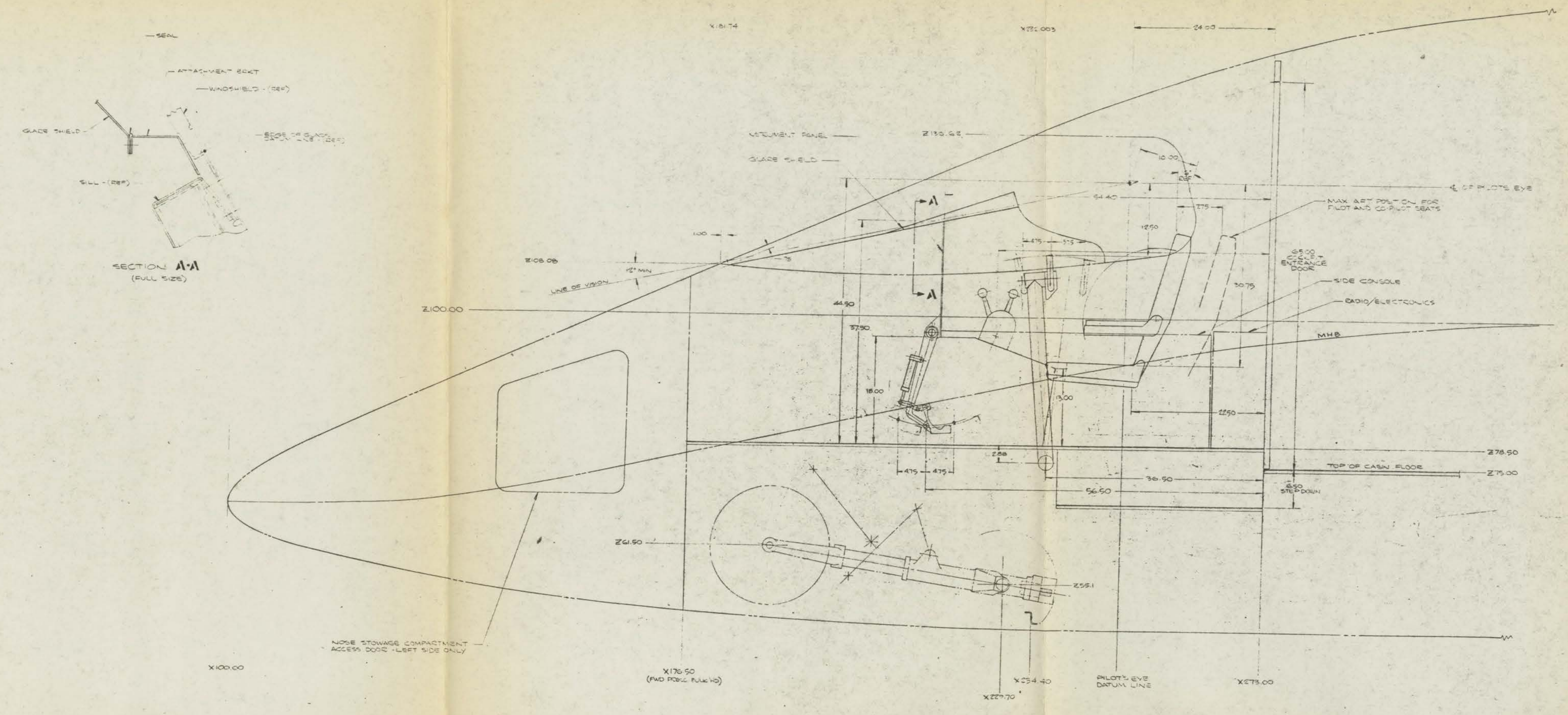


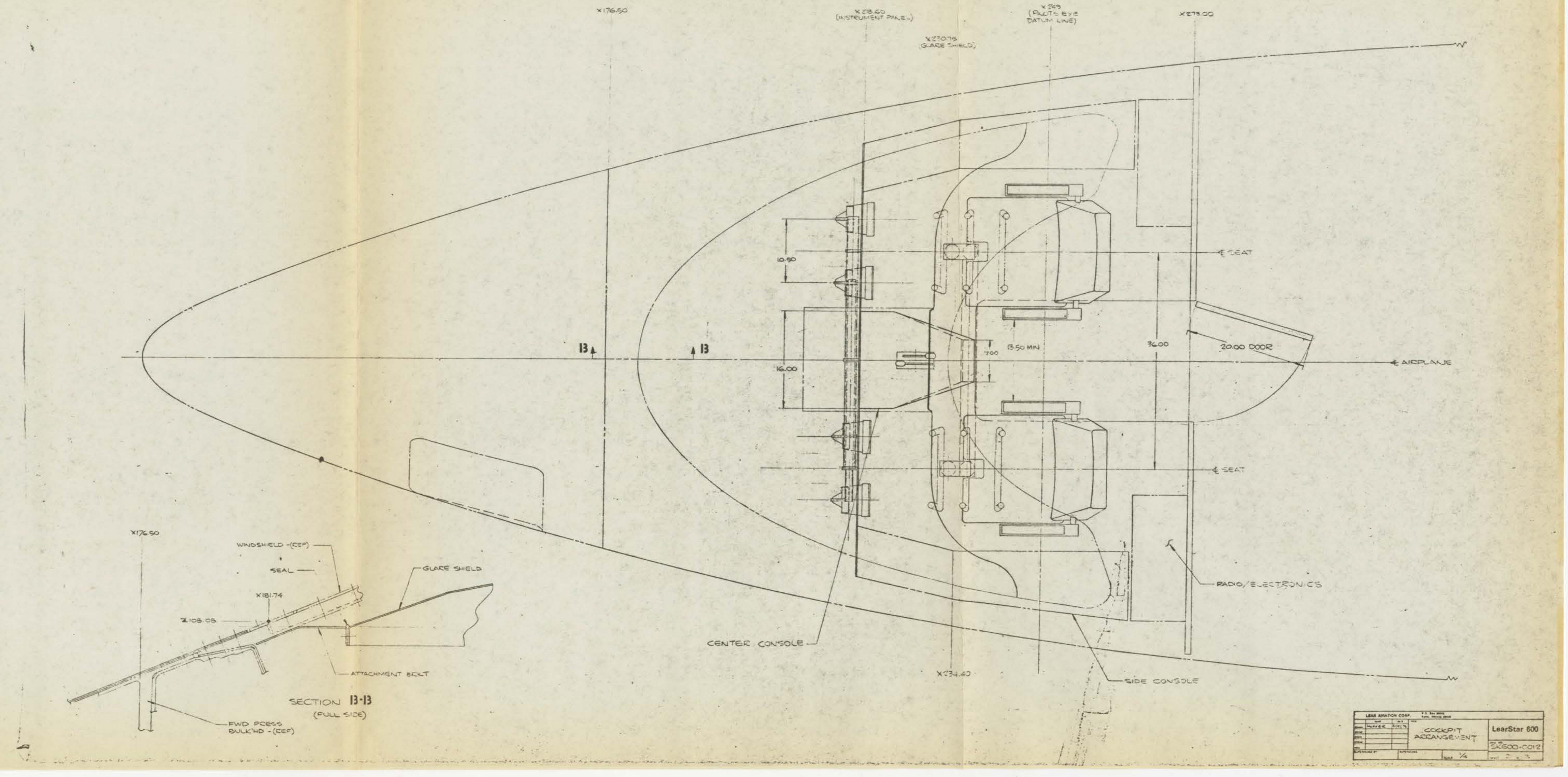
LEAR AVIATION CORP.

COCKPIT ARRANGEMENT

LearStar 600

SK600-0012

SCALE 1/4



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X220.75 (GLARE SHIELD)
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13.50 MIN
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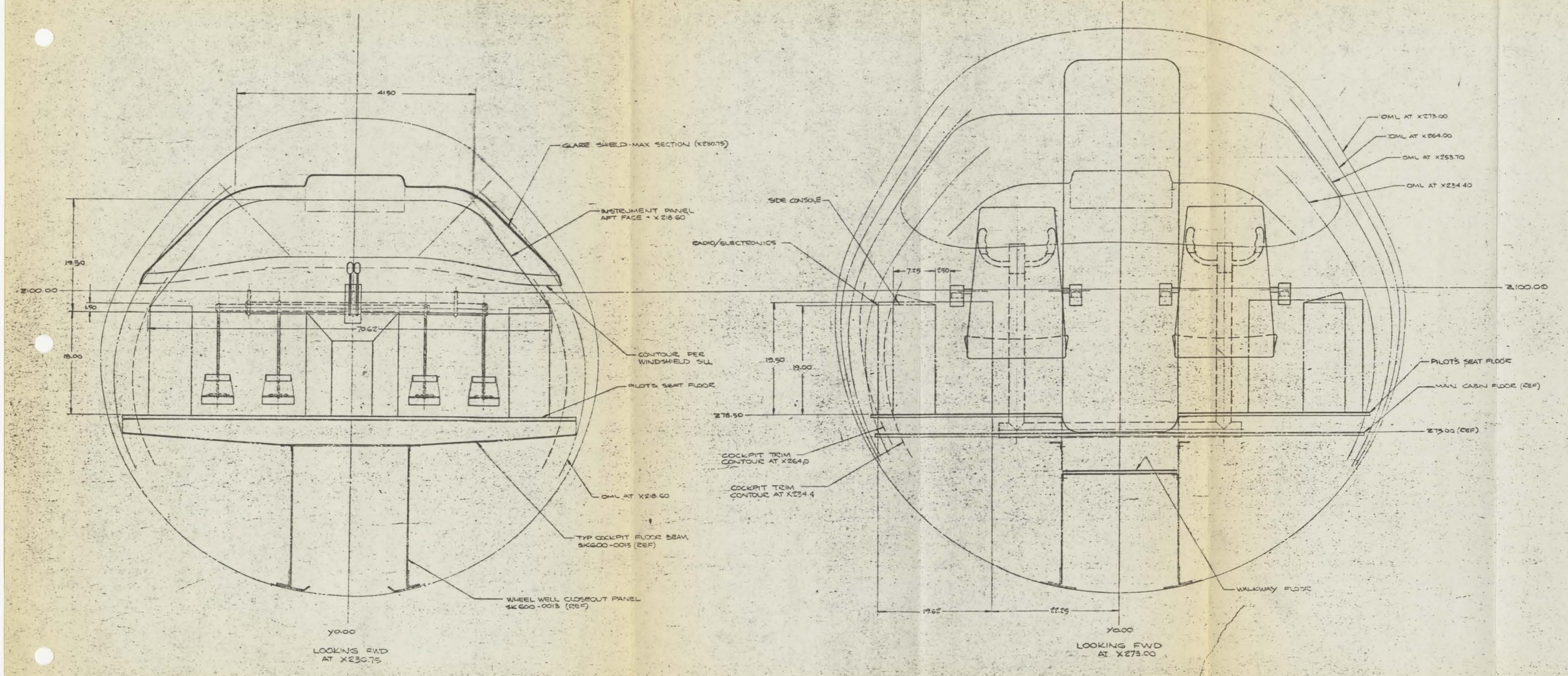
℄ SEAT
℄ AIRPLANE
℄ SEAT
B
B
RADIO/ELECTRONICS
CENTER CONSOLE
X234.40
SIDE CONSOLE
X176.50
WINDSHIELD -(REF)
SEAL
GLARE SHIELD
X181.74
Z108.08
ATTACHMENT BOLT
FWD PRESS BULK'HD -(REF)
SECTION B-B
(FULL SIZE)
LEAR AVIATION CORP.
COCKPIT ARRANGEMENT
LearStar 600
SK600-C012
1/4



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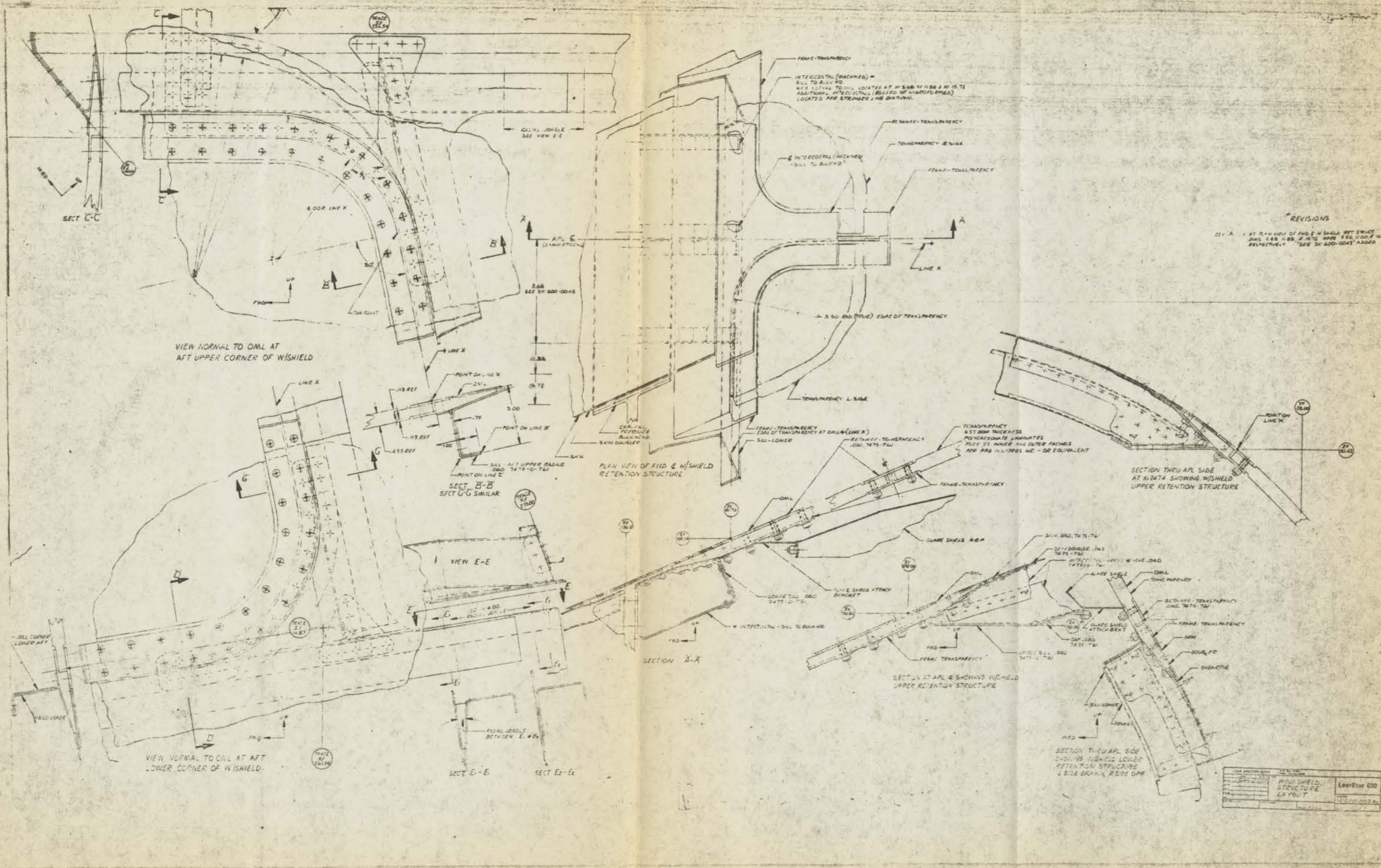
		SK600-0012
	SCALE 1/4	SHEET 3 OF 3


