LEARSTAR CL600-106

AIRFRAME DESIGN DOCUMENT

Document # LR 1.104
January 31, 1977

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Approved ______________

AIRFRAME DESIGN

1.0 Introduction

The airframe design of the LearStar CL600-106 is contained within this report Certain written information describing the construction features, as well as photo-reductions of preliminary design drawings are submitted. Studying these design drawings while reviewing the test will assist in visualizing the structure provided. The report is broken into the following sections:

ACCOMMODATIONS AND INTERIOR

2.0 Airframe Structure

The airframe of the LearStar 600-106 is an all-aluminum riveted structure. Although the aft end of the airplane may appear to be unique due to the engine location, the structure has proved to be basically conventional in design and offers no particular problem in terms of weight penalty. The emphasis placed on this design has been the integration of the design so as to produce a minimum of high points (concentration of load paths) which are found in conventional designs, i.e. wing, fuselage attach points, etc., as well as attention to minimum weight.

2.1 Fuselage

The fuselage of the LearStar 600-106 is of semimonocoque construction, incorporating transverse frame and longitudinal stiffeners, with riveted aluminum alloy sheet covering.

The fuselage structure consists of a center cylindrical section of constant diameter from Sta. 333.0 through Sta. 628.0. The crew and passenger compartments are confined between the forward pressure bulkhead, Sta. 176.5 to the aft pressure bulkhead, Sta. 680.0. This comprises the pressure hull with exception of a pressure floor extending from the aft pressure bulkhead forward to Sta. 425.0.

Passenger windows are incorporated only in the constant section and in that area the use of heavier skins eliminates the use for stringers. This results in lower pressurization induced stresses and the elimination of complex, costly and heavy stringers/window frame intersections. There are 56 equally spaced stringers in the constant section and of course, they change as the fuselage becomes smaller forward and aft. The basic fuselage skin has a thickness of .052" and is chemically milled between stringers, intercostals and frames to a minimum thickness of .032". This design provides the advantages of crackstop and thickness tailoring in areas of varying loads. It has the further advantage of reducing to a minimum the number of doublers and crackstop strips found in conventional designs.

The basic fuselage frames are Zee sections of 2.125" in depth, and the stringers are also Zee sections of .875" in depth. The frames, stringers intercostals and skins are all of riveted construction, making up the fuselage structure. All of the doors of the various configurations are located within the constant section and shall be described in a later section of this report. The design of this structure is depicted on Drawings:

SK600-0013	Nose Structure
SAE77-251	Fwd. Fuselage
SAE77-252	Aft Fuselage
SAE77-253	Fwd. Stringer
SAE77-254	Aft Stringer
SAE77-255	M.L.G. Bulkhead
SAE77-256	Bulkhead at Sta. 234

SK600-0043	Stringer Diagram Fwd. Section
SK600-0044	Stringer Diagram
SAE77-269	Door, Nacelle
SAE77-270	Nacelle Structure
SK600-0042	Basic Dimensional Information
SK600-0098	LearStar 600-106 3-View
SAE77-257	Frame Sta. 386, Sta. 40 & Sta. 416
SAE77-258	Frame at Front Spar
SAE77-259	Frame at Rear Spar
SAE77-260	Forward Pressure Bulkhead
SAE77-261	Aft Pressure Bulkhead
SAE77-262	Engine Mount
SAE77-263	Vertical Tail Attach Fwd
SAE77-264	Pressure Floor
SAE77-265	Vertical Tail Attach Aft
SAE77-266	Frame at Sta. 721
SAE77-268	Bulkhead at Sta. 273
SK600-0086	Composite Materials
SK600-0087	Composite Materials

The nose landing gear is pivoted between two longitudinal gear members and is located beneath the cockpit floor. The wheelwell is not pressurized. Thus provisions have been made for the complete removal and re-assembly of the nose gear without penetrating the pressure hull. The main landing gear trunnion is pivoted between two fuselage frames. They are both virtually identical and are relatively heavy due to landing gear reaction loads. Aft of the pressure bulkhead at Sta. 680.0, the same type of structure is continued aft, however there is a transition from the basic circular shape to a more or less rectangular shape in the engine compartment area. The same type of structure continues aft with a multitude of stringers and a skin outer cover. Engine mounting details are discussed in a later section.

Composite material applications are spread throughout the airplane and are shown on Drawing SK600-0086 and SK600-0087. Although design details are incomplete, the use of fiberglass, Kevlar 49, and graphite fibers in an epoxy resin matrix are anticipated. Both sheet and honeycomb sandwich panel designs are being considered. The wing to fuselage attach is made by the extension of fuselage frames at the forward and aft and to wing bay, i.e. front and rear spar as well as all of the intermediate frames between these two positions. Details of this attachment is shown in the wing section of this document.

2.2 Wing

Wing design of the LearStar 600-106 includes multiple spanwise spar members. Ribs and bulkheads are of web construction. Upper and lower surfaces are stringer stiffened plates. The torque box design results in a "fail safe" wing. The wing is constructed in three basic sections, two outer wing bays, and a center section consisting of a large fuel bay in the fuselage area extending outboard to the wing break.

Starting from the body centerline, seven spars are used. These extend into the inboard wing, taper off to three at the wing break/splice, which then extend outboard to the tip closure.

The wing skins are tapered in thickness from inboard to outboard on the upper and lower surface. The stringers and spars are tapered in thickness, reflecting the required structural area.

The wing is basically a riveted structure. Adhesive bonding is added in the wing and center wing bay to seal the fuel tanks and strengthen the structure. This process simplifies construction and reduces sealant weight. A similar process has been employed successfully in airplanes such as the Convair 880 and 990.

Construction and inspection access is provided in the lower surface by removal of a portion of the lower skin from body side (BL45.2) to the wing break. The outboard wing is likewise provided with removeable panels This feature is necessary for sufficient bay access due to the thinness of the wing. This is also a lighter approach than the conventional multiple sealed access holes.

