856
9.8322	1.4706	0.0338	−0.0830
10.8715	1.5725	0.0388	−0.0777
11.8892	1.6817	0.0472	−0.0731
12.9877	1.7597	0.0539	−0.0665
13.9101	1.8129	0.0640	−0.0612
14.7358	1.8409	0.0765	−0.0579
15.7684	1.7343	0.1345	−0.0771
16.9663	1.5883	0.1993	−0.1008

(B) ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−1.1671	0.0150	0.0763	−0.1154
−0.1862	0.1836	0.0653	−0.1179
0.6170	0.2862	0.0559	−0.1152
1.8387	0.4528	0.0498	−0.1077
2.7266	0.5657	0.0462	−0.1019
3.8841	0.7027	0.0473	−0.0953
4.8915	0.8110	0.0505	−0.0890
5.7865	0.9043	0.0544	−0.0836
6.6269	0.9871	0.0585	−0.0784
7.5395	1.0660	0.0650	−0.0726
8.6740	1.1530	0.0750	−0.0659
9.7720	1.2136	0.0851	−0.0604
10.5728	1.2423	0.0976	−0.0587
11.7550	1.1968	0.1464	−0.0777
12.7123	1.2057	0.1628	−0.0865
13.7106	1.1930	0.1836	−0.0908
14.4382	1.2715	0.1851	−0.0800
15.6925	1.3888	0.1943	−0.0586
16.5211	1.4465	0.2085	−0.0535
17.6483	1.4951	0.2314	−0.0502
18.5385	1.5398	0.2534	−0.0493
19.6117	1.5381	0.2762	−0.0486
20.4663	1.5171	0.3093	−0.0620

(C). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
−0.9756	0.0699	0.0640	−0.1172
−0.0770	0.2295	0.0519	−0.1218
0.9346	0.3771	0.0434	−0.1188
1.9098	0.5167	0.0386	−0.1139
2.7366	0.6214	0.0356	−0.1094
3.6838	0.7339	0.0362	−0.1034
4.7204	0.8583	0.0382	−0.0977
5.9300	0.9930	0.0426	−0.0898
6.7849	1.0817	0.0460	−0.0838
7.7153	1.1768	0.0510	−0.0774
8.5558	1.2622	0.0576	−0.0716
9.6439	1.3516	0.0677	−0.0630
10.6063	1.4137	0.0775	−0.0554
11.7660	1.4920	0.0905	−0.0456
12.7651	1.5586	0.1014	−0.0373
13.9107	1.5403	0.1441	−0.0503
14.6577	1.5558	0.1576	−0.0476
15.7456	1.5850	0.1825	−0.0468
16.7724	1.6106	0.2027	−0.0436
17.8420	1.5947	0.2275	−0.0442
18.7196	1.5931	0.2464	−0.0435
19.7370	1.5567	0.2706	−0.0462
20.6921	1.5093	0.3467	−0.0927

TABLE 86 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 19.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	1.0012	0.9725	1.0020
20	1.0033	1.0371	0.9998
30	0.9899	1.0326	0.9827
40	0.9841	1.0807	0.9740
50	0.9790	1.1097	0.9665
60	0.9823	1.1832	0.9673
70	0.9799	1.2271	0.9621
80	0.9738	1.2296	0.9554
90	0.9733	1.2863	0.9526
100	0.9707	1.3148	0.9498
110	0.9639	1.3018	0.9420
120	0.9647	1.3597	0.9411
130	0.9644	1.3627	0.9406
140	0.9555	1.3694	0.9315
150	0.9569	1.4242	0.9318
160	0.9526	1.4375	0.9280
170	0.9502	1.4337	0.9239
180	0.9494	1.4459	0.9235
190	0.9440	1.4604	0.9194
200	0.9488	1.5200	0.9220
210	0.9475	1.5130	0.9208
220	0.9426	1.5054	0.9158
230	0.9435	1.5607	0.9169
240	0.9414	1.5501	0.9145
250	0.9420	1.5837	0.9141
260	0.9374	1.5843	0.9099
270	0.9342	1.5892	0.9071
280	0.9320	1.6098	0.9051
290	0.9339	1.6250	0.9069
300	0.9299	1.6396	0.9023
310	0.9307	1.6718	0.9021
320	0.9238	1.6752	0.8969
330	0.9277	1.6846	0.9004
340	0.9244	1.6863	0.8953
350	0.9255	1.7512	0.8960
360	0.9220	1.7049	0.8937
370	0.9213	1.7315	0.8913
380	0.9173	1.7371	0.8878
390	0.9209	1.7842	0.8908
400	0.9174	1.7590	0.8887
410	0.9118	1.7720	0.8815
420	0.9171	1.8229	0.8864
430	0.9117	1.8219	0.8809
440	0.9119	1.8177	0.8815
450	0.9051	1.8079	0.8752
460	0.9063	1.8262	0.8751
470	0.9072	1.8611	0.8760
480	0.9064	1.9077	0.8745
490	0.9023	1.8730	0.8721
500	0.9042	1.8889	0.8715
510	0.9015	1.9065	0.8701
520	0.8972	1.9226	0.8671
530	0.8983	1.9237	0.8687
540	0.8950	1.9290	0.8634
550	0.8946	1.9630	0.8636
560	0.8899	1.9655	0.8602
570	0.8894	1.9751	0.8589
580	0.8858	2.0009	0.8556
590	0.8850	2.0117	0.8540
600	0.8866	2.0221	0.8551

TABLE 87 - TEST CONDITIONS FOR RUN NUMBER 19.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 19	Configuration 1° Flap	Date 05-05-88	
P_{air} 78 psig	ΔP_w 70 psid	T_{avg} 17° F	V_∞ 100 mph
Spray Duration 10 min	Ice Accretion Type Rime	A.O.A. 5°	
LWC 0.90 g/m³	MVD 14.4 μm		

Remarks

- Frost on the lower surface from under the slat to the flaps. Frost on the flaps. Ice fingers on the lower surface of Flap 3. Frost on the upper surface from the region behind the leading edge to Flap 1.
- Ice accretion on the Leading Edge Slat approximately 9/16" thick.
- Ice accretion on the leading edge of Flap 2 approximately 3/16" thick. The third flap had ice fingers from the lower surface of the leading edge to the trailing edge
- The ice was uniform across the span.
- The tunnel temperature went to 32° before tracings were made hence there may be some sublimation.
- Ice shape tracings for Leading Edge Slat, Section E and Flap 2, Section C_1 and E not available

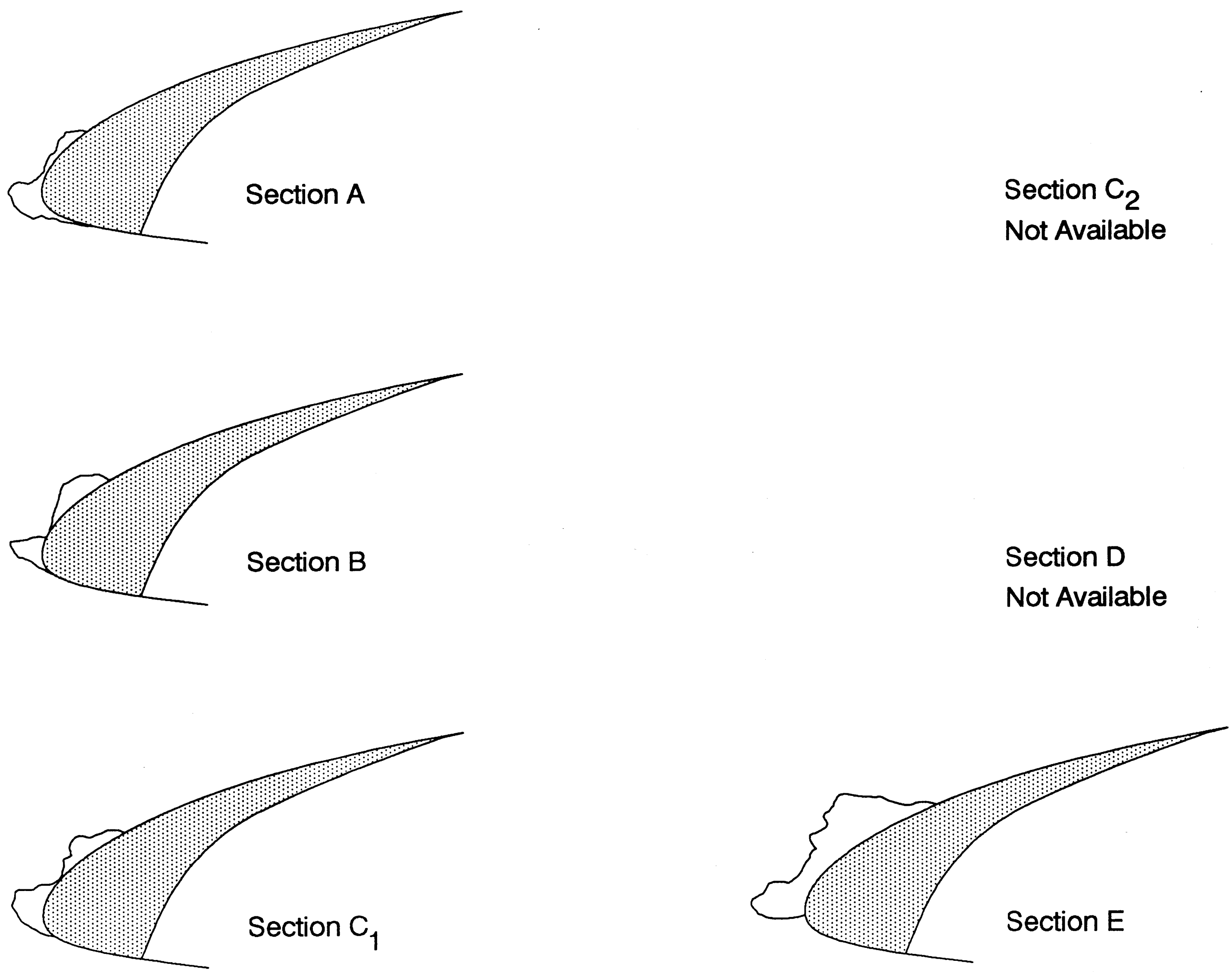


FIGURE 51 - RUN 20 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 88 - RUN 20 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.282145	0.357710	0.411173	0.445316	0.491515	0.494689					0.729226	0.640899
0.268184	0.359678	0.389224	0.459202	0.477532	0.500620					0.717244	0.640867
0.250225	0.365646	0.377245	0.469131	0.457563	0.506536					0.703264	0.640830
0.228295	0.365588	0.359296	0.477051	0.447587	0.506510					0.687288	0.640788
0.210362	0.361529	0.343349	0.480993	0.429629	0.506462					0.665330	0.636761
0.184450	0.359455	0.333384	0.482959	0.413661	0.508410					0.645381	0.628772
0.166512	0.357401	0.319445	0.480930	0.395703	0.508362					0.625421	0.624750
0.150568	0.355353	0.303520	0.476903	0.375776	0.498362					0.601455	0.624687
0.140610	0.351316	0.285592	0.476856	0.359835	0.490362					0.581474	0.628603
0.138643	0.341283	0.263685	0.474805	0.337902	0.484335					0.555496	0.634488
0.134677	0.333251	0.237789	0.474737	0.325941	0.480325					0.531510	0.642362
0.128711	0.327219	0.217885	0.468708	0.309994	0.474314					0.511523	0.648263
0.118754	0.323181	0.205949	0.462700	0.296043	0.468309					0.497533	0.652195
0.110795	0.317143	0.192026	0.454695	0.282081	0.466282					0.481535	0.660090
0.100853	0.307090	0.176116	0.444693	0.262123	0.468219					0.465538	0.667986
0.096903	0.293041	0.162198	0.434696	0.256132	0.470193					0.447548	0.673892
0.092963	0.274981	0.150257	0.430679	0.242154	0.474135					0.419599	0.669849
0.089018	0.258927	0.140308	0.426669	0.230182	0.474103					0.387636	0.673734
0.087056	0.246889	0.128366	0.422653	0.220205	0.474077					0.355677	0.675634
0.081090	0.240857	0.120430	0.410680	0.206249	0.470061					0.325716	0.677540
0.071148	0.230803	0.116483	0.396725	0.194287	0.466050					0.303737	0.681451
0.061196	0.224760	0.112536	0.382770	0.180357	0.452087					0.281759	0.685361
0.047267	0.214695	0.110570	0.372804	0.172402	0.442118					0.267774	0.687309
0.041307	0.206657	0.106623	0.358849	0.168433	0.434150					0.249795	0.689246
0.031391	0.186576	0.100694	0.340905	0.162478	0.422197					0.235815	0.689210
0.023475	0.164495	0.096753	0.324958	0.158520	0.410250					0.219844	0.687183
0.015548	0.146425	0.092816	0.307019	0.158541	0.402292					0.203878	0.683172
0.013596	0.130376	0.086872	0.295051	0.162558	0.392355					0.191932	0.669250
0.009651	0.114322	0.082925	0.281096	0.166570	0.384408					0.183981	0.655338
−0.002290	0.106268	0.075004	0.263146	0.166591	0.376450					0.176019	0.645395
−0.014220	0.094203	0.069060	0.251178	0.168607	0.368497					0.170065	0.631488
−0.022174	0.086160	0.067100	0.239220	0.172619	0.360550					0.170092	0.621566
−0.032110	0.074101	0.065129	0.231247	0.162658	0.354555					0.162124	0.613608
−0.042068	0.070063	0.063163	0.221282	0.154693	0.348565					0.154163	0.603664
−0.050027	0.064026	0.063184	0.213313	0.142732	0.344555					0.146206	0.591737

TABLE 88 - RUN 20 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
-0.059974	0.055977	0.063200	0.207337	0.126790	0.336555					0.134245	0.583768
-0.073914	0.049924	0.063216	0.201361	0.124821	0.326602					0.122278	0.577783
-0.083877	0.047892	0.059264	0.189398	0.126843	0.316660					0.112335	0.561881
-0.105818	0.051844	0.053319	0.177430	0.126870	0.306712					0.118374	0.544038
-0.117785	0.053817	0.047380	0.163470	0.126907	0.292786					0.126384	0.536121
-0.129758	0.057797	0.045409	0.155496	0.122942	0.282828					0.130399	0.528194
-0.139721	0.055765	0.043449	0.143539	0.117015	0.260927					0.136416	0.518288
-0.151678	0.053727	0.039497	0.131576	0.115057	0.246997					0.130473	0.500412
-0.159642	0.049695	0.037526	0.123602	0.109108	0.233054					0.120509	0.492448
-0.173566	0.037625	0.027603	0.109631	0.097183	0.215117					0.102567	0.480495
-0.183519	0.031582	0.019640	0.107618	0.081247	0.205128					0.084620	0.470525
-0.191462	0.019528	0.007688	0.107587	0.065311	0.195138					0.064670	0.462535
-0.199394	0.003463	-0.004269	0.109547	0.049370	0.187138					0.042723	0.454539
-0.199346	-0.014586	-0.022197	0.109500	0.031417	0.185101					0.032759	0.446576
-0.185348	-0.030592	-0.036136	0.107471	0.013459	0.185053					0.032796	0.432685
-0.179330	-0.044614	-0.048083	0.105446	-0.002503	0.185011					0.032828	0.420778
-0.173297	-0.064653	-0.058032	0.101436	-0.020456	0.182974					0.042871	0.398976
-0.167268	-0.082686	-0.067987	0.099418	-0.026436	0.180969					0.048894	0.387085
-0.153280	-0.094682	-0.089878	0.091391	-0.038387	0.172979					0.056904	0.379168
-0.141287	-0.106683	-0.101825	0.089367	-0.048343	0.164995					0.066921	0.367289
-0.129298	-0.116678	-0.117755	0.087333	-0.056303	0.157016					0.054955	0.361303
-0.115316	-0.126668	-0.129702	0.085309	-0.074255	0.154979					0.042988	0.355319
-0.097347	-0.136647	-0.139657	0.083291	-0.092213	0.154931					0.039015	0.347371
-0.081376	-0.144627	-0.153601	0.083254	-0.108181	0.156879					0.031058	0.335444
-0.061413	-0.154601	-0.161569	0.083233	-0.122148	0.156842					0.029114	0.315594
-0.053422	-0.160596	-0.173516	0.081209	-0.136110	0.154815					0.025141	0.307646
0.000354	-0.140398	-0.181484	0.081188	-0.150077	0.154778					0.017180	0.297703
0.028308	-0.156367	-0.187460	0.081172	-0.158043	0.148789					0.005223	0.287749
0.042269	-0.158335	-0.191433	0.077178	-0.167998	0.140805					-0.000731	0.273843
0.064194	-0.156271	-0.191396	0.063233	-0.167966	0.128868					-0.010679	0.259926
0.080149	-0.158235	-0.185383	0.049304	-0.169930	0.116926					-0.022582	0.230128
0.094120	-0.164214	-0.179381	0.039360	-0.173878	0.101000					-0.038506	0.210242
0.108097	-0.172198	-0.173384	0.031408	-0.177832	0.087062					-0.050462	0.200289
0.122063	-0.176172	-0.163371	0.011514	-0.183791	0.077099					-0.070396	0.186345
0.140017	-0.180135	-0.153379	-0.000412	-0.189746	0.065146					-0.078357	0.176402

TABLE 88 - RUN 20 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.163947	−0.182076	−0.143388	−0.012338	−0.179716	0.045278					−0.090324	0.170417
0.189875	−0.186018	−0.133417	−0.016295	−0.159694	0.019467					−0.098302	0.166427
0.203841	−0.189991	−0.117476	−0.018246	−0.153661	0.001578					−0.114284	0.168369
0.231774	−0.197939	−0.107505	−0.022203	−0.139646	−0.016290					−0.122277	0.170333
0.247728	−0.199902	−0.085572	−0.030113	−0.127637	−0.030185					−0.136262	0.172280
0.275645	−0.201833	−0.063633	−0.040015	−0.111637	−0.044069					−0.150242	0.172244
0.301568	−0.203769	−0.051655	−0.049944	−0.095654	−0.051985					−0.172209	0.172186
0.319506	−0.201716	−0.035682	−0.063846	−0.081660	−0.061896					−0.188181	0.170159
		−0.017722	−0.075751	−0.067671	−0.069816					−0.204147	0.166148
		0.002214	−0.081674	−0.049693	−0.077727					−0.216119	0.162148
		0.018176	−0.091592	−0.037699	−0.085653					−0.224075	0.150220
		0.032147	−0.101515	−0.017715	−0.097537					−0.230019	0.132345
		0.044120	−0.109452	0.000265	−0.105448					−0.235984	0.122407
		0.066053	−0.117362	0.014247	−0.111379					−0.243940	0.110479
				0.034211	−0.115306					−0.251907	0.102521
				0.064146	−0.117216					−0.261882	0.098526
										−0.279829	0.088556
										−0.297782	0.080571
										−0.313732	0.070607
										−0.321667	0.050743
										−0.321630	0.036852
										−0.309590	0.015055
										−0.289566	−0.004737
										−0.279549	−0.016617
										−0.263556	−0.022528
										−0.243564	−0.030413
										−0.231561	−0.038319
										−0.211579	−0.042236
										−0.181618	−0.044141
										−0.145665	−0.046031
										−0.113712	−0.045947
										−0.081769	−0.041894
										−0.049826	−0.037840
										−0.019891	−0.029824
										0.000069	−0.025803

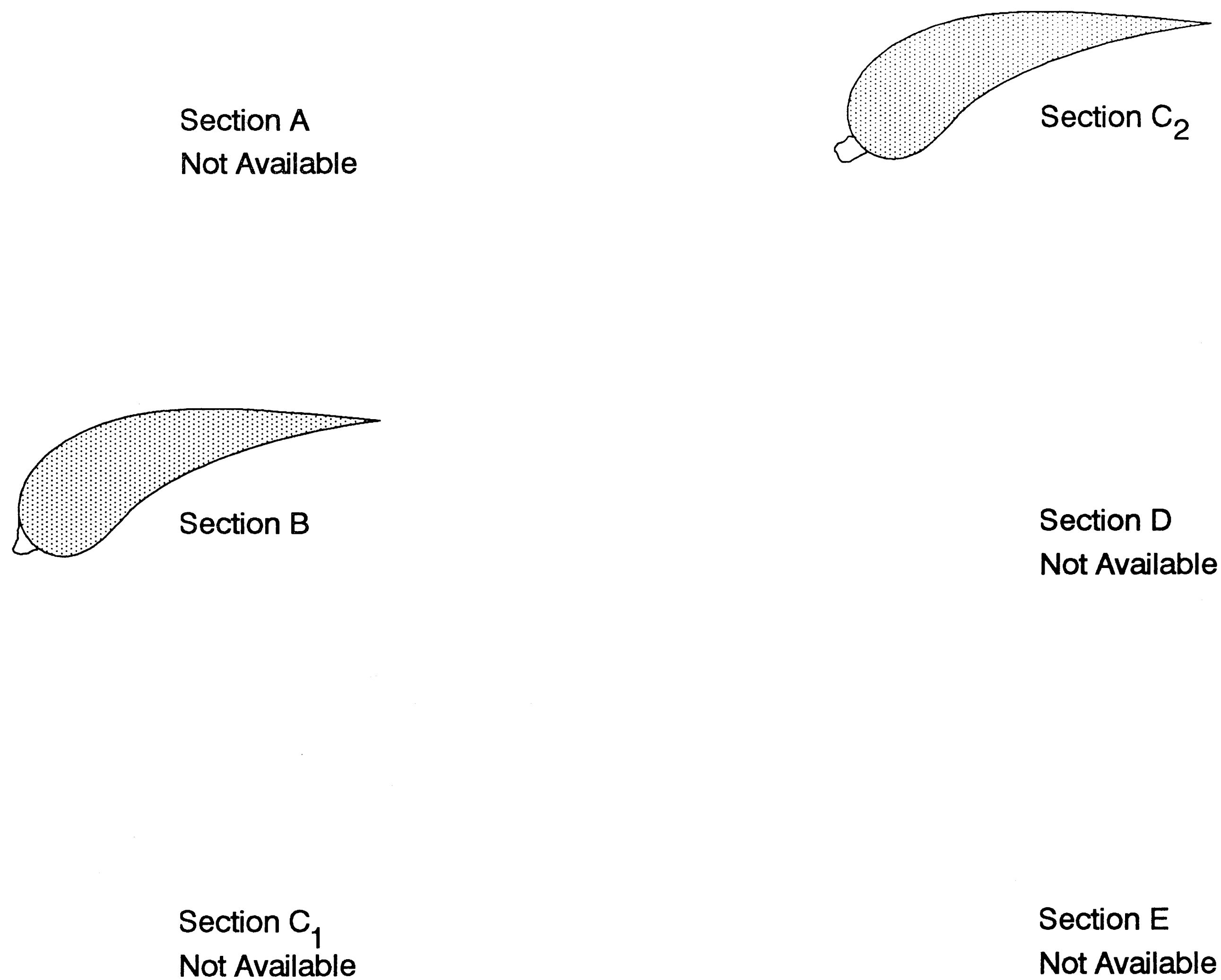


FIGURE 52 - RUN 20 ICE SHAPE TRACINGS FOR FORE FLAP (FLAP 1), SECTIONS A - E.

TABLE 89 - RUN 20 ICE SHAPE COORDINATES FOR FORE FLAP (FLAP1), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
		12.621803	−0.234919			12.626384	−0.270143				
		12.615811	−0.246863			12.614521	−0.286048				
		12.615848	−0.260779			12.600665	−0.297989				
		12.613868	−0.270725			12.580838	−0.303994				
		12.613899	−0.282654			12.568949	−0.309978				
		12.615939	−0.294577			12.559059	−0.321909				
		12.609947	−0.306522			12.553133	−0.331846				
		12.603950	−0.316478			12.553175	−0.347719				
		12.599966	−0.328417			12.561134	−0.355634				
		12.591977	−0.344343			12.569102	−0.367518				
		12.587985	−0.354294			12.573112	−0.383380				
		12.594047	−0.368195			12.579096	−0.395270				
		12.604110	−0.376121			12.591037	−0.409127				
		12.618176	−0.380060			12.610878	−0.409074				
		12.636255	−0.382000			12.628731	−0.407043				
		12.650305	−0.379976			12.640620	−0.401059				
		12.668372	−0.377940			12.654489	−0.393086				
		12.680404	−0.371944			12.670340	−0.385107				
		12.690428	−0.365954			12.690150	−0.373150				
		12.698450	−0.361957			12.706003	−0.365171				
		12.708485	−0.359942			12.721861	−0.359177				
		12.722535	−0.357918								

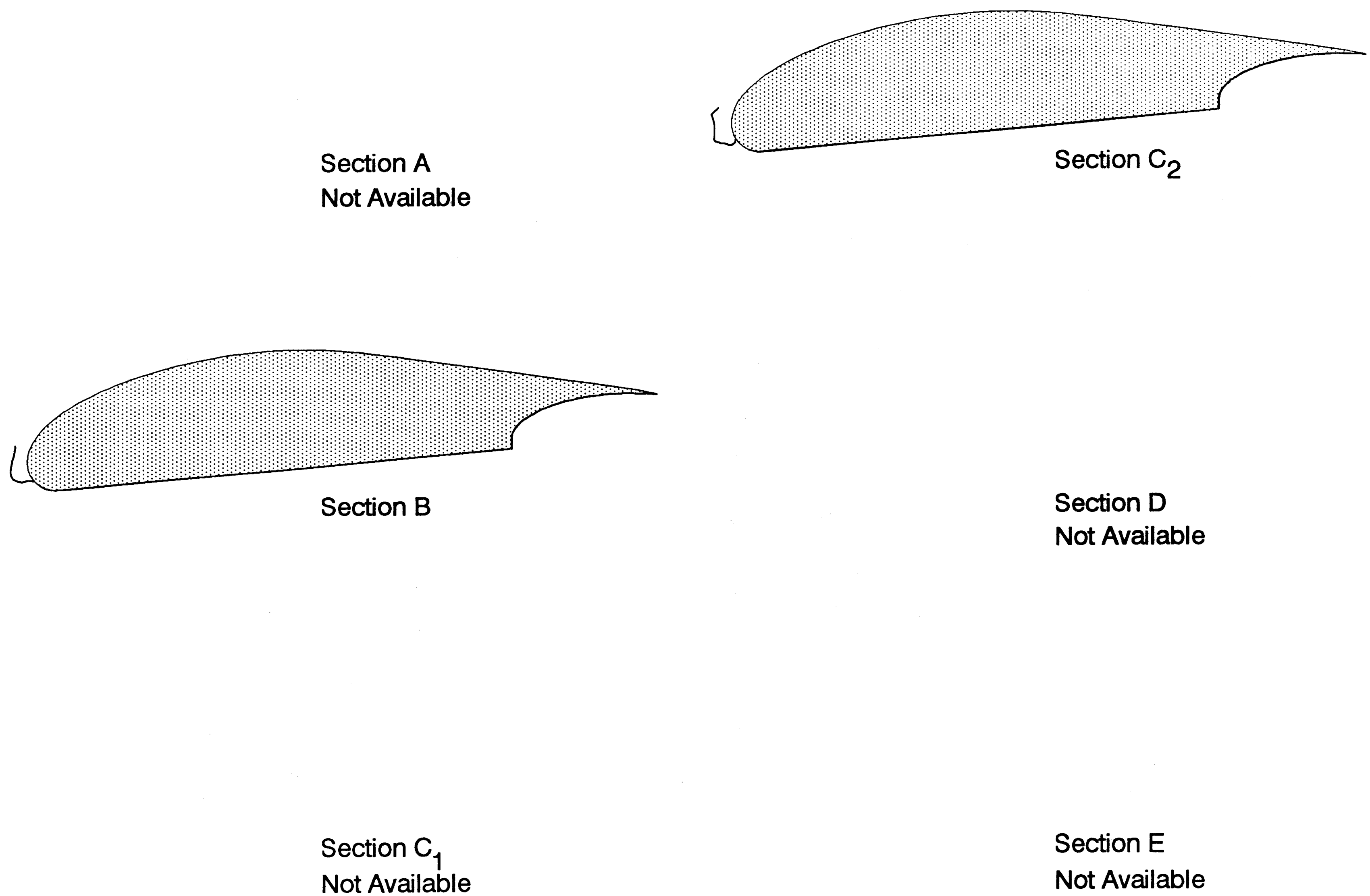


FIGURE 53 - RUN 20 ICE SHAPE TRACINGS FOR MID FLAP (FLAP 2), SECTIONS A - E.