REVISIONS
SECT C-C
VIEW NORMAL TO OML AT
AFT UPPER CORNER OF W/SHIELD
SECT B-B
SECT G-G SIMILAR
PLAN VIEW OF FWD & W/SHIELD
RETENTION STRUCTURE
VIEW E-E
SECTION A-A
SECTION THRU APL SIDE
SHOWING W/SHIELD
UPPER RETENTION STRUCTURE
SECTION AT APL & SHOWING W/SHIELD
UPPER RETENTION STRUCTURE
VIEW NORMAL TO OML AT AFT
LOWER CORNER OF W/SHIELD
SECT E₁-E₁
SECT E₂-E₂
SECTION THRU APL SIDE
SHOWING W/SHIELD LOWER
RETENTION STRUCTURE
L SIDE SHOWN, R SIDE OPP
FRAME-TRANSPARENCY
RETAINER-TRANSPARENCY
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SILL-LOWER
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LINE X
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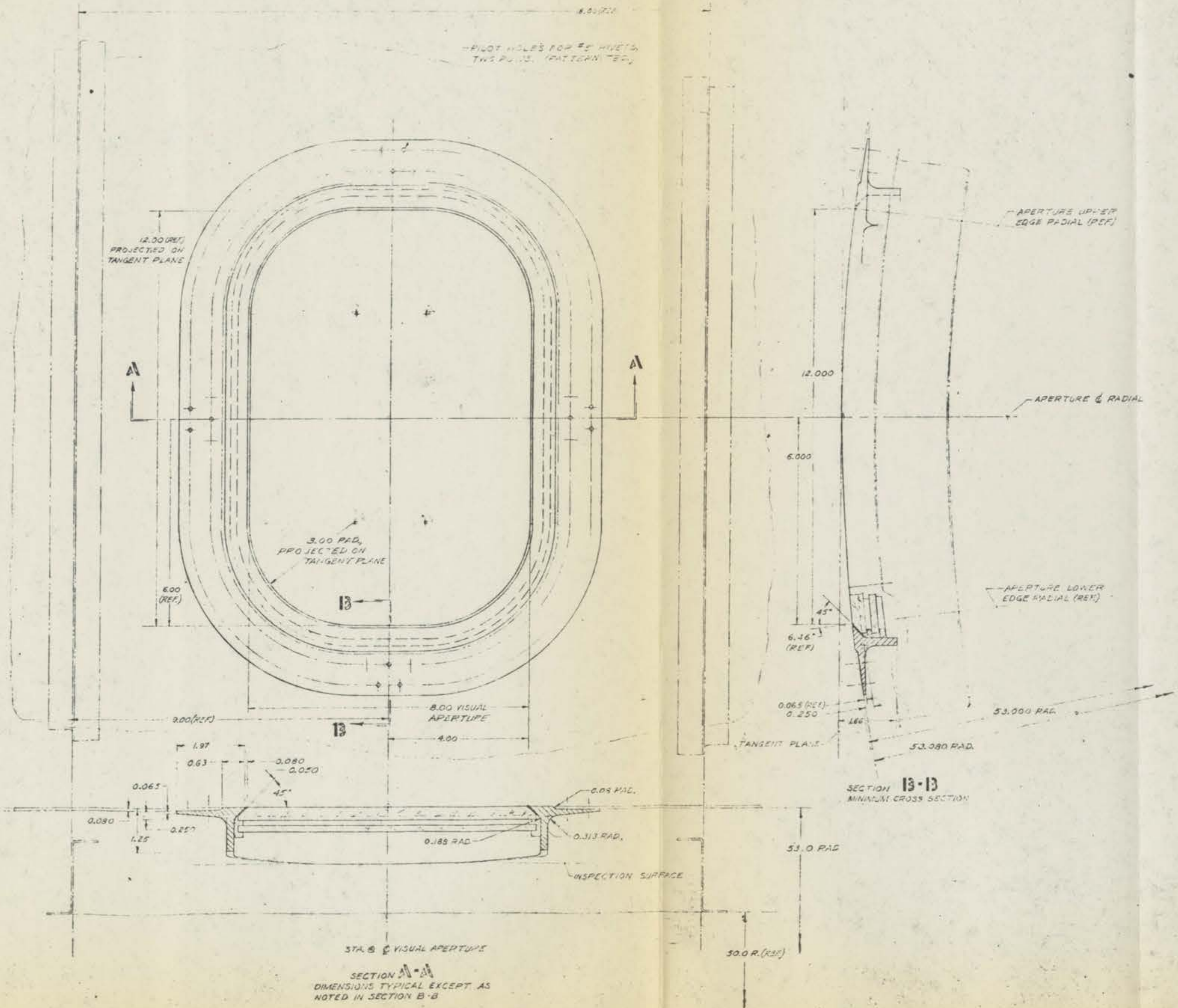
UP
WINDSHIELD
STRUCTURE
LAYOUT
LearStar 600

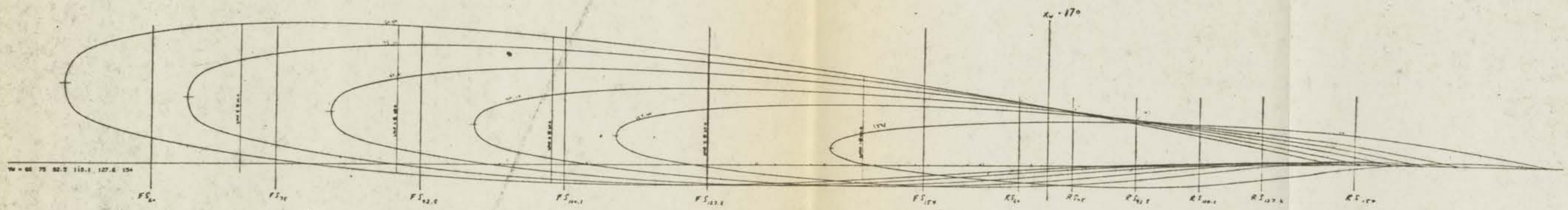


REFERENCE ONLY
NOT FOR FABRICATION
NOV 18 1976

LEAR AVIATION CORP.

Goshan	CONCEPT LAYOUT, STRUCTURAL PROVISION, PASSENGER WINDOW, CONSTANT (0 & 8) SECTION	LearStar 600
	SCALE FULL SIZE	5K600-1-0033

CONTR LEAR	SAN DIEGO AIRCRAFT ENGINEERING, INC.
DATE	
DRAFTSMAN ASTEC	WING - LEARSTAR 600 LOFT LINE REAR SPAR
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE J · CODE IDENT NO 25727 · ASTEC 77-402
APPROVAL	SCALE · CALC WT · SHEET



1/4 SIZE

STREAMWISE

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CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE E · CODE IDENT NO 25727 · ASTEC 77-403
APPROVAL	SCALE · CALC WT LB · SHEET

(2)

X

CONTR LEAR	SAN DIEGO AIRCRAFT ENGINEERING, INC.
DATE 1-19-77	
DRAFTSMAN ASTEC	WING-LEARSTAR 600 LOFT LINE FRONT SPAR
CHK	
SUPERVISOR	
MAINT	
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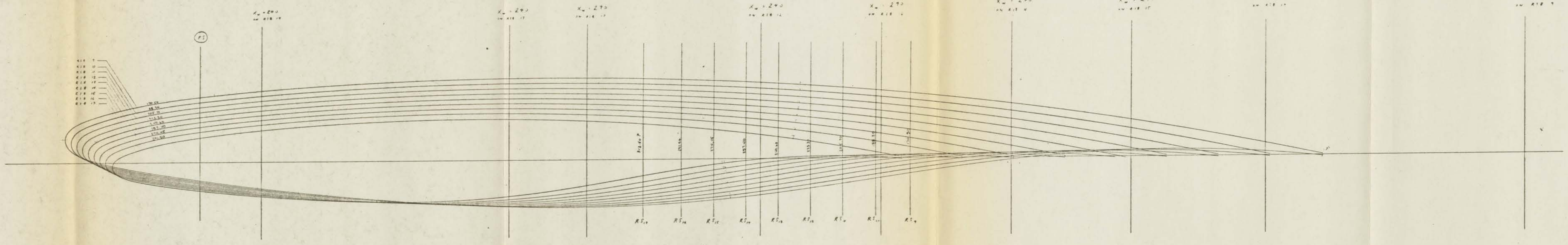
APPROVAL	SCALE · CALC WT · SHEET



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DRAFTSMAN ASTEC			
CHK			
SUPERVISOR			
MAINT			
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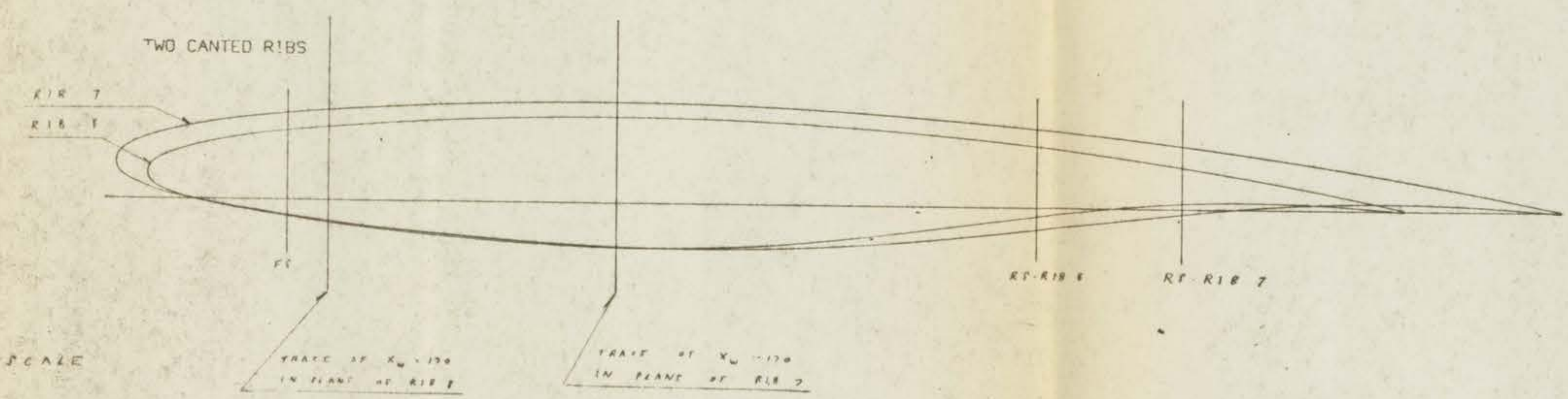

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DATE 1-19-77	WING - LEARSTAR 600 LOFT LINES CANTED RIBS - Yw 127.6, 154.0
DRAFTSMAN ASTEC	
CHK	
SUPERVISOR	
MAINT	
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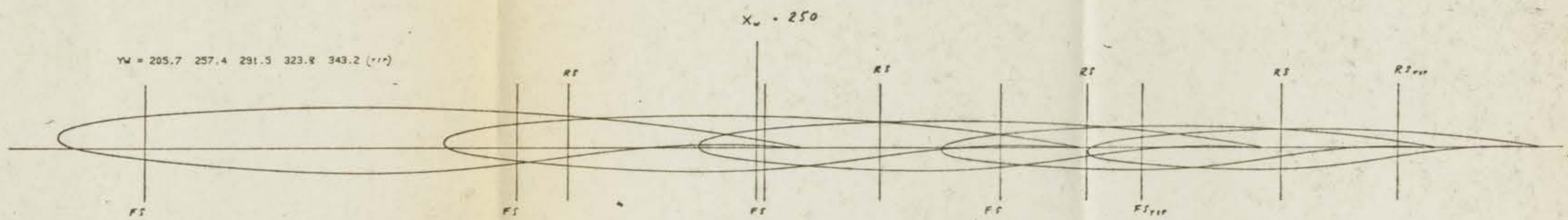