The wing tip fairings are of minimum weight composite construction.

The following drawings depict the design of the wing.

SK600-0023	33° Wing Geometry
SAE77-088	Wing, Planform lower surface
SAE77-089	Wing, trailing edge assy
SAE77-090	Wing, fitting, spar splice
SAE77-091	Wing, Rib-Y_W 92.5 Inboard Panel
SAE77-092	Intermediate flap L/O
SAE77-093	Aileron
SAE77-094	Spoiler Inboard
SAE77-095	Front Spar
SAE77-009	Rib-machined, typical outboard panel
SAE77-012	Access door, lower surface
SAE77-016	Rib-Y_W 291.5 & wing tip assy
SAE77-017	Rib Y_W 170.5 panel splice
SAE77-021	Stringers - typ, outboard panel
SAE77-022	Stringers - typ, inboard panel
SAE77-002	Rib - Y_W 274. 45 outboard panel
SAE77-050	Rib at 45.20 spar splice
SAE77-060	Leading edge with de-icing system
SAE77-056	Loads model
SAE77-077	Wing/Fuselage intersection 10% increase
SAE77-052	Planform, upper surface

2.3 Empennage

The LearStar 600-106 empennage is a "T"-tail design employing an all-flying horizontal stabilizer with a geared anti-servo tab.

The horizontal tail is pivoted at its aerodynamic center (30% of MAC). The pivot is located below the surface to provide access for hinge pin assembly and removal.

The stabilizer pivot is at the upper aft end of the vertical stabilizer and is supported directly by the fin's rear spar and an upper canted rib.

2.3.1 Vertical Stabilizer

The vertical stabilizer is an aluminum alloy torque box comprised of three spars, skin/stringer panels and ribs. The upper end of the torque box terminates with a machined canted rib. This rib intersects the rear spar with a hinge fitting and attaches to the forward and center spars. A machined root rib is used to transfer the empennage loads to the fuselage through a series of vertically oriented tension bolts, thus providing a simple interchangeable single plane joint.

The leading edge design of conventional construction using aluminum skins and ribs.

The rudder assembly is supported at three hinge points. The rudder employs composite construction using Kevlar 49 skins, fiberglass rear spar and full depth Nomex core.

An integrally stiffened Kevlar/Epoxy fairing forms the upper portion of the vertical stabilizer. This is removeable for access to the horizontal tail and its actuation system.

Drawings 600-2001 and SK600-0025 show these design geatures.

2.3.2 Horizontal Stabilizer

The horizontal stabilizer is an aluminum alloy three spar torque box with skin/stringer panels and ribs. The swept outer portions of the box are attached by machined root ribs to a constant center section. These ribs also support the stabilizer pivot fittings and react the actuator loads. The leading edge is a full depth honeycomb structure with aluminum alloy skins, attached to the forward flange of the front spar.

The geared anti-servo tab is attached at three hinge points per side and is a composite/full depth honeycomb core structure.

The tip fairings likewise are composite/full depth honeycomb core construction.

The overall layout of this structure is shown on Dwg. 600-2002 and SK600-0015. The detail torque box design is virtually the same as the vertical stabilizer.

3.0 Landing Gear

The landing gear is of the tricycle type. Both the main and nose landing gear employ the conventional air/oil shock absorber struts. Normal actuation of the gear and lock mechanism is accomplished hydraulically. MIL-H-5606 or equivalent hydraulic fluid is used throughout the hydraulic system. Green Tweed seals are used in the critical seal areas.

In the event of failure of the normal hydraulic actuation system, emergency extension and over center locking is provided.

3.1 Main Landing Gear

The main landing gear is an air/oil telescoping dual wheel type. The trunnion is a break-away type, pivoting between the fuselage frames which extend outboard from the fuselage. The retraction actuator/assembly side brace is a broken over-center A-frame type connected between the gear and airplane structure.

The wheels and multiple disc brakes are designed for extended life and ease of brake disc and tire replacement. Thermal relief plugs, automatic brake adjustment and external means for checking brake wear is provided. Two tubeless 25 x 7.7-14 (12 ply rating) tires are installed on each main landing gear.

The design of the basic main gear axle -- strut trunnion and drag brace is such that they are interchangeable between right and left side.

The main landing gear design is shown in Drawing SK600-0052. The landing gear doors are lightweight composite/honeycomb sandwich construction. The main gear doors close and complete the contour of the wing-fuselage area when the gear is retracted. The inboard doors, conversely, open while the main gear is being retracted. It is possible to open the inboard doors, when the aircraft is on the ground, for access to the wheel well when the main gear is extended. The leading edges of the doors are positively locked to avoid partial opening under airloads.

3.2 Nose Landing Gear

The nose gear assembly includes a shock absorber strut with steering and shimmy damping capability, single nose wheel, drag brace, gear locking device, hydraulic retraction actuator and door operating mechanisms. The shock absorbing unit is of the conventional air/oil type. An over center A-frame drag brace locks the nose gear in the extended position. The gear is held in the retracted position by an internal locking hydraulic actuator. Normal actuation of the locks and gear is accomplished by hydraulic power.

A single tubeless 20 x 5.5 (10 ply rating) tire is installed on the nose gear axle. Drawing SK600-0016 shows the nose gear design.