TABLE 90 - RUN 20 ICE SHAPE COORDINATES FOR MID FLAP (FLAP 2), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
		13.060616	−0.268264			13.054208	−0.272852				
		13.058613	−0.282298			13.007668	−0.315145				
		13.056626	−0.302345			13.013792	−0.329186				
		13.052587	−0.318388			13.017891	−0.345241				
		13.050600	−0.338434			13.022001	−0.365311				
		13.042469	−0.350480			13.026107	−0.383374				
		13.038431	−0.366524			13.026138	−0.395423				
		13.034398	−0.384572			13.028211	−0.411483				
		13.032394	−0.398606			13.028237	−0.421523				
		13.030385	−0.410635			13.028274	−0.435580				
		13.028378	−0.422665			13.028306	−0.447629				
		13.028416	−0.436694			13.026300	−0.455667				
		13.030505	−0.454726			13.026332	−0.467716				
		13.036661	−0.466735			13.024320	−0.473746				
		13.046898	−0.478733			13.030433	−0.483770				
		13.057118	−0.484718			13.038557	−0.487765				
		13.065298	−0.490709			13.052773	−0.493752				
		13.081636	−0.494675			13.069010	−0.497726				
		13.108178	−0.498614			13.085237	−0.497684				
		13.116335	−0.496589			13.105539	−0.503655				
		13.132653	−0.492538			13.123805	−0.507623				
		13.142851	−0.490508			13.140033	−0.507580				
		13.155097	−0.490476			13.152177	−0.497508				
						13.162307	−0.493465				

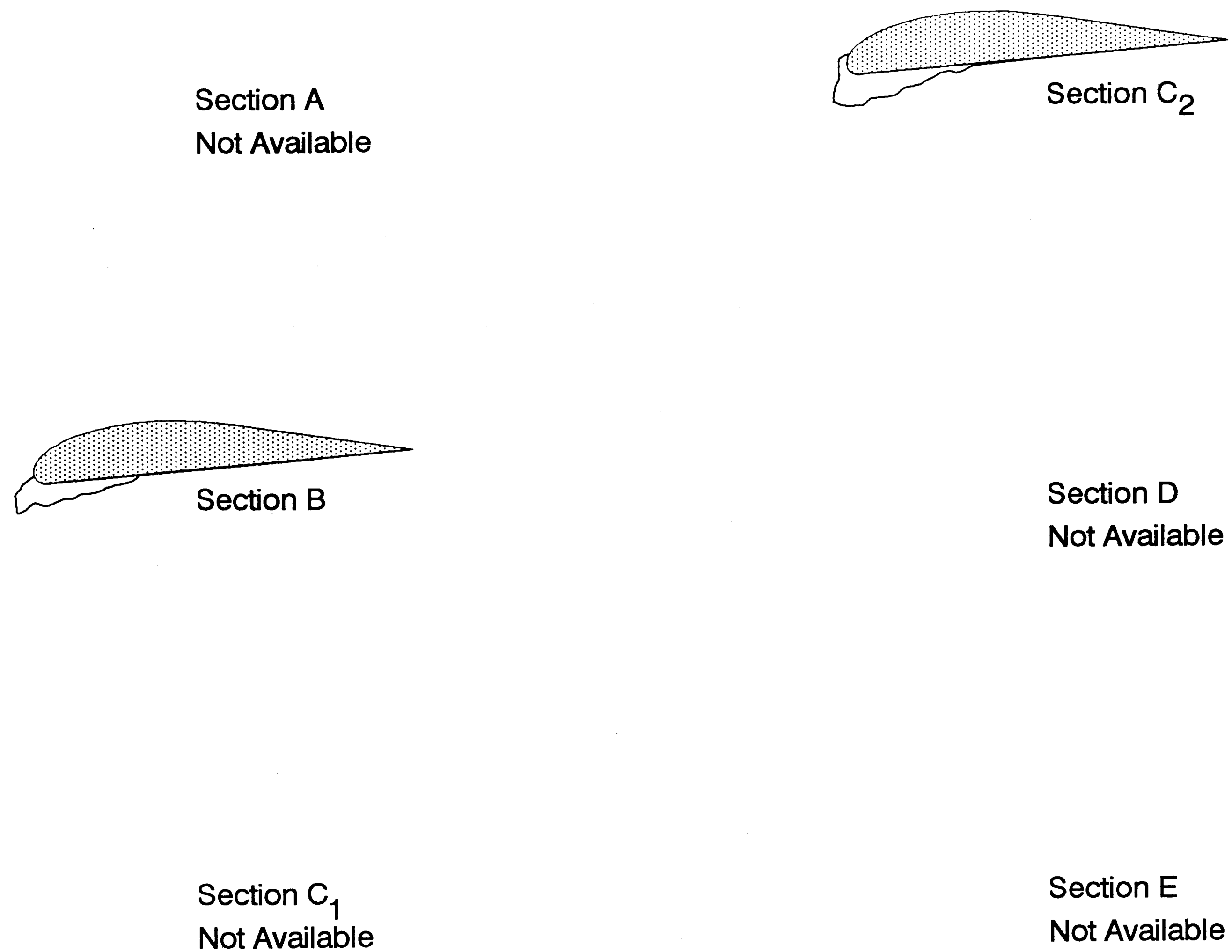


FIGURE 54 - RUN 20 ICE SHAPE TRACINGS FOR AFT FLAP (FLAP 3), SECTIONS A - E.

TABLE 91 - RUN 20 ICE SHAPE COORDINATES FOR AFT FLAP (FLAP 3), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
		16.355099	−0.240215			16.355621	−0.176214				
		16.349070	−0.246159			16.343574	−0.178236				
		16.330966	−0.258064			16.333537	−0.182243				
		16.316890	−0.267982			16.325511	−0.186244				
		16.300806	−0.281858			16.315481	−0.192241				
		16.284720	−0.293758			16.307461	−0.198232				
		16.272671	−0.309600			16.303474	−0.210183				
		16.264648	−0.323455			16.301491	−0.220139				
		16.256611	−0.331381			16.301536	−0.236059				
		16.246569	−0.343265			16.301565	−0.247999				
		16.240549	−0.353163			16.303625	−0.265904				
		16.244628	−0.370939			16.303656	−0.277845				
		16.244680	−0.390702			16.305696	−0.289780				
		16.244719	−0.404536			16.303720	−0.301725				
		16.248786	−0.418359			16.301743	−0.313671				
		16.250867	−0.442070			16.295752	−0.327617				
		16.252892	−0.446017			16.289761	−0.341563				
		16.256933	−0.449959			16.283779	−0.357500				
		16.262977	−0.449944			16.279802	−0.373431				
		16.271030	−0.447946			16.277840	−0.391347				
		16.283104	−0.441986			16.275868	−0.405282				
		16.301219	−0.434033			16.273896	−0.419218				
		16.313271	−0.420168			16.273922	−0.429168				
		16.323318	−0.410260			16.271941	−0.439124				
		16.335382	−0.400347			16.288030	−0.445052				
		16.351480	−0.392400			16.308147	−0.454949				
		16.367616	−0.398287			16.330261	−0.458871				
		16.381738	−0.404180			16.352367	−0.460803				
		16.393840	−0.408101			16.370449	−0.460755				
		16.409964	−0.410035			16.408615	−0.458665				
		16.432123	−0.408001			16.428709	−0.458613				
		16.448221	−0.400054			16.442756	−0.452606				
		16.460294	−0.394093			16.454794	−0.446604				
		16.474380	−0.386152			16.464805	−0.432647				
		16.488478	−0.384139			16.470816	−0.426661				

TABLE 91 - RUN 20 ICE SHAPE COORDINATES FOR AFT FLAP (FLAP 3), SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
		16.500551	−0.378178			16.476831	−0.422665				
		16.522703	−0.372192			16.484858	−0.418663				
		16.542844	−0.370163			16.500930	−0.418622				
		16.562995	−0.370110			16.523027	−0.416573				
		16.575076	−0.366127			16.537084	−0.414546				
		16.587142	−0.358190			16.567211	−0.410487				
		16.605253	−0.348261			16.587297	−0.408444				
		16.625390	−0.344256			16.617422	−0.402395				
		16.649565	−0.342217			16.631453	−0.390418				
		16.677770	−0.340168			16.645486	−0.378441				
		16.691868	−0.338155			16.653499	−0.370459				
		16.709983	−0.330202			16.667542	−0.362462				
		16.728103	−0.324226			16.683604	−0.358440				
		16.750235	−0.312311			16.699674	−0.356407				
		16.772384	−0.306324			16.711721	−0.354386				
		16.794526	−0.298361			16.727781	−0.348373				
		16.818694	−0.294346			16.749870	−0.344335				
		16.850914	−0.286357			16.763918	−0.338328				
		16.867024	−0.282362			16.773939	−0.328352				
		16.885142	−0.276386			16.800018	−0.314352				
		16.905264	−0.266453			16.820096	−0.308330				
		16.919342	−0.256534			16.838140	−0.294352				
		16.929390	−0.246626			16.854190	−0.286349				
		16.943468	−0.236708			16.866226	−0.278357				
						16.890324	−0.274314				
						16.908392	−0.268296				
						16.920452	−0.270255				
						16.932522	−0.276193				
						16.950620	−0.282116				
						16.974716	−0.276083				
						16.994786	−0.268069				
						17.014846	−0.256076				
						17.030896	−0.248074				
						17.040926	−0.242077				

TABLE 92 - TEST CONDITIONS FOR RUN NUMBER 20.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 20	Configuration 15° Flap		Date 05-06-88
P_{air} 80 psig	ΔP_w 72.5 psid	T_{avg} 28° F	V_∞ 100 mph
Spray Duration 8 min	Ice Accretion Type Glaze		A.O.A. 0°
LWC 0.92 g/m³	MVD 14.4 μm		

Remarks

- Frost on the lower surface, including Flaps 1 and 2. Flap 3 had what appeared to be ice deposition and not frost. No ice between slat and leading edge of the main airfoil. Frost was scraped off for second force balance measurements.
- Lost force measurements due to data system error.
- Somewhat less ice near Section A. Ice started melting from the wing and caused difficulties in taking tracings.
- Ice shape tracings not available for

  Leading Edge Slat, Sections C_2 and D
  Flap 1, Sections A, C_1, D and E
  Flap 2, Sections A, C_1, D and E
  Flap 3, Sections A, C_1, D and E

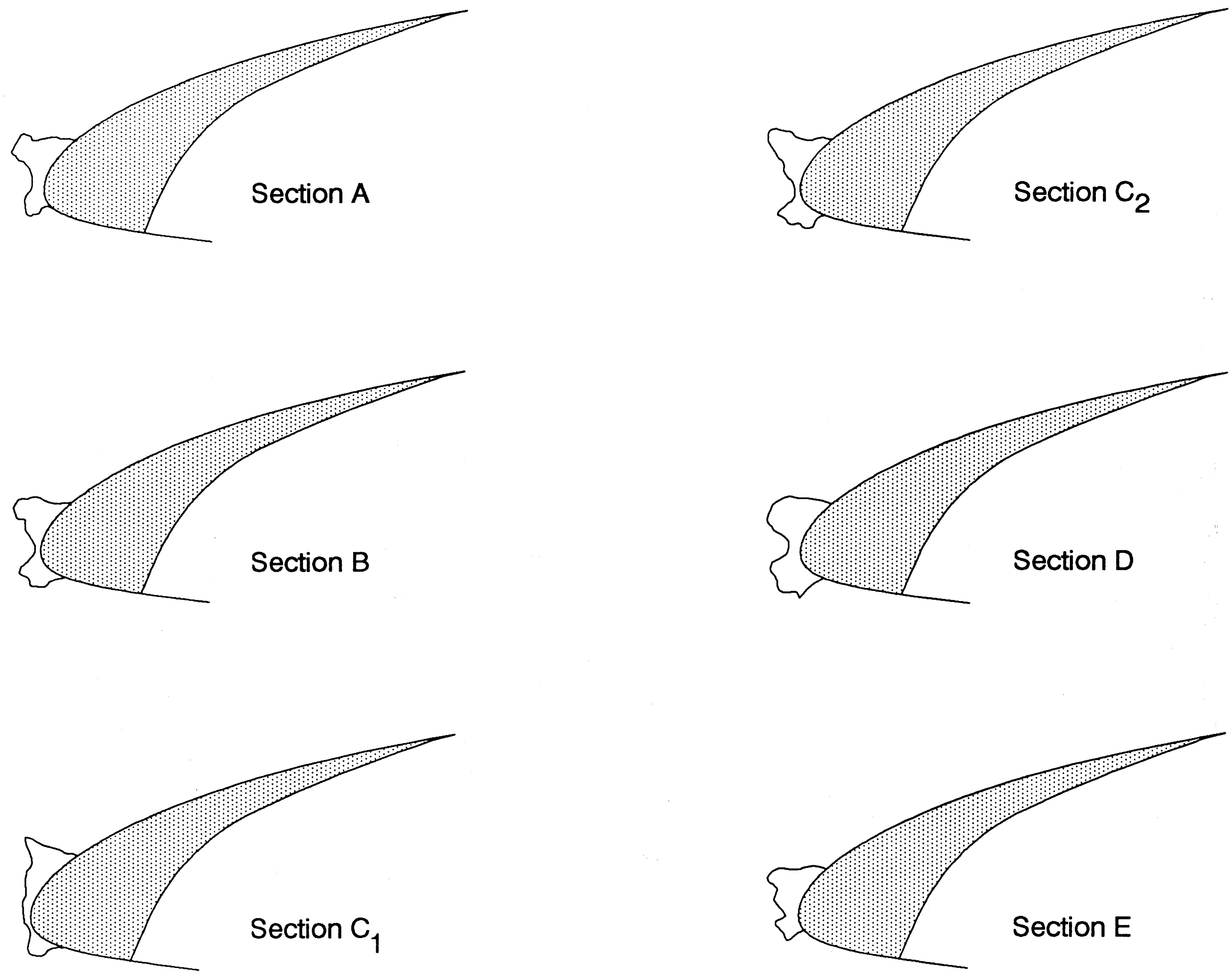


FIGURE 55 - RUN 21 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 93 - RUN 21 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.186760	0.297737	0.176810	0.291706	0.288565	0.355245	0.192921	0.292532	0.168551	0.299681	0.160883	0.274981
0.174788	0.297705	0.158862	0.287669	0.266568	0.367203	0.168948	0.296468	0.152603	0.303602	0.142904	0.282892
0.164806	0.299661	0.140905	0.287622	0.246584	0.373158	0.152962	0.300426	0.142632	0.307539	0.116954	0.286802
0.152824	0.303593	0.106990	0.285537	0.224619	0.373099	0.132982	0.304374	0.124687	0.313437	0.089008	0.290708
0.142847	0.303566	0.085041	0.285479	0.204635	0.379054	0.095057	0.298272	0.104755	0.317347	0.061078	0.288644
0.128886	0.301548	0.065083	0.287421	0.188639	0.387022	0.067122	0.290197	0.082831	0.321253	0.027179	0.280596
0.114918	0.301511	0.043114	0.295342	0.172638	0.396993	0.035177	0.288113	0.062904	0.323182	0.005251	0.272580
0.098951	0.303451	0.025135	0.303273	0.148655	0.404941	0.001203	0.298023	0.037001	0.325096	-0.024674	0.270511
0.078976	0.311325	0.011152	0.309220	0.126674	0.410890	-0.030780	0.309939	0.011103	0.325027	-0.046623	0.270453
0.055033	0.311262	-0.000841	0.317168	0.102696	0.416834	-0.058816	0.339867	-0.012809	0.326946	-0.076564	0.274353
0.027104	0.309207	-0.010828	0.321131	0.072723	0.424766	-0.072799	0.341831	-0.036730	0.332828	-0.090537	0.276306
-0.002805	0.301201	-0.022811	0.325088	0.054725	0.434731	-0.086783	0.343794	-0.050681	0.334773	-0.110490	0.276253
-0.020757	0.299172	-0.038773	0.325046	0.030731	0.446684	-0.096773	0.345767	-0.062644	0.338704	-0.130439	0.274211
-0.038699	0.293180	-0.050740	0.323020	0.010726	0.460649	-0.112753	0.347725	-0.078576	0.336681	-0.146380	0.266210
-0.062637	0.291136	-0.064691	0.316998	-0.007266	0.468613	-0.130736	0.351677	-0.100468	0.328696	-0.156341	0.260215
-0.072630	0.297054	-0.082638	0.312961	-0.023252	0.472575	-0.144735	0.359641	-0.118377	0.320722	-0.172267	0.246246
-0.076673	0.316860	-0.102596	0.314903	-0.031234	0.470551	-0.162702	0.357593	-0.140253	0.306793	-0.182217	0.236272
-0.092652	0.322763	-0.122539	0.310861	-0.033193	0.456527	-0.178661	0.351550	-0.164112	0.288895	-0.190162	0.222324
-0.104634	0.326694	-0.134495	0.304845	-0.029136	0.432505	-0.190611	0.339517	-0.176022	0.273011	-0.186145	0.212387
-0.118612	0.330621	-0.142450	0.294850	-0.019088	0.408500	-0.194557	0.321506	-0.185909	0.245241	-0.182122	0.200460
-0.138539	0.320660	-0.152389	0.280860	-0.009041	0.384494	-0.196507	0.303499	-0.193835	0.229367	-0.172119	0.190539
-0.150463	0.302794	-0.162307	0.258891	-0.001006	0.366491	-0.196459	0.285497	-0.197767	0.209540	-0.152149	0.184623
-0.162376	0.280965	-0.156258	0.234970	0.005022	0.352489	-0.182412	0.259532	-0.201725	0.199621	-0.144147	0.176686
-0.172311	0.265086	-0.148235	0.219033	0.007055	0.338475	-0.166378	0.237573	-0.197698	0.183779	-0.134139	0.164774
-0.180239	0.245248	-0.144202	0.203085	0.009100	0.320456	-0.150340	0.213614	-0.185698	0.165975	-0.130127	0.156827
-0.190184	0.233332	-0.130208	0.193149	0.003157	0.302416	-0.140302	0.193639	-0.171726	0.156104	-0.128105	0.146884
-0.192147	0.221437	-0.104264	0.191222	-0.006790	0.288371	-0.124279	0.175680	-0.159721	0.136319	-0.134043	0.128962
-0.182139	0.209573	-0.092287	0.189259	-0.016742	0.276328	-0.110285	0.169716	-0.143746	0.122489	-0.139998	0.117009
-0.168146	0.199702	-0.092223	0.165322	-0.020731	0.274315	-0.100258	0.153742	-0.125796	0.114610	-0.143951	0.103072
-0.160127	0.185852	-0.092186	0.151359	-0.024703	0.266293	-0.098208	0.133745	-0.111830	0.106720	-0.147916	0.093113
-0.146123	0.172017	-0.090138	0.131416	-0.024666	0.252275	-0.100174	0.121739	-0.093863	0.092896	-0.139897	0.079208
-0.120163	0.164159	-0.080114	0.113490	-0.030588	0.226224	-0.100147	0.111738	-0.083876	0.083014	-0.127888	0.065312
-0.106159	0.150325	-0.068089	0.093574	-0.030529	0.204194	-0.098118	0.099742	-0.071881	0.067192	-0.113878	0.049433

TABLE 93 - RUN 21 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.096150	0.138461	−0.060071	0.079632	−0.030482	0.186170	−0.086089	0.081773	−0.069847	0.051344	−0.105870	0.039506
−0.086137	0.124616	−0.052058	0.067684	−0.028437	0.168151	−0.074071	0.067804	−0.069804	0.035491	−0.095862	0.027595
−0.080103	0.106797	−0.044034	0.051748	−0.028390	0.150127	−0.058059	0.053845	−0.073736	0.015664	−0.091850	0.019647
−0.072074	0.088984	−0.036005	0.033816	−0.028331	0.128097	−0.044033	0.035881	−0.081652	−0.004174	−0.085843	0.011705
−0.068052	0.077104	−0.033963	0.015868	−0.034290	0.116066	−0.040002	0.021890	−0.091586	−0.014108	−0.079819	−0.002206
−0.067983	0.051343	−0.035915	−0.000095	−0.042246	0.104028	−0.035950	−0.000101	−0.111476	−0.026050	−0.091765	−0.012186
−0.067930	0.031527	−0.041854	−0.018064	−0.048204	0.091997	−0.033905	−0.018097	−0.125394	−0.035995	−0.107707	−0.020186
−0.071863	0.009719	−0.051799	−0.030059	−0.050154	0.073967	−0.035844	−0.040104	−0.139324	−0.041977	−0.119663	−0.026186
−0.083792	−0.006166	−0.063728	−0.046049	−0.046096	0.049945	−0.041797	−0.054121	−0.153248	−0.049941	−0.133615	−0.032192
−0.093737	−0.018082	−0.079643	−0.064044	−0.044041	0.027921	−0.055723	−0.074159	−0.163198	−0.053931	−0.139580	−0.040166
−0.101687	−0.029992	−0.091588	−0.074050	−0.039989	0.005902	−0.073668	−0.084208	−0.171145	−0.061878	−0.139548	−0.052103
−0.107651	−0.037935	−0.105524	−0.086055	−0.037934	−0.016122	−0.095581	−0.104268	−0.175098	−0.073779	−0.131540	−0.062030
−0.111594	−0.055780	−0.117469	−0.096061	−0.037897	−0.030141	−0.117500	−0.122328	−0.177074	−0.079729	−0.117546	−0.071941
−0.111547	−0.073614	−0.121428	−0.108040	−0.023888	−0.042120	−0.131436	−0.138366	−0.181016	−0.095593	−0.111539	−0.079883
−0.109509	−0.089463	−0.129362	−0.126014	−0.013867	−0.056112	−0.135392	−0.152378	−0.176995	−0.109454	−0.097534	−0.093773
−0.109472	−0.103334	−0.121349	−0.137962	−0.007844	−0.068112	−0.115402	−0.160326	−0.170992	−0.119346	−0.089521	−0.105689
−0.107429	−0.121163	−0.099379	−0.145882	−0.003819	−0.080118	−0.095401	−0.172273	−0.159002	−0.133186	−0.085493	−0.119606
−0.101396	−0.138982	−0.087391	−0.151835	−0.001780	−0.096134	−0.081381	−0.188237	−0.153010	−0.139115	−0.077475	−0.133512
−0.093383	−0.150851	−0.075398	−0.159782	−0.003734	−0.112161	−0.073361	−0.200217	−0.147007	−0.149008	−0.067466	−0.145422
−0.083396	−0.154787	−0.067391	−0.169735	−0.007675	−0.132198	−0.057360	−0.210176	−0.142986	−0.162869	−0.057495	−0.143407
−0.071429	−0.152774	−0.065353	−0.185688	−0.011631	−0.146228	−0.039388	−0.210128	−0.138975	−0.172766	−0.043554	−0.133422
−0.061474	−0.144822	−0.065306	−0.203641	−0.015593	−0.158255	−0.015441	−0.204064	−0.136930	−0.192578	−0.033598	−0.125437
−0.047512	−0.142803	−0.051317	−0.211583	−0.017543	−0.176284	−0.001452	−0.208027	−0.134896	−0.208426	−0.019657	−0.115453
−0.031560	−0.138798	−0.029369	−0.211524	−0.013507	−0.192295	0.012569	−0.223991	−0.128882	−0.222282	0.000254	−0.099483
−0.019630	−0.122914	−0.009411	−0.213466	−0.007468	−0.210303	0.030568	−0.233944	−0.118890	−0.234145	0.014206	−0.093477
−0.015671	−0.111013	0.016528	−0.213397	0.004528	−0.216279	0.048540	−0.233896	−0.104929	−0.240054	0.028152	−0.085482
−0.007706	−0.105048	0.030485	−0.209371	0.020519	−0.222244	0.074483	−0.227827	−0.085007	−0.240001	0.040113	−0.081472
0.008235	−0.097079	0.044420	−0.197365	0.038496	−0.224200	0.082423	−0.209805	−0.067078	−0.239953		
0.028188	−0.097026	0.054365	−0.185371	0.064454	−0.224130	0.088367	−0.191787	−0.051152	−0.235948		
		0.068311	−0.177355	0.082399	−0.214069	0.102297	−0.173748	−0.033222	−0.235901		
		0.090233	−0.167323	0.094343	−0.200018	0.122235	−0.161694	−0.021259	−0.239833		
		0.112171	−0.163275	0.100318	−0.193995	0.146181	−0.155630	−0.015256	−0.249725		
		0.128123	−0.159243	0.114269	−0.183944			−0.011245	−0.259623		
		0.158031	−0.151184	0.136218	−0.177878			−0.005237	−0.271497		

TABLE 93 - RUN 21 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
				0.174152	−0.175774			0.002705	−0.261568		
				0.190132	−0.177734			0.016619	−0.249641		
								0.026548	−0.237725		
								0.044419	−0.215879		
								0.068272	−0.196000		
								0.092135	−0.180084		
								0.110038	−0.170128		
								0.129928	−0.158185		
								0.145839	−0.148235		

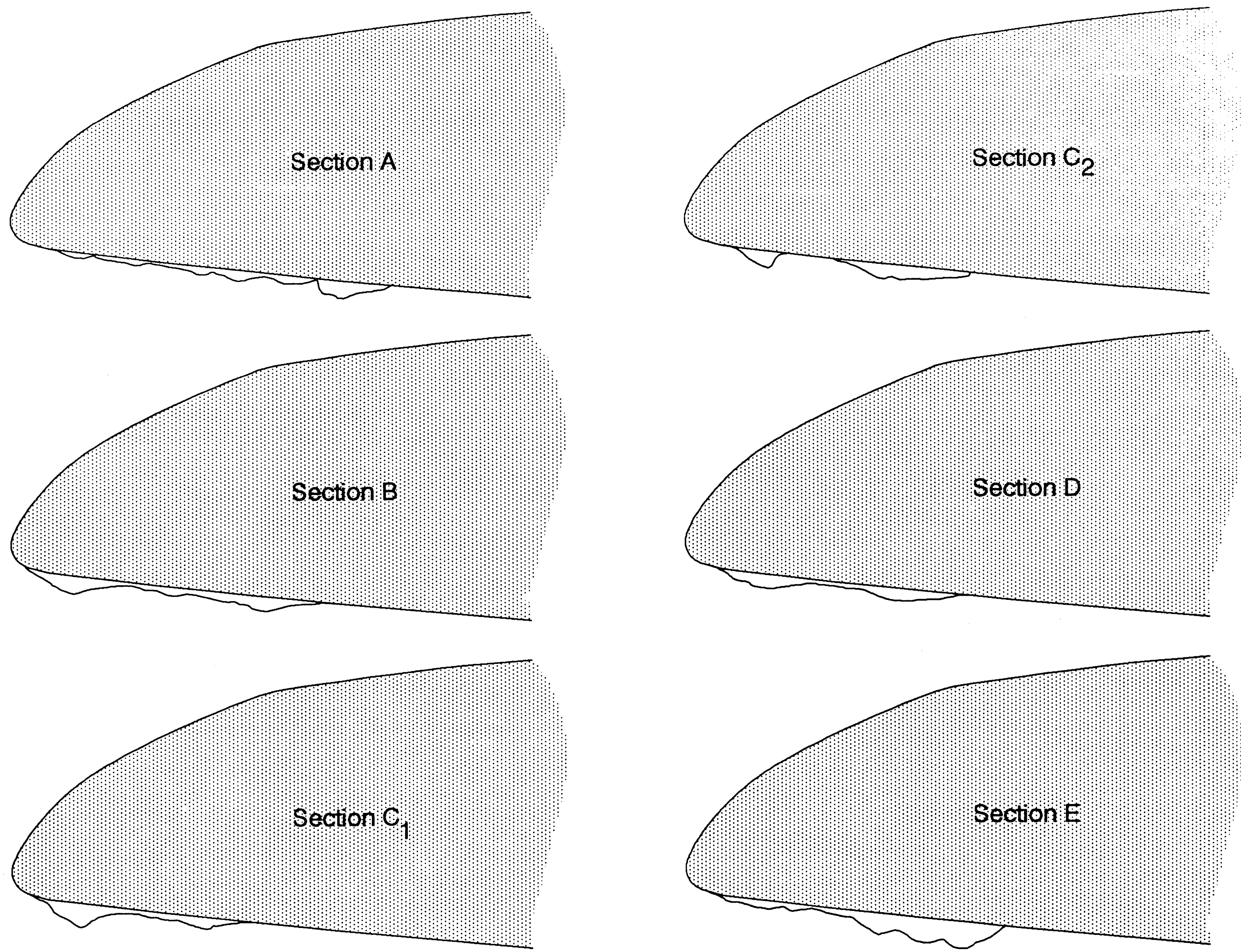


FIGURE 56 - RUN 21 ICE SHAPE TRACINGS FOR MAIN AIRFOIL, SECTIONS A - E.