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SUPERVISOR	
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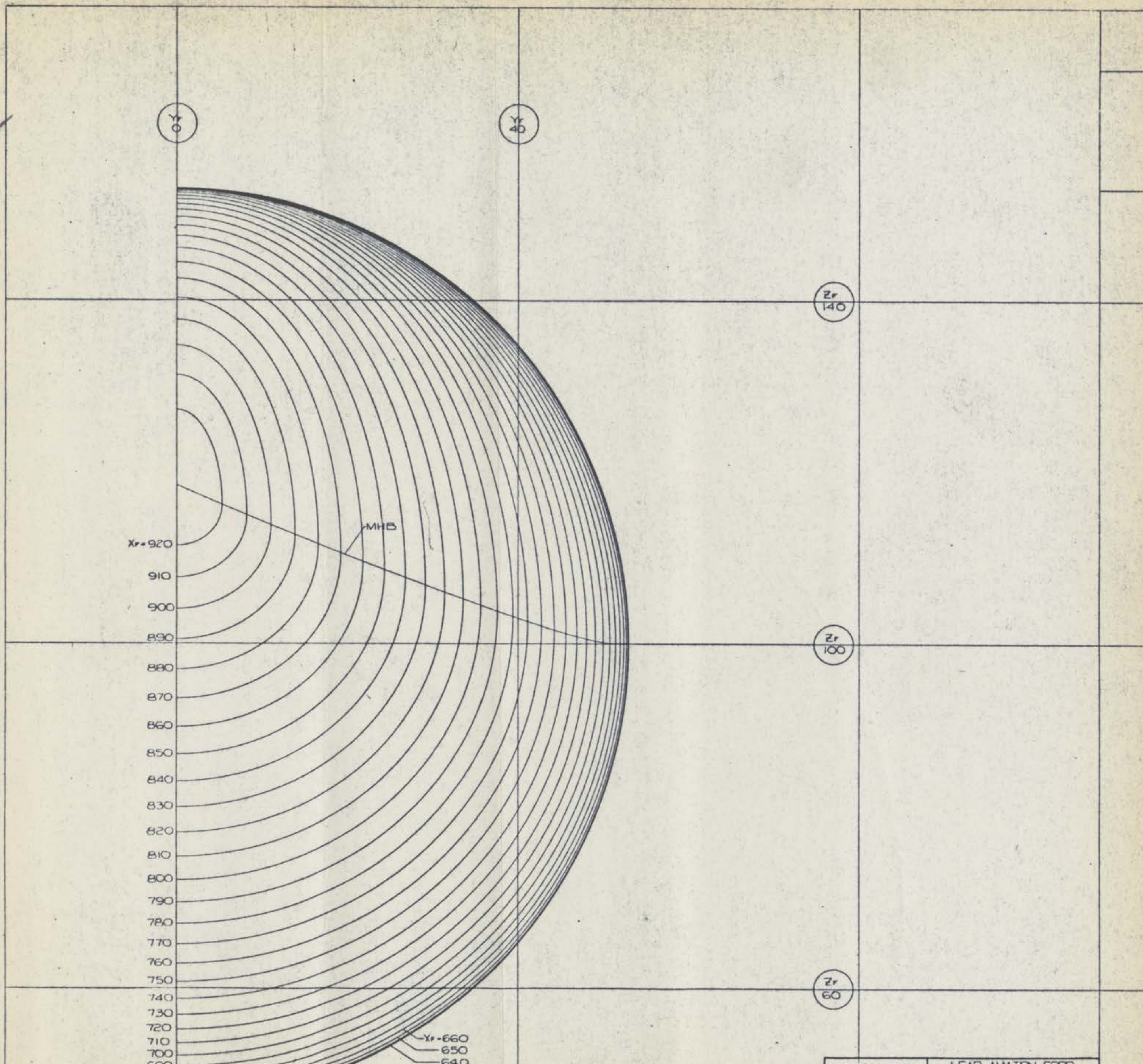

VIEW LOOKING AFT

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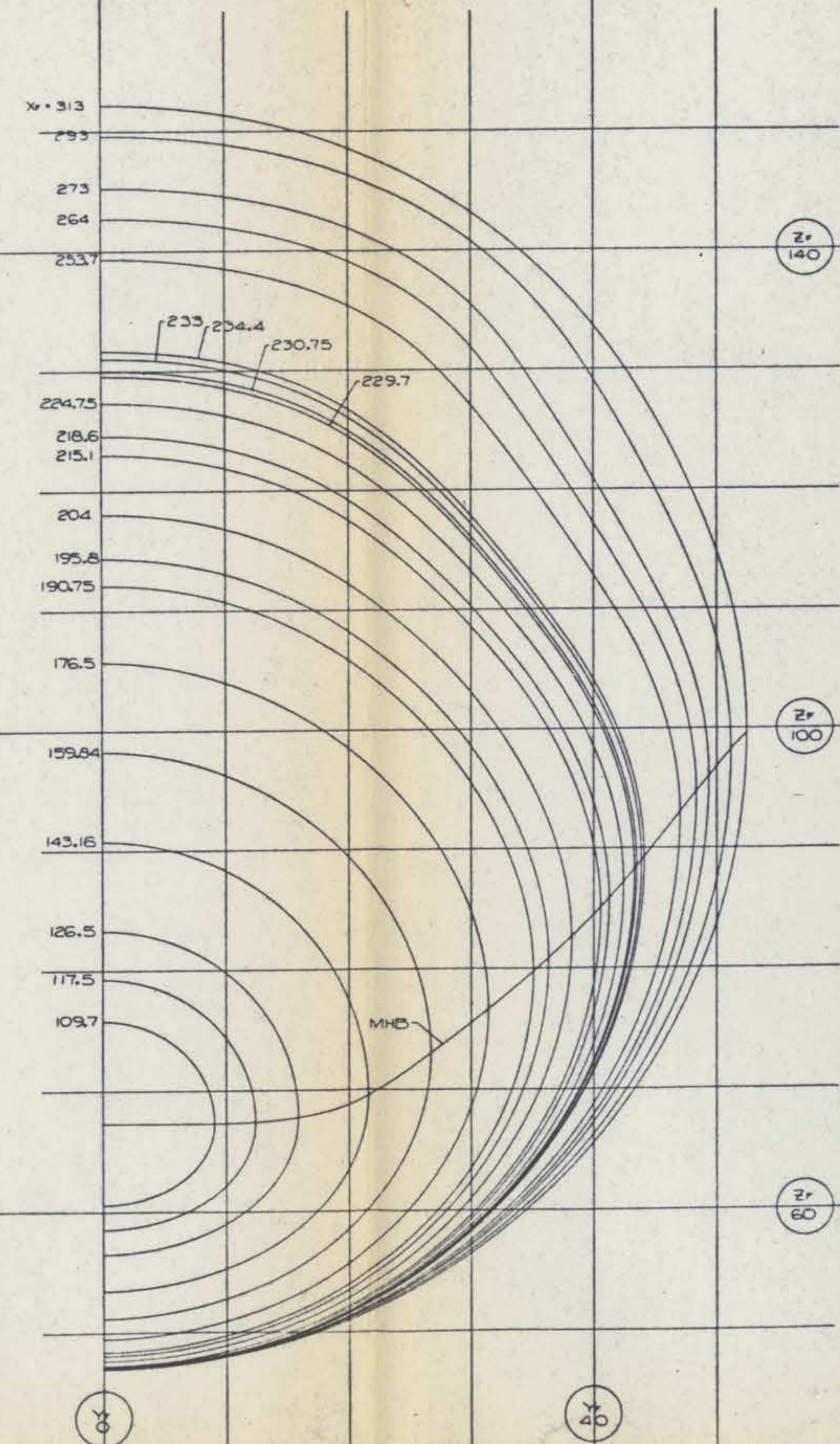

NOTES:
1. ALL LINES ARE TO AIR SURFACE.

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SIZE / CODE IDENT. NO.	DWG NO. ML0600-0080
TAPE NO. LJ 003	SCALE 1/4 — SHEET

LEARSTAR 600	LEAR AVIATION CORP. P.O. BOX 60000 RENO, NEVADA 89506
SIGNATURES / DATE — DWN GEISSER; CHK	BASIC LINES- FWD FUSELAGE Xr =100 TO 333
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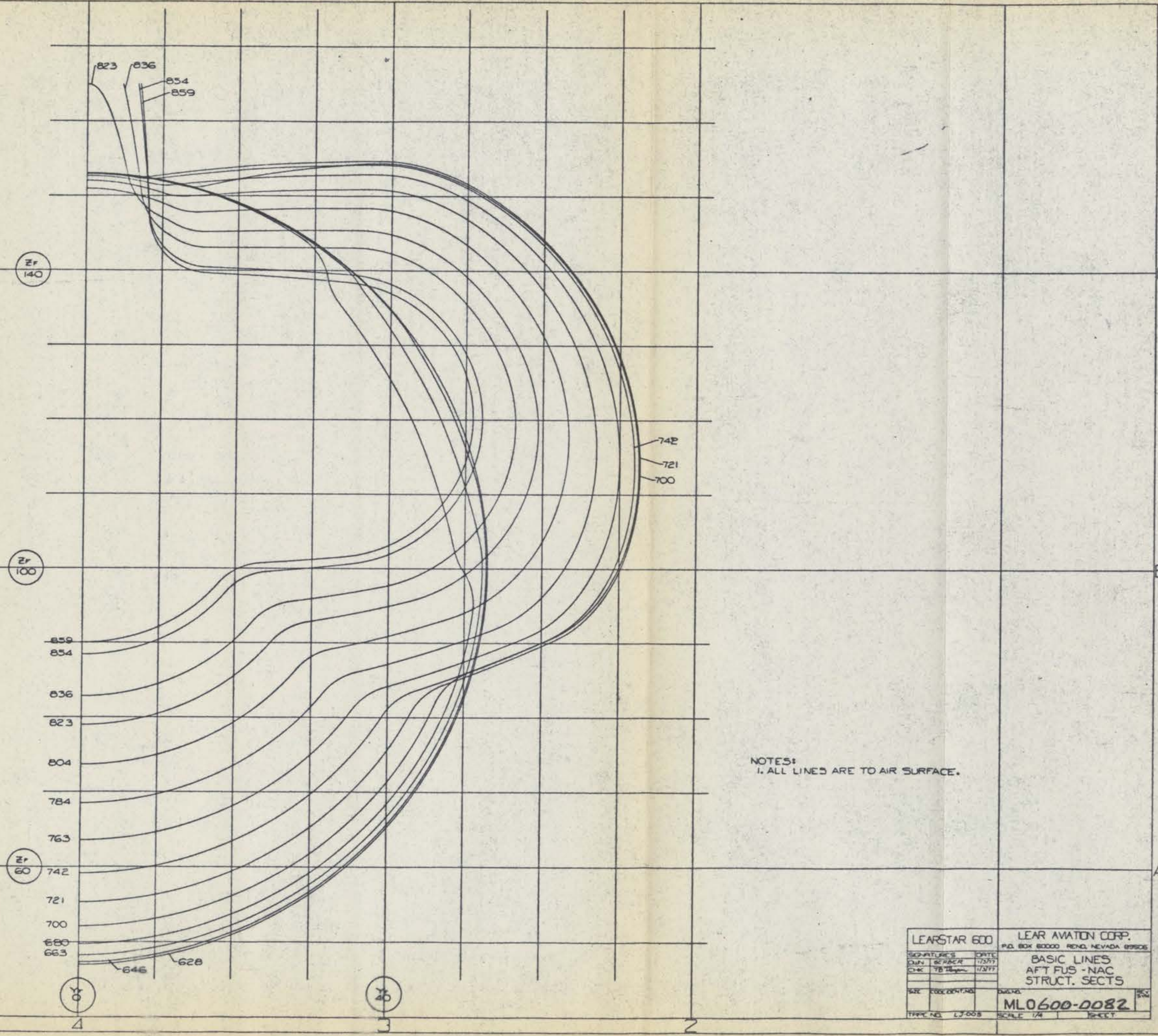

NOTES:
1. ALL LINES ARE TO AIR SURFACE.

LEARSTAR 600	LEAR AVIATION CORP. P.O. BOX 60000 RENO, NEVADA 89506	
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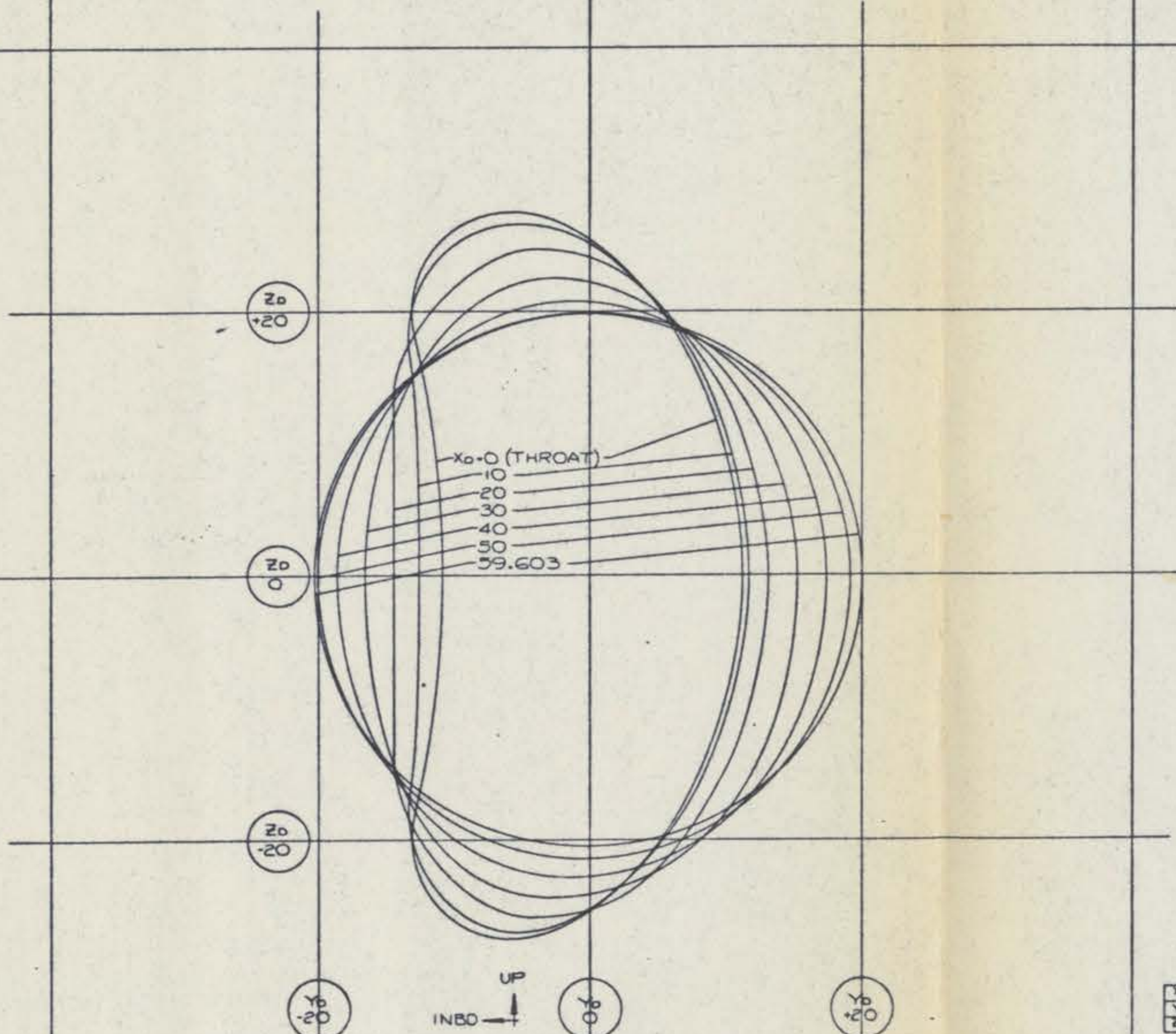

VIEW LOOKING AFT
L.H. SIDE

NOTES
1. ALL LINES ARE TO AIR SURFACE.
2. Xo=59.603 IS A SECTION THRU CONSTANT PORTION OF DUCT APPROXIMATELY FIVE INCHES FWD OF ENGINE FACE.