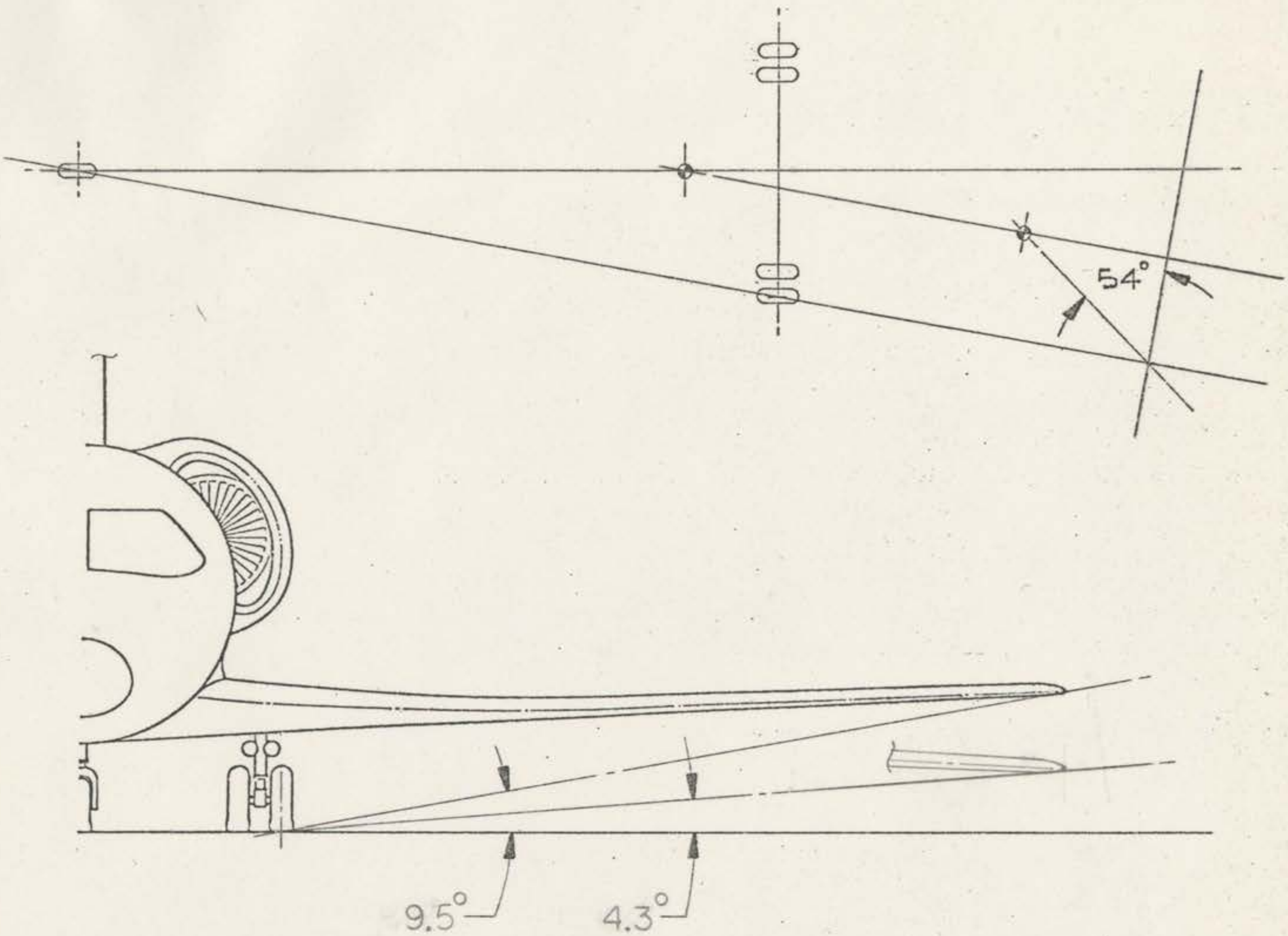
Nose gear steering is powered by two unbalanced actuators. Both actuators work in unison, one extending, the other retracting, until the retracting actuator bypasses at the fully retracted position. It remains bypassed for the remainder of the turn. Valving is accomplished by rotating valves installed on the actuator trunnions. Both actuators are controlled by a common valve module containing a dual coil electro-hydraulic valve (EHV) and a bypass valve. Hydraulic pressure is obtained from the landing gear down line thus precluding steering with the nose gear retracted. Refer to the systems Document for detailed figures.