TABLE 94 - RUN 21 ICE SHAPE COORDINATES FOR MAIN AIRFOIL, SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
1.068489	−0.319232	0.860147	−0.280555	0.905458	−0.288407	1.064027	−0.309615	0.969005	−0.299882	0.910542	−0.286693
1.110823	−0.340990	0.882151	−0.294442	0.917490	−0.300328	1.082067	−0.321507	0.987028	−0.311775	0.928545	−0.294622
1.143059	−0.350846	0.908154	−0.310309	0.937512	−0.308243	1.100092	−0.327430	1.007039	−0.319683	0.948541	−0.300551
1.191422	−0.368613	0.936161	−0.328164	0.961533	−0.316148	1.122135	−0.339312	1.025057	−0.329586	0.964541	−0.306491
1.225645	−0.368523	0.962154	−0.340048	0.979554	−0.324068	1.146194	−0.357160	1.041075	−0.339494	0.984542	−0.314414
1.253839	−0.372425	0.988157	−0.355916	0.995576	−0.331994	1.166252	−0.375017	1.053102	−0.351403	0.998550	−0.322353
1.282001	−0.364399	1.020163	−0.375752	1.007613	−0.345906	1.190322	−0.396845	1.063118	−0.359337	1.010554	−0.328304
1.292056	−0.360397	1.036181	−0.391646	1.017650	−0.359825	1.212365	−0.408727	1.079142	−0.371235	1.024571	−0.340231
1.318211	−0.354364	1.062174	−0.403530	1.023672	−0.367777	1.234413	−0.422598	1.091158	−0.379164	1.038573	−0.346176
1.334348	−0.366250	1.074183	−0.413458	1.031703	−0.379709	1.258456	−0.434475	1.105161	−0.383107	1.060562	−0.350106
1.362553	−0.374129	1.088188	−0.423382	1.039736	−0.391639	1.278493	−0.444373	1.119160	−0.385061	1.078549	−0.352052
1.394784	−0.381997	1.102173	−0.425337	1.047757	−0.399587	1.294516	−0.450301	1.133163	−0.389004	1.104523	−0.351984
1.424996	−0.387882	1.122164	−0.433252	1.055767	−0.403550	1.308534	−0.454244	1.143164	−0.390967	1.120518	−0.355929
1.453186	−0.389796	1.158142	−0.445110	1.067789	−0.411486	1.318539	−0.454217	1.153159	−0.390941	1.134510	−0.357887
1.485417	−0.397664	1.176132	−0.451038	1.081805	−0.417426	1.330534	−0.450206	1.163160	−0.392905	1.152508	−0.363821
1.519645	−0.399563	1.196091	−0.447001	1.099826	−0.425346	1.338517	−0.442224	1.175164	−0.396853	1.172503	−0.369750
1.533742	−0.401515	1.224028	−0.438959	1.115842	−0.431280	1.350480	−0.426272	1.189173	−0.402787	1.188503	−0.375690
1.549863	−0.407437	1.239983	−0.430949	1.133874	−0.443185	1.356451	−0.414316	1.199200	−0.414701	1.208499	−0.381619
1.563970	−0.413364	1.271909	−0.420904	1.143890	−0.449135	1.364413	−0.398375	1.213209	−0.420634	1.230498	−0.389537
1.590157	−0.419259	1.303846	−0.414843	1.157917	−0.459058	1.372380	−0.384424	1.221216	−0.424593	1.252477	−0.389479
1.624380	−0.419170	1.337784	−0.410769	1.171944	−0.468981	1.382358	−0.374447	1.233216	−0.426552	1.274465	−0.393409
1.650524	−0.409161	1.361749	−0.410706	1.185970	−0.478905	1.392347	−0.368451	1.249213	−0.428500	1.288457	−0.395366
1.672662	−0.407115	1.395688	−0.406632	1.197986	−0.484849	1.402347	−0.366435	1.267209	−0.430442	1.306449	−0.399307
1.702859	−0.407036	1.429621	−0.400566	1.218002	−0.490773			1.283207	−0.432390	1.320435	−0.399270
1.727027	−0.410949	1.493515	−0.396413	1.235992	−0.486741	Reattachment		1.293213	−0.436344	1.342397	−0.393229
1.749182	−0.414867	1.515483	−0.396354	1.249981	−0.482720	1.786668	−0.415172	1.309210	−0.438292	1.364365	−0.389183
1.775363	−0.418775	1.555423	−0.396249	1.259965	−0.476717	1.832712	−0.423011	1.325208	−0.440240	1.374355	−0.389157
1.801550	−0.424670	1.583392	−0.400159	1.269944	−0.468723	1.860758	−0.434877	1.345198	−0.440187	1.388331	−0.385132
1.829755	−0.432549	1.601376	−0.404096	1.277923	−0.460733	1.888803	−0.446743	1.361180	−0.436165	1.398315	−0.383111
1.857943	−0.434463	1.619365	−0.410024	1.287902	−0.452739	1.914853	−0.460605	1.371164	−0.432158	1.412312	−0.387062
1.884125	−0.438371	1.639362	−0.419932	1.303881	−0.444728	1.942899	−0.472472	1.379160	−0.432137	1.426319	−0.395001
1.912324	−0.444262	1.657345	−0.423869	1.315865	−0.438720	1.970950	−0.486328	1.387156	−0.432116	1.438328	−0.402945
1.942542	−0.452135	1.683306	−0.423800	1.327849	−0.432712	1.988991	−0.498221	1.395147	−0.430105	1.450327	−0.406902

TABLE 94 - RUN 21 ICE SHAPE COORDINATES FOR MAIN AIRFOIL, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
1.970747	−0.460014	1.703277	−0.423747	1.337828	−0.424718	2.003019	−0.506144	1.415132	−0.428061	1.468320	−0.410843
1.992918	−0.469897	1.723257	−0.427678	1.353818	−0.420691	2.019053	−0.516052	1.431119	−0.426029	1.490293	−0.408790
2.009050	−0.479794	1.737242	−0.429633	1.369813	−0.418657	2.041090	−0.525944	1.447106	−0.423997	1.508264	−0.404755
2.033218	−0.483707	1.759230	−0.437544	1.391792	−0.410630	2.063112	−0.529866	1.459090	−0.419985	1.524243	−0.402718
2.059383	−0.481650	1.789223	−0.451409	1.411786	−0.408586	2.077124	−0.531820	1.477075	−0.417948	1.550211	−0.400655
2.085543	−0.477606	1.805215	−0.457343	1.425776	−0.404565	2.089130	−0.531788	1.493062	−0.415915	1.574183	−0.398598
2.105647	−0.467613	1.821202	−0.461285	1.443776	−0.404517	2.101131	−0.529766	1.513048	−0.413872	1.598153	−0.396541
2.125773	−0.465572	1.847173	−0.465200	1.461766	−0.400485	2.111119	−0.523770	1.525042	−0.413841	1.622140	−0.400465
2.139897	−0.477463	1.865147	−0.465152	1.485771	−0.402414	2.123120	−0.521748	1.539029	−0.411814	1.640133	−0.404406
2.164070	−0.483364	1.887104	−0.461110	1.515772	−0.402335	2.135121	−0.519726	1.563002	−0.405780	1.660134	−0.412329
2.186225	−0.487283	1.909060	−0.457068	1.557772	−0.402224	2.153145	−0.525649	1.586995	−0.407707	1.672132	−0.416285
2.196296	−0.489245	1.933014	−0.453021	1.571778	−0.404179	2.171176	−0.533562	1.614982	−0.407633	1.696135	−0.426192
2.210414	−0.499148	1.958981	−0.454944	1.593783	−0.406113	2.189200	−0.539484	1.626976	−0.407601	1.720121	−0.430117
2.226540	−0.507059	1.992940	−0.458838	1.607783	−0.406076	2.217214	−0.539410	1.644988	−0.415514	1.742110	−0.434047
2.246693	−0.514958	2.016920	−0.464751	1.621794	−0.410023	2.243222	−0.537352	1.662985	−0.417457	1.762101	−0.437982
2.268859	−0.522853	2.044900	−0.472646	1.635804	−0.413970	2.265232	−0.537294	1.678977	−0.417415	1.784095	−0.443906
2.282961	−0.526792	2.078865	−0.478532	1.653815	−0.417907	2.317253	−0.535166	1.700972	−0.419347	1.806084	−0.447836
2.309126	−0.524735	2.110844	−0.488408	1.667832	−0.423846	2.339274	−0.539088	1.726964	−0.421268	1.826074	−0.451771
2.327239	−0.522700	2.150811	−0.498263	1.691847	−0.429759	2.373291	−0.538999	1.740963	−0.423221	1.850050	−0.451708
2.343322	−0.514705	2.180787	−0.506152	1.707842	−0.427725	2.395296	−0.536951	1.758965	−0.427154	1.868053	−0.459636
2.363438	−0.508688	2.218742	−0.510035	1.731848	−0.429653	2.415301	−0.534908	1.784963	−0.431066	1.884069	−0.471558
2.383558	−0.504659	2.236704	−0.506004	1.745864	−0.435593	2.439302	−0.530864	1.806957	−0.432998	1.902094	−0.487463
2.403684	−0.502618	2.252680	−0.505962	1.767880	−0.441511	2.465315	−0.530796	1.828968	−0.440900	1.918110	−0.499385
2.435883	−0.498558	2.270669	−0.511890	1.789891	−0.445437	2.489322	−0.528742	1.856954	−0.440826	1.940120	−0.511291
2.458016	−0.494524	2.288674	−0.523795	1.827896	−0.447329	2.525345	−0.530638	1.878949	−0.442758	1.954132	−0.521224
2.476144	−0.498452	2.314641	−0.525718	1.849897	−0.447270	2.563357	−0.528547	1.892947	−0.444711	1.976137	−0.531136
2.502337	−0.506336	2.334622	−0.529650	1.859897	−0.447244	2.595368	−0.526473	1.906940	−0.444674	1.988156	−0.543068
2.516434	−0.508287	2.354608	−0.535573	1.873897	−0.447207	2.615367	−0.522440	1.928940	−0.448596	2.000171	−0.553007
2.536597	−0.520163	2.368630	−0.551473	1.889918	−0.455133	2.637368	−0.518402	1.946942	−0.452529	2.016181	−0.562935
2.550715	−0.530067	2.380622	−0.555425	1.907934	−0.461062	2.651369	−0.516375	1.964955	−0.460442	2.036183	−0.570858
2.564818	−0.534006	2.402610	−0.563336	1.927956	−0.468977			1.986976	−0.472324	2.062136	−0.562813
2.591015	−0.543878	2.430585	−0.569238	1.947977	−0.476892			2.008986	−0.480226	2.086096	−0.556768
2.629264	−0.543778	2.474525	−0.571114	1.971993	−0.482805			2.027004	−0.490129	2.106060	−0.550733

TABLE 94 - RUN 21 ICE SHAPE COORDINATES FOR MAIN AIRFOIL, SECTION A - E (con't).

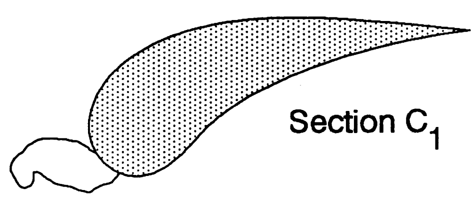
SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
2.655435	−0.543710	2.512447	−0.563045	1.994015	−0.490715			2.051013	−0.498027	2.122039	−0.548696
2.691665	−0.541627	2.542385	−0.556989	2.016031	−0.496634			2.063023	−0.503965	2.144001	−0.542656
2.713809	−0.541569	2.578306	−0.546934	2.032047	−0.502567			2.089037	−0.513847	2.167982	−0.544587
2.741977	−0.535531	2.616223	−0.536873	2.052057	−0.506499			2.113036	−0.517764	2.181974	−0.546544
2.760084	−0.531507	2.634185	−0.532842	2.066063	−0.508454			2.135036	−0.521686	2.197984	−0.556472
2.778186	−0.525495	2.684095	−0.526733	2.076058	−0.506435			2.147041	−0.525634	2.209994	−0.564416
2.798301	−0.519478	2.716047	−0.526649	2.086053	−0.504417			2.177026	−0.525555	2.230005	−0.576327
2.812388	−0.517453	2.771959	−0.524509	2.090042	−0.500422			2.203019	−0.527477	2.244034	−0.592243
2.818470	−0.533342	2.815888	−0.522401	2.096037	−0.498414			2.239001	−0.527382	2.264046	−0.604154
2.822534	−0.547248	2.833845	−0.516377	2.108005	−0.486430			2.268987	−0.527303	2.286055	−0.616060
2.826608	−0.565131	2.857783	−0.506353	2.126011	−0.488375			2.300961	−0.523238	2.308044	−0.619990
2.836727	−0.584985			2.156000	−0.484311			2.324949	−0.523175	2.338025	−0.623899
2.850872	−0.604830			2.177990	−0.480269			2.348932	−0.521121	2.371991	−0.623809
2.871025	−0.612729			2.203979	−0.476216			2.378907	−0.517062	2.391966	−0.621762
2.891155	−0.612676			2.239969	−0.472137			2.408892	−0.516983	2.417919	−0.613717
2.911292	−0.614612			2.257964	−0.470098			2.426883	−0.516935	2.439881	−0.607677
2.925400	−0.620539			2.275959	−0.468058			2.450877	−0.518862	2.455860	−0.605641
2.945552	−0.628439			2.285954	−0.466040			2.466859	−0.514840	2.473836	−0.603599
2.953631	−0.638358							2.478847	−0.512818	2.487860	−0.617520
2.977794	−0.640283							2.502814	−0.504795	2.505889	−0.635419
2.989878	−0.642240							2.540785	−0.500714	2.531906	−0.651303
3.009993	−0.636223							2.558766	−0.496686	2.555903	−0.659215
3.032110	−0.626224							2.574742	−0.490674	2.577891	−0.663146
3.054233	−0.618214									2.607862	−0.663066
3.080377	−0.608205									2.625838	−0.661025
3.102516	−0.606159									2.653773	−0.646992
3.134721	−0.604087									2.669731	−0.636980
3.158867	−0.600047									2.683685	−0.624978
3.181006	−0.598001									2.711641	−0.618922
3.203134	−0.591979									2.735601	−0.612877
3.239365	−0.589896									2.761533	−0.596856
3.263506	−0.583868									2.789484	−0.588806
3.279596	−0.577861									2.817398	−0.566797
3.297681	−0.565885									2.847310	−0.544783
3.315783	−0.559874									2.859266	−0.532787
3.329853	−0.551885									2.875219	−0.520781
3.341895	−0.537936									2.887185	−0.512773

Section A
Not Available

Section C_2
Not Available

Section B
Not Available

Section D
Not Available



Section E
Not Available

FIGURE 57 - RUN 21 ICE SHAPE TRACINGS FOR FORE FLAP (FLAP 1), SECTIONS A - E.

TABLE 95 - RUN 21 ICE SHAPE COORDINATES FOR FORE FLAP (FLAP 1), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
				12.624464	−0.256800						
				12.614382	−0.244898						
				12.602300	−0.236977						
				12.590224	−0.231044						
				12.578144	−0.223124						
				12.566072	−0.219179						
				12.556011	−0.215230						
				12.541936	−0.213278						
				12.523841	−0.211338						
				12.511770	−0.207393						
				12.499704	−0.205437						
				12.479599	−0.203501						
				12.465534	−0.205526						
				12.449444	−0.201592						
				12.431354	−0.201640						
				12.415274	−0.201682						
				12.387133	−0.201756						
				12.361025	−0.209776						
				12.346971	−0.215778						
				12.330906	−0.221784						
				12.322883	−0.227769						
				12.302808	−0.237762						
				12.292790	−0.249717						
				12.284783	−0.261667						
				12.270745	−0.273632						
				12.262721	−0.279618						
				12.252691	−0.287596						
				12.242668	−0.297563						
				12.226636	−0.315497						
				12.220643	−0.329430						
				12.216650	−0.339380						
				12.216682	−0.351309						
				12.218724	−0.363233						

TABLE 95 - RUN 21 ICE SHAPE COORDINATES FOR FORE FLAP (FLAP 1), SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
				12.226812	−0.381104						
				12.230863	−0.393022						
				12.240946	−0.404924						
				12.246998	−0.412861						
				12.253054	−0.422785						
				12.259111	−0.432709						
				12.263146	−0.438663						
				12.265167	−0.442634						
				12.271208	−0.446594						
				12.285289	−0.450534						
				12.293329	−0.450513						
				12.299354	−0.448509						
				12.309393	−0.444506						
				12.315417	−0.442502						
				12.321432	−0.436523						
				12.333455	−0.422575						
				12.335433	−0.410641						
				12.335391	−0.394736						
				12.335352	−0.380820						
				12.337336	−0.370874						
				12.341356	−0.370863						
				12.355426	−0.370826						
				12.367508	−0.378747						
				12.381604	−0.388650						
				12.399725	−0.400531						
				12.421875	−0.414390						
				12.442011	−0.428254						
				12.464143	−0.436148						
				12.496318	−0.442028						
				12.520450	−0.445941						
				12.546606	−0.455812						
				12.570748	−0.463701						
				12.594884	−0.469603						

TABLE 95 - RUN 21 ICE SHAPE COORDINATES FOR FORE FLAP (FLAP 1), SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
				12.615000	−0.475514						
				12.629065	−0.473489						
				12.637095	−0.469492						
				12.649128	−0.459520						
				12.659162	−0.453529						
				12.675220	−0.445535						
				12.701325	−0.435526						
				12.721414	−0.431498						
				12.743502	−0.423487						
				12.749506	−0.413531						
				12.757519	−0.403569						
				12.763533	−0.397590						
				12.769552	−0.393597						

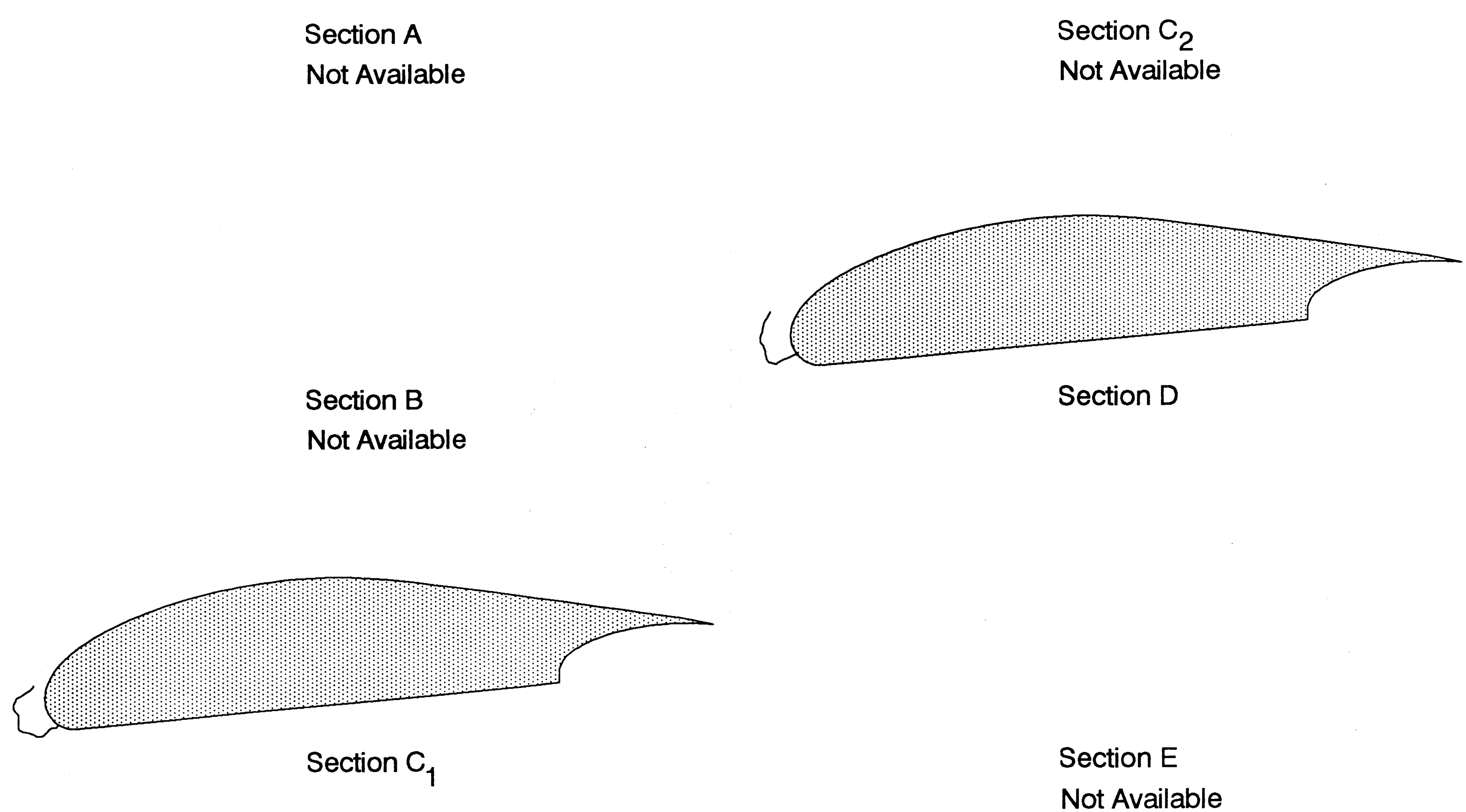


FIGURE 58 - RUN 21 ICE SHAPE TRACINGS FOR MID FLAP (FLAP 2), SECTIONS A - E.

TABLE 96 - RUN 21 ICE SHAPE COORDINATES FOR MID FLAP (FLAP 2), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
				13.074842	−0.298358			13.017562	−0.232393		
				13.066729	−0.310404			13.011515	−0.246437		
				13.056572	−0.320451			13.005456	−0.256473		
				13.044375	−0.328499			12.997374	−0.268519		
				13.032170	−0.334543			12.987265	−0.280569		
				13.019973	−0.342591			12.981219	−0.294614		
				13.009805	−0.348630			12.977188	−0.304644		
				12.997608	−0.356678			12.973179	−0.322691		
				12.985404	−0.362722			12.971184	−0.334721		
				12.975237	−0.368761			12.969188	−0.346750		
				12.965075	−0.376804			12.965159	−0.356781		
				12.963055	−0.382821			12.961134	−0.368816		
				12.959003	−0.390847			12.955102	−0.388871		
				12.952920	−0.400884			12.955135	−0.400896		
				12.948869	−0.408910			12.957190	−0.410911		
				12.948895	−0.418931			12.963302	−0.420914		
				12.950965	−0.430950			12.969403	−0.426911		
				12.955060	−0.438955			12.975521	−0.438919		
				12.961196	−0.448959			12.979609	−0.450932		
				12.967323	−0.454956			12.985743	−0.468953		
				12.975497	−0.464955			12.987809	−0.482976		
				12.979596	−0.474965			12.991898	−0.494989		
				12.981671	−0.488988			12.993963	−0.509012		
				12.981703	−0.501012			12.993979	−0.515024		
				12.979699	−0.513041			13.000092	−0.525028		
				12.979731	−0.525065			13.008227	−0.533023		
				12.979758	−0.535085			13.016346	−0.535006		
				12.979785	−0.545105			13.026498	−0.538987		
				12.979801	−0.551118			13.038673	−0.540959		
				12.985928	−0.557114			13.050849	−0.542931		
				12.998163	−0.563094			13.058958	−0.540906		
				13.004283	−0.567086			13.067054	−0.534873		
				13.012436	−0.569069			13.075157	−0.530843		

TABLE 96 - RUN 21 ICE SHAPE COORDINATES FOR MID FLAP (FLAP 2), SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
				13.020588	−0.571052			13.083255	−0.524810		
				13.030776	−0.573029			13.095408	−0.518767		
				13.040965	−0.575007			13.107568	−0.514727		
				13.049117	−0.576989			13.117699	−0.510692		
				13.057274	−0.580976			13.133909	−0.504637		
				13.069499	−0.582949			13.148092	−0.498588		
				13.077657	−0.586936			13.162269	−0.490535		
				13.081741	−0.590933			13.172405	−0.488505		
				13.093976	−0.596913						
				13.108239	−0.598880						
				13.114348	−0.598864						
				13.124526	−0.596833						
				13.130625	−0.592809						
				13.138761	−0.588780						
				13.146886	−0.580743						
				13.152985	−0.576719						
				13.161104	−0.566677						
				13.165167	−0.562658						
				13.169224	−0.556636						
				13.177354	−0.550602						
				13.183460	−0.548582						
				13.191595	−0.544553						
				13.201771	−0.542522						
				13.211956	−0.542496						
				13.220096	−0.540470						

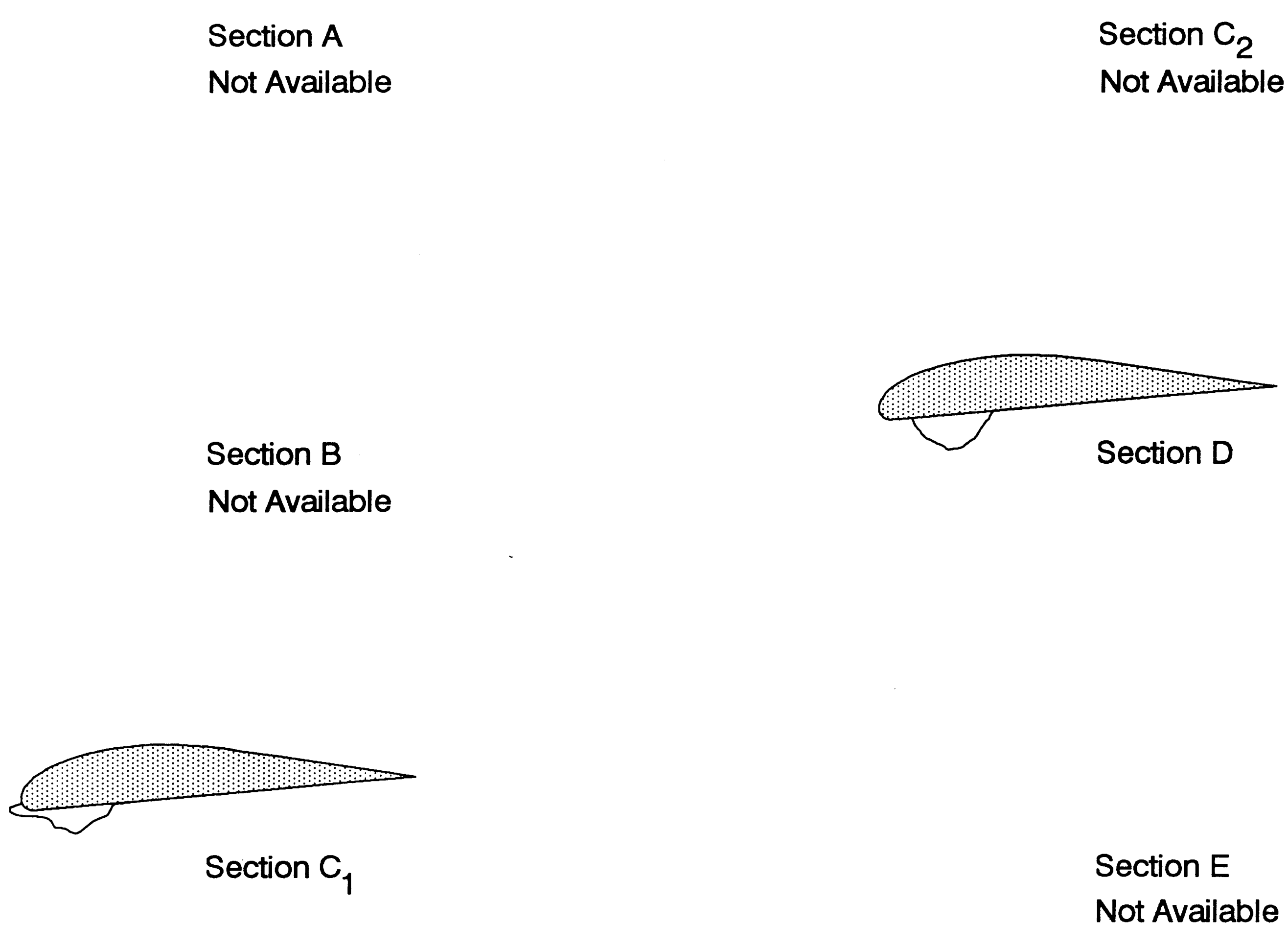


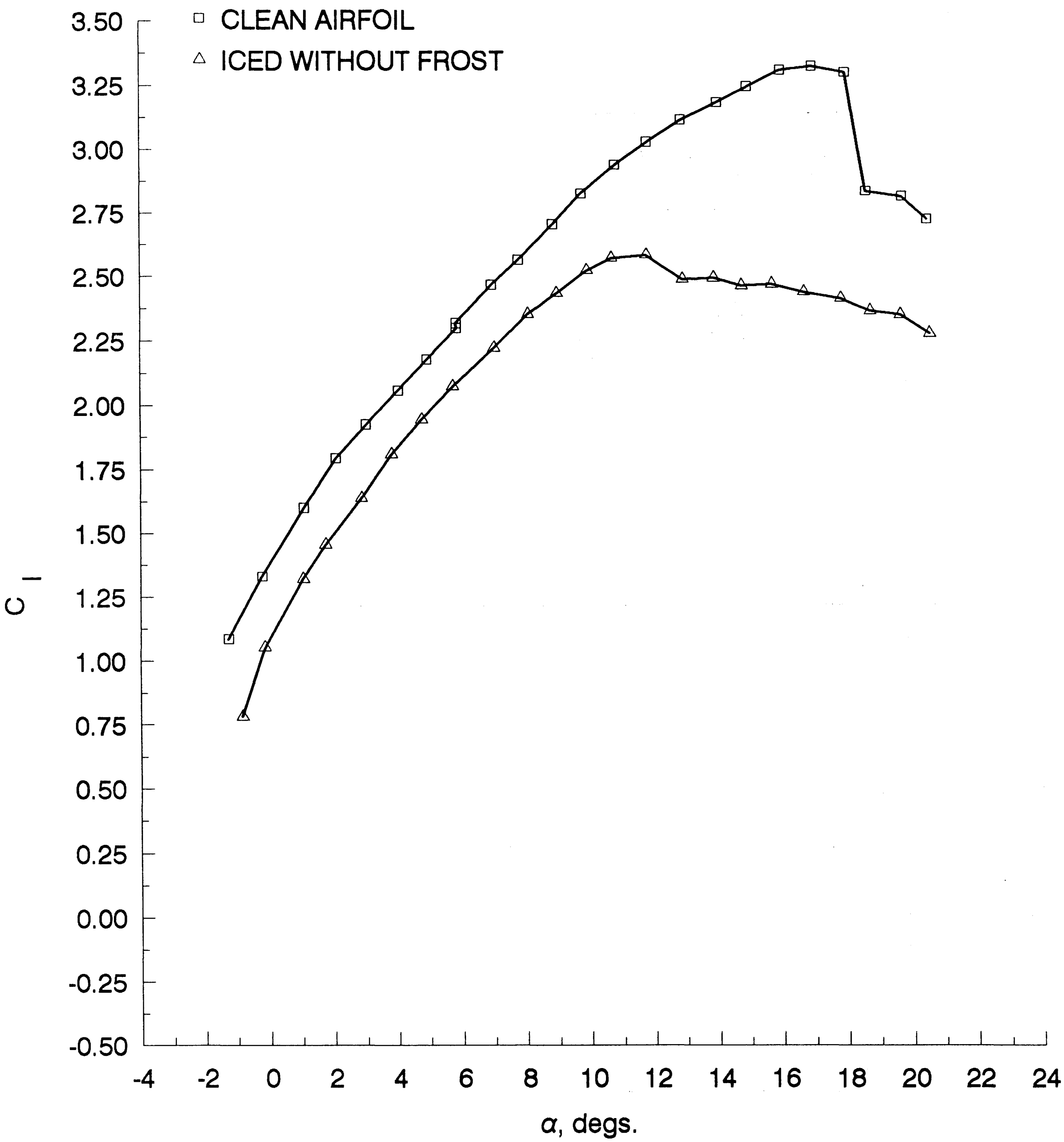
FIGURE 59 - RUN 21 ICE SHAPE TRACINGS FOR AFT FLAP (FLAP 3), SECTIONS A - E.