CONVERSION MATRIX
FUSELAGE - DUCT

	Xo	Yo	Zo	
Xf	.98819887	.15317635	0.0	683.23281
Yf	-.13888238	.89602078	-.42173075	52.046243
Zf	-.06459636	.41675385	.90672111	124.20758
	-660.31331	-203.11484	-90.672105	

LEARSTAR 600	LEAR AVIATION CORP. P.O. BOX 60000 RENO, NEVADA 89506	
SIGNATURES / DATE DWN GERBER 1/7/77 CHK T.B. Rogers 1/-/77	BASIC LINES ENGINE AIR DUCT (DUCT SYSTEM)	
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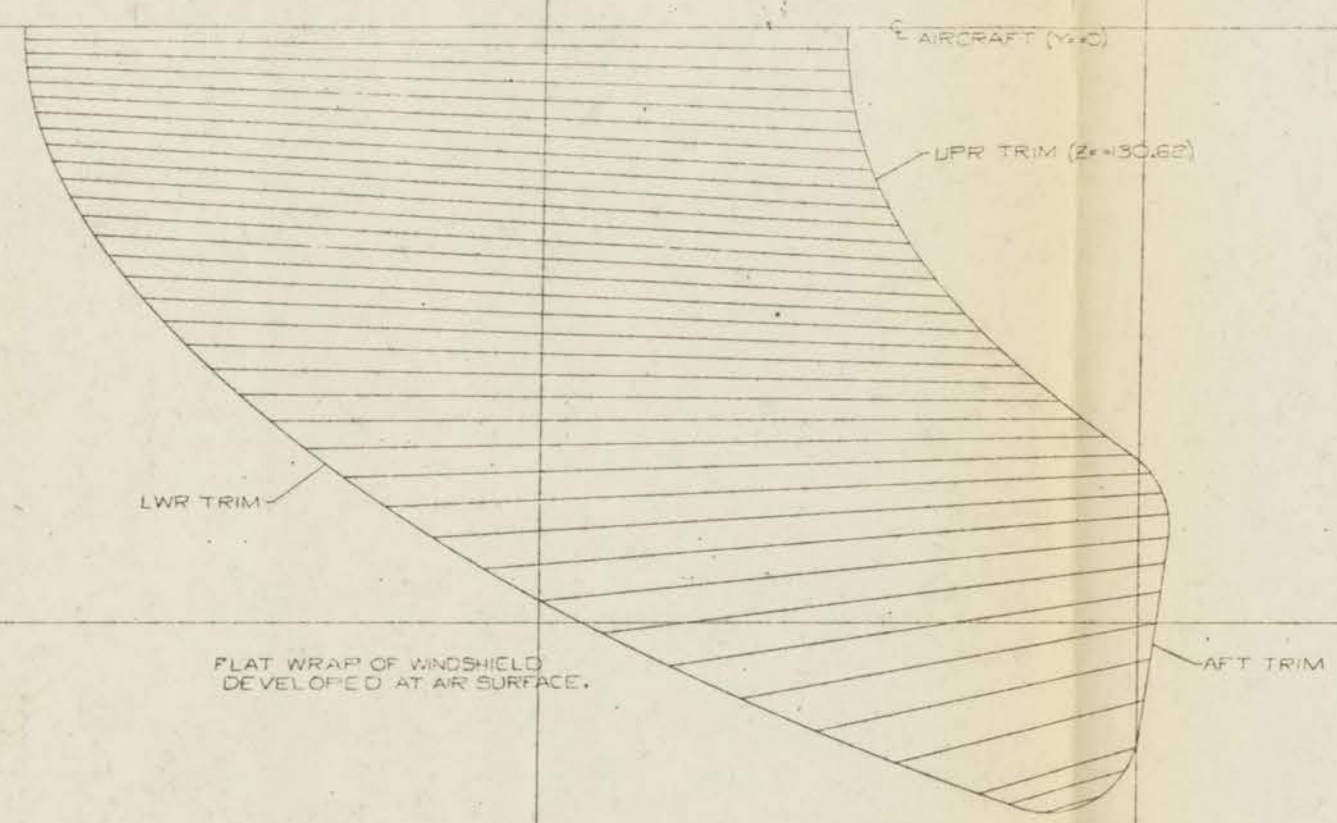

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DWN	GERBER			
CHK				
SIZE	CODE IDENT. NO.		DWG. NO. ML0 600-0024	REV. SYM
TAPE NO.			SCALE 1/4	

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LEARSTAR CL600-106

AIRFRAME REFINEMENTS DOCUMENT

Document # LR 1,107
January 31, 1977

Author: R. R. Tracy

Approved:

LEARAVIA

DOCUMENT NO.

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FORM LC7 7/74-2

LEARSTAR CL600-106

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1.0 Introduction

2.0 Wing Planform and Profile Developments

3.0 Engine Installation

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5.0 Weight Reduction

DESIGN REFINEMENTS

1.0 Introduction

The LearStar 600 configuration persented at the end of January, 1977, by the Reno group (LearAvia) does not represent the conclusion of a preliminary design effort. It is a "snap shot" at midpoint of a design begun in late November 1977 to utilize the concepts of the Allegro design as a point of departure for an airplane to meet or exceed the Canadair guarantees to their existing customers and offer maximum potential for further sales and profits. Consequently, several currently in-work improvements are reported separately in this report. Some are necessary to correct problem areas uncovered during the design work to date. Some have been contemplated virtually from the outset but could not be included because commitments already made, e.g. Wind Tunnel model configuration established in early October. Most are believed to offer significant potential for improvement.

The work areas to be discussed here are:

a) Wing planform & profile developments
b) Engine installation and interval flow improvements
c) Cockpit and nose gear arrangement refinements
d) Weight reduction

In each case, the basic reason for the work will be set forth, the status of work to date summarized, the additional effort required to complete, and the anticipated effect on weight, cost and performance will be stated.

2.0 Wing Planform and Profile Developments

2.1 Assessment of Wing Design from Wind Tunnel Tests

The present design, and especially the wing, fully realized its target in terms of high speed drag characteristics based on Wind Tunnel results. The wing tested did not incorporate profile improvements developed after start of model construction which indicate some performance improvement along with lighter wing structure.

However the tests revealed three problems related to the wing and some extent, tail:

1. Moderate Pitch-up, especially at intermediate Mach Nos.
2. Forward location and shift of aerodynamic center with Mach No. combined with insufficient tail effectiveness to provide adequate stability at aft CG.
3. Inadequate buffet margin at moderate Mach Nos. and high lift coefficient to assure adequate maneuver capabilities.

These characteristics, along with the otherwise excellent cruise performance and dash speed capability are described in the Wind Tunnel Test Report, Report #LR 1.101. The problems arise mainly from the large "glove" at the wing root and to some extent the detailed profile in the vicinity of the leading edge.

Alterations in the wing planform are expected to reduce the adverse a.c. location and travel, improve tail effectiveness, and minimize pitch-up. Profile improvements, beyond those already developed (but not yet tested), should readily increase the buffet angle of attack to provide adequate C_L margin for maneuver and climb requirements.

The objective, of course, is to accomplish these ends without compromising the attained high speed performance.

2.2 Current Wing Design Status

In addition to the foregoing problems, the wing is structurally flutter critical and has barely sufficient fuel volume. Any changes should, if possible, have favorable impact on these areas and not degrade high or low speed performance.

An initial attempt at planform modification by simply straightening the leading edge between body side and wing tip resulted in, if anything, a slight improvement in pressure distribution at $\alpha = 3°$, M = .85 using the transonic analysis computer code. This type of planform is estimated to alleviate the first two of the three problem areas through elimination of the highly swept leading edge glove.

Accordingly an optimization of planform has been begun and a preliminary result is as follows:

		NEW	AS TESTED
S_{ref} (ft^2)	=	399	363
A	=	7.95	9.00
$(Sweep)_{1/4}$	=	35°	33°
Taper Ratio		.308	0.38

Although the wing has an apparently lower aspect ratio and higher wetted area than the wing tested on the current configuration, the span is only 10" less and the wetted wing area is nearly identical (341 ft^2 vs. 332 ft^2). The principal advantage is that although the root and tip are virtually the same, the chord and thickness at the "break" are some 10% greater, thus reducing the local lift coefficient and providing structural improvements in the most stiffness critical area. Additional benefits are some increase in wing volume and reduction in structural sweep at the root.

2.3 Work to Complete

The following principal steps are required to complete the development work:

1. Refine airfoil sections to achieve required buffet margin. Check overall wing flow using transonic analysis computer code at representative α and M.(3 weeks)
2. Calculate weight (both strength and flutter), fuel volume, and review design and performance of high lift devices for new planform. Consider effect of minor variations in area, span, chord and sweep. (3 weeks)
3. Perform additional trade studies to confirm planform selected and determine optimum configuration. (1 week)
4. Perform final transonic flow calculations to check any changes resulting from Step 3. (1-2 weeks)

Since steps 1 and 2 can be carried out concurrently, the entire program should take from 5-6 weeks to final definition of a wing.

[illegible]

2.4 Results of Wing Improvements

Although a further increase in high speed performance can be hoped, possible weight reductions and improved low speed characteristics may also result from this effort. The minimum anticipated results will be:

1. Reduction of pitch up to acceptable levels
2. Increase longitudinal stability to include require CG range
3. Achievement of acceptable buffet margin at maneuver and climb lift coefficient
4. Provide flutter-free wing structure.

All of the above to be achieved at not more than the present wing weight and with no reduction of fuel volume.

3.0 Engine Installation

3.1 Assessment of Engine Installation

The original engine installation in Allegro placed the engines within the fuselage well aft of the pressure bulkhead and within eight inches of the fuselage centerline at their closest point. This arrangement left a very narrow "I" shaped structure to carry aft fuselage loads as well as limited space for equipment aft of the rear pressure bulkhead.

Allegro utilized an inlet diffuser which combined an inboard trim, a crossection change from "D" shape to circular, and a 33% area increase; all in a limited length. The result was a rather severe inner wall contour. In addition, the initial configuration adopted for wind tunnel test was not provided with a boundary layer splitter or suction slot (it had been planned to add such devices if initial tests proved the necessity).

Analyses were performed prior to wind tunnel testing which indicated that boundary layer separation would occur on the wall of the fuselage ahead of the inlet lip; and if separation could be delayed by suction or other means, the separation would occur in the duct somewhat downstream of the throat. (See Figures 1 and 2)

The test results as presented in the Wind Tunnel Report (LS 1.101) confirmed this prediction. Addition of vortex generators ahead of the inlet did delay separation until well past the inlet of the duct, however the total pressure profile at the engine face was almost unchanged. The separation resulted in nearly zero velocity over about one-third of the area at the engine face.

An attempt was made to incorporate a make-shift splitter plate but the flow behind the plate was too restricted, and caused a separation of the fuselage boundary layers ahead of the splitter.

Because the model permits changing the inlet duct (and such modifications as addition of properly designed splitters) only by replacing the entire forward nacelle units, further testing of the internal nacelle flows was discontinued until major redesign could be accomplished. It should also be noted that there were no provisions for varying the exit nozzle area (which determines the internal flow through the nacelle) and the results showed that only