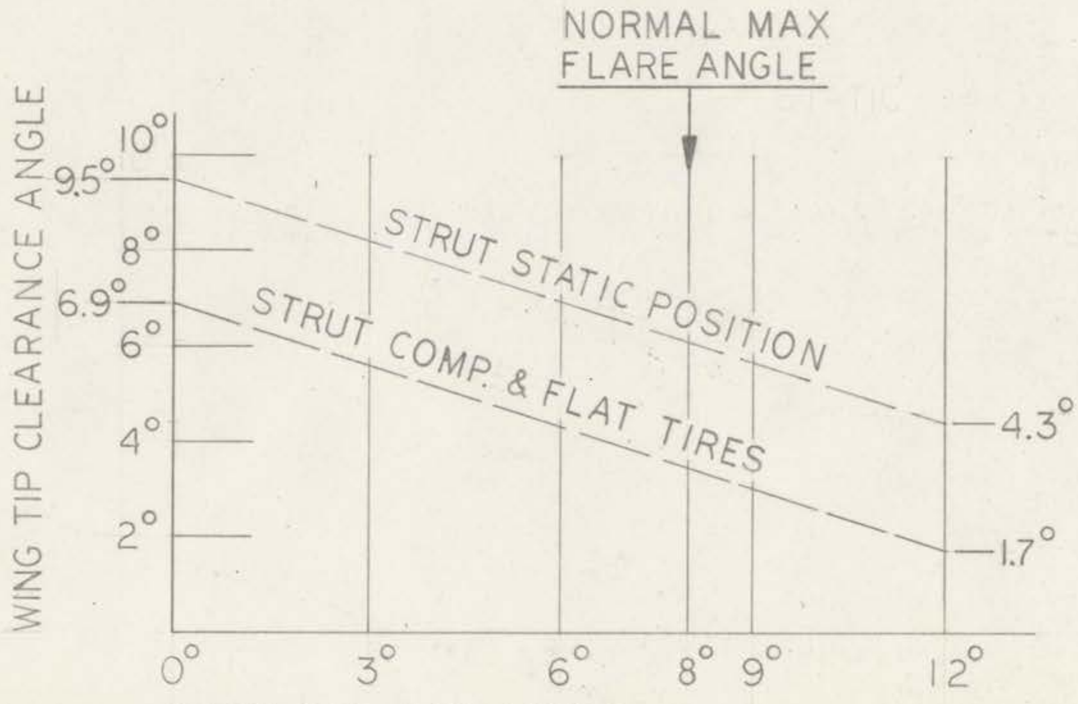
3.3 Brake Control System

The rudder pedal controlled brakes are hydraulically operated by either the pilot or co-pilot. Brake system pressure is modulated from zero to maximum by means of master cylinder brake control valves. In the event that all power fails or has not been turned on, limited braking capability is provided by the master cylinders. The skid control system is equivalent to a hydro-aire Mark III master cylinder system utilizing individual wheel control with touch-down and locked-wheel protection. The system is controlled by master brake cylinders and with all power off, it automatically reverts to the manual mode which provides ground handling and parking brake capability.

A parking brake control valve is installed in the flight compartment for setting the parking brakes.

3.4 Roll Over Angles





4.0 Fuel Bays and Volume

The fuel for the LearStar 600-106 is carried in the wings and wing structure.

The arrangement is shown on Drawing SK600-0028 and provides for six separate tanks.

1. Main center-section, located between wing/body intersection ribs.
2. Aft center-section, located aft of the rear spar
3. Inboard wing, L.H.
4. Inboard wing, R.H.
5. Outboard wing, L.H.
6. Outboard sing, R.H

The fual management is accomplished automatically and is shown in detail in the System Document. (LR 1.103)

The fuel volume was estimated by computing the external volume,and applying a factor to account for structure, expansion, and unuseable fuel.

The center fuel bay volume calculations were made by Sandaire Engineering from detail drawing analysis. Wing volume was calculated by ASTEC Engineering, using the Boeing Master Dimension Computer integration of wing rib area between front and rear spars.

Tabulation of fuel volume is summarized in Table 4-1.

TABLE 4-1 - FUEL VOLUME

Tank	External Volume ft^3	Space Factor	Useable Fuel Volume ft^3
Center Bay	139.42	.92	128.27
L.H. Inboard Wing	56.98	.88	50.14
R.H. Inboard Wing	56.98	.88	50.14
L.H. Outboard Wing	14.33	.85	12.18
R.H. Outboard Wing	14.33	.85	12.18
Rear Center Bay	27.40	.92	25.21

Total Volume = 278.12
Assumed Fuel Dessity = 50.87 lb/ft^3 (6.8 lb/gal)
Fuel Weight = 278.12 x 50.87 = 14,148.0 lb.

5.0 Engine Installation

The engines for the LearStar 600-106 are semi-submerged in the aft fuselage. The engine centerline is canted 8° from the airplane centerline to provide a more direct path for the engine inlet air. This also allows the exhaust outlets to be near the center of the airplane which minimized asymmetric thrust during one engine out operation.

A large engine access door is provided on each side of the aft fuselage for engine removal. A small engine accessory door is located in the nacelle below the engine for normal maintenance.

5.1 Engine Mounting

The engines are mounted on three brackets. The upper inboard attach carries the vertical, thrust and lateral reactions. The lower inboard attach reacts the lateral and thrust loads while the third attachment, being aft of the other two and on the horizontal centerline, reacts only lateral loads.

The two forward engine attach brackets are machined fittings. They extend between two fuselage frames where the loads are sheared into the fuselage skins and stringers. The main loads in the aft fuselage are carried forward to the pressure bulkhead through two relatively large channel shaped longerons on each side of the fuselage. These longerons are near the intersection of the basic fuselage and the nacelle shape. Stringer stiffened skins of a concave shape form the area between the engines and serve as a firewall as well.

Drawings SAE77-262 Sheet 1 and Sheet 2

5.2 Engine Burst Containment

Engine position in the fuselage exposes the R.H. engine to some disc fragments from the L.H. bursting engine and vice-versa. Also, certain aircraft equipment and control system elements are located within the burst disc fragment threat envelope. The containment philosophy employed by LearAvia is to provide the minimum shielding weight which will just enable local aircraft structure to absorb the exit energy required to bring a fragment to a complete stop before it can reach aircraft components on the opposite engine. Redundancy of local airframe structure assures aircraft structural integrity.

Lycoming Report No. LYC 75-92, entitled "Blade Containment Report for Avco Lycoming ALR 502 Engines" has been accepted by the Department of Transportation, Federal Aviation Administration, New England Region, as satisfying the containment requirements of FAR 33.19 for the model ALF 502 engine. According to the Lycoming analysis, any blade (or series of blades) shed by any (or all) stage(s) of the ALF 50-model engine will be contained within the engine casing. Only in the unlikely eventuality of engine disc burst will any fragments penetrate the engine casing with significant energy. Disc fragments of only certain stages will penetrate. Minimum shielding weight will

be achieved by placing efficient shielding material adjacent to the energy source (bursting engine disc) only in the threat path to potential targets (local aircraft structure, component and system elements). Fragment paths that do not threaten vital aircraft elements are protected only by the incidental energy absorption capability of local structure.

The shielding material selected is DuPont "Kevlar 49" laminated within a thermosetting "Epoxy" resin system. Absorption capability to match local exit energy threat requirement is achieved by tailoring the shielding material thickness. (The Kevlar-Epoxy laminate is applied in an engineered thickness pattern designed to leave only enough energy in the fragment to match the energy absorption capability of the local structure to which the shielding material is attached. The end result is that a burst disc fragment will be brought to a complete stop at the inboard side of the local structure which supports the shield, protecting other structural elements, aircraft control system elements, aircraft accessories, and the opposite engine).