TABLE 97 - RUN 21 ICE SHAPE COORDINATES FOR AFT FLAP (FLAP 3), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
				16.327445	−0.258998			16.523432	−0.271332		
				16.313450	−0.266999			16.529481	−0.289103		
				16.303443	−0.269016			16.535506	−0.298969		
				16.293449	−0.275016			16.539537	−0.310817		
				16.291494	−0.292940			16.547574	−0.324630		
				16.313557	−0.306820			16.555604	−0.334491		
				16.337604	−0.314721			16.567635	−0.346318		
				16.369647	−0.316627			16.575672	−0.360131		
				16.417703	−0.316500			16.587705	−0.371957		
				16.457757	−0.320377			16.601736	−0.383779		
				16.491813	−0.326260			16.609754	−0.389687		
				16.511883	−0.344127			16.627769	−0.395569		
				16.523950	−0.364005			16.637785	−0.401472		
				16.533994	−0.375925			16.645796	−0.405403		
				16.562032	−0.377842			16.649808	−0.409345		
				16.592073	−0.381744			16.659817	−0.413272		
				16.618156	−0.401586			16.667819	−0.413251		
				16.648206	−0.407480			16.677827	−0.417177		
				16.672198	−0.393480			16.685845	−0.423085		
				16.706161	−0.365515			16.693861	−0.428993		
				16.732139	−0.345537			16.701881	−0.436878		
				16.762135	−0.331520			16.707894	−0.440814		
				16.798132	−0.315497			16.715905	−0.444746		
				16.814130	−0.307491			16.725900	−0.442744		
				16.826086	−0.285558			16.737895	−0.440736		
				16.840044	−0.263620			16.745884	−0.436763		
				16.854032	−0.253628			16.759884	−0.436726		
								16.777880	−0.434702		
								16.795858	−0.426750		
								16.809828	−0.414855		
								16.819800	−0.404947		
								16.837768	−0.393042		
								16.849748	−0.385105		

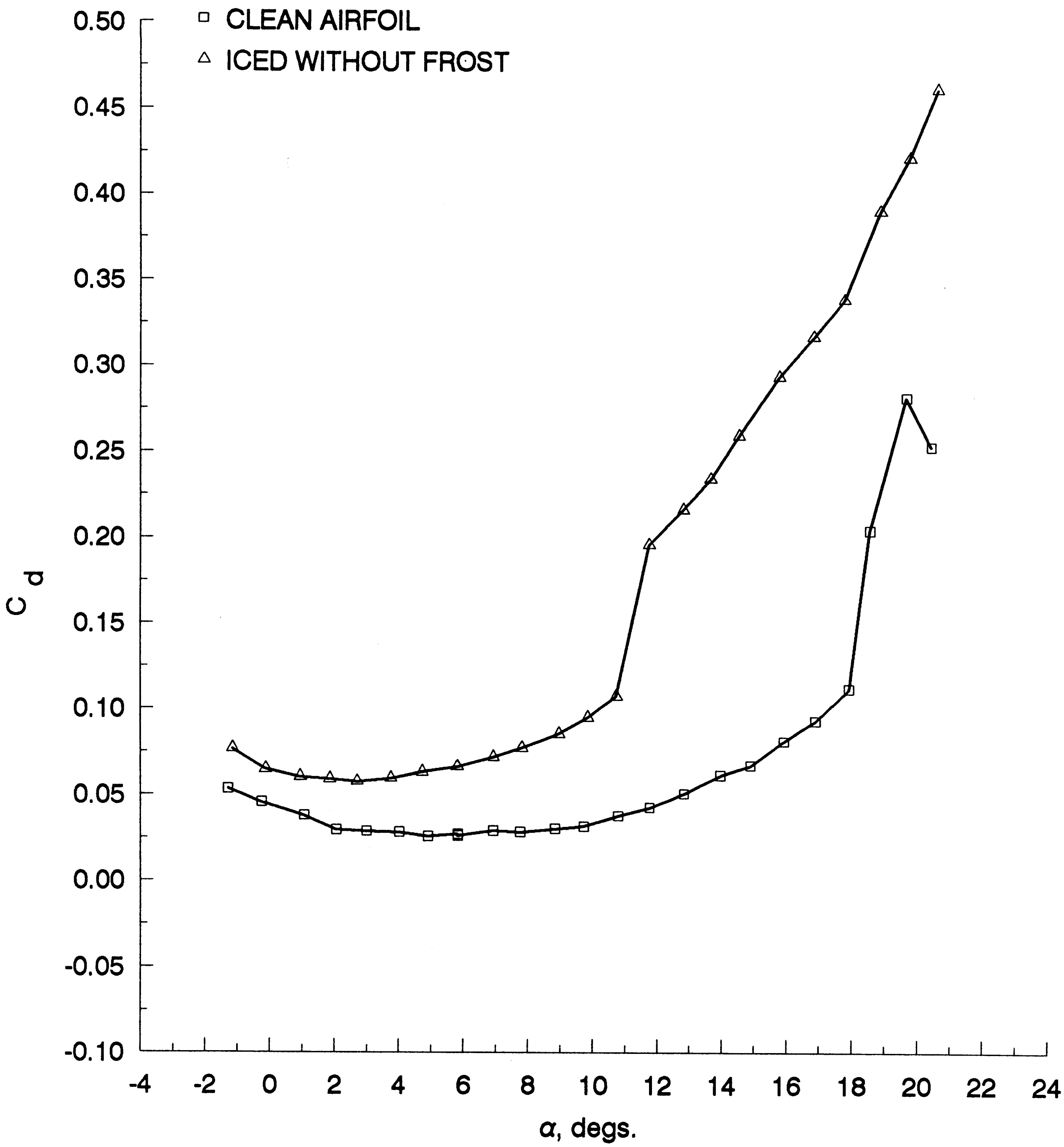
TABLE 97 - RUN 21 ICE SHAPE COORDINATES FOR AFT FLAP (FLAP 3), SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
								16.861712	−0.371239		
								16.875660	−0.351439		
								16.885616	−0.335603		
								16.897562	−0.315808		
								16.907528	−0.301947		
								16.917490	−0.288087		
								16.927470	−0.280155		
								16.933434	−0.266305		
								16.939410	−0.258384		
								16.945384	−0.248487		
								16.953348	−0.234632		
								16.959338	−0.230663		



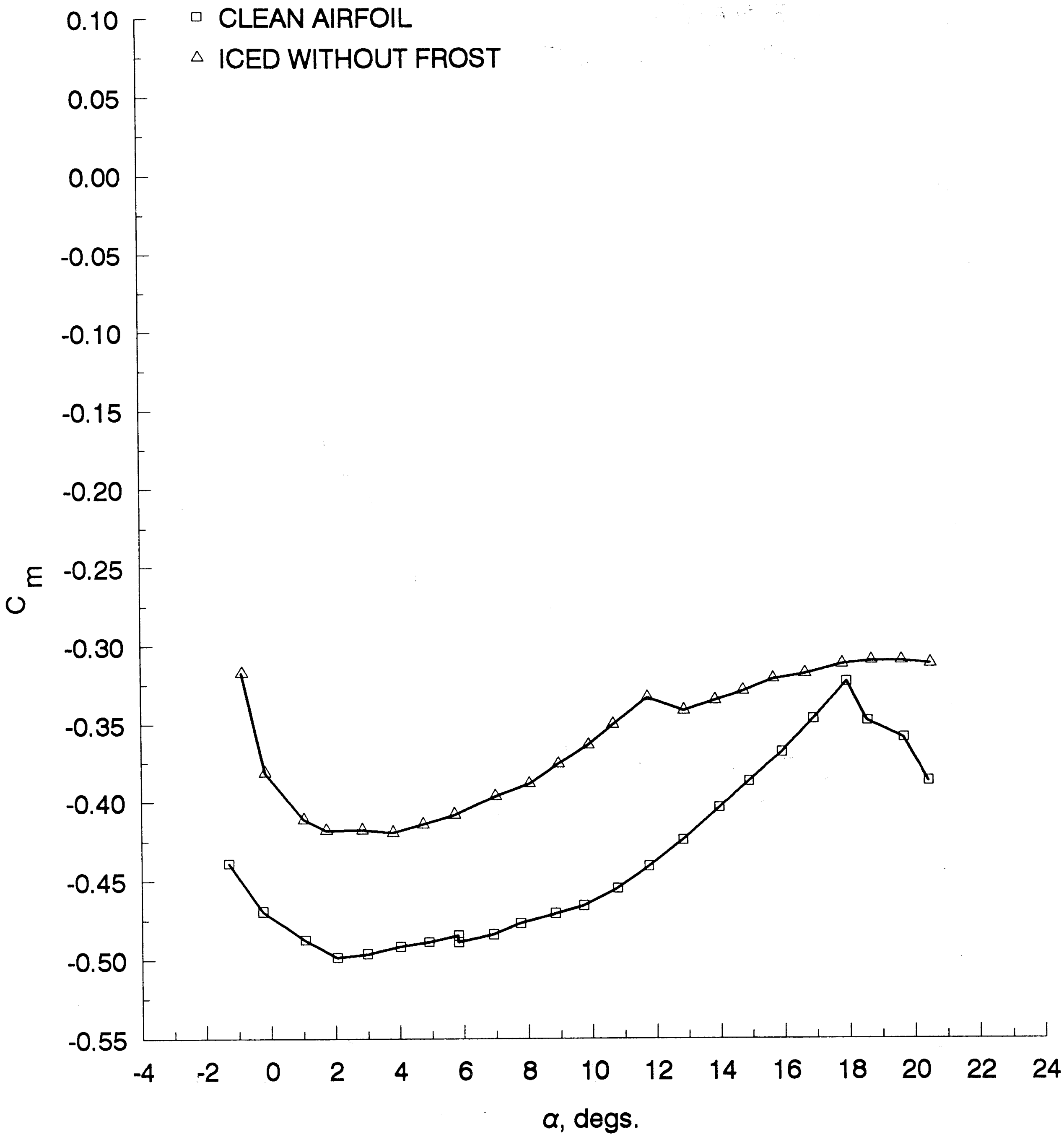
(A) C_l VERSUS α

FIGURE 60 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 21.



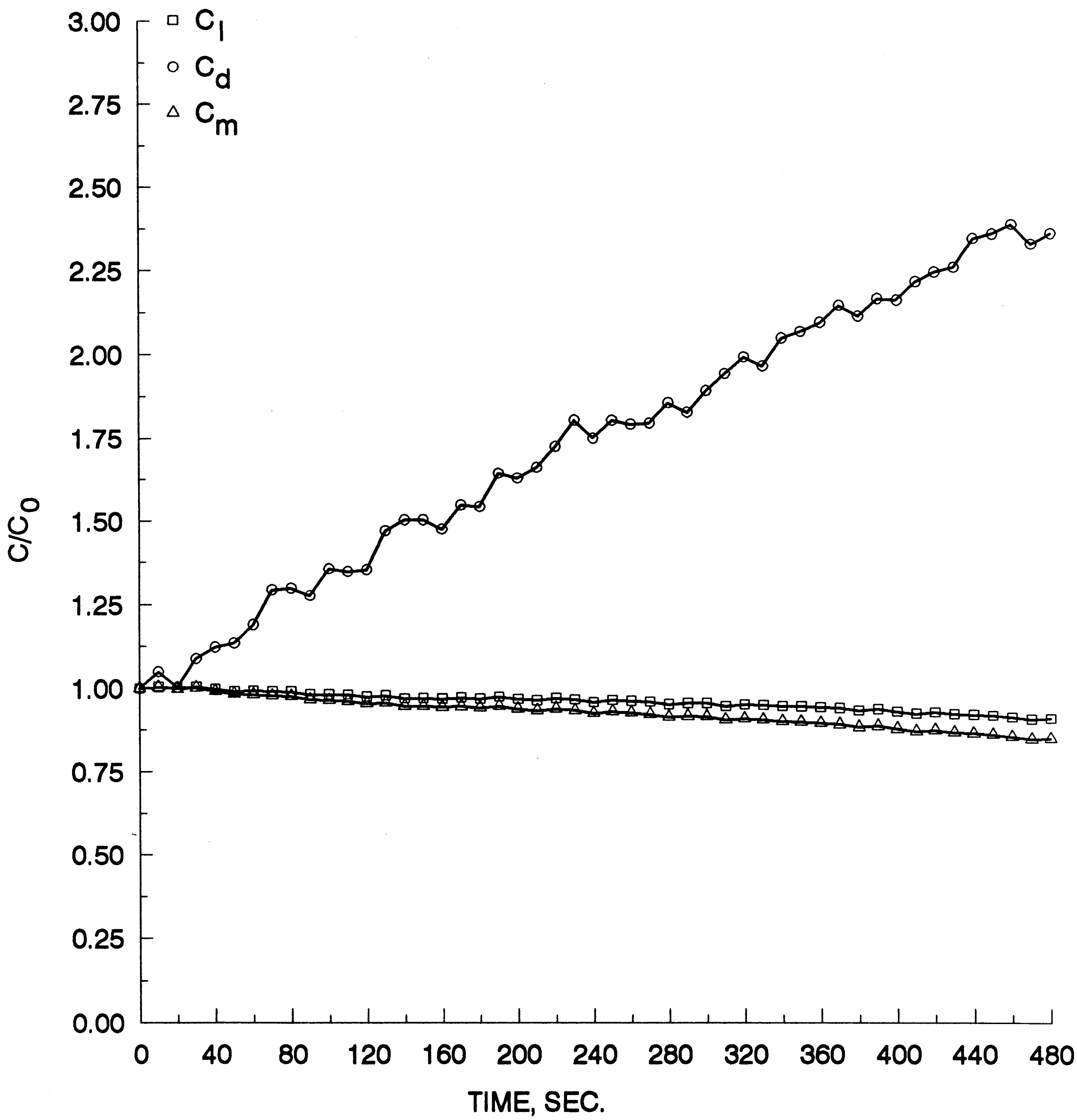
(A) C_d VERSUS α

FIGURE 60 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 21 (con't).



(A) C_m VERSUS α

FIGURE 60 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 21 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 60 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 21 (con't).

TABLE 98 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 21.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.2842	1.0856	0.0534	−0.4390
−0.2438	1.3309	0.0456	−0.4694
1.0645	1.6021	0.0379	−0.4871
2.0532	1.7948	0.0296	−0.4982
3.0004	1.9262	0.0287	−0.4960
4.0219	2.0587	0.0282	−0.4913
4.9066	2.1788	0.0257	−0.4885
5.8305	2.2995	0.0270	−0.4844
5.8294	2.3198	0.0261	−0.4887
6.9280	2.4682	0.0288	−0.4838
7.7683	2.5652	0.0281	−0.4769
8.8365	2.7047	0.0300	−0.4708
9.7340	2.8268	0.0314	−0.4659
10.7811	2.9403	0.0376	−0.4549
11.7717	3.0303	0.0424	−0.4410
12.8443	3.1175	0.0506	−0.4242
13.9769	3.1862	0.0613	−0.4037
14.9100	3.2484	0.0669	−0.3868
15.9437	3.3130	0.0811	−0.3683
16.9195	3.3282	0.0930	−0.3467
17.9471	3.3030	0.1116	−0.3228
18.5755	2.8381	0.2041	−0.3480
19.6854	2.8174	0.2817	−0.3587
20.4520	2.7277	0.2531	−0.3866

(B). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
−0.8496	0.7829	0.0804	−0.3171
−0.1554	1.0529	0.0689	−0.3812
1.0383	1.3223	0.0618	−0.4110
1.7323	1.4577	0.0611	−0.4178
2.8522	1.6393	0.0590	−0.4176
3.8091	1.8096	0.0586	−0.4194
4.7481	1.9451	0.0585	−0.4142
5.7295	2.0742	0.0607	−0.4080
7.0075	2.2230	0.0644	−0.3964
8.0617	2.3540	0.0707	−0.3884
8.9597	2.4356	0.0776	−0.3759
9.9015	2.5248	0.0859	−0.3638
10.6710	2.5729	0.0934	−0.3506
11.7579	2.5861	0.1232	−0.3330
12.8971	2.4903	0.1446	−0.3415
13.8663	2.4955	0.1677	−0.3350
14.7350	2.4664	0.1900	−0.3289
15.6822	2.4728	0.2198	−0.3213
16.6674	2.4421	0.2528	−0.3178
17.8123	2.4163	0.2915	−0.3118
18.7074	2.3685	0.3143	−0.3095
19.6339	2.3534	0.3475	−0.3095
20.5352	2.2816	0.3786	−0.3114

TABLE 99 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 21.

TIME SEC.	C_l/C_{l_0}	C_d/C_{d_0}	C_m/C_{m_0}
0	1.0000	1.0000	1.0000
10	1.0039	1.0493	1.0036
20	1.0016	1.0037	0.9997
30	1.0047	1.0886	1.0016
40	0.9982	1.1234	0.9922
50	0.9919	1.1354	0.9834
60	0.9929	1.1907	0.9826
70	0.9914	1.2947	0.9792
80	0.9906	1.2996	0.9768
90	0.9825	1.2774	0.9673
100	0.9821	1.3569	0.9651
110	0.9817	1.3484	0.9631
120	0.9757	1.3544	0.9557
130	0.9789	1.4717	0.9575
140	0.9699	1.5036	0.9474
150	0.9708	1.5036	0.9473
160	0.9689	1.4758	0.9445
170	0.9724	1.5490	0.9466
180	0.9691	1.5441	0.9426
190	0.9751	1.6451	0.9469
200	0.9683	1.6303	0.9395
210	0.9645	1.6628	0.9341
220	0.9709	1.7266	0.9399
230	0.9671	1.8060	0.9347
240	0.9586	1.7515	0.9256
250	0.9655	1.8053	0.9310
260	0.9626	1.7937	0.9271
270	0.9603	1.7974	0.9230
280	0.9525	1.8582	0.9145
290	0.9560	1.8295	0.9167
300	0.9561	1.8953	0.9161
310	0.9470	1.9464	0.9056
320	0.9518	1.9960	0.9093
330	0.9505	1.9686	0.9065
340	0.9471	2.0525	0.9016
350	0.9464	2.0719	0.8997
360	0.9434	2.0992	0.8957
370	0.9414	2.1492	0.8922
380	0.9337	2.1184	0.8838
390	0.9382	2.1699	0.8871
400	0.9305	2.1653	0.8786
410	0.9243	2.2206	0.8709
420	0.9288	2.2494	0.8746
430	0.9234	2.2632	0.8681
440	0.9209	2.3493	0.8650
450	0.9185	2.3636	0.8609
460	0.9136	2.3924	0.8553
470	0.9083	2.3351	0.8483
480	0.9109	2.3663	0.8496

TABLE 100 - TEST CONDITIONS FOR RUN NUMBER 21.

NASA LEWIS ICING RESEARCH TUNNEL		
Run No. 21	Configuration 15° Flap	Date 05-06-88
P_{air} 80 psig	ΔP_w 72.5 psid	T_{avg} 28° F
V_∞ 100 mph		
Spray Duration 8 min	Ice Accretion Type Glaze	A.O.A. 5°
LWC 0.92 g/m³	MVD 14.4 μm	

Remarks

- No frost. Ice accretion on undersurface was from deposition. Considerable ice in the gap between slat and leading edge of main airfoil. Ice on flap leading edges - Ice on all of flap udersurfaces for flaps 2 and 3.
- The accretion was less near Section A.
- Ice accretion on Leading Edge Slat approximately 1/8" thick.
- Ice accretion on leading edge of Flaps 1 and 2 approximately 7/16" and 1/8" thick, respectively. The ice on Flap 3 was more like fingers and extended from just under the leading edge about 1/4" back along the flap.
- Ice shape tracings not available for

  Flap 1, Sections A, B, C_2, D and E
  Flap 2, Sections A, B, C_2, D and E
  Flap 3, Sections A, B, C_2, D and E

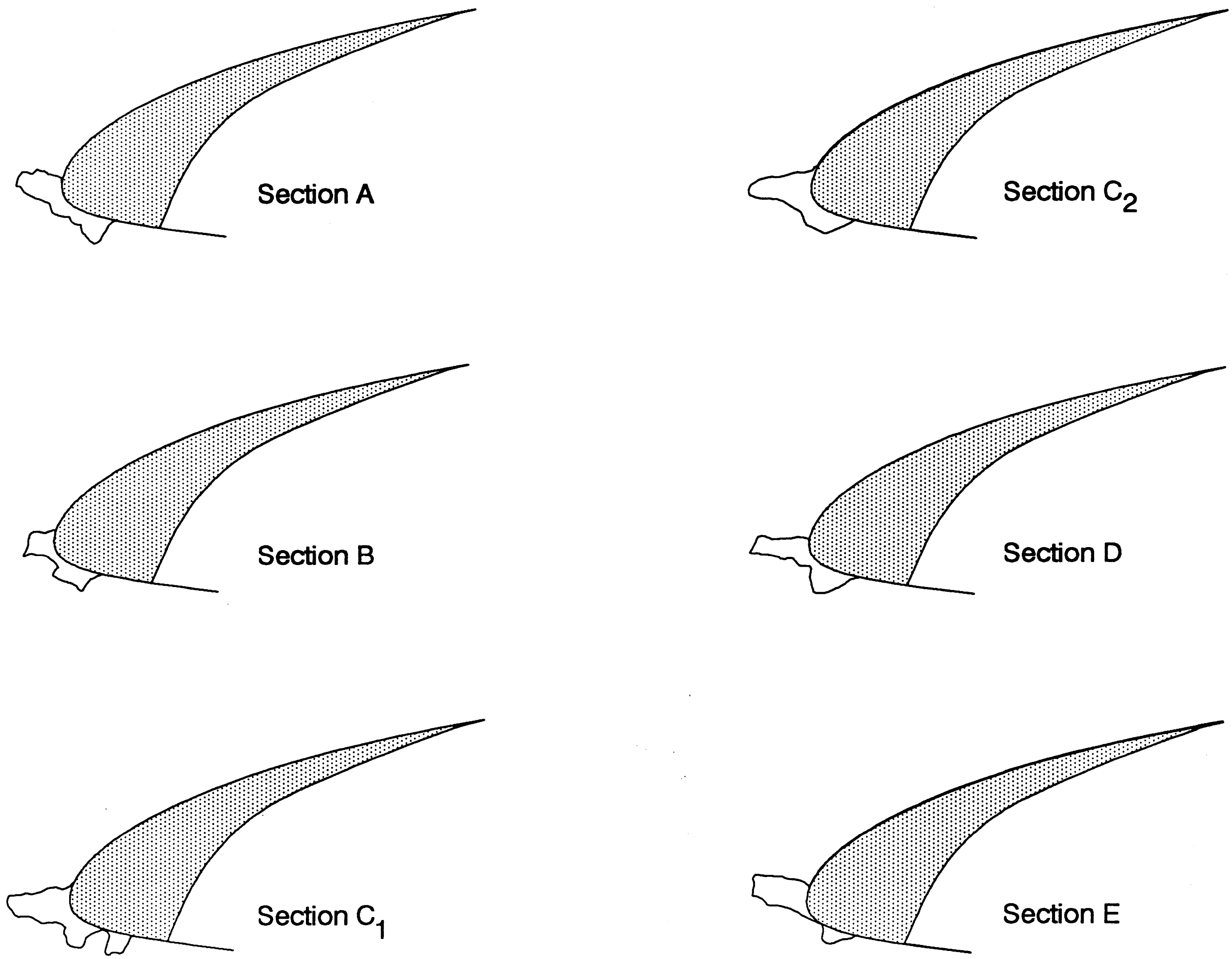


FIGURE 61 - RUN 22 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 101 - RUN 22 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E.

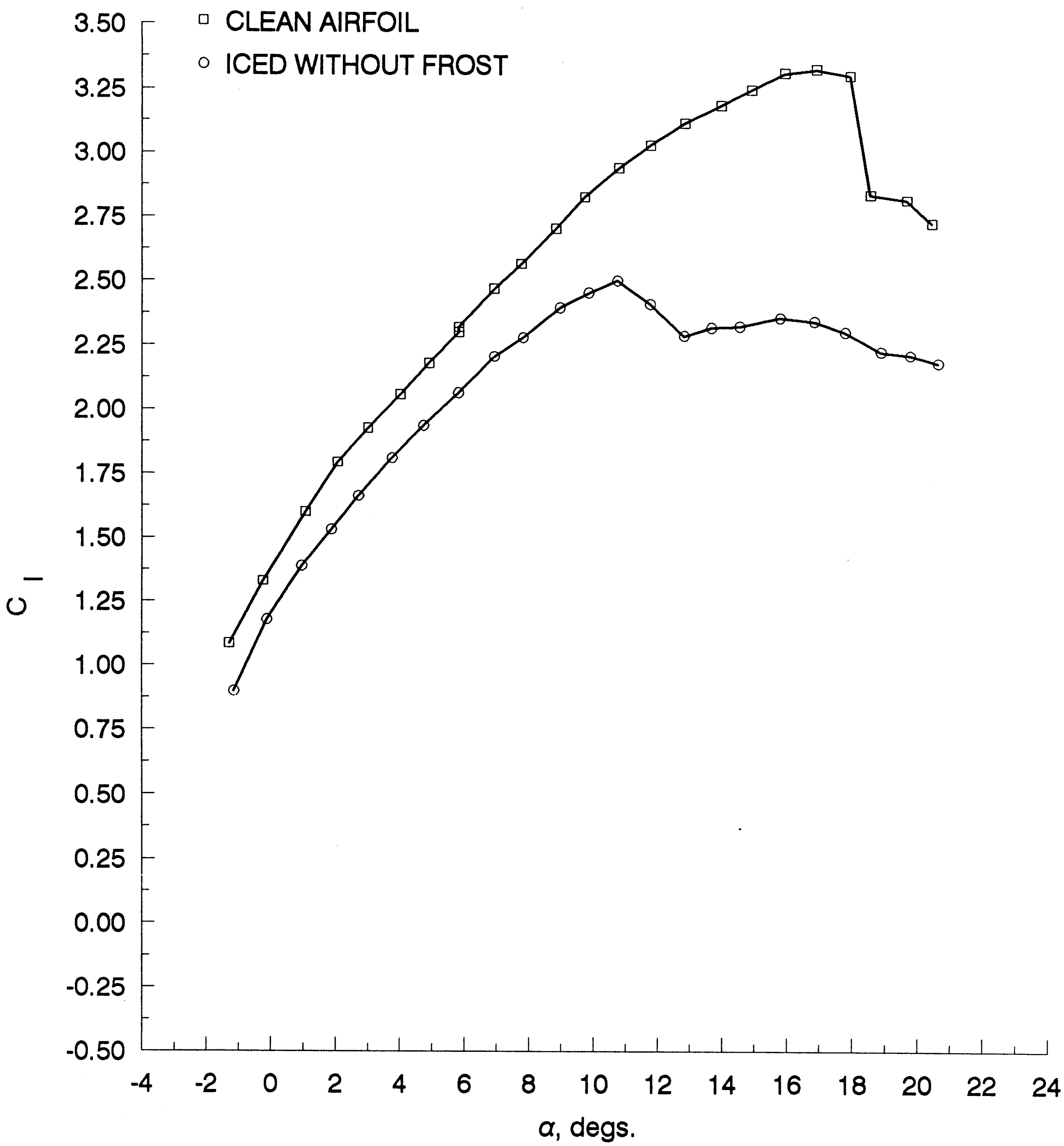
SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.004135	0.050194	0.021749	0.077864	0.021692	0.101664	0.021646	0.124076	0.009892	0.036077	0.015755	0.091566
−0.026156	0.064193	0.009784	0.071848	0.009736	0.091671	0.019669	0.116070	−0.002094	0.034042	−0.004278	0.109419
−0.046152	0.068156	−0.006187	0.069810	−0.000217	0.079691	0.013694	0.108052	−0.014090	0.036013	−0.030291	0.121288
−0.056150	0.070138	−0.020155	0.065784	−0.014175	0.071685	0.005715	0.102031	−0.024093	0.039992	−0.054289	0.127193
−0.072149	0.074112	−0.036114	0.059757	−0.028133	0.063679	−0.010269	0.099988	−0.042085	0.041948	−0.080280	0.131104
−0.084140	0.074080	−0.052074	0.053730	−0.050096	0.061629	−0.034237	0.093923	−0.052083	0.043923	−0.102264	0.131046
−0.092156	0.082091	−0.066053	0.053693	−0.066093	0.069555	−0.044230	0.093897	−0.066077	0.045889	−0.126263	0.136952
−0.102164	0.088089	−0.080042	0.057646	−0.084077	0.073492	−0.060219	0.093854	−0.080062	0.043849	−0.148273	0.146841
−0.108170	0.092090	−0.090032	0.059614	−0.110033	0.071431	−0.076214	0.095812	−0.094040	0.039806	−0.184252	0.148736
−0.114161	0.090066	−0.104016	0.061572	−0.131996	0.069380	−0.090199	0.093775	−0.114020	0.037751	−0.216234	0.150641
−0.126163	0.094050	−0.114001	0.061546	−0.143962	0.063372	−0.108176	0.089727	−0.134000	0.035695	−0.244218	0.152557
−0.140163	0.098030	−0.123980	0.059524	−0.159912	0.053369	−0.128147	0.083673	−0.155983	0.035636	−0.270205	0.154478
−0.150172	0.104027	−0.135951	0.055503	−0.179861	0.045347	−0.148117	0.077619	−0.167974	0.035604	−0.294192	0.156404
−0.160132	0.091951	−0.143923	0.049497	−0.205807	0.039302	−0.166089	0.071570	−0.189952	0.033543	−0.314178	0.156351
−0.168111	0.085906	−0.147901	0.043502	−0.233750	0.033251	−0.188064	0.067511	−0.203942	0.033506	−0.328130	0.142387
−0.180081	0.077840	−0.151874	0.035511	−0.245737	0.035211	−0.202054	0.067474	−0.225925	0.033447	−0.326100	0.130455
−0.192072	0.077809	−0.153844	0.025531	−0.261724	0.039154	−0.212047	0.067448	−0.237927	0.037421	−0.322060	0.114549
−0.206072	0.081788	−0.157817	0.017542	−0.275703	0.039116	−0.222041	0.067421	−0.245931	0.041406	−0.321997	0.090675
−0.218074	0.085772	−0.159782	0.005567	−0.289667	0.033103	−0.234038	0.069389	−0.253931	0.043387	−0.325946	0.072759
−0.230071	0.087749	−0.159756	−0.004408	−0.307630	0.029071	−0.248023	0.067352	−0.263939	0.049369	−0.327892	0.052858
−0.244060	0.087711	−0.159729	−0.014382	−0.323606	0.029029	−0.269998	0.063293	−0.271944	0.053354	−0.331841	0.034941
−0.256015	0.073622	−0.163691	−0.026362	−0.347560	0.024981	−0.289968	0.057239	−0.283935	0.053322	−0.321843	0.032978
−0.263982	0.063559	−0.165657	−0.038337	−0.365528	0.022941	−0.307940	0.051191	−0.291929	0.053300	−0.311845	0.031015
−0.271945	0.051489	−0.175599	−0.054323	−0.379502	0.020912	−0.325907	0.043142	−0.301910	0.049268	−0.301842	0.027062
−0.275905	0.037421	−0.181553	−0.068303	−0.385446	0.002965	−0.337877	0.035109	−0.313891	0.045231	−0.287842	0.023120
−0.277871	0.025366	−0.185536	−0.072303	−0.387400	−0.012978	−0.351841	0.025071	−0.317867	0.037209	−0.275835	0.017183
−0.279849	0.017328	−0.189504	−0.082288	−0.385361	−0.028911	−0.363817	0.019038	−0.323830	0.025176	−0.263822	0.009257
−0.281821	0.007282	−0.191490	−0.086283	−0.379333	−0.042841	−0.373763	0.001008	−0.325808	0.017159	−0.255807	0.001320
−0.277803	−0.000740	−0.189482	−0.090267	−0.369321	−0.052776	−0.377728	−0.011004	−0.331782	0.009132	−0.247786	−0.008607
−0.265811	−0.000708	−0.179498	−0.090241	−0.357302	−0.066691	−0.377697	−0.023005	−0.339744	−0.002906	−0.237757	−0.022508
−0.253815	−0.002684	−0.167537	−0.082230	−0.349271	−0.082607	−0.373657	−0.038997	−0.345708	−0.014938	−0.221763	−0.024455
−0.247793	−0.012710	−0.151583	−0.074208	−0.339254	−0.094534	−0.357641	−0.048956	−0.347685	−0.022955	−0.203776	−0.024407
−0.235749	−0.032760	−0.141603	−0.072187	−0.325254	−0.102467	−0.341636	−0.054914	−0.351656	−0.032980	−0.181787	−0.026339