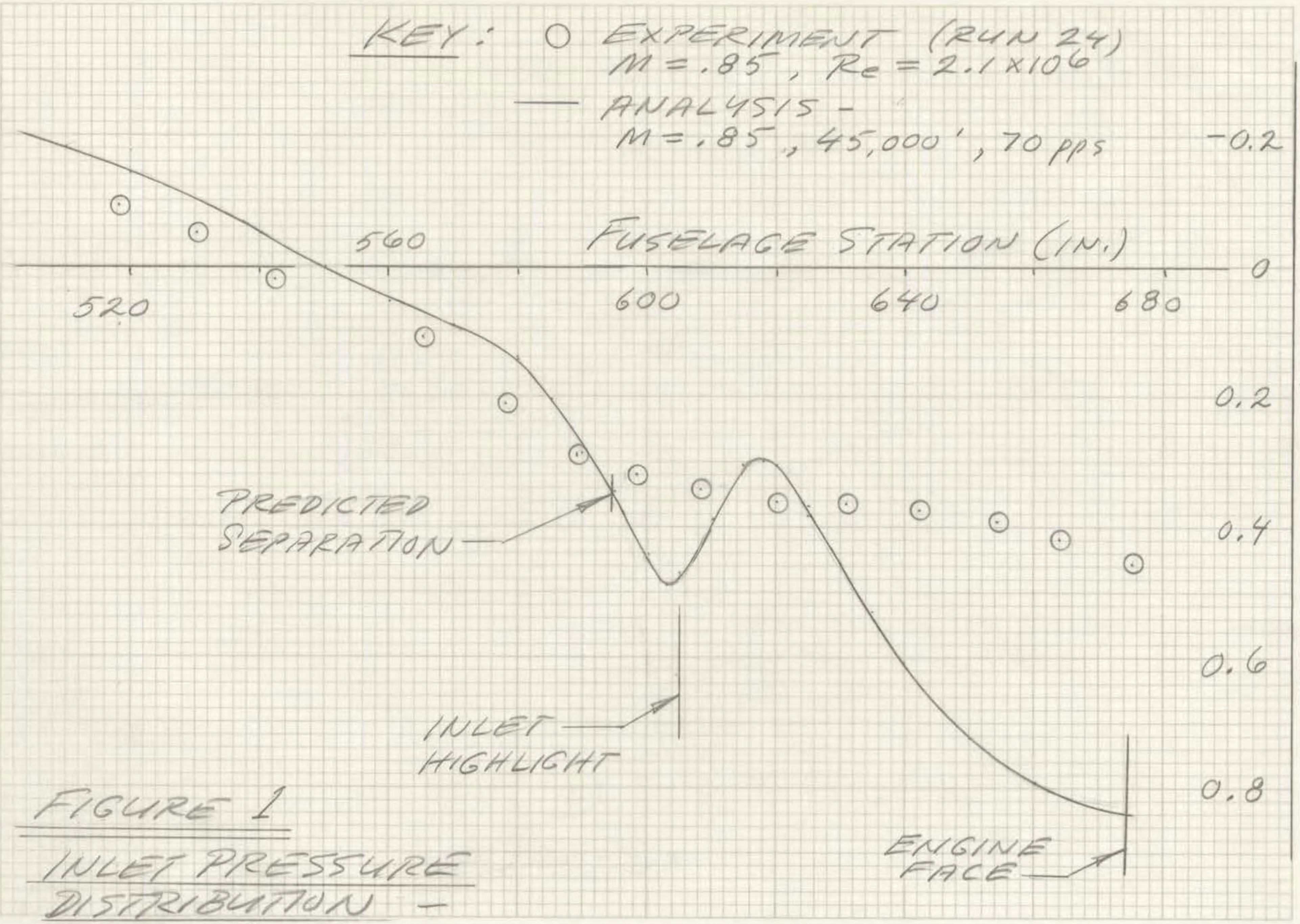

FIGURE 1

INLET PRESSURE DISTRIBUTION - BASIC CONFIGURATION

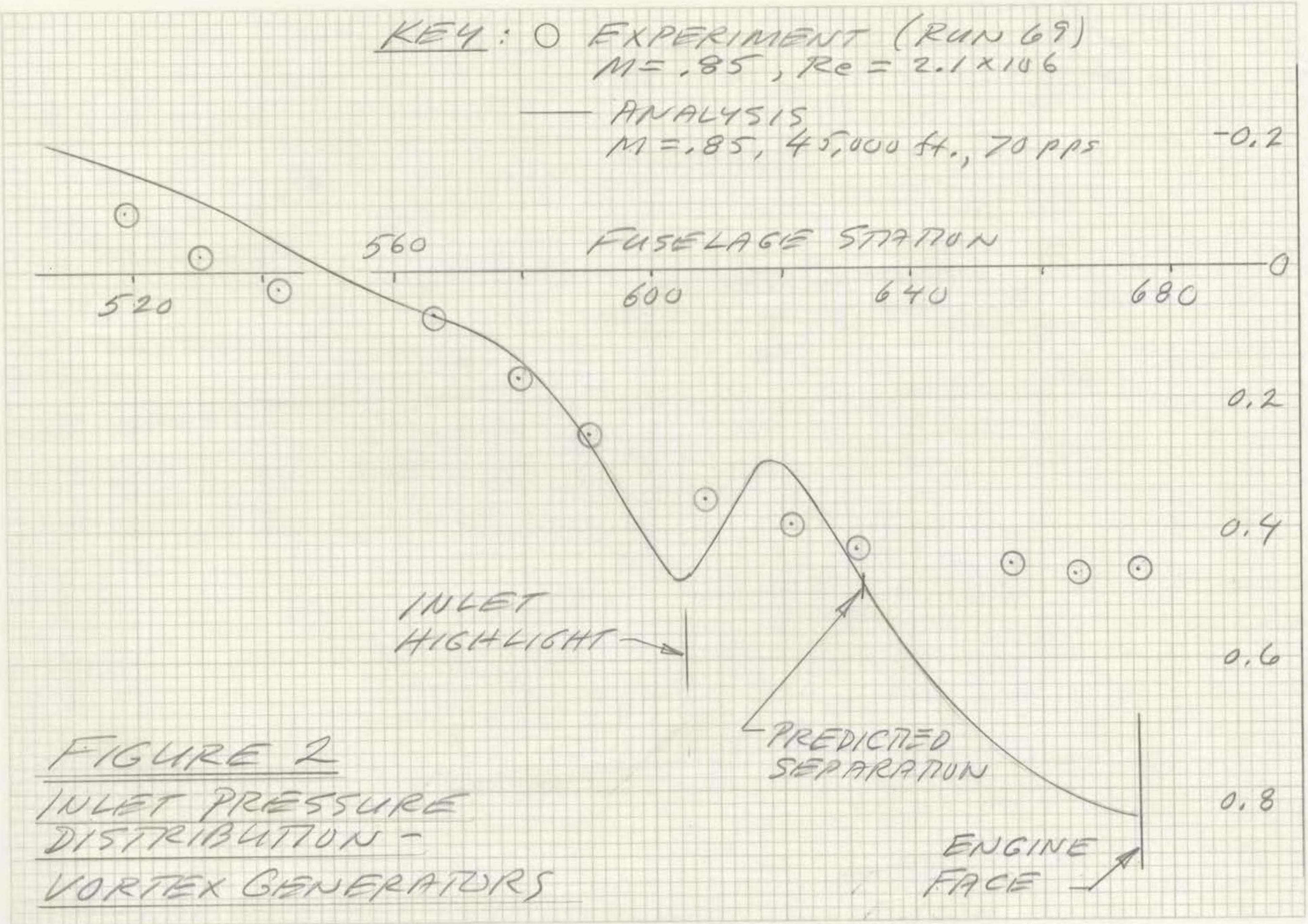

FIGURE 2
INLET PRESSURE DISTRIBUTION - VORTEX GENERATORS

about 70% of the design flow was attained as result of inadequate exit area of the nozzle on the model.

Prior to the Wind Tunnel test, the basic lines of the current 106" configuration were laid down. Lofting, including new nacelles and ducts was completed. Compared to Allegro, the engines were moved outboard and forward. The structural efficiency of the aft fuselage improved considerably and more space resulted for equipment. The inlet contours were developed using computer lofting, however, no inlet splitter was provided.

Following the test it became clear that the effort to absorb the fuselage boundary layer into the engines could involve a lengthy development program.

Further effort should be directed to a conservative inlet design to achieve the principal benefits of the submerged engine ("tailcelle") configuration.

Submerged Engine Benefits:

1. Overall net drag reduction (after counting inlet related losses) of 5-8%.
2. Reduced weight due to elimination of pylons and skin area.
3. Reduced asymmetric thrust in one engine out operation.
4. Reduced noise inside cabin and on the ground due to inlet and exhaust duct arrangement and engine location.
5. Visual appeal.

Accordingly, a parallel design effort was initiated:

A. Develope a conservative engine installation and inlet duct design to realize the above advantages.
B. Perform studies of podded engine installation to estimate effect on aircraft weight and performance.

3.2 Status of Design Program

A new set of inlet geometry criteria has been adopted and a family of inlet ducts (called Series 2) are currently being evaluated. This is being done by using a two-dimensional, integral boundary layer calculation method previously developed for Allegro. The Series 2 inlet layout leads to further relocation of engine outboard and forward. Some increase in nacelle wetted area is incurred. A splitter is incorporated and the diverted boundary layer flow will be passed internally to an exit at the engine nozzle.

Work has started on layout of the structure of a podded engine installation as well as modifications to aircraft arrangement needed to balance such a configuration.

Planning and preliminary design of an inlet test model and test program has been initiated. This model will consist of a simplified fuselage and stub wing to which an instrumented tailcelle or pod can be mounted. An ejector provides controlled air flow simulating the fan of a model engine.

This model will be used in a low speed tunnel and will provide accurate data for all low speed and static conditions. It will also simulate internal duct flows for high speed flight.

In addition, modified high speed and new low speed wind tunnel models are being laid out to incorporate the wing, engine, and other final configuration features of the 106" configuration. These models will permit test of podded or submerged engine installations.

3.3 Completion of the Engine Installation Design

The design activities to complete the preliminary engineering and selection of an engine installation are as follows:

1. Optimize basic inlet geometry using two-dimensional analysis. (3 weeks)
2. Build inlet test model. (6 weeks)
3. Perform three-dimensional analysis. (5 weeks)
4. Perform Wind Tunnel Test of inlet test model. (2 weeks)
5. Revise layout, structure design, and weight analysis of configuration. (3 weeks)
6. Complete layout, structure design and weight analysis of podded installation. (3 weeks)
7. Evaluate test and select configuration for final high and low speed testing and make new overall weight and performance calculations. (2 weeks)

Due to concurrent activities, Items 1, 2, 5 & 6 can be completed in six weeks. The entire effort, including Items 3, 4, & 7 will be completed in eight weeks.

3.4 Result of Engine Installation Study

First, a meaningful basis for selection of podded versus submerged engine will be provided.

Second, this choice will be made between two definitely feasible approaches, each engineered and requiring only final wind tunnel confirmation.

With respect to the present configuration, the final configuration, if it is decided also to use submerged engines, may be contemplated to be lighter, provide better engine access, and show inlet recovery comparable to a conventional pod. The following minimum results are expected:

1. Reduction of inlet total pressure losses to 1-1/2% used in current performance calculations and show satisfactory yaw and pitch behavior.

2. Be no heavier than current design projections.
3. Provide drag levels no greater than current design projections.

In summary, the result of the outlined design effort will lead to a submerged engine configuration having at least as good weight and performance as the present design projections. If a podded engine results in superior overall performance, it will be selected for the application.

4.0 Cockpit

The importance of pilot convenience and comfort is of primary concern at LearAvia. Continuing improvements to the cockpit are in work.

The improvements anticipated include:

1. Windshield angle
2. Windshield size
3. Pilot seat
4. Pilot position
5. Instrument panel
6. Console and controls
7. Better utilization of cockpit cabin space

The full-size mock-up is a necessary tool for this development work.

5.0 Weight Reduction

5.1 Assessment of Current Weights

Sizing of primary airplane structure has been based upon conservative enveloping load conditions. Historically this is a rational basis for anticipating final weights to within 5% accuracy. Optimization of member spacing, and refinement of load conditions will result in weight reductions that tend to be offset by flutter or fatigue critical areas.

Composite materials and adhesive bonding have been called out in all areas where there is ample precedent in the aviation industry.

LearAvia has initiated work on composite/adhesive applications where the state-of-art in other industries (or military/research aircraft projects) has indicated feasibility.

5.2 Areas of Potential Improvement

Specific components which are presently under evaluation are shown on Drawing SK600-0087 (Airframe Design Document, LR 1.104). Considerable certification effort is anticipated in these areas, and cost effectiveness/schedule considerations will be weighed before commitments become firm.

The following table lists candidate components, and compares composite design weights with conventional construction used in the current design:

Component	Current Wt. (lbs)	Composite Wt. (lbs)
Horizontal Tail Structural Box	124.3	87.6
Horizontal Tail Leading Edge	61.9	41.6
Vertical Tail Structural Box	131.9	109.3
Vertical Tail Leading Edge	19.9	10.7
Passenger Type III Emergency Door - 2 required	64.0	48.0
Cargo Door	185.0	138.8
Passenger Door	115.0	86.5
Passenger Type I Exit Door	50.0	37.5
Crew Emergency Exit	47.5	35.6
Inboard Wing Leading Edge	84.6 ea.	63.5 ea.
Outboard Wing Leading Edge	53.0 ea.	39.8 ea.
Pressure Bulkheads - 2 required	211.5	158.6
TOTAL WEIGHT COMPARISON	1286.2	960.8

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DESIGN REFINEMENTS DOCUMENT
Doc. # LR 1.107

5980 ALPHA • (702) 972-0711
P.O. BOX 60,000 • RENO, NEVADA 89506

JANUARY 1977

LEARSTAR CL600-106

AIRFRAME REFINEMENTS DOCUMENT

Document # LR 1,107
January 31, 1977

Author: R. R. Tracy

Approved:

LEARAVIA

DOCUMENT NO.

SHEET

ISSUE

FORM LC7 7/74-2

LEARSTAR CL600-106

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2.1 Assessment of Wing Design from Wind Tunnel Tests

The present design, and especially the wing, fully realized its target in terms of high speed drag characteristics based on Wind Tunnel results. The wing tested did not incorporate profile improvements developed after start of model construction which indicate some performance improvement along with lighter wing structure.

However the tests revealed three problems related to the wing and some extent, tail:

1. Moderate Pitch-up, especially at intermediate Mach Nos.
2. Forward location and shift of aerodynamic center with Mach No. combined with insufficient tail effectiveness to provide adequate stability at aft CG.
3. Inadequate buffet margin at moderate Mach Nos. and high lift coefficient to assure adequate maneuver capabilities.

These characteristics, along with the otherwise excellent cruise performance and dash speed capability are described in the Wind Tunnel Test Report, Report #LR 1.101. The problems arise mainly from the large "glove" at the wing root and to some extent the detailed profile in the vicinity of the leading edge.

Alterations in the wing planform are expected to reduce the adverse a.c. location and travel, improve tail effectiveness, and minimize pitch-up. Profile improvements, beyond those already developed (but not yet tested), should readily increase the buffet angle of attack to provide adequate C_L margin for maneuver and climb requirements.

The objective, of course, is to accomplish these ends without compromising the attained high speed performance.

2.2 Current Wing Design Status

In addition to the foregoing problems, the wing is structurally flutter critical and has barely sufficient fuel volume. Any changes should, if possible, have favorable impact on these areas and not degrade high or low speed performance.

An initial attempt at planform modification by simply straightening the leading edge between body side and wing tip resulted in, if anything, a slight improvement in pressure distribution at $\alpha = 3°$, M = .85 using the transonic analysis computer code. This type of planform is estimated to alleviate the first two of the three problem areas through elimination of the highly swept leading edge glove.

Accordingly an optimization of planform has been begun and a preliminary result is as follows:

		NEW	AS TESTED
S_{ref} (ft^2)	=	399	363
A	=	7.95	9.00
$(Sweep)_{1/4}$	=	35°	33°
Taper Ratio		.308	0.38

Although the wing has an apparently lower aspect ratio and higher wetted area than the wing tested on the current configuration, the span is only 10" less and the wetted wing area is nearly identical (341 ft^2 vs. 332 ft^2). The principal advantage is that although the root and tip are virtually the same, the chord and thickness at the "break" are some 10% greater, thus reducing the local lift coefficient and providing structural improvements in the most stiffness critical area. Additional benefits are some increase in wing volume and reduction in structural sweep at the root.

2.3 Work to Complete

The following principal steps are required to complete the development work:

1. Refine airfoil sections to achieve required buffet margin. Check overall wing flow using transonic analysis computer code at representative α and M.(3 weeks)
2. Calculate weight (both strength and flutter), fuel volume, and review design and performance of high lift devices for new planform. Consider effect of minor variations in area, span, chord and sweep. (3 weeks)
3. Perform additional trade studies to confirm planform selected and determine optimum configuration. (1 week)
4. Perform final transonic flow calculations to check any changes resulting from Step 3. (1-2 weeks)

Since steps 1 and 2 can be carried out concurrently, the entire program should take from 5-6 weeks to final definition of a wing.