Drawing SK600-0022 shows detail for the Kevlar-Epoxy laminate installation. The laminates are pre-made and mechanically attached to Titanium "Stress Skin" panels which form the structural side of the fuselage in the area between the engines.

6.0 Thrust Reverser

The "Learverser" (Patent pending) is a totally self-contained thrust reverser that is installed as a segment in series with the engine tail-pipe. The tailpipe or duct portion contains triangular elements hinged at the aft end for deployment as a cone within the total discharge stream. Thus the hot core and fan discharge is diverted through a series of cascades located outside the petal type elements. The cascades are supported between two frames that match the exterior loft lines of the nacelle.

Any petal segment may be closed off to prevent gas discharge within its circular arc and the distance between the two frames may be changed varying the exit area. Engine matching may be accomplished by trimming the tip ends of the petals that form the apex of the cone. This allows a lesser portion of the hot core gases to be diverted.

The petals are deployed through an interconnecting mechanical linkage activated by two hydraulic actuators either of which is capable of total deployment. Although a positive pressure is available within the tailpipe, a mechanical locking system will prevent deployment except on command.

The "Learverser's" simplicity of design and minimal number of moving parts provides a significant weight reduction over conventional cascade or "bucket" reversers. It is anticipated that maintenance costs of this unit will also be substantially reduced relative to the older systems.

Drawing SK600-0090 and SK600-0091 provide design details.

EFFECTIVENESS OF THRUST REVERSER

TOTAL FLOW VERSUS FAN ONLY

Thrust Component	Engine Component		
	Fan	Cone	Totals
Normal Thrust	+80% (1)	+20% (1)	+100%
Reversed Thrust (2)	-40%	-10%	--
Fan Only Reversed	-40%	+20%	-20%
Fan and Core Reversed	-40%	-10%	-50%

Conclusion: Ratio of reversed thrust for fan and core to fan only 250%

(1) Approximate division of total engine thrust

(2) Assumes 50% effective thrust in reversed mode

7.0 High Lift Devices

Leading edge high lift devices acting in conjunction with trailing edge fowler flaps, increase wing area slightly (approx. 16 sq. ft./aircraft) and have a significant effect on aircraft C_L max. These effects combine to assist in permitting lower landing, takeoff and tip stall velocities.

7.1 Leading Edge Flaps

The leading edge devices are located on the outboard wing leading edge between the tip fairing and the outboard contour break of the inboard glove section. Each wing panel is equipped with four segments of nearly equal span (spprox. 42 in.). Approximately eight square feet of leading edge flap is deployed from the outboard wing on each side of the aircraft. Flap chord is constant at 6". When retracted, these flap chord lengths are reduced to fit ahead of the front spar position by folding a nose portion of the flap during retraction travel. When retracting, the flap body section contour is shaped to match the wing leading edge lower contour. Drawing SK600-0077 provides design details.

7.1.1 Actuation

Each flap segment is driven by two actuator cylinders supplied with 2850 psig local hydraulic pressure. Flap drive stations are located at quarter-length positions inboard from each end of the individual flap segment. The flap body section is pivoted at approximately 0.02c, very close to the upper contour. The drive cylinder pistons act upon body channel rib reaching from the pivot to the flap body segment. The mechanism scheme for the flap body pivot action is a simple rotation brought about by extension travel of the piston rod.

The folding nose of the flap is pivoted on the flap body segment edge which faces forward when the flap is in the extended position. The mechanism which unfolds the nose to its extended position is a four-bar linkage of which one link is formed by an angled continuation of the piston rod.

7.2 Trailing Edge Flaps

The trailing edge flaps for this airplane are plain fowler type, there are three segments, two outboard and one inboard. They are deployed in a conical movement along wing element lines. The first position is for takeoff (12°)* while the landing position is 42°.* Every flap is supported on each end with a wheeled carriage which in turn is guided by a track. The track is attached to the lower surface of the wing, extends aft and is shaped to provide the required flap position at various stages of deployment. The flap track is covered by a fixed fairing with an aft fairing attached to the flap itself which deploys with the flap. Details of this design are shown on Drawings SAE77-083, SAE77-084 and SAE77-085.

Flap actuation and timing is provided by a linkage--bell crank arrangement attached directly to the rear spar and extending inboard to the center line of the airplane, where both sides are connected, and a single high actuator is located. Drawings SAE77-081, SAE77-086 and SAE77-087 show these details.

*Current aerodynamic performance analysis indicates that 15° and 30° are the proper flap settings for takeoff and landing respectively.

8.0 Cockpit

The cockpit crew compartment extends aft from the forward pressure bulkhead at FS 176.5 to the crew compartment structural bulkhead at FS 273.0, a 20-inch wide door in this bulkhead provides cockpit access.

The adjustable pilots seats are mounted on rails attached to a balsa cored aluminum faced structural floor. A depressed 20-inch wide walkway stretches forward from the aft crew compartment access door to the aft end of the center control console. This affords good headroom for flight crew on entry and exit. The flooring is supported by transverse beams and tied to fuselage frame sides together with vertical vectored struts down to the lower fuselage frame structure.

In configurations requiring a lockable flight crew compartment door there is an emergency evacuation hatch for crew egress. The hatch is designed to open inwardly after cabin depressurization, and consists of an aluminum skinned hatch located in a framed sill which in turn is tied into the upper fuselage stiffened skin structure.

Radio and electronics equipment is racked behind the pilots seats and fastened to the floor and cockpit bulkhead. The pilots side consoles are situated outboard of the seat stations, and are secured to the floor and frame structure.

A non-structural instrument panel is mounted vertically on Frame FS 195.8, being tied into the aft face of the frame web. A transverse beam, carries the foot pedal control assembly. A dual control column assembly is mounted below the floor to the floor structure. Drawing SK600-0012 shows the cockpit arrangement and SK600-0013 shows the nose structure.