TABLE 101 - RUN 22 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.215726	−0.046764	−0.127619	−0.074144	−0.317255	−0.106430	−0.319635	−0.060856	−0.357630	−0.041007	−0.155801	−0.028260
−0.195714	−0.056752	−0.117619	−0.080102	−0.301294	−0.100411	−0.301637	−0.064810	−0.361600	−0.051031	−0.131797	−0.036155
−0.179705	−0.064742	−0.109626	−0.082076	−0.287315	−0.100374	−0.279652	−0.064751	−0.343603	−0.054989	−0.107799	−0.042060
−0.163695	−0.072733	−0.099636	−0.084044	−0.271339	−0.100332	−0.249672	−0.064671	−0.323624	−0.052933	−0.089796	−0.047981
−0.143699	−0.076696	−0.089651	−0.084018	−0.255362	−0.100289	−0.227681	−0.066614	−0.307630	−0.054893	−0.071783	−0.057882
−0.125696	−0.082672	−0.079666	−0.083992	−0.239370	−0.106224	−0.207690	−0.068561	−0.293630	−0.058862	−0.053780	−0.063803
−0.113689	−0.088665	−0.069681	−0.083965	−0.221370	−0.116138	−0.189686	−0.074514	−0.273645	−0.058809	−0.037760	−0.075698
−0.095681	−0.096650	−0.057694	−0.085928	−0.203376	−0.124060	−0.165681	−0.082451	−0.257652	−0.060769	−0.019742	−0.087587
−0.085678	−0.100640	−0.045702	−0.089886	−0.189375	−0.131992	−0.145663	−0.094400	−0.241659	−0.062729	0.004273	−0.099462
−0.077678	−0.102627	−0.031697	−0.099824	−0.175375	−0.139924	−0.125645	−0.106349	−0.227659	−0.066698	0.022281	−0.107372
−0.069658	−0.112646	−0.025690	−0.105793	−0.157401	−0.139876	−0.105621	−0.120298	−0.213659	−0.070666	0.034288	−0.113309
−0.067622	−0.126698	−0.013687	−0.113740	−0.135439	−0.137826	−0.089605	−0.130257	−0.201662	−0.072637	0.054294	−0.121214
−0.063593	−0.138737	−0.005684	−0.119704	−0.113471	−0.137768	−0.067594	−0.140200	−0.183660	−0.078598	0.066301	−0.127152
−0.061568	−0.148773	0.002325	−0.127663	−0.085523	−0.133709	−0.055570	−0.152170	−0.175650	−0.084585	0.082305	−0.133078
−0.055546	−0.158798	0.010334	−0.135621	−0.067534	−0.139638	−0.047533	−0.168151	−0.147656	−0.090519	0.094307	−0.137025
−0.043528	−0.168807	0.016346	−0.143584	−0.055536	−0.145584	−0.041495	−0.184137	−0.131683	−0.084468	0.102333	−0.148941
−0.029523	−0.174794	0.020361	−0.151554	−0.043527	−0.155513	−0.039459	−0.198134	−0.115695	−0.084426	0.106388	−0.170816
−0.015522	−0.178774	0.024371	−0.157528	−0.033521	−0.163456	−0.031427	−0.212115	−0.109700	−0.084410	0.104427	−0.184748
0.002475	−0.182742	0.018396	−0.163529	−0.027514	−0.169417	−0.023390	−0.228095	−0.097704	−0.086381	0.100462	−0.196696
0.020473	−0.186711	0.008433	−0.171535	−0.031481	−0.179389	−0.005387	−0.234048	−0.089683	−0.096374	0.098516	−0.216596
0.032464	−0.186678	0.002468	−0.181525	−0.035460	−0.185376	0.012617	−0.240002	−0.081663	−0.106367	0.102556	−0.232502
0.044455	−0.186647	−0.001515	−0.185525	−0.037430	−0.195343	0.028633	−0.249961	−0.073642	−0.116359	0.112575	−0.242424
0.050462	−0.190647	−0.005488	−0.193515	−0.035401	−0.207291	0.042644	−0.257925	−0.065632	−0.122347	0.124587	−0.250350
0.054490	−0.202686	−0.007458	−0.203495	−0.027392	−0.215239	0.058650	−0.263883	−0.059621	−0.128339	0.144588	−0.256266
0.062522	−0.216722	−0.001446	−0.211459	−0.021374	−0.225184	0.072661	−0.271847	−0.047619	−0.132313	0.168555	−0.250234
0.072530	−0.222720	0.010557	−0.219406	−0.019340	−0.239125	0.080666	−0.275827	−0.033625	−0.134278	0.192511	−0.240223
0.084543	−0.230721	0.020557	−0.225365	−0.019309	−0.251078	0.098660	−0.277779	−0.017642	−0.132233	0.210482	−0.234207
0.098543	−0.234700	0.038556	−0.235291	−0.011278	−0.266996	0.110641	−0.273747	−0.007644	−0.134209	0.230451	−0.228185
0.108536	−0.234674	0.048552	−0.239255	−0.003268	−0.274944	0.126609	−0.265703	0.002348	−0.134183	0.250436	−0.228133
0.116530	−0.234652	0.058547	−0.243218	0.008730	−0.280889	0.146569	−0.255649	0.006361	−0.140181	0.282397	−0.222080
0.116572	−0.250717	0.066545	−0.247187	0.020728	−0.286834	0.172525	−0.245578	0.010369	−0.144176	0.304339	−0.206106
0.120596	−0.260748	0.080524	−0.247150	0.034712	−0.288789	0.196482	−0.235514	0.012394	−0.154184	0.318307	−0.198111
0.122642	−0.278817	0.086525	−0.251123	0.060679	−0.290713	0.226430	−0.223432	0.010406	−0.158195		

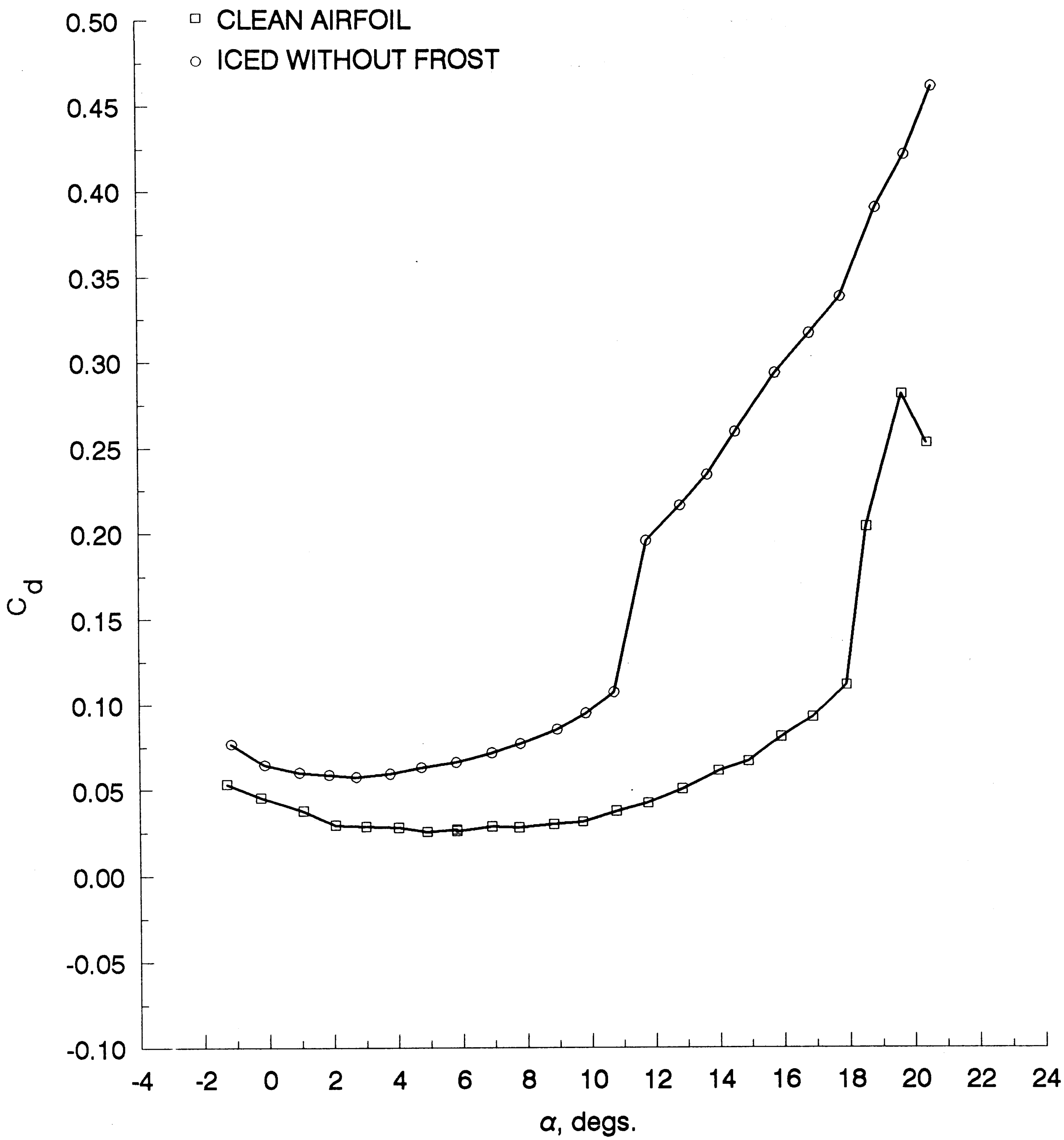
TABLE 101 - RUN 22 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.130658	−0.286828	0.096515	−0.253092	0.074643	−0.284699	0.250377	−0.209366	0.008434	−0.168215		
0.140666	−0.292826	0.104514	−0.257061	0.086577	−0.266737	0.270331	−0.197312	0.006456	−0.176231		
0.148681	−0.300838	0.112507	−0.259034	0.090540	−0.254773	0.278310	−0.191289	0.006488	−0.188248		
0.160715	−0.316871	0.120505	−0.263003	0.098464	−0.230844			0.004511	−0.196264		
0.170745	−0.330902	0.130506	−0.268961	0.110425	−0.222844			0.006552	−0.212281		
0.182757	−0.338903	0.134505	−0.270946	0.122386	−0.214842			0.010586	−0.226290		
0.190762	−0.342899	0.140512	−0.276914	0.146319	−0.202826			0.012611	−0.236299		
0.198772	−0.348902	0.144532	−0.286878	0.162274	−0.194815			0.014631	−0.244305		
0.208760	−0.346867	0.156540	−0.296821	0.180237	−0.190782			0.016661	−0.256317		
0.216743	−0.342829	0.164539	−0.300790	0.196192	−0.182771			0.020690	−0.268323		
0.228713	−0.334764	0.170535	−0.302769	0.208180	−0.184732			0.022715	−0.278332		
0.236681	−0.324702	0.172516	−0.296779	0.222175	−0.190672			0.024740	−0.288340		
0.242655	−0.316653	0.178486	−0.288784	0.230174	−0.194635			0.026754	−0.294343		
0.252595	−0.296545	0.184455	−0.280788	0.238194	−0.206568			0.032755	−0.296331		
0.262551	−0.282461	0.190425	−0.272793	0.242220	−0.218510			0.040759	−0.300315		
0.272506	−0.268376	0.196389	−0.262802	0.236298	−0.244426			0.050752	−0.300288		
0.280453	−0.250281	0.202359	−0.254807	0.230349	−0.260380			0.062743	−0.300256		
0.286422	−0.240224	0.212312	−0.242811	0.224405	−0.278326			0.070737	−0.300235		
0.292396	−0.232176	0.218287	−0.236810	0.218467	−0.298265			0.080729	−0.300209		
0.302368	−0.224116	0.226259	−0.230804	0.216518	−0.316201			0.090722	−0.300182		
0.310346	−0.218070	0.238225	−0.224788	0.222551	−0.332123			0.104701	−0.296139		
0.318330	−0.214032	0.246202	−0.220777	0.230545	−0.334094			0.118680	−0.292097		
0.328312	−0.209989	0.260159	−0.212761	0.246521	−0.334052			0.138643	−0.284032		
0.338294	−0.205946	0.272130	−0.208739	0.252491	−0.326067			0.158602	−0.273965		
		0.280108	−0.204728	0.260469	−0.322061			0.180564	−0.265895		
		0.294070	−0.198707	0.278437	−0.320021			0.194527	−0.255844		
				0.290424	−0.321982			0.206502	−0.249804		
				0.302422	−0.327927			0.216484	−0.245772		
				0.322372	−0.319905			0.232440	−0.233712		
				0.340271	−0.291966			0.242417	−0.227677		
				0.358165	−0.262034			0.252383	−0.217637		
				0.368103	−0.244077			0.256374	−0.215623		
				0.376038	−0.224133			0.262365	−0.213605		
				0.389985	−0.212143			0.272352	−0.211575		
								0.286330	−0.207532		
								0.292321	−0.205514		



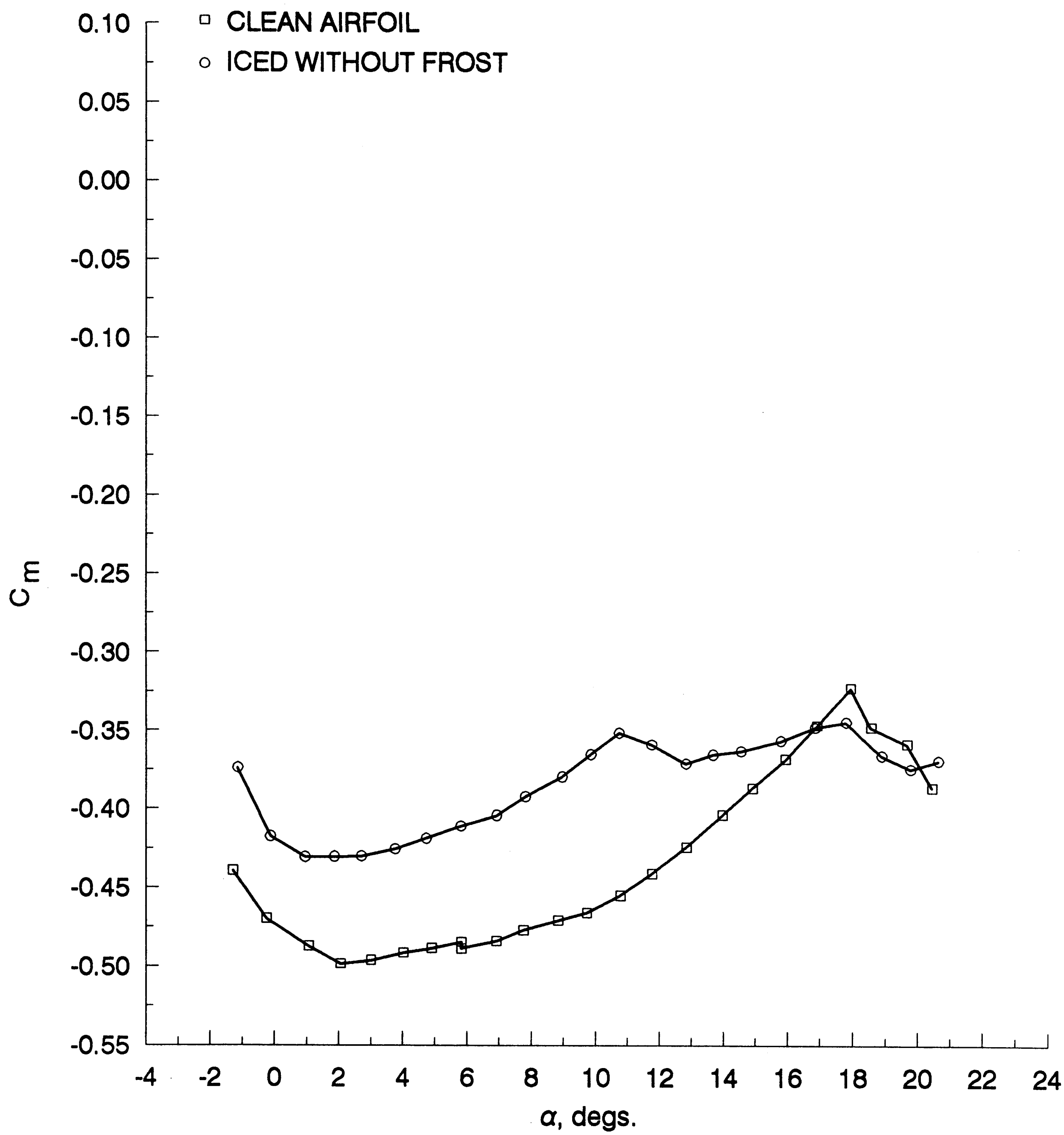
(A) C_l VERSUS α

FIGURE 62 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 22.



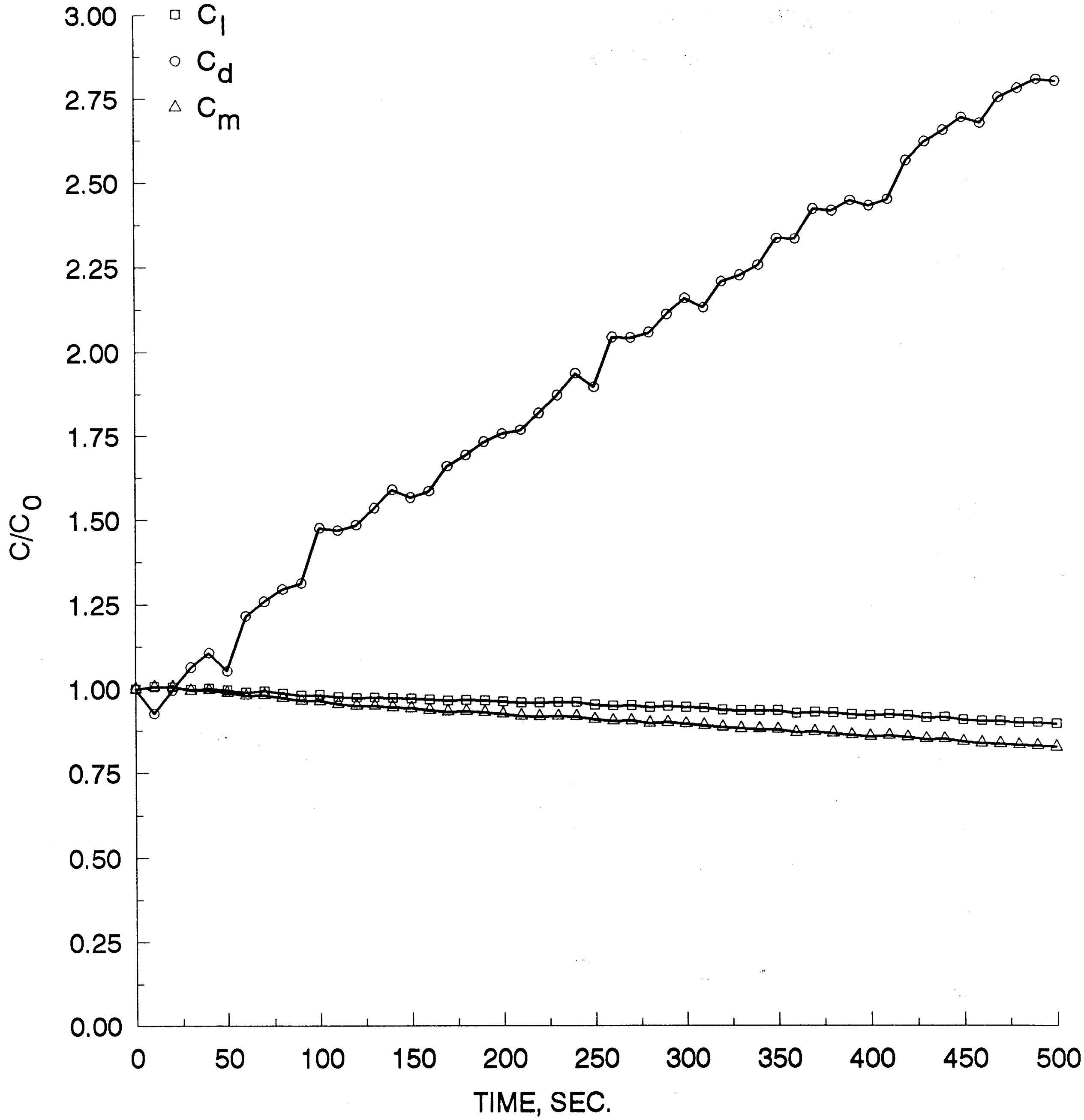
(B) C_d VERSUS α

FIGURE 62 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 22 (con't).



(C) C_m VERSUS α

FIGURE 62 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 22 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 62 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 22 (con't).

TABLE 102 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 22.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.2842	1.0856	0.0534	−0.4390
−0.2438	1.3309	0.0456	−0.4694
1.0645	1.6021	0.0379	−0.4871
2.0532	1.7948	0.0296	−0.4982
3.0004	1.9262	0.0287	−0.4960
4.0219	2.0587	0.0282	−0.4913
4.9066	2.1788	0.0257	−0.4885
5.8305	2.2995	0.0270	−0.4844
5.8294	2.3198	0.0261	−0.4887
6.9280	2.4682	0.0288	−0.4838
7.7683	2.5652	0.0281	−0.4769
8.8365	2.7047	0.0300	−0.4708
9.7340	2.8268	0.0314	−0.4659
10.7811	2.9403	0.0376	−0.4549
11.7717	3.0303	0.0424	−0.4410
12.8443	3.1175	0.0506	−0.4242
13.9769	3.1862	0.0613	−0.4037
14.9100	3.2484	0.0669	−0.3868
15.9437	3.3130	0.0811	−0.3683
16.9195	3.3282	0.0930	−0.3467
17.9471	3.3030	0.1116	−0.3228
18.5755	2.8381	0.2041	−0.3480
19.6854	2.8174	0.2817	−0.3587
20.4520	2.7277	0.2531	−0.3866

(B). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
−1.1450	0.8991	0.0768	−0.3739
−0.1267	1.1795	0.0648	−0.4173
0.9441	1.3898	0.0604	−0.4303
1.8581	1.5321	0.0591	−0.4301
2.7027	1.6634	0.0577	−0.4299
3.7592	1.8102	0.0595	−0.4254
4.7361	1.9358	0.0632	−0.4187
5.8180	2.0645	0.0662	−0.4109
6.9321	2.2054	0.0718	−0.4042
7.8190	2.2791	0.0771	−0.3922
8.9647	2.3956	0.0854	−0.3797
9.8551	2.4539	0.0950	−0.3654
10.7367	2.5012	0.1074	−0.3516
11.7600	2.4101	0.1958	−0.3591
12.8296	2.2867	0.2163	−0.3713
13.6786	2.3189	0.2342	−0.3655
14.5556	2.3236	0.2594	−0.3633
15.8004	2.3570	0.2938	−0.3566
16.8556	2.3434	0.3171	−0.3481
17.8022	2.3016	0.3386	−0.3447
18.8988	2.2267	0.3907	−0.3661
19.7897	2.2124	0.4219	−0.3747
20.6560	2.1819	0.4618	−0.3694

TABLE 103 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 22.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	1.0055	0.9261	1.0060
20	1.0051	0.9960	1.0057
30	0.9970	1.0634	0.9953
40	1.0004	1.1059	0.9959
50	0.9957	1.0530	0.9886
60	0.9889	1.2155	0.9794
70	0.9936	1.2593	0.9820
80	0.9869	1.2955	0.9726
90	0.9809	1.3130	0.9644
100	0.9822	1.4769	0.9637
110	0.9757	1.4699	0.9547
120	0.9736	1.4861	0.9501
130	0.9746	1.5366	0.9494
140	0.9730	1.5906	0.9459
150	0.9715	1.5678	0.9422
160	0.9674	1.5865	0.9361
170	0.9650	1.6609	0.9326
180	0.9662	1.6935	0.9330
190	0.9647	1.7341	0.9297
200	0.9611	1.7585	0.9251
210	0.9576	1.7693	0.9193
220	0.9577	1.8198	0.9176
230	0.9594	1.8729	0.9184
240	0.9599	1.9375	0.9176
250	0.9514	1.8969	0.9082
260	0.9489	2.0457	0.9042
270	0.9502	2.0444	0.9047
280	0.9454	2.0602	0.8979
290	0.9482	2.1142	0.8997
300	0.9451	2.1622	0.8953
310	0.9424	2.1342	0.8910
320	0.9373	2.2117	0.8853
330	0.9344	2.2300	0.8816
340	0.9352	2.2601	0.8801
350	0.9354	2.3399	0.8791

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
360	0.9270	2.3381	0.8698
370	0.9305	2.4263	0.8720
380	0.9282	2.4214	0.8683
390	0.9230	2.4519	0.8624
400	0.9208	2.4362	0.8583
410	0.9242	2.4549	0.8607
420	0.9196	2.5697	0.8557
430	0.9140	2.6255	0.8504
440	0.9161	2.6593	0.8510
450	0.9075	2.6976	0.8425
460	0.9044	2.6808	0.8386
470	0.9033	2.7576	0.8366
480	0.8994	2.7850	0.8330
490	0.8995	2.8123	0.8308
500	0.8962	2.8068	0.8273

TABLE 104 - TEST CONDITIONS FOR RUN NUMBER 22.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 22	Configuration 15° Flap	Date 05-06-88	
P_{air} 80 psig	ΔP_w 72.5 psid	T_{avg} 28° F	V_∞ 100 mph
Spray Duration 8 min	Ice Accretion Type Glaze	A.O.A. 8°	
LWC 0.92 g/m³	MVD 14.4 μm		

Remarks

- Considerable ice deposition on the lower surface. Relatively small amount on the upper surface of the slat. Ice in the gap between slat and main airfoil. No ice on upper surface behind gap. No frost evident. Ice deposits on the lower surface were more like fingers of ice.
- Ice accretion on Leading Edge Slat approximately 3/8" thick.
- Ice accretion on leading edge of Flap 1 approximately 1/4" thick.
- Ice accretion on leading edge of Flap 2 approximately 3/16" thick.
- Flap 3 had ice fingers.
- The uniformity was better than the previous two runs. There was still a somewhat smaller deposit on the side near Section A.