2.4 Results of Wing Improvements

Although a further increase in high speed performance can be hoped, possible weight reductions and improved low speed characteristics may also result from this effort. The minimum anticipated results will be:

1. Reduction of pitch up to acceptable levels
2. Increase longitudinal stability to include require CG range
3. Achievement of acceptable buffet margin at maneuver and climb lift coefficient
4. Provide flutter-free wing structure.

All of the above to be achieved at not more than the present wing weight and with no reduction of fuel volume.

3.0 Engine Installation

3.1 Assessment of Engine Installation

The original engine installation in Allegro placed the engines within the fuselage well aft of the pressure bulkhead and within eight inches of the fuselage centerline at their closest point. This arrangement left a very narrow "I" shaped structure to carry aft fuselage loads as well as limited space for equipment aft of the rear pressure bulkhead.

Allegro utilized an inlet diffuser which combined an inboard trim, a crossection change from "D" shape to circular, and a 33% area increase; all in a limited length. The result was a rather severe inner wall contour. In addition, the initial configuration adopted for wind tunnel test was not provided with a boundary layer splitter or suction slot (it had been planned to add such devices if initial tests proved the necessity).

Analyses were performed prior to wind tunnel testing which indicated that boundary layer separation would occur on the wall of the fuselage ahead of the inlet lip; and if separation could be delayed by suction or other means, the separation would occur in the duct somewhat downstream of the throat. (See Figures 1 and 2)

The test results as presented in the Wind Tunnel Report (LS 1.101) confirmed this prediction. Addition of vortex generators ahead of the inlet did delay separation until well past the inlet of the duct, however the total pressure profile at the engine face was almost unchanged. The separation resulted in nearly zero velocity over about one-third of the area at the engine face.

An attempt was made to incorporate a make-shift splitter plate but the flow behind the plate was too restricted, and caused a separation of the fuselage boundary layers ahead of the splitter.

Because the model permits changing the inlet duct (and such modifications as addition of properly designed splitters) only by replacing the entire forward nacelle units, further testing of the internal nacelle flows was discontinued until major redesign could be accomplished. It should also be noted that there were no provisions for varying the exit nozzle area (which determines the internal flow through the nacelle) and the results showed that only

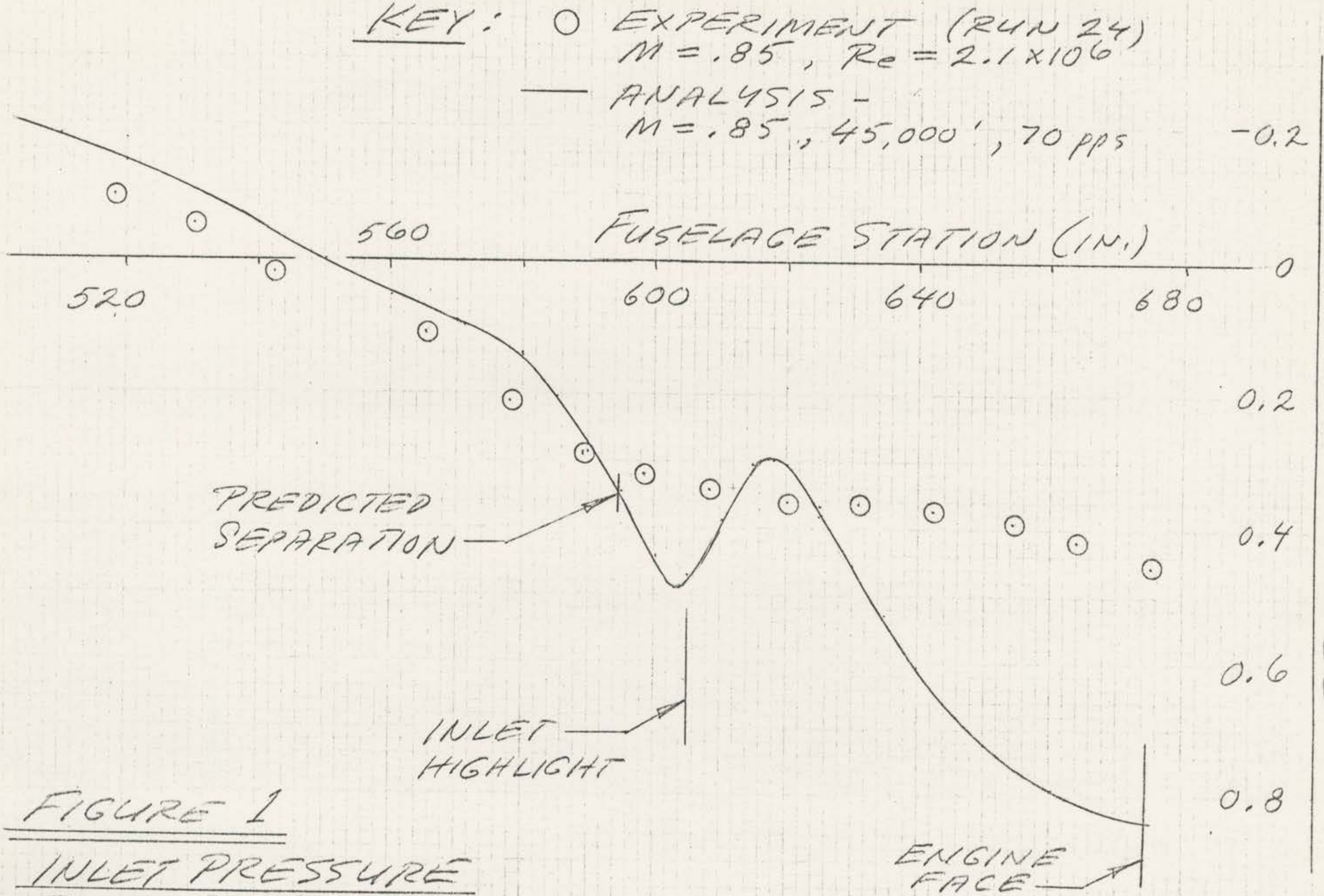


FIGURE 1

INLET PRESSURE DISTRIBUTION - BASIC CONFIGURATION

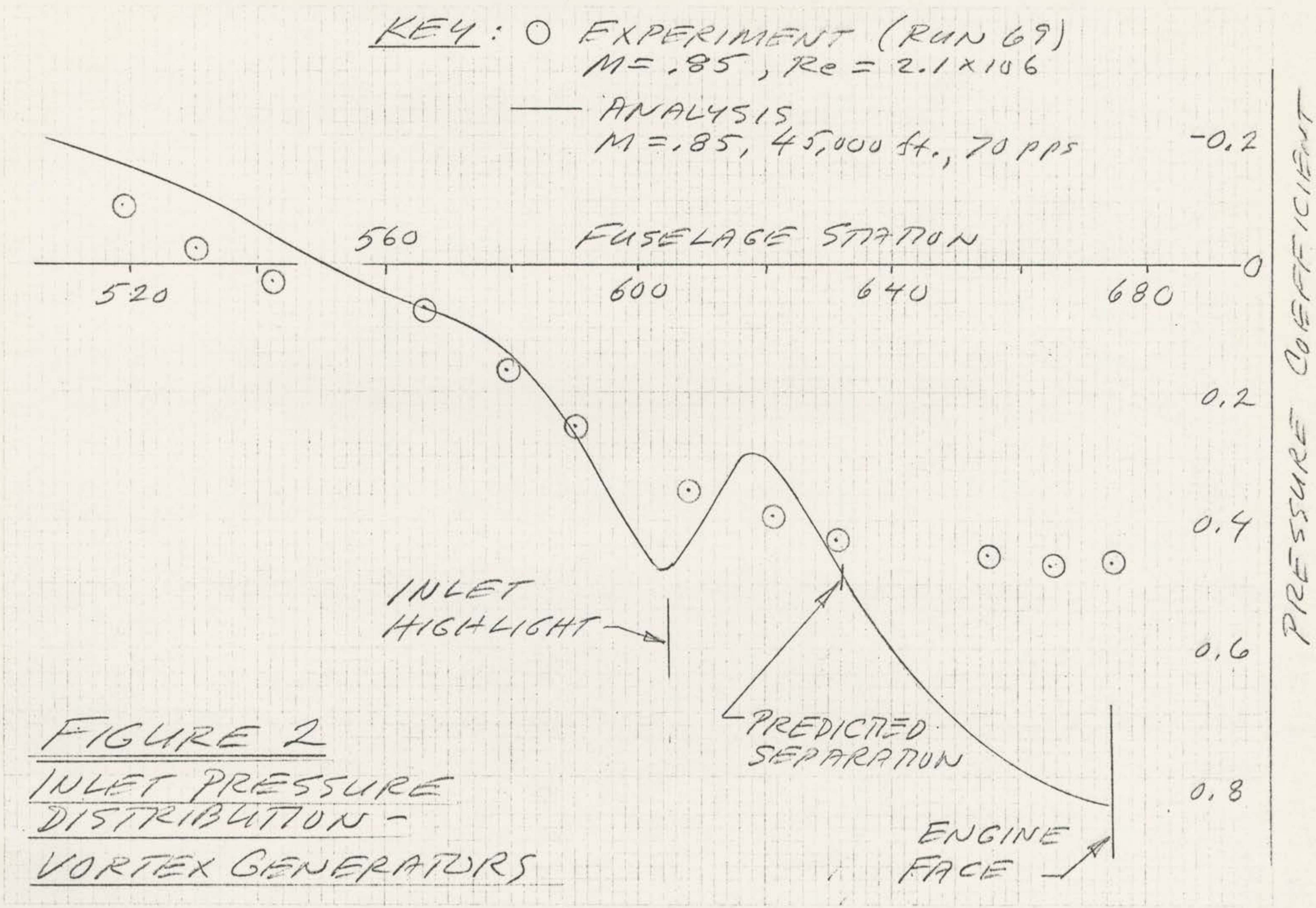


FIGURE 2

INLET PRESSURE DISTRIBUTION - VORTEX GENERATORS

about 70% of the design flow was attained as result of inadequate exit area of the nozzle on the model.

Prior to the Wind Tunnel test, the basic lines of the current 106" configuration were laid down. Lofting, including new nacelles and ducts was completed. Compared to Allegro, the engines were moved outboard and forward. The structural efficiency of the aft fuselage improved considerably and more space resulted for equipment. The inlet contours were developed using computer lofting, however, no inlet splitter was provided.

Following the test it became clear that the effort to absorb the fuselage boundary layer into the engines could involve a lengthy development program.

Further effort should be directed to a conservative inlet design to achieve the principal benefits of the submerged engine ("tailcelle") configuration.

Submerged Engine Benefits:

1. Overall net drag reduction (after counting inlet related losses) of 5-8%.
2. Reduced weight due to elimination of pylons and skin area.
3. Reduced asymmetric thrust in one engine out operation.
4. Reduced noise inside cabin and on the ground due to inlet and exhaust duct arrangement and engine location.
5. Visual appeal.

Accordingly, a parallel design effort was initiated:

A. Develope a conservative engine installation and inlet duct design to realize the above advantages.
B. Perform studies of podded engine installation to estimate effect on aircraft weight and performance.

3.2 Status of Design Program

A new set of inlet geometry criteria has been adopted and a family of inlet ducts (called Series 2) are currently being evaluated. This is being done by using a two-dimensional, integral boundary layer calculation method previously developed for Allegro. The Series 2 inlet layout leads to further relocation of engine outboard and forward. Some increase in nacelle wetted area is incurred. A splitter is incorporated and the diverted boundary layer flow will be passed internally to an exit at the engine nozzle.

Work has started on layout of the structure of a podded engine installation as well as modifications to aircraft arrangement needed to balance such a configuration.

Planning and preliminary design of an inlet test model and test program has been initiated. This model will consist of a simplified fuselage and stub wing to which an instrumented tailcelle or pod can be mounted. An ejector provides controlled air flow simulating the fan of a model engine.

This model will be used in a low speed tunnel and will provide accurate data for all low speed and static conditions. It will also simulate internal duct flows for high speed flight.

In addition, modified high speed and new low speed wind tunnel models are being laid out to incorporate the wing, engine, and other final configuration features of the 106" configuration. These models will permit test of podded or submerged engine installations.

3.3 Completion of the Engine Installation Design

The design activities to complete the preliminary engineering and selection of an engine installation are as follows:

1. Optimize basic inlet geometry using two-dimensional analysis. (3 weeks)
2. Build inlet test model. (6 weeks)
3. Perform three-dimensional analysis. (5 weeks)
4. Perform Wind Tunnel Test of inlet test model. (2 weeks)
5. Revise layout, structure design, and weight analysis of configuration. (3 weeks)
6. Complete layout, structure design and weight analysis of podded installation. (3 weeks)
7. Evaluate test and select configuration for final high and low speed testing and make new overall weight and performance calculations. (2 weeks)

Due to concurrent activities, Items 1, 2, 5 & 6 can be completed in six weeks. The entire effort, including Items 3, 4, & 7 will be completed in eight weeks.

3.4 Result of Engine Installation Study

First, a meaningful basis for selection of podded versus submerged engine will be provided.

Second, this choice will be made between two definitely feasible approaches, each engineered and requiring only final wind tunnel confirmation.

With respect to the present configuration, the final configuration, if it is decided also to use submerged engines, may be contemplated to be lighter, provide better engine access, and show inlet recovery comparable to a conventional pod. The following minimum results are expected:

1. Reduction of inlet total pressure losses to 1-1/2% used in current performance calculations and show satisfactory yaw and pitch behavior.

2. Be no heavier than current design projections.
3. Provide drag levels no greater than current design projections.

In summary, the result of the outlined design effort will lead to a submerged engine configuration having at least as good weight and performance as the present design projections. If a podded engine results in superior overall performance, it will be selected for the application.

4.0 Cockpit

The importance of pilot convenience and comfort is of primary concern at LearAvia. Continuing improvements to the cockpit are in work.

The improvements anticipated include:

1. Windshield angle
2. Windshield size
3. Pilot seat
4. Pilot position
5. Instrument panel
6. Console and controls
7. Better utilization of cockpit cabin space

The full-size mock-up is a necessary tool for this development work.