9.0 Windshield

The windshield transparency is fabricated from three polycarbonate laminates with internal and external face laminates of cast acrylic. The design is consistent with the requirements of FAR 25.775 and the objectives of AS 580A.

The windshield support structure consists of joggeled frame and external transparency retainer. Transparency loads are transmitted via rubber/metal/rubber bushings, edge fasteners in double shear, frame and retainer to the skin structure.

Transparency interchangeability is achieved by using matched drill tooling for edge fastener hole locations in transparency, frame and retainer. Normal hole location tolerances are absorbed by the transparency edge fastener bushings.

Details of the design of the windshield and its attachment are shown on Drawing SK600-0024

9.1 Windows

The window installation used in the LearStar 600-106 is a "plug in" type.

This design is a "fail safe" concept and has been used on many successful airplane programs, i.e. 747, 727, etc.

This design uses an outer window of stretched acrylic; .315 inch thickness while the inner window is .187 inches thick. The outer window is sized for fatique while the inside pane is sized for strength. A small hole is provided in the inner window to allow the outside window to experience primary cycle pressure loads. Drawing SK600-0033 shows details of installation.

10.0 Loft Lines

The airplane external contours were developed by mathematically defining all of the surfaces using digital master dimension computer programs. The surfaces were drawn using a Gerber Flatbed automatic drafting machine.

The wing numerical definitions were developed by Boeing Computer Service.

See drawings: ASTEC 77-402 Loft Line, Y_W 60, 75, 92.5, 110.1, 127.6, 154
ASTEC 77-404 Loft Line Front Spar
ASTEC 77-407 Loft Line Ribs-Out'bd Panel
ASTEC 77-408 Loft Line Canted Ribs Y_W 127.6, 154
ASTEC 77-409 Loft Line Out'bd Tip

The fuselage was developed by Teledyn Ryan.

See drawings: MLO 600-0079 Basic Lines Fus. Afterbody
MLO 600-0080 Basic Lines Fwd. Fus. Struct. Locations
MLO 600-0081 Basic Lines Fwd. Fuselage
MLO 600-0082 Basic Lines Aft Fuselage
MLO 600-0083 Basic Lines Engine Air Duct
MLO 600-0084 Windshield Flap Wrap

The loft lines are stored on computer tapes or discs, and available for accessing as needed.

11.0 Index of Drawings

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SAE 77-252	1	Aft Fuselage
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SAE 77-260	1	Fwd Pressure Bulkhead
SAE 77-256	1	Bhd Sta 234
SAE 77-257	1	Pass or Cargo Door Frame
SAE 77-258	1	Frame at Front Spar
SAE 77-259	1	Frame at Rear Spar
SAE 77-255	1	M.L.G. Bhd (Fittings)
SAE 77-261	1	Aft Press. Bhd
SAE 77-263	1	Vert. Tail Attach, Fwd
SAE 77-264	1	Pressure Floor
SAE 77-265	1	Vert. Tail Attach, Aft
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ML0600-0080	1	Basic Lines Fwd Fuse. Struct. Locations
ML0600-0081	1	Basic Lines Fwd Fuselage X_f = 100 to 333
ML0600-0082	1	Basic Lines Aft Fus. Nac. Struct. Sec.
ML0600-0083	1	Basic Lines Engine Air Duct (Duct Sys)
ML0600-0084	1	Windshield Flat Wrap
SK600-0086	2	Composite Materials Applications - Current Aircraft State-of-the-art
SK600-0087	1	Composite Mtls. Appl. - Fus. 2/Add. Cert.
SK600-0024	1	Windshield Structure L/O
SK600-0077	1	Concept L/O, Flap Mechanism, Leading Edge
SK600-0033	1	Concept L/O, Struc. Provision, Pass. Window
SK600-0043	1	Stringer Dia. Fwd. Section

Drawing No.	No. of Sheets	Title
SK600-0044	1	Stringer Diagram 10.00 X_f Sta.
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SK600-0028	1	Fuel Tank Arrangement
SK600-0052	1	Main Landing Gear Geometry
SK600-0046	1	Gen. Arrangement Cargo Configuration
SK600-0047	1	Gen. Arrangement Passenger Configuration
SK600-0067	1	Gen. Arr. Long Range Exec. Config.
SK600-0048	1	Gen. Arr. Long Range Exec. Config.
SK600-0049	1	Onboard Cargo Handling System
SAE 77-262	2	Engine Mount
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SAE 77-091	1	Wing, Rib at Y_W 92.50
SAE 77-092	1	Wing, Intermediate Flap L/O
SAE 77-093	1	Wing, Aileron
SAE 77-094	1	Wing, Spoiler, Inboard
SAE 77-095	1	Wing, Front Spar
SAE 77-096	1	Wing, Aft & Ctr Fuel Tanks
SAE 77-009	1	Wing, Machined Rib Y_W 223.30
SAE 77-012	1	Wing, Lower Surface Access Door
SAE 77-016	1	Wing, Tip Assy, & Rib 291.5
SAE 77-017	1	Wing, Rib Y_W 170.5 Panel Splice
SAE 77-021	1	Wing, Stringer Details - Outb'd Panel
SAE 77-022	1	Wing, Stringer Details - Inb'd Panel
SAE 77-002	1	Wing, Rib Cut at Y_W 274.45
SAE 77-050	2	Wing, Rib at 45.20 Spar Splice
SAE 77-052	1	Wing, Planform Upper Surface
SAE 77-056	1	Wing, Loads Model
SAE 77-059	1	Wing, Y_W 45.00 Rib
SAE 77-060	1	Wing, Leading Edge with De-Icing System
SAE 77-077	1	Wing, Wing/Fuse Intersection 10% Increase
SAE 77-081	1	Flap Actuator