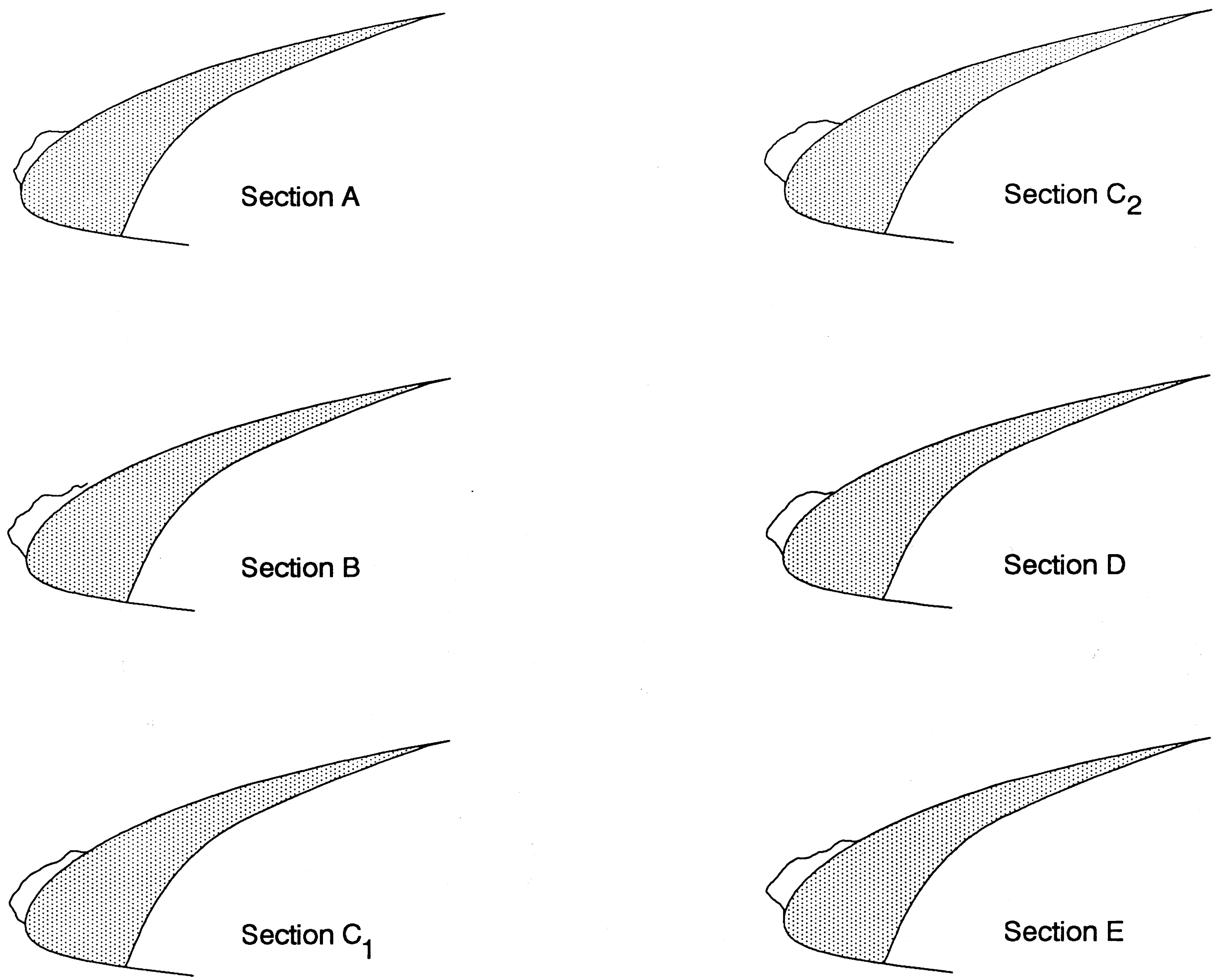


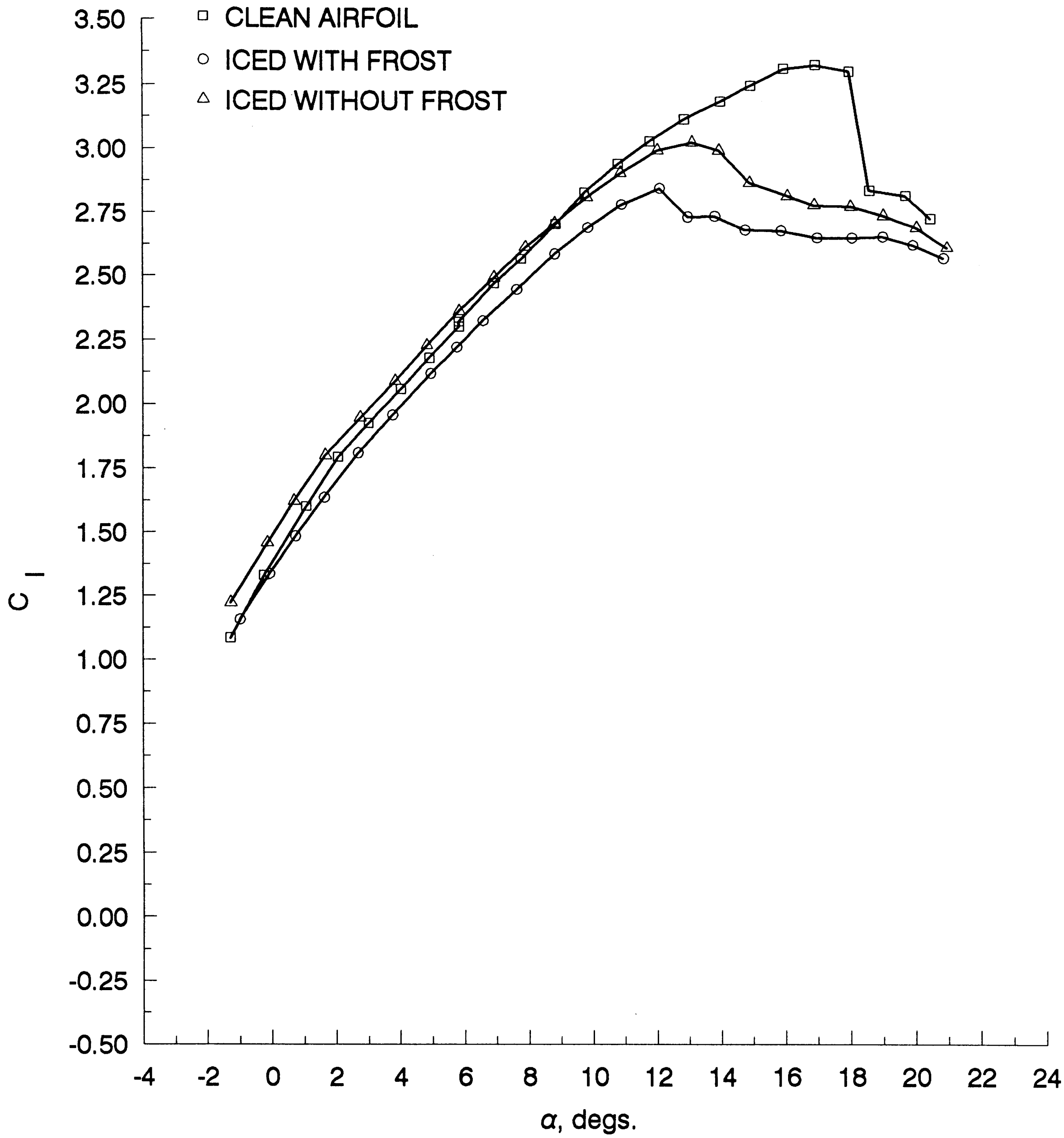
FIGURE 63 - RUN 23 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 105 - RUN 23 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.302271	0.377790	0.365080	0.452978	0.354907	0.420975	0.352907	0.405692	0.322195	0.386268	0.439347	0.463163
0.286320	0.373779	0.355089	0.446951	0.338906	0.420933	0.338913	0.403671	0.310229	0.384250	0.423393	0.465121
0.274354	0.371764	0.343095	0.440920	0.324895	0.424896	0.320908	0.405609	0.296263	0.384213	0.409438	0.465084
0.266373	0.371743	0.335100	0.436898	0.310888	0.426859	0.304903	0.407551	0.284292	0.384181	0.397471	0.467052
0.254413	0.367743	0.327109	0.430877	0.298882	0.428827	0.286893	0.411471	0.270342	0.378184	0.383511	0.469015
0.242441	0.367711	0.315095	0.432846	0.286882	0.428796	0.268883	0.415392	0.250401	0.374158	0.373543	0.468988
0.232460	0.369669	0.307072	0.438824	0.274881	0.428764	0.252862	0.423286	0.230434	0.380065	0.355590	0.472941
0.220483	0.371622	0.299066	0.438803	0.266891	0.424742	0.236863	0.423244	0.216457	0.384002	0.335676	0.464888
0.206512	0.373569	0.289064	0.436777	0.250922	0.412699	0.200885	0.415213	0.198495	0.385941	0.321742	0.456850
0.186560	0.373516	0.277076	0.428744	0.238948	0.402666	0.182891	0.413182	0.170563	0.385867	0.309797	0.450819
0.176578	0.375474	0.267110	0.412718	0.230979	0.390644	0.162892	0.413129	0.148627	0.381836	0.297856	0.442788
0.160622	0.373448	0.253121	0.404681	0.219005	0.380612	0.140892	0.413071	0.120726	0.369842	0.289903	0.434766
0.138691	0.367438	0.229139	0.390618	0.203025	0.372568	0.124920	0.403109	0.092815	0.361821	0.279962	0.424740
0.122740	0.363428	0.209150	0.380564	0.179051	0.362504	0.104947	0.393136	0.076880	0.351845	0.270010	0.418714
0.104820	0.349491	0.181133	0.378490	0.155065	0.356440	0.094968	0.385173	0.054971	0.337880	0.258064	0.412682
0.096855	0.343518	0.159111	0.380432	0.133085	0.348381	0.080990	0.377199	0.039046	0.323931	0.248107	0.408655
0.088895	0.335560	0.141092	0.382384	0.099125	0.332290	0.071017	0.367253	0.025128	0.306014	0.228177	0.406603
0.084931	0.325629	0.123072	0.384336	0.087151	0.322257	0.067038	0.359306	0.013204	0.288102	0.210240	0.404555
0.078993	0.307756	0.111063	0.384305	0.069177	0.312209	0.055060	0.351338	−0.008695	0.270163	0.196306	0.396518
0.073045	0.293851	0.091058	0.380251	0.041212	0.298133	0.043065	0.349322	−0.022613	0.252246	0.180379	0.388475
0.061116	0.277947	0.077079	0.368214	0.023243	0.286085	0.027076	0.345312	−0.038532	0.236310	0.168433	0.382444
0.045202	0.260047	0.065096	0.358183	0.001295	0.266025	0.013098	0.337339	−0.048471	0.222376	0.156493	0.374412
0.023286	0.248085	0.053119	0.346152	−0.016664	0.249976	−0.000875	0.327381	−0.060410	0.210424	0.146530	0.372386
0.009357	0.234159	0.039140	0.334115	−0.026632	0.237949	−0.018843	0.315429	−0.068364	0.200469	0.134580	0.368354
0.001413	0.220249	0.037159	0.326109	−0.034596	0.223927	−0.032821	0.307456	−0.082288	0.184539	0.120625	0.368317
−0.008531	0.208318	0.027194	0.310083	−0.044549	0.205898	−0.044799	0.299488	−0.090232	0.170611	0.100684	0.370264
−0.012479	0.192434	0.013225	0.294046	−0.060502	0.187855	−0.050783	0.293521	−0.094196	0.160666	0.084735	0.370221
−0.018417	0.174561	−0.008755	0.279987	−0.076460	0.171811	−0.054762	0.285574	−0.096143	0.142781	0.072789	0.364190
−0.024371	0.162641	−0.022744	0.271950	−0.088408	0.151778	−0.066735	0.275622	−0.096096	0.124900	0.060844	0.358158
−0.032331	0.154684	−0.036739	0.265913	−0.096355	0.131755	−0.080692	0.259712	−0.086088	0.113006	0.044922	0.348116
−0.042285	0.146720	−0.054716	0.251866	−0.094302	0.111759	−0.092665	0.249760	−0.060109	0.097181	0.030988	0.340079
−0.044249	0.134811	−0.064703	0.243839	−0.080259	0.095795	−0.104623	0.233855	−0.046106	0.083311	0.015066	0.330036
−0.034220	0.114995	−0.068679	0.233829	−0.070216	0.079820	−0.108590	0.221940	−0.036093	0.069430	0.005135	0.316010

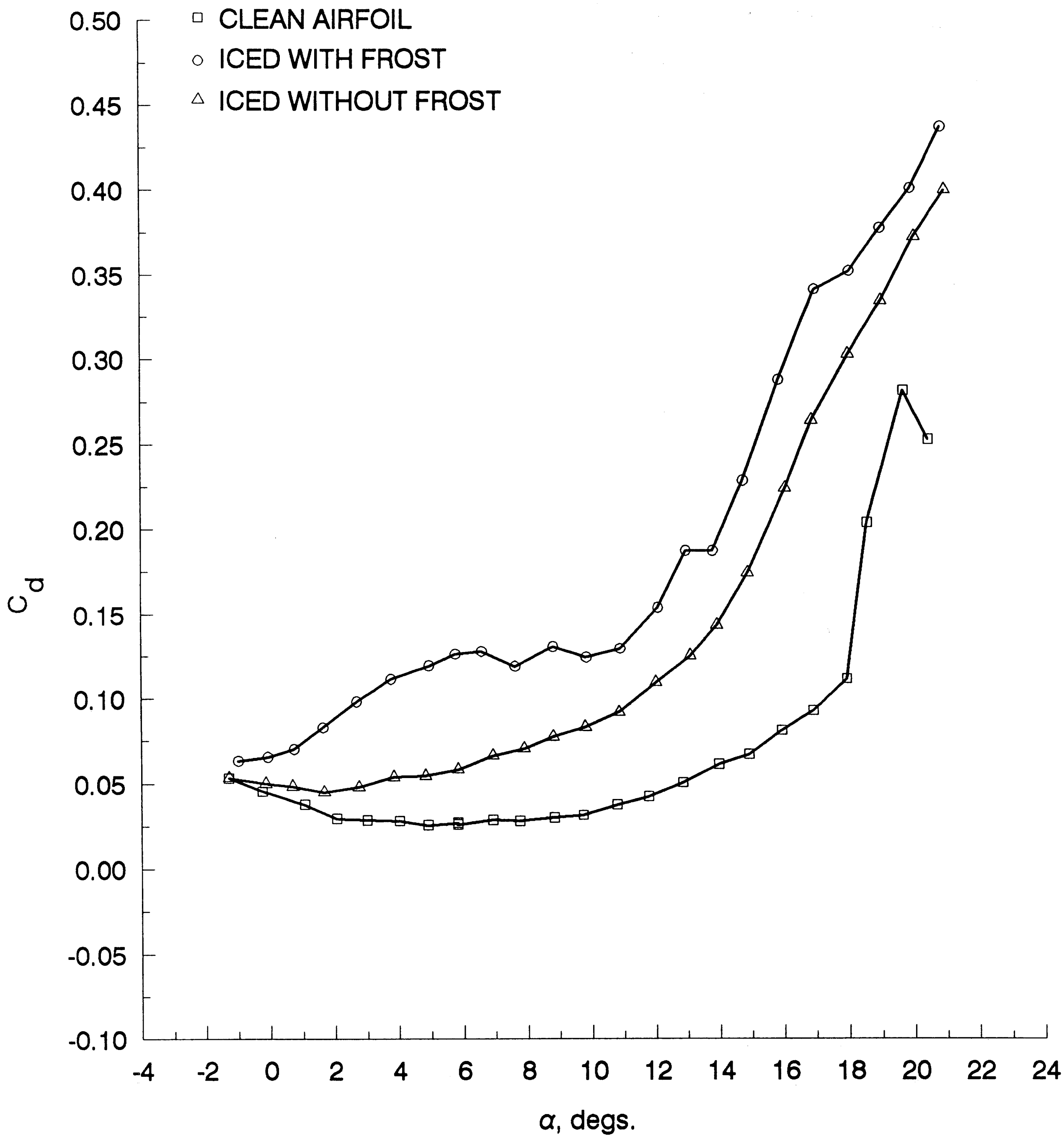
TABLE 105 - RUN 23 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E. (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
−0.030166	0.091196	−0.072650	0.221818	−0.062178	0.065840	−0.110564	0.212014	−0.024079	0.053568	−0.004801	0.303984
−0.022159	0.081296	−0.076632	0.213808	−0.060141	0.051845	−0.114532	0.200099	−0.014061	0.037700	−0.016720	0.287952
−0.016152	0.073376	−0.082600	0.199792	−0.048082	0.029875	−0.116495	0.186205	−0.004033	0.017859	−0.030633	0.271916
−0.004149	0.061503	−0.092581	0.189765	−0.034050	0.017912	−0.116463	0.174300	−0.000026	0.011909	−0.040569	0.259889
		−0.100572	0.183744	−0.014022	0.007964	−0.110421	0.158444			−0.052504	0.249858
		−0.104564	0.179734			−0.096379	0.142608			−0.064428	0.235826
		−0.110553	0.173718			−0.086342	0.128745			−0.080340	0.221783
		−0.112533	0.165713			−0.072311	0.116878			−0.090276	0.209757
		−0.112512	0.157713			−0.056279	0.105015			−0.098218	0.197736
		−0.106465	0.141728			−0.040248	0.093153			−0.102190	0.191726
		−0.096399	0.119755			−0.028211	0.079295			−0.104146	0.177721
		−0.088345	0.101776			−0.012180	0.067433			−0.100133	0.167732
		−0.068287	0.085830			−0.000148	0.055560			−0.092132	0.157753
		−0.054244	0.073867			−0.000095	0.035719			−0.078135	0.141790
		−0.038189	0.057910							−0.064148	0.129828
		−0.026132	0.039942							−0.056158	0.123849
		−0.010071	0.021984							−0.044175	0.115881
		−0.002033	0.010005							−0.034192	0.109908
										−0.022199	0.097940
										−0.012199	0.085967
										−0.008191	0.077977
										−0.002194	0.071993



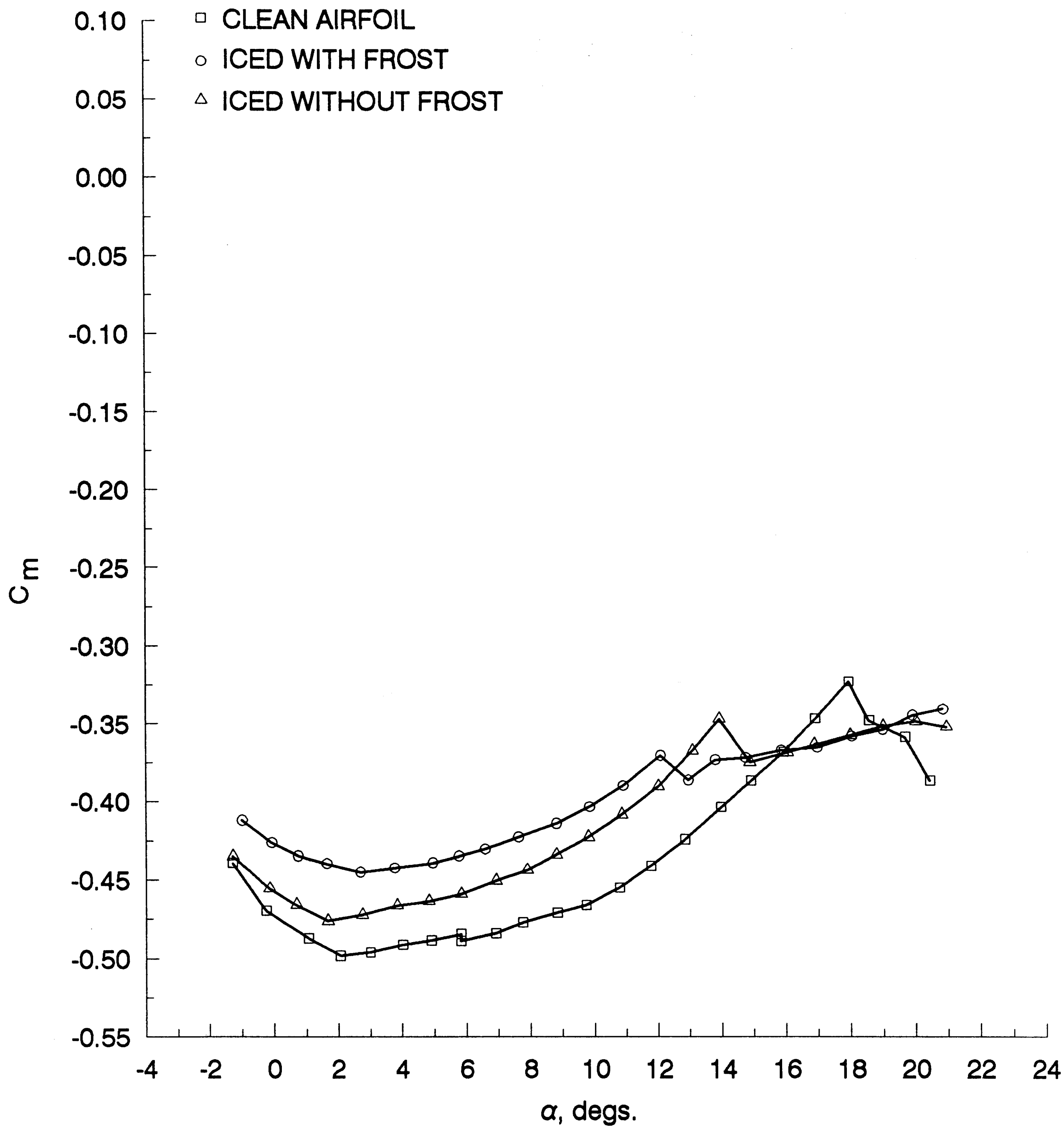
(A) C_l VERSUS α

FIGURE 64 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 23.



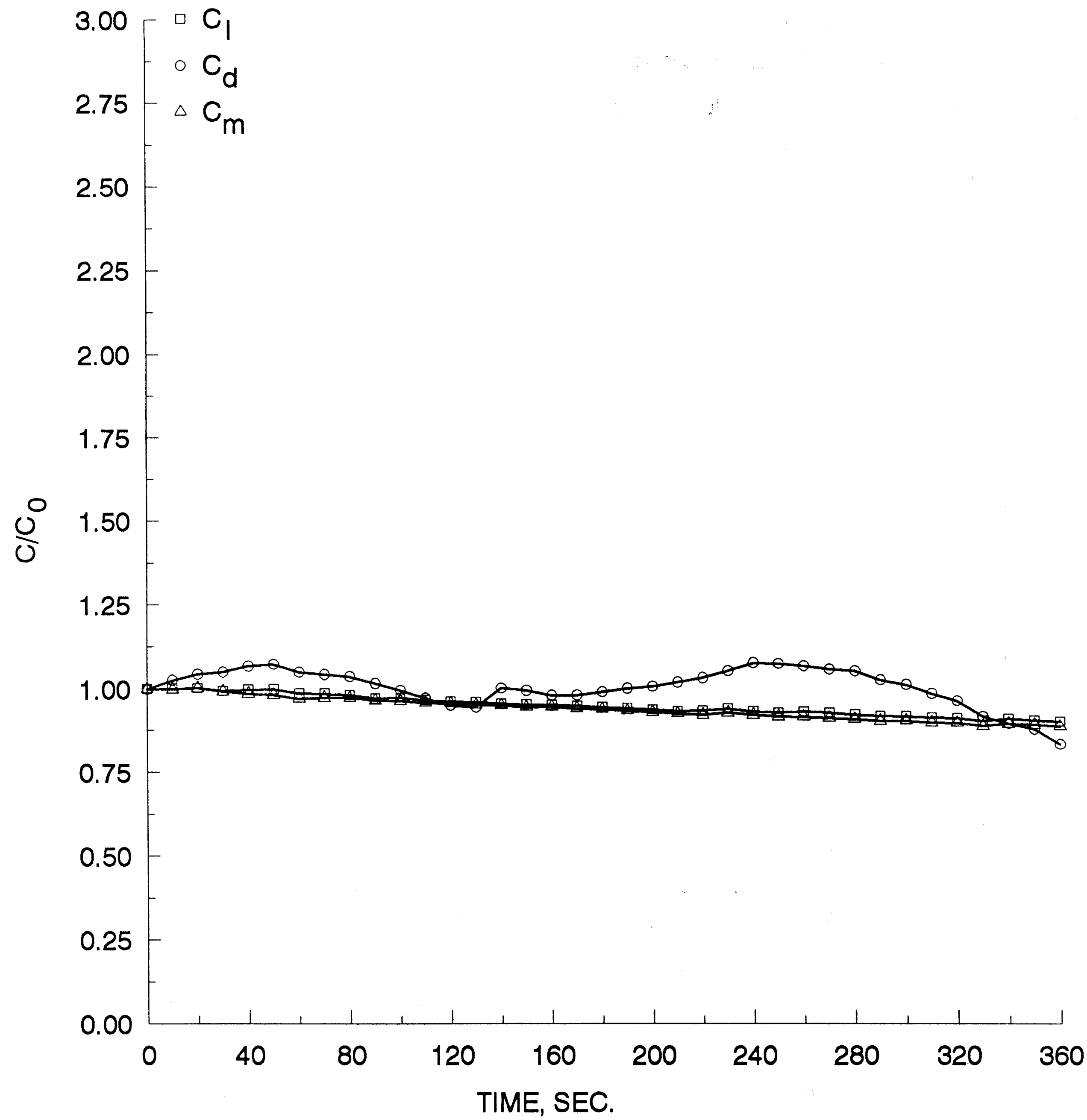
(B) C_d VERSUS α

FIGURE 64 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 23 (con't).



(C) C_m VERSUS α

FIGURE 64 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 23 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 64 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 23 (con't).

TABLE 106 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 23.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
−1.2842	1.0856	0.0534	−0.4390
−0.2438	1.3309	0.0456	−0.4694
1.0645	1.6021	0.0379	−0.4871
2.0532	1.7948	0.0296	−0.4982
3.0004	1.9262	0.0287	−0.4960
4.0219	2.0587	0.0282	−0.4913
4.9066	2.1788	0.0257	−0.4885
5.8305	2.2995	0.0270	−0.4844
5.8294	2.3198	0.0261	−0.4887
6.9280	2.4682	0.0288	−0.4838
7.7683	2.5652	0.0281	−0.4769
8.8365	2.7047	0.0300	−0.4708
9.7340	2.8268	0.0314	−0.4659
10.7811	2.9403	0.0376	−0.4549
11.7717	3.0303	0.0424	−0.4410
12.8443	3.1175	0.0506	−0.4242
13.9769	3.1862	0.0613	−0.4037
14.9100	3.2484	0.0669	−0.3868
15.9437	3.3130	0.0811	−0.3683
16.9195	3.3282	0.0930	−0.3467
17.9471	3.3030	0.1116	−0.3228
18.5755	2.8381	0.2041	−0.3480
19.6854	2.8174	0.2817	−0.3587
20.4520	2.7277	0.2531	−0.3866

(B) ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
−0.9938	1.1575	0.0634	−0.4119
−0.0779	1.3369	0.0657	−0.4260
0.7341	1.4843	0.0703	−0.4344
1.6296	1.6365	0.0831	−0.4394
2.6816	1.8099	0.0984	−0.4449
3.7596	1.9576	0.1115	−0.4422
4.9460	2.1185	0.1194	−0.4389
5.7677	2.2205	0.1263	−0.4345
6.5837	2.3233	0.1278	−0.4302
7.6299	2.4447	0.1190	−0.4225
8.8132	2.5852	0.1306	−0.4140
9.8446	2.6907	0.1243	−0.4035
10.8975	2.7811	0.1295	−0.3900
12.0863	2.8452	0.1539	−0.3707
12.9604	2.7334	0.1875	−0.3864
13.8019	2.7371	0.1875	−0.3734
14.7483	2.6829	0.2288	−0.3720
15.8642	2.6802	0.2880	−0.3671
16.9727	2.6522	0.3414	−0.3654
18.0424	2.6518	0.3523	−0.3581
18.9865	2.6558	0.3777	−0.3538
19.9143	2.6232	0.4013	−0.3445
20.8634	2.5707	0.4377	−0.3407

(C). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
−1.2766	1.2220	0.0535	−0.4347
−0.1466	1.4586	0.0502	−0.4553
0.6892	1.6225	0.0486	−0.4656
1.6635	1.8004	0.0452	−0.4759
2.7449	1.9476	0.0481	−0.4721
3.8426	2.0891	0.0539	−0.4661
4.8313	2.2271	0.0547	−0.4633
5.8381	2.3606	0.0583	−0.4588
6.9260	2.4908	0.0663	−0.4502
7.8998	2.6122	0.0705	−0.4435
8.8066	2.7063	0.0773	−0.4338
9.8080	2.8092	0.0831	−0.4226
10.8606	2.9054	0.0919	−0.4083
12.0145	2.9949	0.1094	−0.3903
13.0911	3.0264	0.1252	−0.3676
13.9269	2.9952	0.1434	−0.3470
14.8869	2.8674	0.1744	−0.3749
16.0587	2.8159	0.2243	−0.3685
16.8828	2.7802	0.2642	−0.3635
18.0058	2.7739	0.3029	−0.3575
19.0034	2.7389	0.3346	−0.3516
20.0225	2.6915	0.3725	−0.3486
20.9702	2.6121	0.4003	−0.3522

TABLE 107 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 23.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
0	1.0000	1.0000	1.0000
10	1.0016	1.0265	0.9994
20	1.0026	1.0442	1.0026
30	0.9943	1.0503	0.9924
40	0.9983	1.0681	0.9859
50	0.9998	1.0739	0.9828
60	0.9875	1.0504	0.9721
70	0.9868	1.0436	0.9744
80	0.9820	1.0375	0.9737
90	0.9726	1.0169	0.9659
100	0.9749	0.9960	0.9644
110	0.9667	0.9735	0.9583
120	0.9632	0.9504	0.9565
130	0.9615	0.9445	0.9522
140	0.9560	1.0029	0.9504
150	0.9540	0.9954	0.9449
160	0.9528	0.9809	0.9465
170	0.9488	0.9812	0.9410
180	0.9459	0.9908	0.9391
190	0.9420	1.0019	0.9341
200	0.9379	1.0079	0.9295
210	0.9334	1.0202	0.9259
220	0.9345	1.0333	0.9214
230	0.9404	1.0538	0.9283
240	0.9326	1.0780	0.9214
250	0.9281	1.0754	0.9167
260	0.9317	1.0683	0.9158
270	0.9285	1.0583	0.9126
280	0.9226	1.0536	0.9086
290	0.9182	1.0272	0.9031
300	0.9175	1.0136	0.9037
310	0.9131	0.9861	0.8984
320	0.9115	0.9644	0.8975
330	0.9045	0.9168	0.8882
340	0.9100	0.8950	0.8949
350	0.9050	0.8782	0.8913
360	0.9017	0.8339	0.8873

TABLE 108 - TEST CONDITIONS FOR RUN NUMBER 23.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 23	Configuration 15° Flap	Date 05-06-88	
P_{air} 80 psig	ΔP_w 41 psid	T_{avg} -10° F	V_∞ 100 mph
Spray Duration 6 min	Ice Accretion Type Rime	A.O.A. 0°	
LWC 0.62 g/m³	MVD 12.2 μm		

Remarks

- Frost on the lower surface and in the region between the slat and the leading edge of the main wing section. There was frost on Flap 3.
- Ice accretion on Leading Edge Slat approximately 1/8" thick. The ice extended from the leading edge to about 1/2" back along the upper surface.
- Ice accretions on leading edge of Flaps 1 and 2 < 1/16" thick, too small to trace.
- The uniformity across the span was better than previous cases.