5.0 Weight Reduction

5.1 Assessment of Current Weights

Sizing of primary airplane structure has been based upon conservative enveloping load conditions. Historically this is a rational basis for anticipating final weights to within 5% accuracy. Optimization of member spacing, and refinement of load conditions will result in weight reductions that tend to be offset by flutter or fatigue critical areas.

Composite materials and adhesive bonding have been called out in all areas where there is ample precedent in the aviation industry.

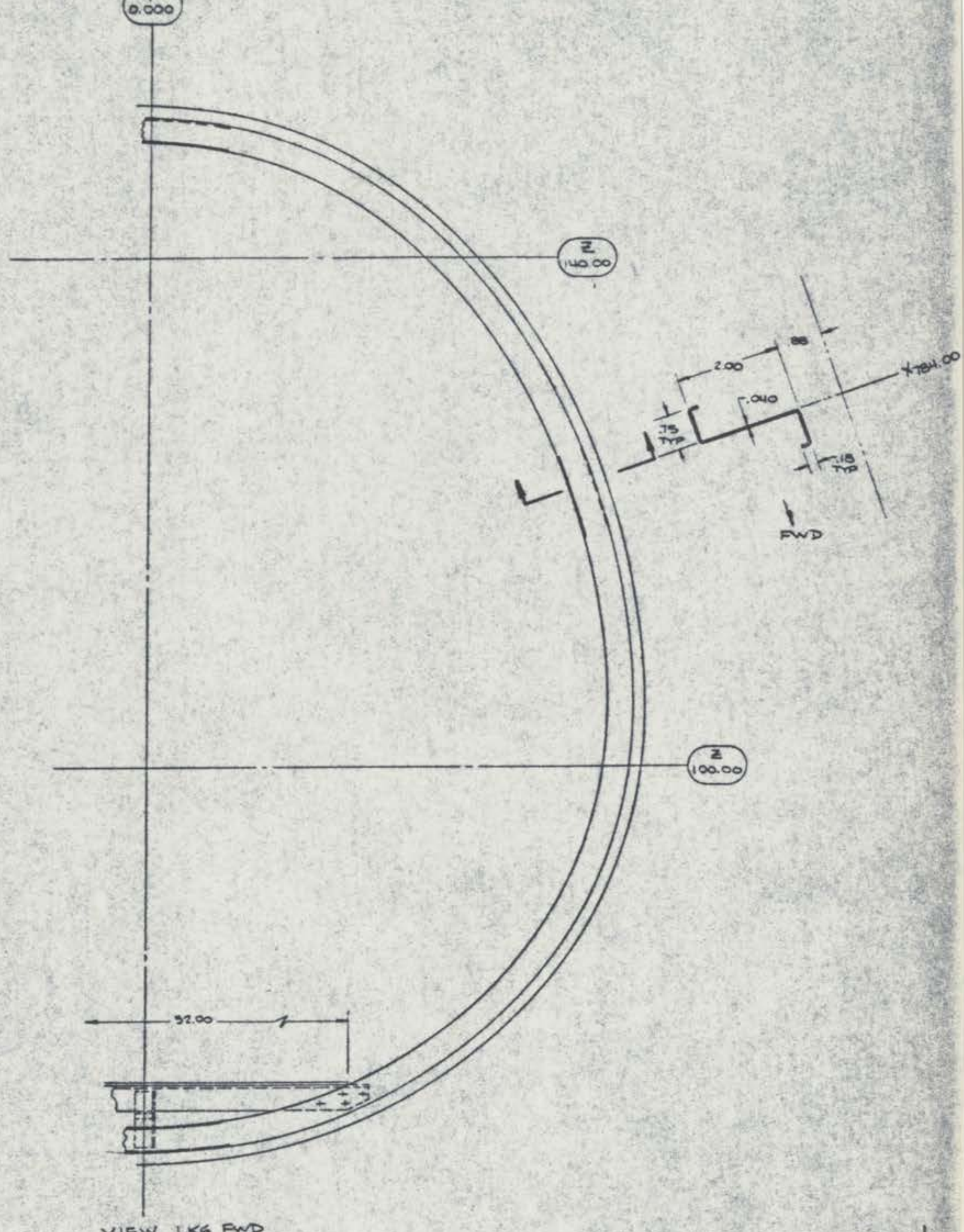
LearAvia has initiated work on composite/adhesive applications where the state-of-art in other industries (or military/research aircraft projects) has indicated feasibility.

5.2 Areas of Potential Improvement

Specific components which are presently under evaluation are shown on Drawing SK600-0087 (Airframe Design Document, LR 1.104). Considerable certification effort is anticipated in these areas, and cost effectiveness/schedule considerations will be weighed before commitments become firm.

The following table lists candidate components, and compares composite design weights with conventional construction used in the current design:

Component	Current Wt. (lbs)	Composite Wt. (lbs)
Horizontal Tail Structural Box	124.3	87.6
Horizontal Tail Leading Edge	61.9	41.6
Vertical Tail Structural Box	131.9	109.3
Vertical Tail Leading Edge	19.9	10.7
Passenger Type III Emergency Door - 2 required	64.0	48.0
Cargo Door	185.0	138.8
Passenger Door	115.0	86.5
Passenger Type I Exit Door	50.0	37.5
Crew Emergency Exit	47.5	35.6
Inboard Wing Leading Edge	84.6 ea.	63.5 ea.
Outboard Wing Leading Edge	53.0 ea.	39.8 ea.
Pressure Bulkheads - 2 required	211.5	158.6
TOTAL WEIGHT COMPARISON	1286.2	960.8



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DRAFTSMAN CALHOUN	FUSELAGE - 600 PROPOSED VERSION TYP FRAME - AFT STA 784.00		
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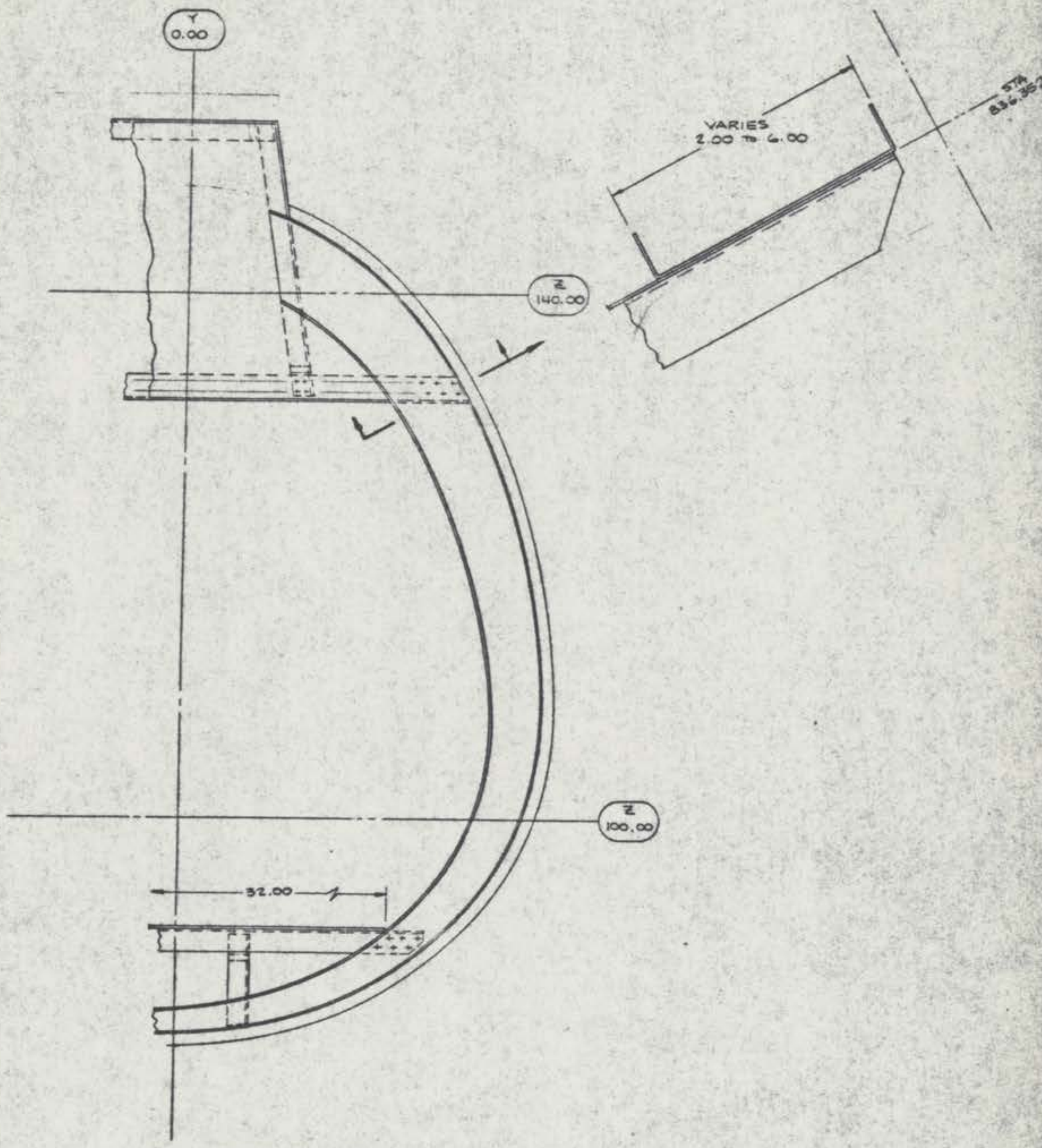

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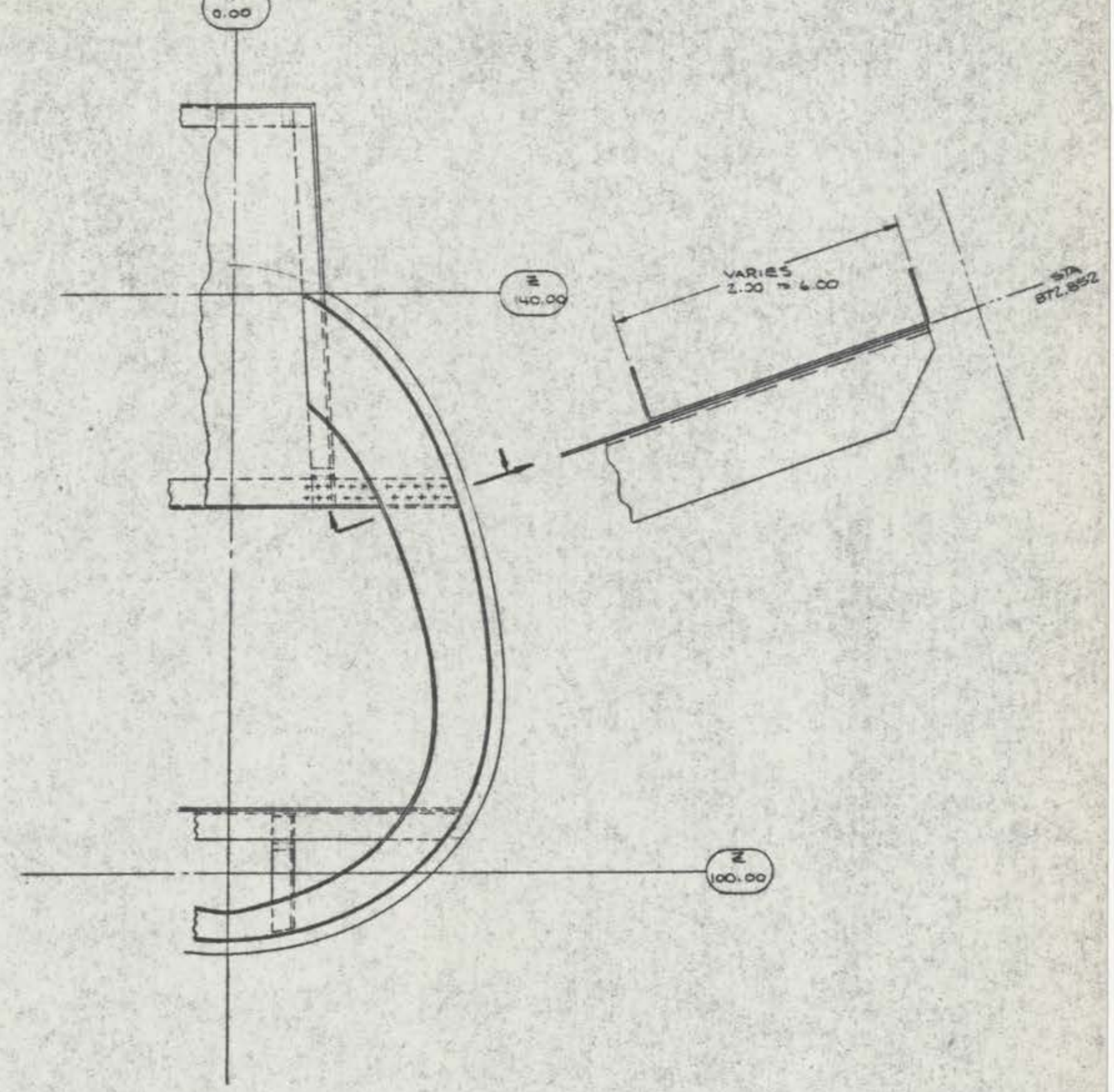