Drawing No.	No. of Sheets	Title
SAE 77-083	1	Flap Deployment Geometry Sta. 205.7
SAE 77-084	1	Flap Carriage Sta 154 & 205.7
SAE 77-085	1	Flap Deployment Geometry Sta. 254.7
SAE 77-086	1	Flap and Spoiler Actuation Mech. Outb'd Flap
SAE 77-087	1	Flap and Spoiler Control Systems
SAE 77-098	1	Kinematic Study Trailing Edge Flaps
SK600-0023	1	33° Wing Geometry
ASTEC 77-403	1	Loft Line Y_W 60, 75, 92.5, 110.1, 127.6, 154
ASTEC 77-404	1	Loft Line, Front Spar
ASTEC 77-407	1	Loft Lines, Ribs - Outb'd Panel
ASTEC 77-409	1	Loft Lines, Outb'd Tip
SK600-0025	1	Vertical Tail Geometry
SK600-0015	1	Horizontal Tail Geometry
SK600-2001	3	Vertical Fin. and Stabilizer support L/O
SK600-2002	4	Horiz. Stab. L/O Conventional vs Composite Construction
ASTEC 77-408	1	Loft Lines, Canted Ribs Y_W 127.6, 154

End of this document

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AIRFRAME DESIGN DOCUMENT
LR 1,104

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JANUARY 1977

LEARSTAR CL600-106

AIRFRAME DESIGN DOCUMENT

Document # LR 1.104
January 31, 1977

Author R. E. Schapel

Approved ______________________

AIRFRAME DESIGN

1.0 Introduction

The airframe design of the LearStar CL600-106 is contained within this report Certain written information describing the construction features ,as well as photo-reductions of preliminary design drawings are submitted. Studying these design drawings while reviewing the test will assist in visualizing the structure provided. The report is broken into the following sections:

2.0 Airframe Structure

- 2.1 Fuselage
- 2.2 Wing
- 2.3 Empennage

3.0 Landing Gear

4.0 Fuel Bays & Volume

5.0 Engine Installation & Engine Burst Containment

6.0 Thrust Reverser

7.0 High Lift Devices

- 7.1 Leading Edge Flaps
- 7.2 Trailing Edge Flaps.

8.0 Cockpit

9.0 Windshield/Windows

- 9.1 Windshield
- 9.2 Windows

10.0 Loft Lines

11.0 Index of Drawings

ACCOMMODATIONS AND INTERIOR

2.0 Airframe Structure

The airframe of the LearStar 600-106 is an all-aluminum riveted structure. Although the aft end of the airplane may appear to be unique due to the engine location, the structure has proved to be basically conventional in design and offers no particular problem in terms of weight penalty. The emphasis placed on this design has been the integration of the design so as to produce a minimum of high points (concentration of load paths) which are found in conventional designs, i.e. wing, fuselage attach points, etc., as well as attention to minimum weight.

2.1 Fuselage

The fuselage of the LearStar 600-106 is of semimonocoque construction, incorporating transverse frame and longitudinal stiffeners, with riveted aluminum alloy sheet covering.

The fuselage structure consists of a center cylindrical section of constant diameter from Sta. 333.0 through Sta. 628.0. The crew and passenger compartments are confined between the forward pressure bulkhead, Sta. 176.5 to the aft pressure bulkhead, Sta. 680.0. This comprises the pressure hull with exception of a pressure floor extending from the aft pressure bulkhead forward to Sta. 425.0.

Passenger windows are incorporated only in the constant section and in that area the use of heavier skins eliminates the use for stringers. This results in lower pressurization induced stresses and the elimination of complex, costly and heavy stringers/window frame intersections. There are 56 equally spaced stringers in the constant section and of course, they change as the fuselage becomes smaller forward and aft. The basic fuselage skin has a thickness of .052" and is chemically milled between stringers, intercostals and frames to a minimum thickness of .032". This design provides the advantages of crackstop and thickness tailoring in areas of varying loads. It has the further advantage of reducing to a minimum the number of doublers and crackstop strips found in conventional designs.

The basic fuselage frames are Zee sections of 2.125" in depth, and the stringers are also Zee sections of .875" in depth. The frames, stringers intercostals and skins are all of riveted construction, making up the fuselage structure. All of the doors of the various configurations are located within the constant section and shall be described in a later section of this report. The design of this structure is depicted on Drawings:

SK600-0013	Nose Structure
SAE77-251	Fwd. Fuselage
SAE77-252	Aft Fuselage
SAE77-253	Fwd. Stringer
SAE77-254	Aft Stringer
SAE77-255	M.L.G. Bulkhead
SAE77-256	Bulkhead at Sta. 234

SK600-0043	Stringer Diagram Fwd. Section
SK600-0044	Stringer Diagram
SAE77-269	Door, Nacelle
SAE77-270	Nacelle Structure
SK600-0042	Basic Dimensional Information
SK600-0098	LearStar 600-106 3-View
SAE77-257	Frame Sta. 386, Sta, 40 & Sta. 416
SAE77-258	Frame at Front Spar
SAE77-259	Frame at Rear Spar
SAE77-260	Forward Pressure Bulkhead
SAE77-261	Aft Pressure Bulkhead
SAE77-262	Engine Mount
SAE77-263	Vertical Tail Attach Fwd
SAE77-264	Pressure Floor
SAE77-265	Vertical Tail Attach Aft
SAE77-266	Frame at Sta. 721
SAE77-268	Bulkhead at Sta. 273
SK600-0086	Composite Materials
SK600-0087	Composite Materials

The nose landing gear is pivoted between two longitudinal gear members and is located beneath the cockpit floor. The wheelwell is not pressurized. Thus provisions have been made for the complete removal and re-assembly of the nose gear without penetrating the pressure hull. The main landing gear trunnion is pivoted between two fuselage frames. They are both virtually identical and are relatively heavy due to landing gear reaction loads. Aft of the pressure bulkhead at Sta. 680.0, the same type of structure is continued aft, however there is a transition from the basic circular shape to a more or less rectangular shape in the engine compartment area. The same type of structure continues aft with a multitude of stringers and a skin outer cover. Engine mounting details are discussed in a later section.