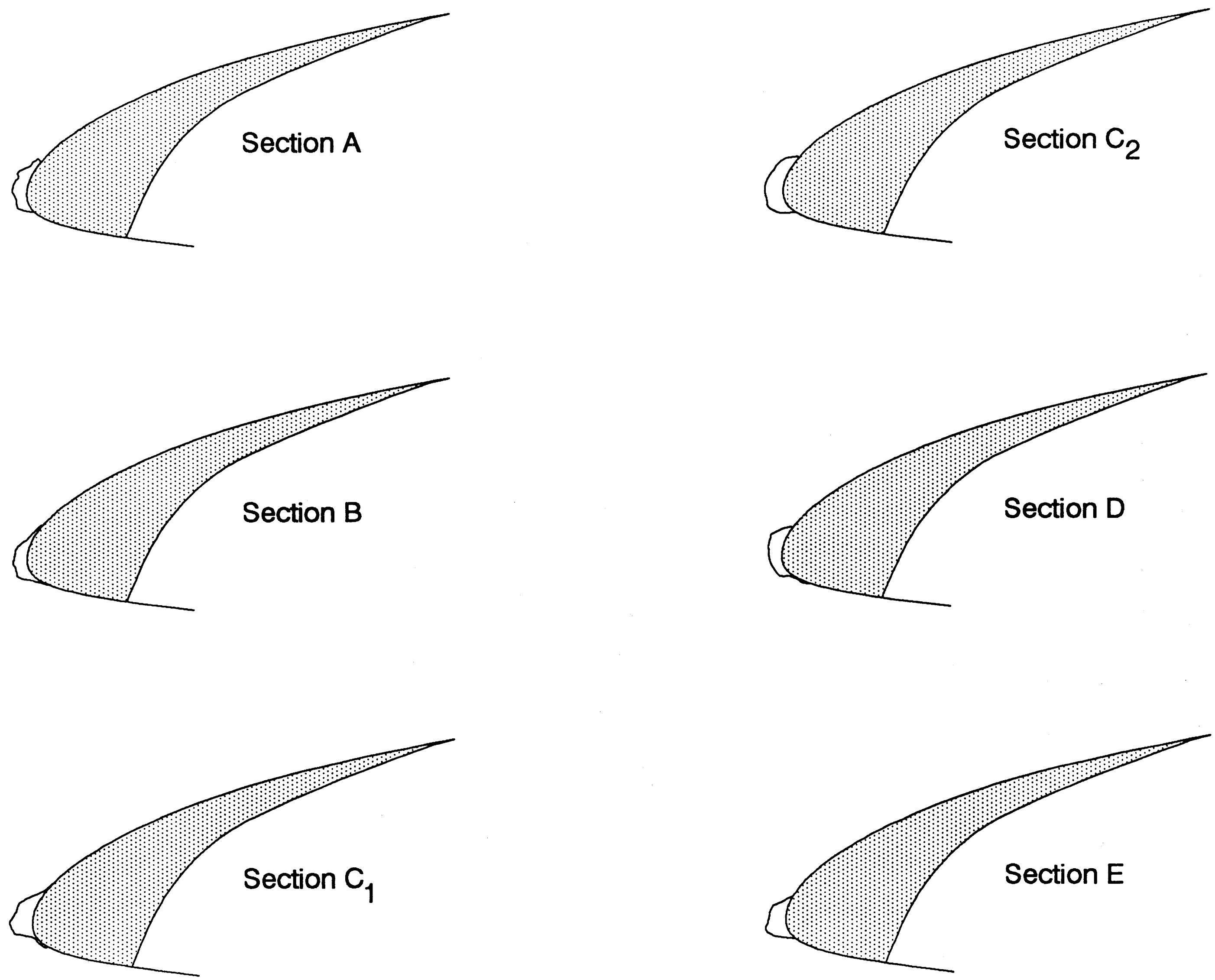


FIGURE 65 - RUN 24 ICE SHAPE TRACINGS FOR LEADING EDGE SLAT, SECTIONS A - E.

TABLE 109 - RUN 24 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.087432	0.189491	0.086427	0.206794	0.119199	0.233996	0.084664	0.207963	0.058417	0.174635	0.044243	0.134132
0.085412	0.197454	0.074317	0.196736	0.102991	0.219972	0.064377	0.205913	0.050299	0.172608	0.034116	0.130105
0.081393	0.205412	0.060190	0.184666	0.092858	0.211957	0.044090	0.203862	0.040149	0.170577	0.026010	0.128084
0.071374	0.215347	0.050103	0.174612	0.082731	0.201943	0.015696	0.197796	0.025944	0.166529	0.013860	0.122051
0.055418	0.203351	0.042038	0.164564	0.070562	0.195919	0.001513	0.189769	0.011738	0.162481	−0.000312	0.114014
0.035465	0.191346	0.031951	0.154510	0.056373	0.185896	−0.014700	0.181737	−0.008549	0.154406	−0.014484	0.105976
0.031489	0.183366	0.019841	0.144450	0.042179	0.177869	−0.028867	0.167718	−0.024780	0.148347	−0.030684	0.097933
0.021528	0.171387	0.011783	0.132397	0.025948	0.171835	−0.045058	0.151697	−0.041000	0.138278	−0.044861	0.091895
0.011551	0.165384	0.005741	0.122353	0.005656	0.165790	−0.059198	0.127691	−0.053170	0.132229	−0.061067	0.085853
−0.006414	0.157367	−0.004346	0.112300	−0.016656	0.155745	−0.071331	0.111680	−0.061282	0.128197	−0.075244	0.079815
−0.018395	0.153351	−0.020512	0.106241	−0.034912	0.147708	−0.083453	0.091674	−0.065317	0.118160	−0.083323	0.067793
−0.032368	0.147338	−0.032622	0.096181	−0.049101	0.137684	−0.095575	0.071668	−0.067316	0.106122	−0.089373	0.055776
−0.040352	0.143332	−0.042714	0.088133	−0.067356	0.129647	−0.103627	0.047678	−0.073360	0.088057	−0.093402	0.045765
−0.048330	0.137334	−0.054824	0.078074	−0.079509	0.117632	−0.109666	0.029685	−0.077374	0.069998	−0.097425	0.033754
−0.054294	0.125365	−0.060865	0.068031	−0.089609	0.097631	−0.109618	0.011709	−0.079372	0.057960	−0.097398	0.023753
−0.048267	0.113428	−0.068924	0.055977	−0.093612	0.075650	−0.107546	−0.004265	−0.077277	0.033900	−0.099393	0.011747
−0.048229	0.099483	−0.070915	0.043939	−0.101697	0.061647	−0.103444	−0.020234	−0.075203	0.017863	−0.099372	0.003746
−0.056202	0.091492	−0.072895	0.027890	−0.111803	0.043645	−0.097303	−0.040192	−0.075165	0.003825	−0.105412	−0.012271
−0.066168	0.081505	−0.074896	0.019863	−0.119899	0.033637	−0.095214	−0.062158	−0.073085	−0.014219	−0.107418	−0.020277
−0.074131	0.069531	−0.074864	0.007830	−0.128001	0.025627	−0.095171	−0.078138	−0.068981	−0.030252	−0.111452	−0.028288
−0.078112	0.063544	−0.076860	−0.002202	−0.134072	0.017621	−0.089046	−0.092103	−0.062834	−0.050290	−0.119520	−0.044311
−0.080079	0.051586	−0.082912	−0.008235	−0.138112	0.009622	−0.074808	−0.104051	−0.050595	−0.070312	−0.119482	−0.058312
−0.080057	0.043617	−0.084914	−0.016262	−0.136055	−0.000360	−0.056529	−0.109996	−0.040397	−0.086328	−0.115411	−0.064301
−0.086037	0.037625	−0.084887	−0.026289	−0.129930	−0.012328	−0.036204	−0.121927	−0.034278	−0.096340	−0.109301	−0.074286
−0.087993	0.021682	−0.080820	−0.034300	−0.125825	−0.028296	−0.009813	−0.125853	−0.026127	−0.106345	−0.099146	−0.080260
−0.081966	0.009744	−0.070679	−0.044301	−0.115639	−0.040254	0.024690	−0.127760	−0.011879	−0.118340	−0.088992	−0.086234
−0.075944	−0.000201	−0.066596	−0.058329	−0.109503	−0.056217	0.055124	−0.125683	0.014534	−0.122282	−0.074777	−0.094198
−0.067918	−0.012133	−0.062513	−0.072356	−0.099338	−0.060185	0.075411	−0.123633	0.026709	−0.118239	−0.060572	−0.098161
−0.061875	−0.030047	−0.060458	−0.084383	−0.074963	−0.062119			0.030770	−0.118229	−0.040285	−0.102108
−0.061816	−0.051961	−0.058408	−0.094405	−0.058705	−0.066072			0.044987	−0.118191	−0.017975	−0.104050
−0.055768	−0.071868	−0.058392	−0.100421	−0.036356	−0.070008			0.061255	−0.126170	−0.001748	−0.106008
−0.051750	−0.079826	−0.046240	−0.106406	−0.009939	−0.075931			0.077524	−0.134150	0.012456	−0.109971
−0.029750	−0.085743	−0.032064	−0.112385	0.008355	−0.081875			0.097860	−0.144124	0.032733	−0.109918

TABLE 109 - RUN 24 ICE SHAPE COORDINATES FOR LEADING EDGE SLAT, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
-0.015739	-0.093675	-0.013848	-0.116348	0.020567	-0.091830			0.110078	-0.156124	0.048960	-0.111875
0.008248	-0.095604	0.008413	-0.120300	0.030758	-0.105785			0.130403	-0.162087		
0.026246	-0.099541	0.032697	-0.124248	0.040940	-0.115745			0.156815	-0.166029		
0.050233	-0.101470	0.054969	-0.132211	0.055182	-0.125695			0.171037	-0.167997		
		0.077235	-0.138169	0.075523	-0.137626						
		0.099502	-0.144126								
		0.117723	-0.150095								
		0.148075	-0.154026								

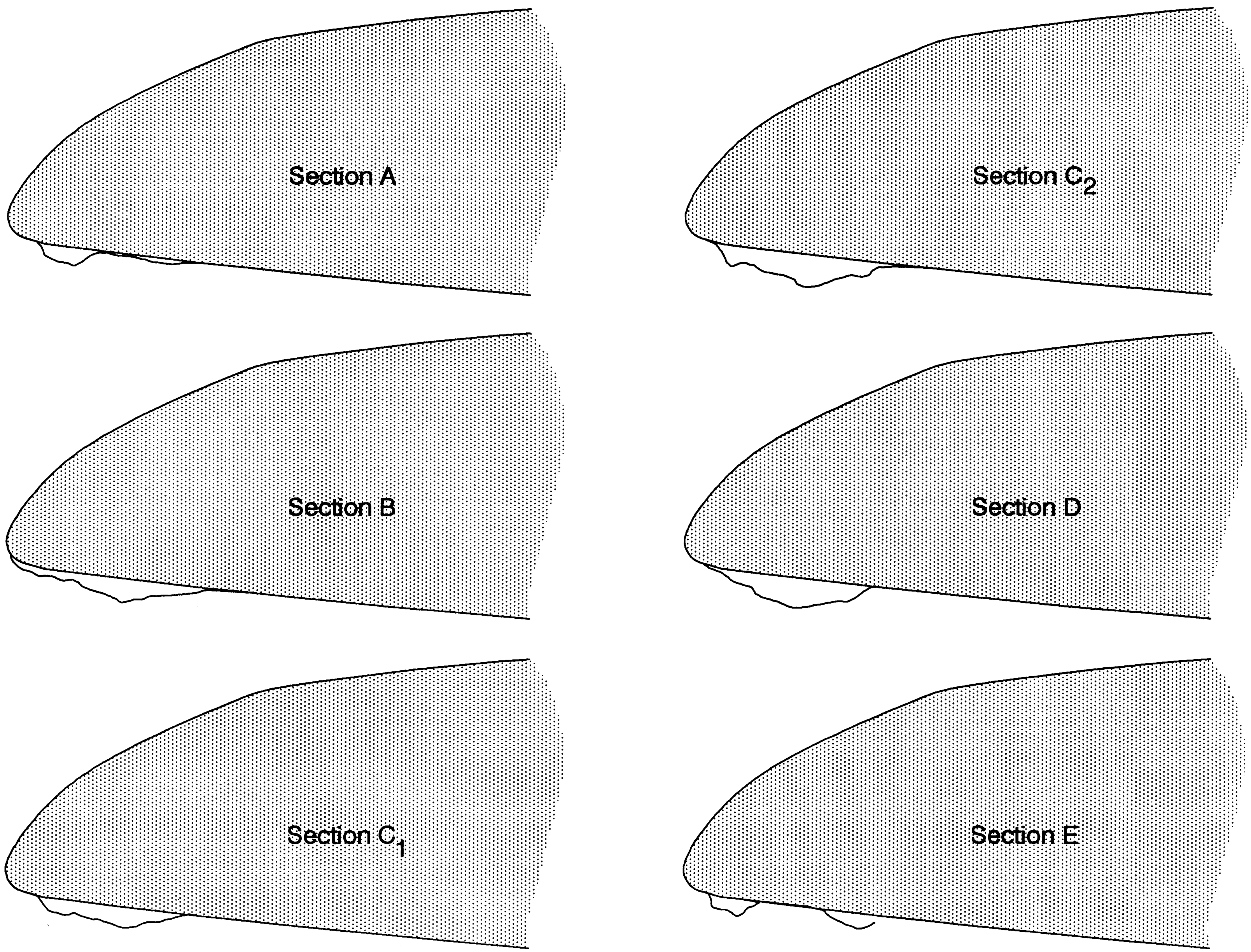


FIGURE 66 - RUN 24 ICE SHAPE TRACINGS FOR MAIN AIRFOIL, SECTIONS A - E.

TABLE 110 - RUN 24 ICE SHAPE COORDINATES FOR MAIN AIRFOIL, SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
0.946989	−0.290298	0.783333	−0.236672	0.968480	−0.300936	0.959990	−0.307138	0.892557	−0.283880	0.922199	−0.284416
0.959026	−0.306203	0.801408	−0.264487	0.978532	−0.316783	0.972038	−0.323091	0.908567	−0.293778	0.930266	−0.300332
0.973061	−0.322103	0.817451	−0.280365	0.994607	−0.338567	0.984087	−0.339043	0.918579	−0.301704	0.936315	−0.312268
0.979080	−0.330055	0.831483	−0.292269	1.010677	−0.358367	0.998131	−0.352992	0.934579	−0.307626	0.940354	−0.322217
0.987113	−0.343978	0.847515	−0.304168	1.024740	−0.376189	1.008178	−0.368950	0.952577	−0.313544	0.942392	−0.334164
0.993147	−0.357907	0.871548	−0.316045	1.040804	−0.394005	1.014224	−0.384918	0.968578	−0.319466	0.942424	−0.346116
0.997198	−0.377817	0.897565	−0.321947	1.052838	−0.401910	1.022275	−0.402879	0.984578	−0.325388	0.942456	−0.358068
1.013222	−0.389727	0.915576	−0.325880	1.072875	−0.407810	1.028315	−0.416849	1.000578	−0.331310	0.946494	−0.368018
1.025237	−0.397664	0.931598	−0.333798	1.086890	−0.407773	1.034350	−0.428821	1.020596	−0.345174	0.958551	−0.375955
1.039246	−0.403603	0.937619	−0.341742	1.100910	−0.409720	1.046388	−0.440778	1.034609	−0.355077	0.974610	−0.379896
1.055254	−0.409537	0.949635	−0.347681	1.120952	−0.417605	1.054413	−0.448748	1.048621	−0.364981	0.994686	−0.385820
1.075271	−0.419444	0.969657	−0.355589	1.138986	−0.423510	1.062428	−0.452723	1.064643	−0.378856	1.010744	−0.389761
1.087281	−0.425389	0.987658	−0.355541	1.159013	−0.425442	1.070432	−0.452702	1.076663	−0.390753	1.026798	−0.391711
1.103279	−0.427339	0.997653	−0.353525	1.175024	−0.423416	1.086424	−0.446666	1.092668	−0.398663	1.048874	−0.395637
1.117272	−0.427302	1.013654	−0.353482	1.197026	−0.415421	1.104417	−0.440624	1.112660	−0.402587	1.064944	−0.403563
1.129271	−0.429262	1.025654	−0.353451	1.213032	−0.411410	1.120403	−0.432590	1.126662	−0.408514	1.081012	−0.411489
1.139271	−0.431228	1.041660	−0.355399	1.227063	−0.417326	1.132399	−0.428562	1.144660	−0.414431	1.089063	−0.421428
1.149272	−0.433193	1.055665	−0.357352	1.241099	−0.425226	1.152409	−0.428509	1.164656	−0.420343	1.101115	−0.427372
1.165280	−0.439127	1.073682	−0.363275	1.255124	−0.429158	1.166426	−0.432468	1.180646	−0.422289	1.111161	−0.433322
1.177295	−0.447064	1.095709	−0.373167	1.281178	−0.439010	1.186463	−0.442404	1.198645	−0.428205	1.125198	−0.431293
1.189300	−0.451016	1.111731	−0.381086	1.301215	−0.444911	1.200470	−0.442368	1.208650	−0.434144	1.139219	−0.423288
1.199295	−0.450990	1.133748	−0.386998	1.317242	−0.448837	1.210475	−0.442341	1.214676	−0.446056	1.153234	−0.413290
1.215266	−0.442980	1.153738	−0.382965	1.335271	−0.452758	1.220501	−0.450307	1.224704	−0.459947	1.163237	−0.403304
1.225245	−0.436977	1.169733	−0.380933	1.357289	−0.450716	1.236546	−0.464250	1.228732	−0.471865	1.169234	−0.395320
1.241216	−0.428966	1.179728	−0.378916	1.379323	−0.454627	1.250579	−0.474203	1.246735	−0.479770	1.177236	−0.387331
1.251195	−0.422964	1.187723	−0.376905	1.409391	−0.468437	1.272622	−0.486133	1.266758	−0.495622	1.183239	−0.381339
1.261174	−0.416961	1.201745	−0.384829	1.435435	−0.474321	1.300657	−0.494051	1.294752	−0.503501	1.197264	−0.375326
1.271143	−0.406975	1.223766	−0.392731	1.457474	−0.480216	1.330683	−0.497968	1.322746	−0.511379	1.213302	−0.371300
1.285110	−0.396977	1.233783	−0.398675	1.477510	−0.486116	1.372725	−0.505849	1.348742	−0.519263	1.231340	−0.365276
1.297082	−0.388977	1.245815	−0.410584	1.495556	−0.495990	1.406758	−0.511752	1.374737	−0.527147	1.243349	−0.355284
1.309055	−0.380977	1.257847	−0.422493	1.511589	−0.501901	1.440806	−0.523650	1.396737	−0.535042	1.251357	−0.349287
1.319040	−0.376967	1.281874	−0.432380	1.533622	−0.505811	1.456830	−0.529602	1.414746	−0.544935	1.263383	−0.345271
1.329024	−0.372956	1.301901	−0.442278	1.565656	−0.505727	1.482880	−0.543519	1.434753	−0.554823	1.596451	−0.372283

TABLE 110 - RUN 24 ICE SHAPE COORDINATES FOR MAIN AIRFOIL, SECTION A - E (con't).

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
1.348999	−0.366927	1.325923	−0.450175	1.593680	−0.503669	1.492944	−0.565471	1.458756	−0.564700	1.608498	−0.376235
1.368983	−0.364882	1.369962	−0.463990	1.621698	−0.499627	1.510984	−0.577412	1.480740	−0.566630	1.620545	−0.380188
1.390978	−0.366816	1.397979	−0.469886	1.639701	−0.493627	1.539025	−0.587327	1.516705	−0.566535	1.634597	−0.384135
1.410963	−0.364771	1.426012	−0.481753	1.649696	−0.487648	1.565043	−0.589256	1.554663	−0.564447	1.650656	−0.388077
1.424967	−0.368719	1.448034	−0.489656	1.667694	−0.479664	1.603057	−0.587158	1.582624	−0.560397	1.666709	−0.390026
1.442973	−0.374647	1.460060	−0.499575	1.699700	−0.469658	1.623061	−0.585107	1.614567	−0.550372	1.680767	−0.395965
1.454973	−0.376607	1.478072	−0.503507	1.717719	−0.469611	1.653050	−0.575037	1.642529	−0.546322	1.692824	−0.403902
1.472975	−0.380544	1.488093	−0.511442	1.749758	−0.471511	1.671037	−0.566998	1.668498	−0.544266	1.704897	−0.417814
1.492970	−0.382483	1.506131	−0.525325	1.781786	−0.469443	1.697029	−0.558937	1.692459	−0.538238	1.720982	−0.431716
1.506968	−0.384439	1.520142	−0.529268	1.801791	−0.463437	1.719013	−0.548888	1.714421	−0.532216	1.739068	−0.443621
1.524960	−0.384391	1.542137	−0.527220	1.823793	−0.455443	1.742999	−0.538835	1.746374	−0.526167	1.759155	−0.453528
1.542961	−0.388327	1.558127	−0.523198	1.853814	−0.451395	1.760997	−0.534791	1.766349	−0.524126	1.781253	−0.465422
1.560953	−0.388280	1.582107	−0.515174	1.869820	−0.447385	1.782997	−0.530737	1.794322	−0.524053	1.799317	−0.469359
1.582947	−0.390214	1.600097	−0.511146	1.893819	−0.437401	1.808994	−0.524674	1.812310	−0.525993	1.813380	−0.477290
1.600943	−0.392158	1.618092	−0.509109	1.913829	−0.433380	1.826987	−0.518632	1.832290	−0.525940	1.823426	−0.483239
1.618945	−0.396095	1.648093	−0.509029	1.939841	−0.427359	1.854980	−0.510566	1.864222	−0.511939	1.839490	−0.489173
1.634948	−0.400037	1.672089	−0.506976	1.965857	−0.423321	1.868997	−0.514525	1.886169	−0.499952	1.855554	−0.495107
1.652955	−0.405966	1.680068	−0.498994	1.981858	−0.417327	1.901029	−0.520434	1.916076	−0.476016	1.873624	−0.501035
1.668952	−0.407915	1.700047	−0.490981			1.923046	−0.522374	1.938007	−0.458065	1.887687	−0.508966
1.680952	−0.409876	1.732038	−0.486916			1.945046	−0.518320	1.959953	−0.446079	1.903746	−0.512908
1.692967	−0.417812	1.770039	−0.486816			1.965045	−0.514270	1.981900	−0.434092	1.915787	−0.514869
1.710964	−0.419757	1.802029	−0.482751			1.975024	−0.504254	2.003857	−0.426081	1.929829	−0.514832
1.726972	−0.425691	1.838031	−0.482656			1.986987	−0.488238	2.015840	−0.424062	1.945866	−0.510805
1.746962	−0.425638	1.878027	−0.480561			1.996965	−0.478222			1.965910	−0.504776
1.764953	−0.425590	1.914017	−0.476486			2.008950	−0.470198			1.989955	−0.494753
1.780956	−0.429532	1.946008	−0.472421			2.020935	−0.462174			2.003971	−0.484756
1.800956	−0.433464	1.980003	−0.470341			2.038933	−0.458130			2.019992	−0.474754
1.830952	−0.437369	2.011999	−0.468266			2.058948	−0.460075				
1.854946	−0.439297	2.031984	−0.462243			2.084956	−0.458008				
1.876930	−0.437247	2.071948	−0.448207			2.108962	−0.455947				
1.898919	−0.437189	2.099944	−0.446143			2.126966	−0.453901				
1.920892	−0.431155										
1.930882	−0.429136										

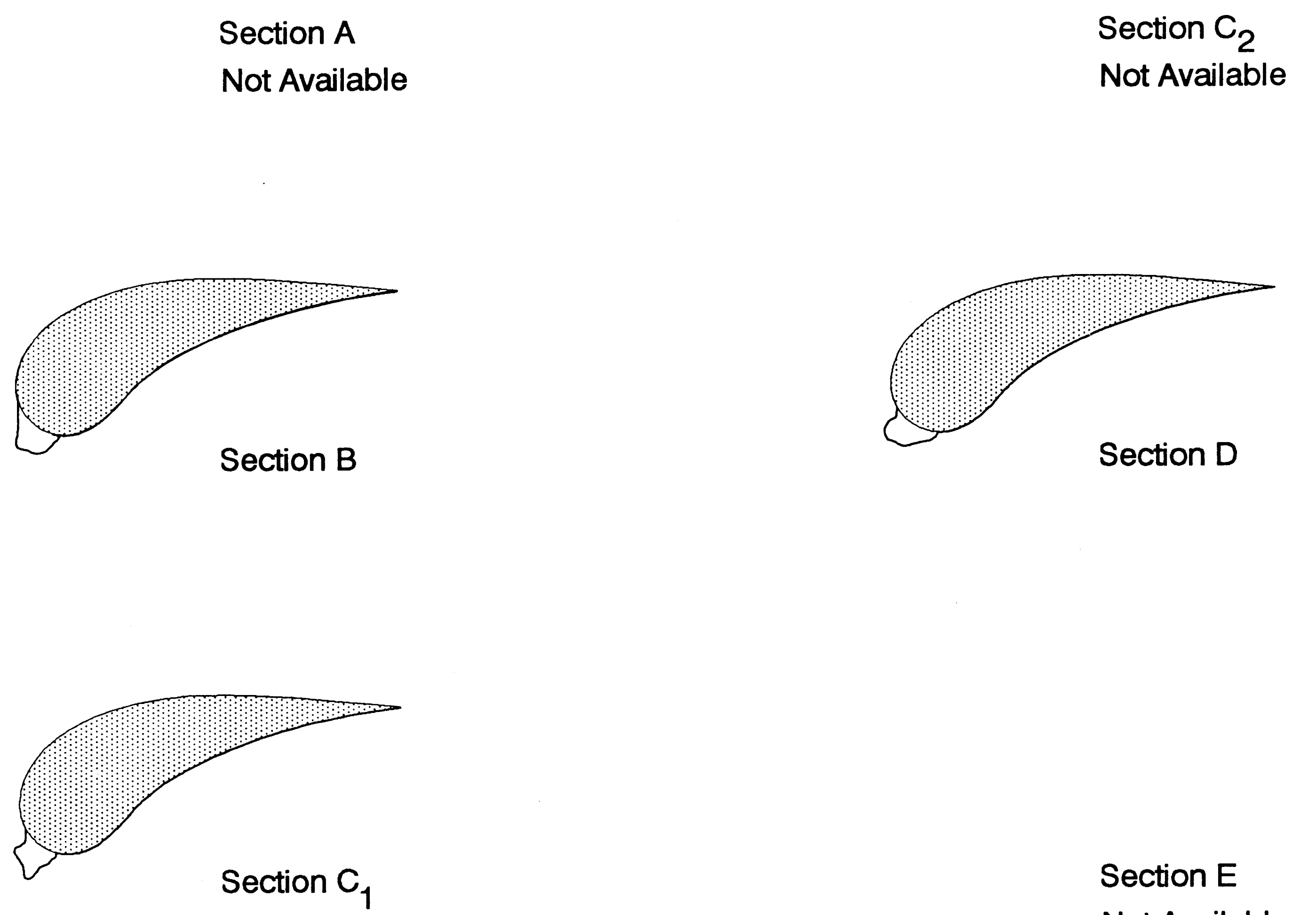


FIGURE 67 - RUN 24 ICE SHAPE TRACINGS FOR FORE FLAP (FLAP 1), SECTIONS A - E.