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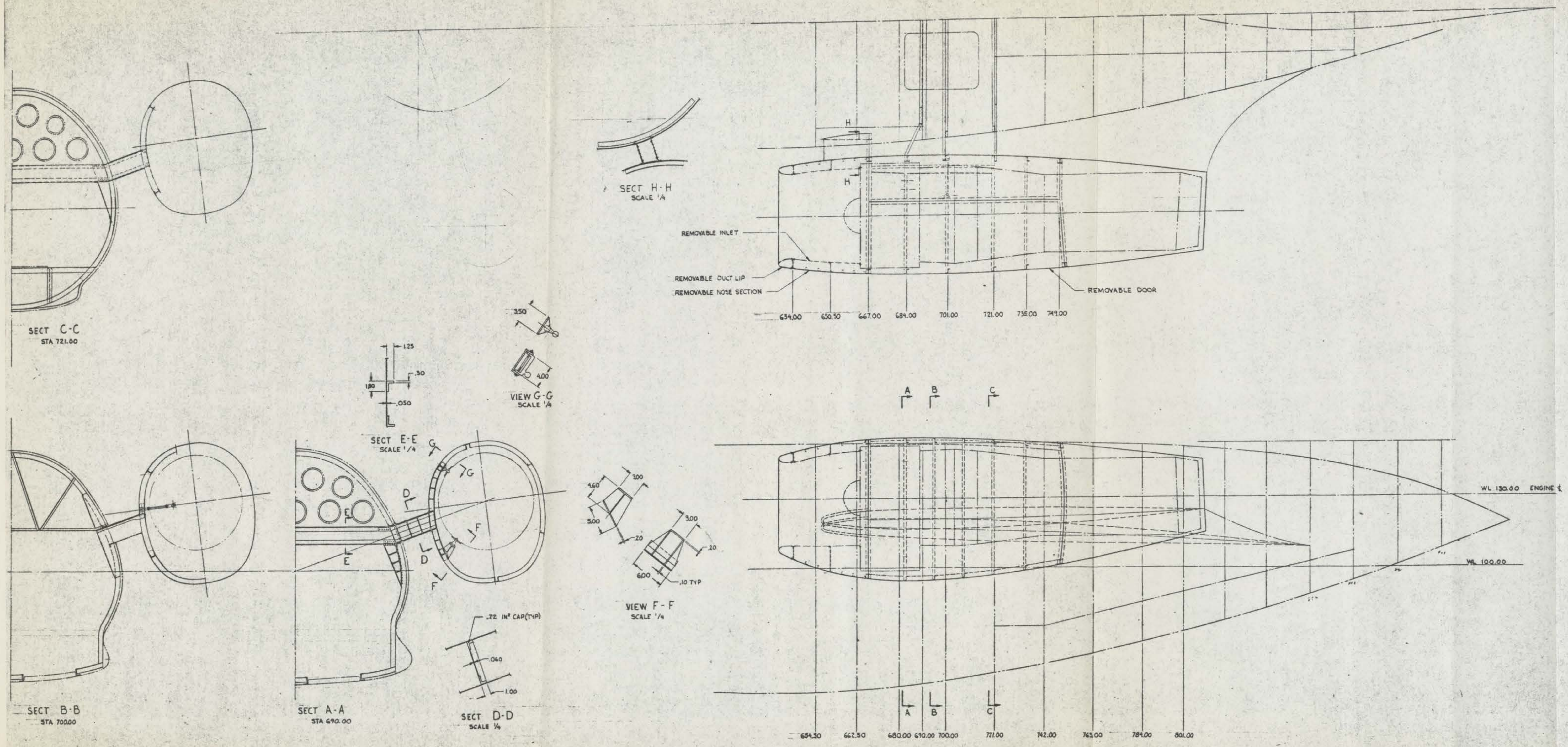

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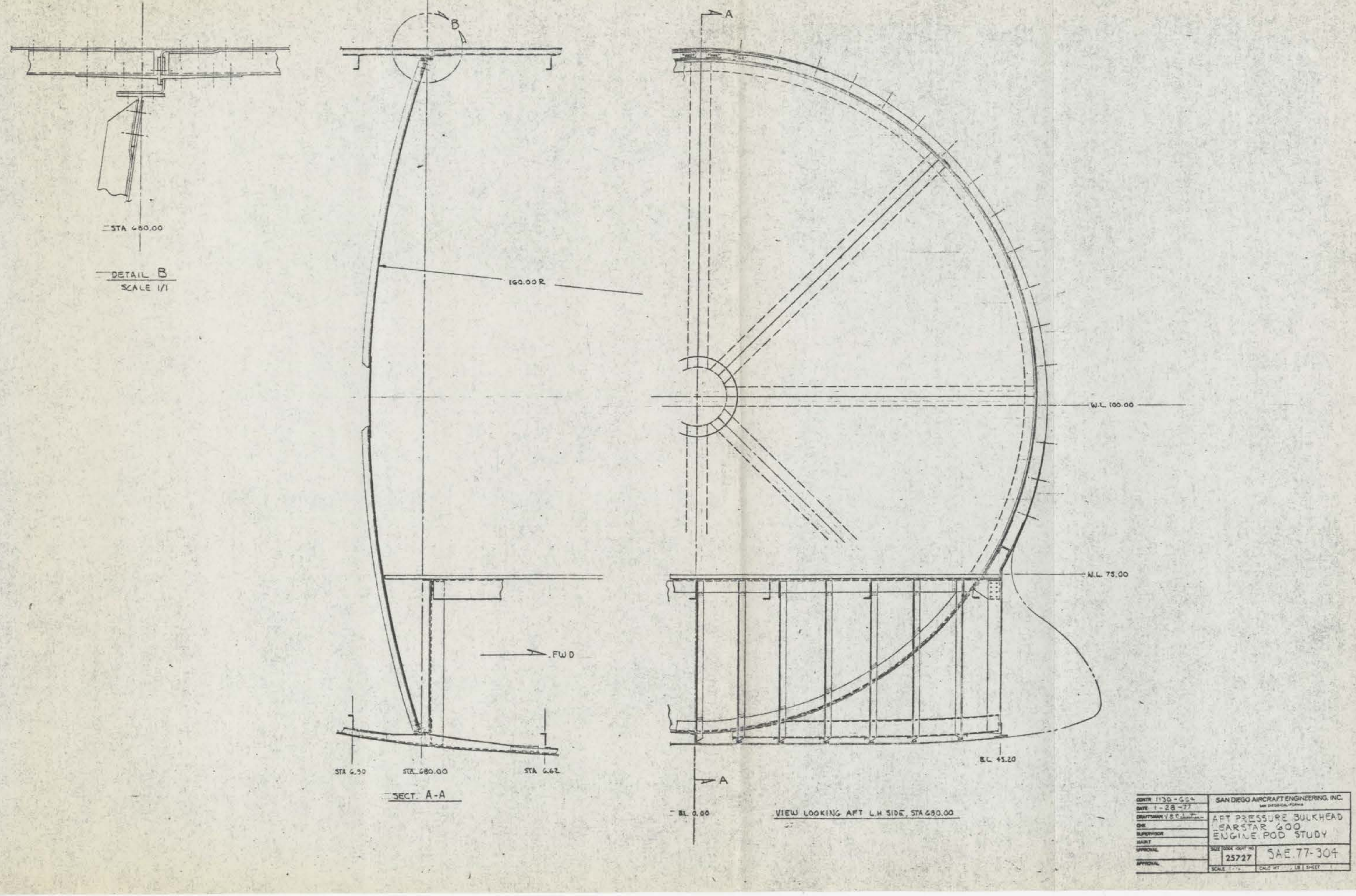
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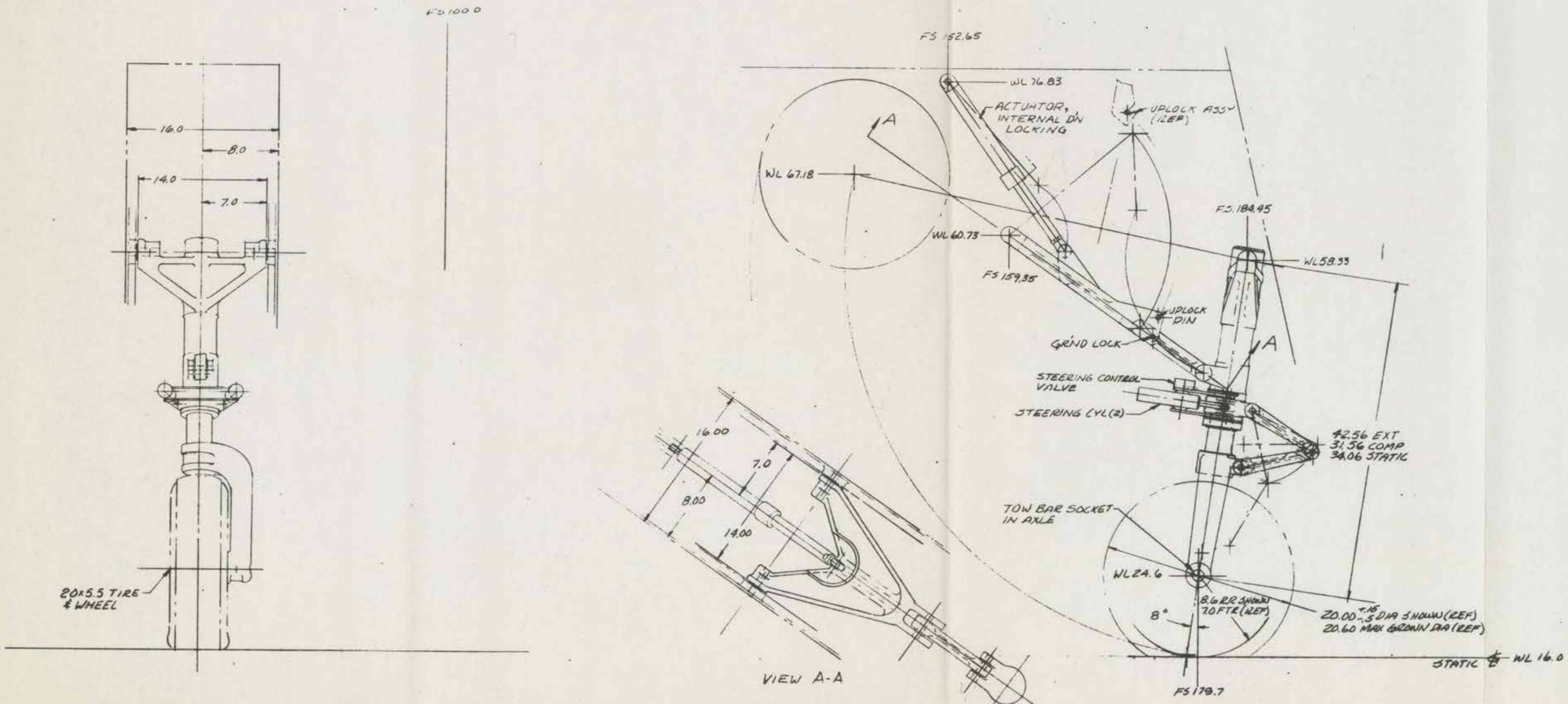

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8.0
14.0
7.0
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WL 76.83
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UPLOCK ASSY (REF)
A
WL 67.18
WL 60.73
FS 159.35
FS 184.95
WL 58.33
UPLOCK PIN
GRND LOCK
STEERING CONTROL VALVE
STEERING CYL (2)
42.56 EXT
31.56 COMP
34.06 STATIC
TOW BAR SOCKET IN AXLE
WL 24.6
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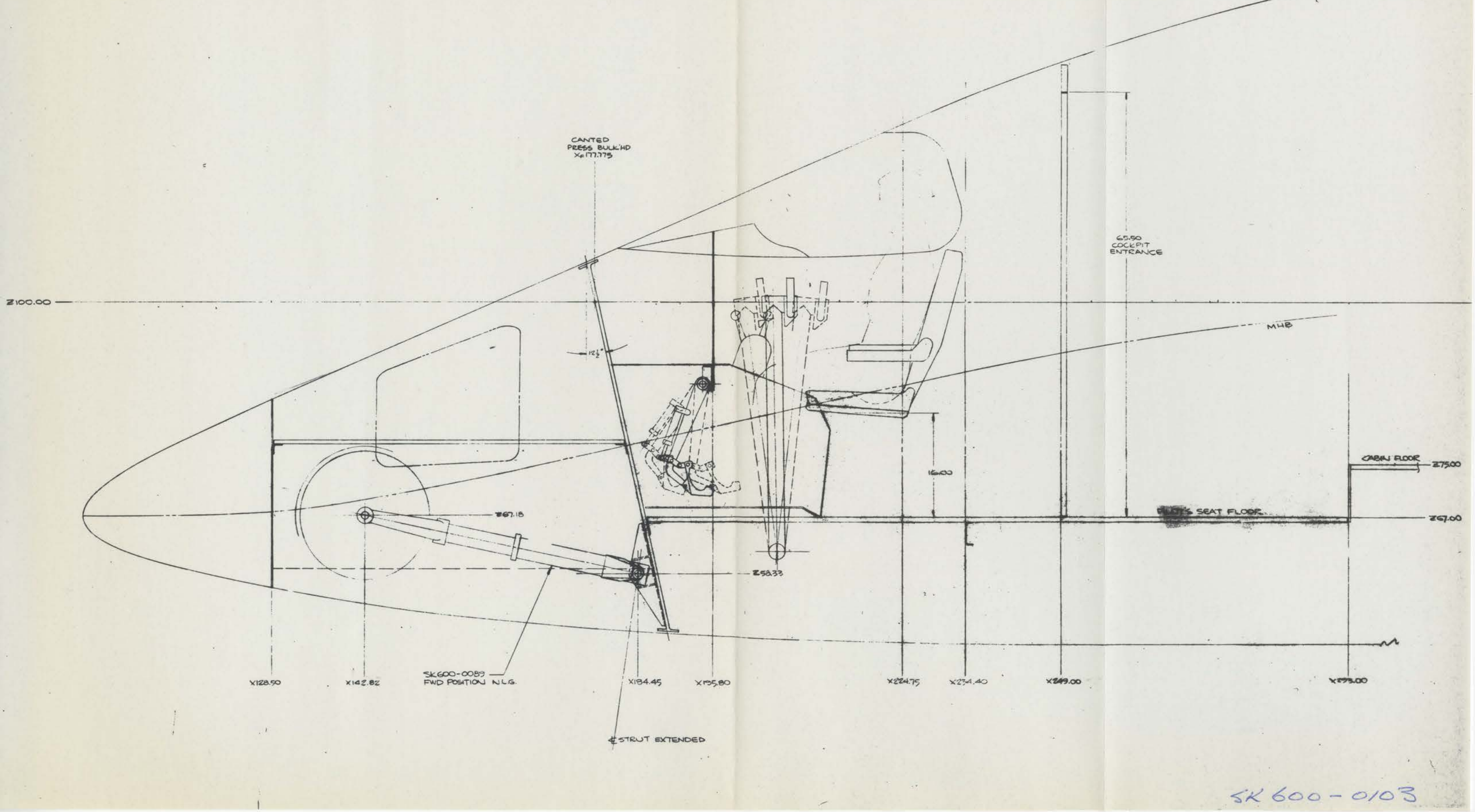

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