TABLE 111 - RUN 24 ICE SHAPE COORDINATES FOR FORE FLAP (FLAP 1), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
		12.632160	−0.282614	12.650209	−0.312051			12.649500	−0.310056		
		12.632192	−0.294543	12.648251	−0.325959			12.641521	−0.318022		
		12.632235	−0.310447	12.644290	−0.337886			12.627543	−0.326003		
		12.632266	−0.322376	12.630333	−0.343882			12.615563	−0.333979		
		12.632313	−0.340268	12.618379	−0.351857			12.603584	−0.341955		
		12.632355	−0.356173	12.604422	−0.357853			12.595622	−0.355879		
		12.628422	−0.378053	12.592463	−0.363843			12.589648	−0.365826		
		12.626469	−0.393963	12.590514	−0.381723			12.585675	−0.375767		
		12.622530	−0.413854	12.598534	−0.395605			12.587723	−0.393637		
		12.622599	−0.439699	12.610559	−0.413449			12.591760	−0.407530		
		12.628633	−0.457576	12.616567	−0.421377			12.597786	−0.417444		
		12.646614	−0.463493	12.622588	−0.433279			12.605824	−0.431326		
		12.664589	−0.467422	12.632604	−0.447155			12.617840	−0.437253		
		12.680562	−0.469367	12.636640	−0.463034			12.633855	−0.443169		
		12.694560	−0.479271	12.638672	−0.476931			12.647871	−0.449091		
		12.718529	−0.485172	12.638715	−0.492820			12.665897	−0.458975		
		12.742486	−0.487097	12.642749	−0.508699			12.685914	−0.464880		
		12.774391	−0.475084	12.646762	−0.516633			12.711908	−0.462826		
		12.790327	−0.463113	12.660745	−0.520568			12.727893	−0.456825		
		12.808238	−0.443185	12.670725	−0.520542			12.745882	−0.452805		
		12.820183	−0.431225	12.686656	−0.506597			12.767862	−0.444803		
		12.836108	−0.415278	12.696599	−0.492668			12.791856	−0.442754		
		12.850027	−0.395360	12.708538	−0.478733			12.809845	−0.438734		
				12.714509	−0.472759			12.823835	−0.434725		
				12.720477	−0.464799			12.833814	−0.426754		
				12.730436	−0.456828			12.845792	−0.418777		
				12.736414	−0.452840			12.855761	−0.406835		
				12.752370	−0.448825						
				12.764337	−0.444822						
				12.770309	−0.438847						
				12.782254	−0.426899						
				12.790211	−0.416947						
				12.798185	−0.412954						
				12.804162	−0.408966						

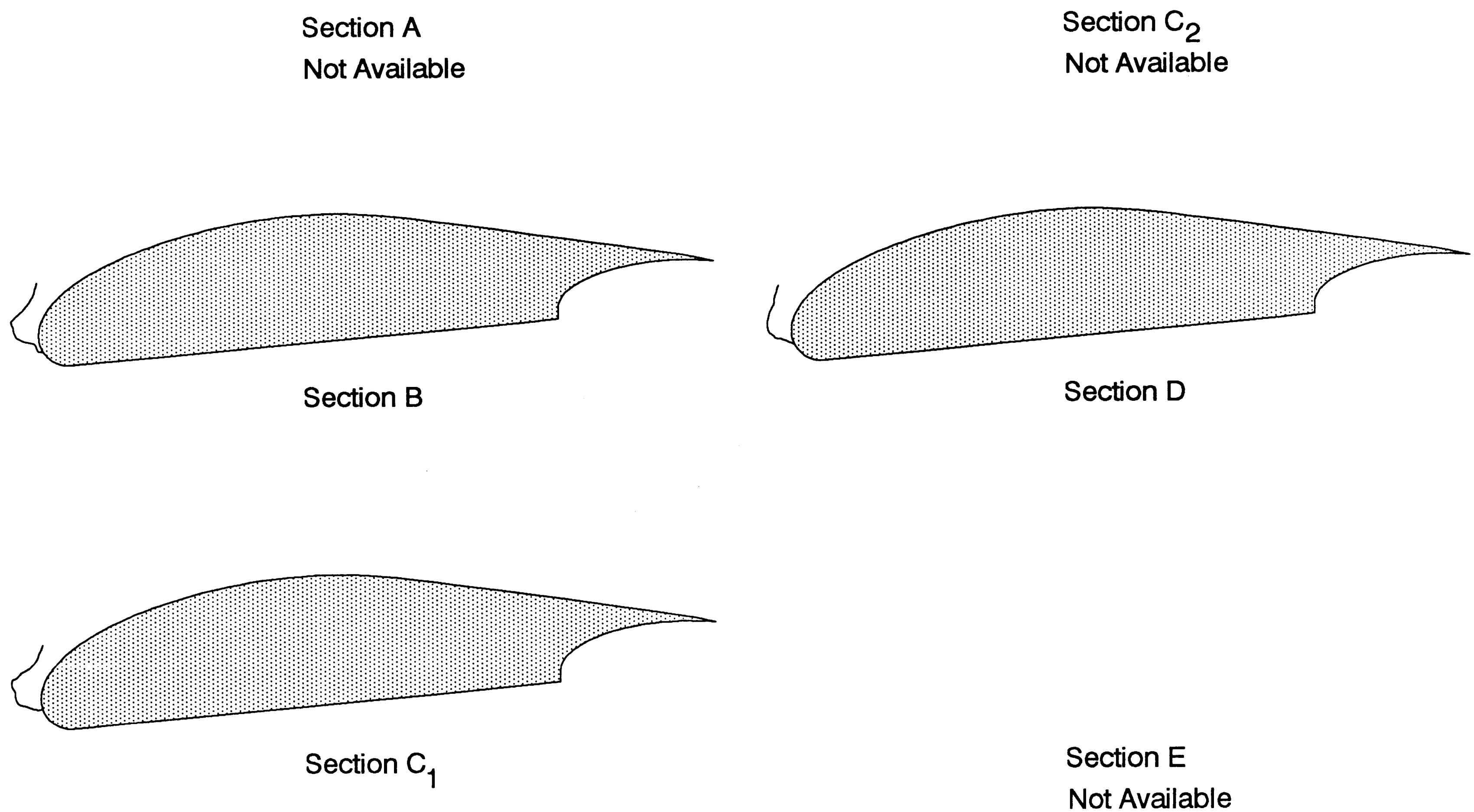
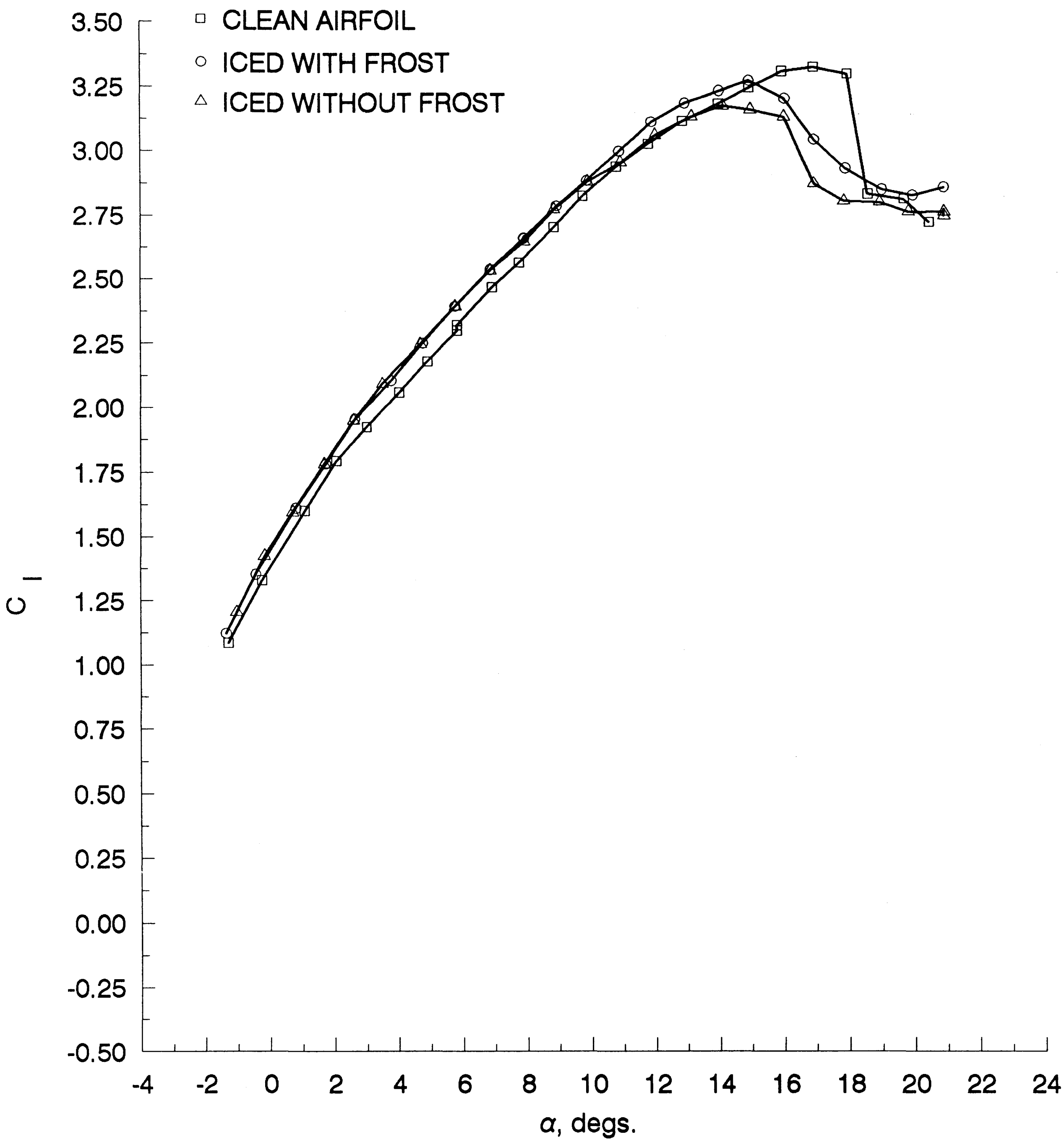


FIGURE 68 - RUN 24 ICE SHAPE TRACINGS FOR MID FLAP (FLAP 2), SECTIONS A - E.

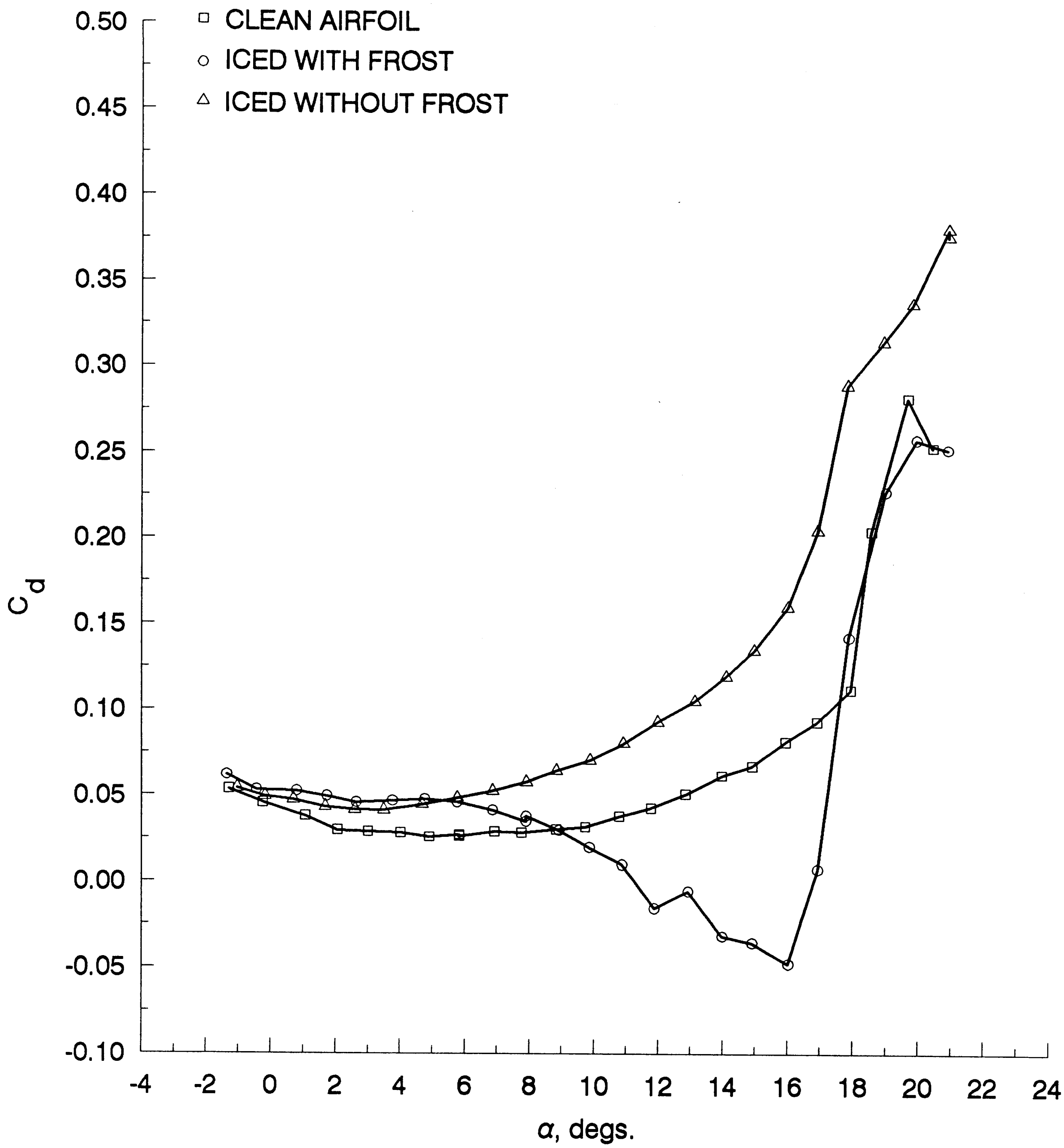
TABLE 112 - RUN 24 ICE SHAPE COORDINATES FOR MID FLAP (FLAP 2), SECTION A - E.

SECTION A		SECTION B		SECTION C_1		SECTION C_2		SECTION D		SECTION E	
X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in	X, in	Y, in
		13.133264	−0.059697	13.155517	−0.059779			13.064097	−0.104447		
		13.127214	−0.081758	13.147428	−0.077873			13.060059	−0.116530		
		13.121147	−0.097806	13.143402	−0.093949			13.056044	−0.136662		
		13.115097	−0.119867	13.135302	−0.108027			13.052014	−0.150756		
		13.111066	−0.135910	13.127212	−0.126121			13.045958	−0.168881		
		13.102952	−0.147956	13.121156	−0.144210			13.041932	−0.184988		
		13.086735	−0.176055	13.113050	−0.156279			13.041987	−0.205109		
		13.072527	−0.194129	13.100881	−0.170368			13.037954	−0.219204		
		13.058319	−0.212203	13.086677	−0.184462			13.031878	−0.229280		
		13.044099	−0.226269	13.080589	−0.190502			13.023778	−0.243386		
		13.031907	−0.236321	13.074502	−0.196542			13.017706	−0.255475		
		13.017687	−0.250387	13.060276	−0.202603			13.009623	−0.275616		
		13.003463	−0.262448	13.044028	−0.212687			13.005597	−0.291724		
		12.987213	−0.278524	13.027772	−0.220762			13.003600	−0.305814		
		12.977051	−0.286566	13.019655	−0.228815			13.001598	−0.317892		
		12.981179	−0.306596	13.011538	−0.236869			13.001636	−0.331976		
		12.991422	−0.328615	13.003427	−0.246930			13.001679	−0.348072		
		12.995566	−0.354657	12.993271	−0.252981			13.001728	−0.366181		
		13.003755	−0.370668	12.983109	−0.257024			13.005828	−0.378242		
		13.011940	−0.384675	12.972947	−0.261067			13.013988	−0.386270		
		13.034381	−0.398646	12.966871	−0.271123			13.026223	−0.396297		
		13.056812	−0.408607	12.966929	−0.293212			13.038451	−0.404314		
		13.077188	−0.412563	12.973071	−0.307252			13.048657	−0.416360		
		13.105713	−0.416496	12.979202	−0.317277			13.064943	−0.420341		
		13.117944	−0.420473	12.987378	−0.331312			13.079190	−0.422316		
		13.128154	−0.430466	12.989482	−0.357412			13.093442	−0.426303		
		13.136371	−0.456498	12.993594	−0.373466			13.107700	−0.432302		
		13.144550	−0.468501	13.001787	−0.393525			13.123993	−0.438295		
				13.009947	−0.401536			13.138245	−0.442282		
				13.024210	−0.409532			13.146394	−0.446285		
				13.042532	−0.413500						
				13.060848	−0.415460						
				13.071037	−0.421458						
				13.083261	−0.427450						
				13.101582	−0.431418						
				13.111761	−0.433400						
				13.126013	−0.437378						



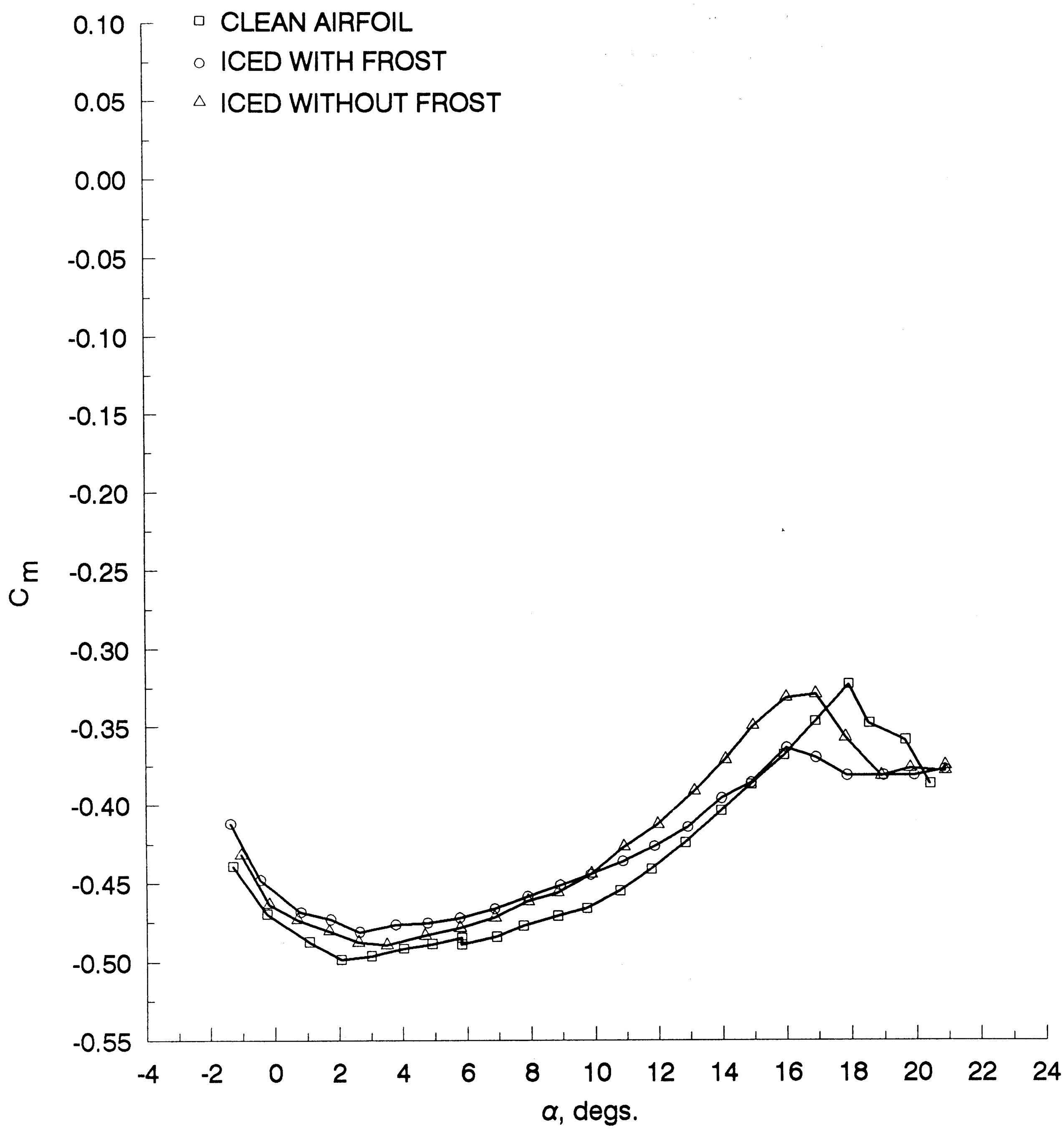
(A) C_l VERSUS α

FIGURE 69 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 24.



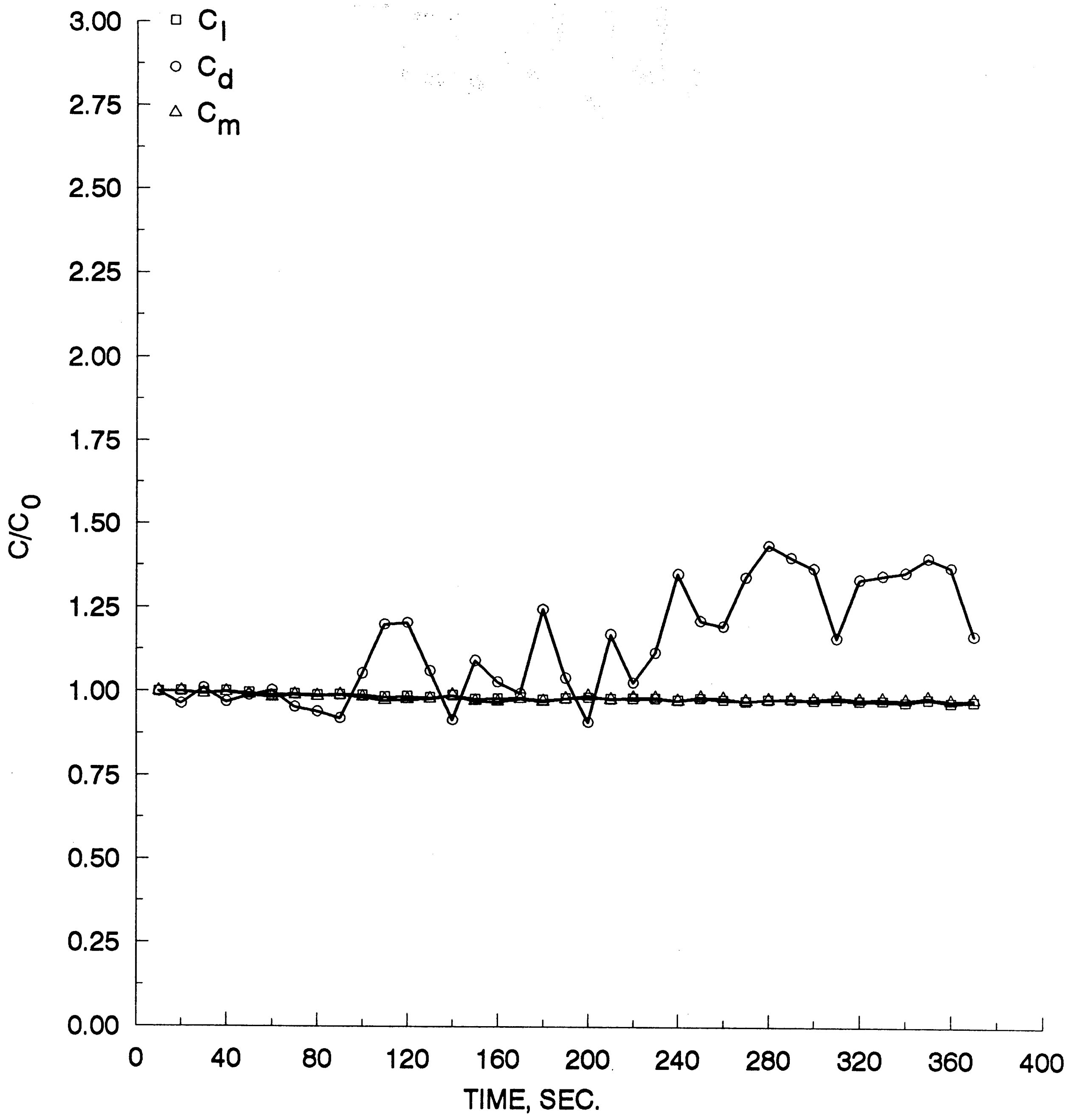
(B) C_d VERSUS α

FIGURE 69 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 24 (con't).



(C) C_m VERSUS α

FIGURE 69 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 24 (con't).



(D) RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL VERSUS TIME.

FIGURE 69 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 24 (con't).

TABLE 113 - FORCE BALANCE MEASUREMENTS FOR RUN NUMBER 24.

(A). CLEAN AIRFOIL

α DEG.	C_l CLEAN AIRFOIL	C_d CLEAN AIRFOIL	C_m CLEAN AIRFOIL
-1.2842	1.0856	0.0534	-0.4390
-0.2438	1.3309	0.0456	-0.4694
1.0645	1.6021	0.0379	-0.4871
2.0532	1.7948	0.0296	-0.4982
3.0004	1.9262	0.0287	-0.4960
4.0219	2.0587	0.0282	-0.4913
4.9066	2.1788	0.0257	-0.4885
5.8305	2.2995	0.0270	-0.4844
5.8294	2.3198	0.0261	-0.4887
6.9280	2.4682	0.0288	-0.4838
7.7683	2.5652	0.0281	-0.4769
8.8365	2.7047	0.0300	-0.4708
9.7340	2.8268	0.0314	-0.4659
10.7811	2.9403	0.0376	-0.4549
11.7717	3.0303	0.0424	-0.4410
12.8443	3.1175	0.0506	-0.4242
13.9769	3.1862	0.0613	-0.4037
14.9100	3.2484	0.0669	-0.3868
15.9437	3.3130	0.0811	-0.3683
16.9195	3.3282	0.0930	-0.3467
17.9471	3.3030	0.1116	-0.3228
18.5755	2.8381	0.2041	-0.3480
19.6854	2.8174	0.2817	-0.3587
20.4520	2.7277	0.2531	-0.3866

(B) ICED AIRFOIL WITH FROST

α DEG.	C_l ICED, WITH FROST	C_d ICED, WITH FROST	C_m ICED, WITH FROST
-1.3567	1.1224	0.0617	-0.4119
-0.4441	1.3537	0.0530	-0.4477
0.7926	1.6129	0.0523	-0.4682
1.7187	1.7832	0.0494	-0.4728
2.6305	1.9571	0.0457	-0.4808
3.7631	2.1051	0.0467	-0.4762
4.7629	2.2506	0.0476	-0.4751
5.7670	2.3931	0.0458	-0.4719
6.8618	2.5374	0.0413	-0.4662
7.9000	2.6606	0.0347	-0.4585
7.9002	2.6635	0.0377	-0.4585
8.9206	2.7875	0.0296	-0.4512
9.8602	2.8864	0.0197	-0.4446
10.8710	3.0008	0.0097	-0.4361
11.8773	3.1149	-0.0157	-0.4264
12.9259	3.1877	-0.0058	-0.4143
13.9872	3.2361	-0.0318	-0.3959
14.9135	3.2763	-0.0356	-0.3859
16.0224	3.2072	-0.0477	-0.3637
16.9309	3.0478	0.0072	-0.3700
17.8871	2.9365	0.1422	-0.3814
19.0031	2.8541	0.2273	-0.3813
19.9515	2.8318	0.2576	-0.3812
20.9150	2.8647	0.2521	-0.3773

(C). ICED AIRFOIL WITHOUT FROST

α DEG.	C_l ICED, WITHOUT FROST	C_d ICED, WITHOUT FROST	C_m ICED, WITHOUT FROST
-1.0371	1.2051	0.0539	-0.4318
-0.1821	1.4260	0.0491	-0.4632
0.6949	1.5970	0.0473	-0.4729
1.6728	1.7830	0.0431	-0.4802
2.5908	1.9513	0.0416	-0.4873
3.4919	2.0916	0.0411	-0.4890
4.6835	2.2473	0.0445	-0.4830
5.7790	2.3923	0.0483	-0.4782
6.8682	2.5336	0.0522	-0.4717
7.9075	2.6466	0.0573	-0.4613
8.8414	2.7734	0.0640	-0.4560
9.8778	2.8821	0.0700	-0.4440
10.9185	2.9577	0.0801	-0.4269
11.9918	3.0642	0.0927	-0.4126
13.1394	3.1361	0.1049	-0.3913
14.1102	3.1774	0.1193	-0.3712
14.9698	3.1629	0.1346	-0.3497
16.0121	3.1360	0.1599	-0.3315
16.9305	2.8772	0.2044	-0.3291
17.8388	2.8097	0.2889	-0.3572
18.9354	2.8052	0.3143	-0.3817
19.8243	2.7672	0.3367	-0.3768
20.9275	2.7686	0.3805	-0.3784
20.9270	2.7533	0.3761	-0.3751

TABLE 114 - RATIO OF FORCE COEFFICIENTS/FORCE COEFFICIENT OF CLEAN AIRFOIL FOR RUN NUMBER 24.

TIME SEC.	C_l / C_{l_0}	C_d / C_{d_0}	C_m / C_{m_0}
10	1.0000	1.0000	1.0000
20	1.0013	0.9640	1.0009
30	0.9968	1.0105	0.9941
40	1.0013	0.9701	0.9988
50	0.9963	0.9890	0.9913
60	0.9903	1.0045	0.9841
70	0.9940	0.9551	0.9902
80	0.9905	0.9409	0.9871
90	0.9922	0.9215	0.9902
100	0.9905	1.0553	0.9849
110	0.9850	1.2012	0.9758
120	0.9864	1.2063	0.9780
130	0.9835	1.0625	0.9794
140	0.9896	0.9167	0.9901
150	0.9788	1.0937	0.9734
160	0.9804	1.0300	0.9717
170	0.9833	0.9955	0.9796
180	0.9765	1.2461	0.9722
190	0.9815	1.0423	0.9805
200	0.9845	0.9105	0.9891
210	0.9805	1.1723	0.9793
220	0.9818	1.0290	0.9847
230	0.9814	1.1177	0.9840
240	0.9768	1.3516	0.9760
250	0.9825	1.2132	0.9855
260	0.9775	1.1969	0.9834
270	0.9738	1.3427	0.9755
280	0.9789	1.4374	0.9786
290	0.9795	1.4018	0.9809
300	0.9761	1.3691	0.9794
310	0.9799	1.1625	0.9853
320	0.9747	1.3365	0.9789
330	0.9758	1.3478	0.9803
340	0.9712	1.3576	0.9774
350	0.9803	1.4004	0.9865
360	0.9707	1.3716	0.9759

TABLE 115 - TEST CONDITIONS FOR RUN NUMBER 24.

NASA LEWIS ICING RESEARCH TUNNEL			
Run No. 24	Configuration 15° Flap	Date 05-06-88	
P_{air} 80 psig	ΔP_w 41 psid	T_{avg} -10° F	V_∞ 100 mph
Spray Duration 6 min	Ice Accretion Type Rime	A.O.A. 5°	
LWC 0.62 g/m³	MVD 12.2 μm		

Remarks

- Frost on lower surface of main wing body. Ice deposits on lower flaps. Ice in the region behind the slat and before the leading edge of the main airfoil body. Ice on leading edges of all flaps.
- Uniformity across the span was very good.
- Ice accretion on Leading Edge Slat approximately 1/8" thick.
- Ice accretions on leading edge of Flaps 1, 2 and 3 approximately 1/16" thick.
- Flap 3 had ice fingers.
- The upper surface had no frost.
- Ice shape tracings not available for

  Flap 1, Sections A, C_2, D and E
  Flap 2, Sections A, C_2, D and E

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (*Leave blank*)

2. REPORT DATE
December 1991

3. REPORT TYPE AND DATES COVERED
Technical Memorandum

4. TITLE AND SUBTITLE
Experimental Ice Shape and Performance Characteristics for a Multi-Element Airfoil in the NASA Lewis Icing Research Tunnel

5. FUNDING NUMBERS
WU–505–68–10

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio 44135–3191

8. PERFORMING ORGANIZATION REPORT NUMBER
E–6767

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
National Aeronautics and Space Administration
Washington, DC 20546–0001

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
NASA TM–105380

11. SUPPLEMENTARY NOTES
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Unclassified - Unlimited
Subject Category: 02

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This publication is available from the NASA Center for AeroSpace Information, 301–621–0390.

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 words)***

An investigation of the ice accretion patterns and performance characteristics of a multi-element airfoil was undertaken in the NASA Lewis Icing Research Tunnel. Several configurations were examined to determine the ice shape and performance characteristics. The testing included glaze, rime, and mixed icing regimes. Tunnel cloud conditions were set to correspond to those typical of the operating environment for commercial transport aircraft. Measurements acquired included ice profile tracings and aerodynamic forces both during the accretion process and in a post-accretion evaluation over a range of angle of attack. Substantial ice accretions developed on the main wing, flaps and slat surfaces. Force measurements indicate severe performance degradation, especially near CL max, for both light and heavy ice accretions. Frost was seen on the lower surface of the airfoil which was found to contribute significantly to the force components.

14. SUBJECT TERMS
Aircraft icing; Performance characteristics; Multi-element airfoil

15. NUMBER OF PAGES
322

16. PRICE CODE
A14

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	