Composite material applications are spread throughout the airplane and are shown on Drawing SK600-0086 and SK600-0087. Although design details are incomplete, the use of fiberglass, Kevlar 49, and graphite fibers in an epoxy resin matrix are anticipated. Both sheet and honeycomb sandwich panel designs are being considered. The wing to fuselage attach is made by the extension of fuselage frames at the forward and aft and to wing bay, i.e. front and rear spar as well as all of the intermediate frames between these two positions. Details of this attachment is shown in the wing section of this document.

2.2 Wing

Wing design of the LearStar 600-106 includes multiple spanwise spar members. Ribs and bulkheads are of web construction. Upper and lower surfaces are stringer stiffened plates. The torque box design results in a "fail safe" wing. The wing is constructed in three basic sections, two outer wing bays, and a center section consisting of a large fuel bay in the fuselage area extending outboard to the wing break.

Starting from the body centerline, seven spars are used. These extend into the inboard wing, taper off to three at the wing break/splice, which then extend outboard to the tip closure.

The wing skins are tapered in thickness from inboard to outboard on the upper and lower surface. The stringers and spars are tapered in thickness, reflecting the required structural area.

The wing is basically a riveted structure. Adhesive bonding is added in the wing and center wing bay to seal the fuel tanks and strengthen the structure. This process simplifies construction and reduces sealant weight. A similar process has been employed successfully in airplanes such as the Convair 880 and 990.

Construction and inspection access is provided in the lower surface by removal of a portion of the lower skin from body side (BL45.2) to the wing break. The outboard wing is likewise provided with removeable panels This feature is necessary for sufficient bay access due to the thinness of the wing. This is also a lighter approach than the conventional multiple sealed access holes.

The wing tip fairings are of minimum weight composite construction.

The following drawings depict the design of the wing.

SK600-0023	33° Wing Geometry
SAE77-088	Wing, Planform lower surface
SAE77-089	Wing, trailing edge assy
SAE77-090	Wing, fitting, spar splice
SAE77-091	Wing, Rib-Y_W 92.5 Inboard Panel
SAE77-092	Intermediate flap L/O
SAE77-093	Aileron
SAE77-094	Spoiler Inboard
SAE77-095	Front Spar
SAE77-009	Rib-machined, typical outboard panel
SAE77-012	Access door, lower surface
SAE77-016	Rib-Y_W 291.5 & wing tip assy
SAE77-017	Rib Y_W 170.5 panel splice
SAE77-021	Stringers - typ, outboard panel
SAE77-022	Stringers - typ, inboard panel
SAE77-002	Rib - Y_W 274. 45 outboard panel
SAE77-050	Rib at 45.20 spar splice
SAE77-060	Leading edge with de-icing system
SAE77-056	Loads model
SAE77-077	Wing/Fuselage intersection 10% increase
SAE77-052	Planform, upper surface

2.3 Empennage

The LearStar 600-106 empennage is a "T"-tail design employing an all-flying horizontal stabilizer with a geared anti-servo tab.

The horizontal tail is pivoted at its aerodynamic center (30% of MAC). The pivot is located below the surface to provide access for hinge pin assembly and removal.

The stabilizer pivot is at the upper aft end of the vertical stabilizer and is supported directly by the fin's rear spar and an upper canted rib.

2.3.1 Vertical Stabilizer

The vertical stabilizer is an aluminum alloy torque box comprised of three spars, skin/stringer panels and ribs. The upper end of the torque box terminates with a machined canted rib. This rib intersects the rear spar with a hinge fitting and attaches to the forward and center spars. A machined root rib is used to transfer the empennage loads to the fuselage through a series of vertically oriented tension bolts, thus providing a simple interchangeable single plane joint.

The leading edge design of conventional construction using aluminum skins and ribs.

The rudder assembly is supported at three hinge points. The rudder employs composite construction using Kevlar 49 skins, fiberglass rear spar and full depth Nomex core.

An integrally stiffened Kevlar/Epoxy fairing forms the upper portion of the vertical stabilizer. This is removeable for access to the horizontal tail and its actuation system.

Drawings 600-2001 and SK600-0025 show these design geatures.

2.3.2 Horizontal Stabilizer

The horizontal stabilizer is an aluminum alloy three spar torque box with skin/stringer panels and ribs. The swept outer portions of the box are attached by machined root ribs to a constant center section. These ribs also support the stabilizer pivot fittings and react the actuator loads. The leading edge is a full depth honeycomb structure with aluminum alloy skins, attached to the forward flange of the front spar.

The geared anti-servo tab is attached at three hinge points per side and is a composite/full depth honeycomb core structure.

The tip fairings likewise are composite/full depth honeycomb core construction.

The overall layout of this structure is shown on Dwg. 600-2002 and SK600-0015. The detail torque box design is virtually the same as the vertical stabilizer.

3.0 Landing Gear

The landing gear is of the tricycle type. Both the main and nose landing gear employ the conventional air/oil shock absorber struts. Normal actuation of the gear and lock mechanism is accomplished hydraulically. MIL-H-5606 or equivalent hydraulic fluid is used throughout the hydraulic system. Green Tweed seals are used in the critical seal areas.

In the event of failure of the normal hydraulic actuation system, emergency extension and over center locking is provided.

3.1 Main Landing Gear

The main landing gear is an air/oil telescoping dual wheel type. The trunnion is a break-away type, pivoting between the fuselage frames which extend outboard from the fuselage. The retraction actuator/assembly side brace is a broken over-center A-frame type connected between the gear and airplane structure.

The wheels and multiple disc brakes are designed for extended life and ease of brake disc and tire replacement. Thermal relief plugs, automatic brake adjustment and external means for checking brake wear is provided. Two tubeless 25 x 7.7-14 (12 ply rating) tires are installed on each main landing gear.

The design of the basic main gear axle -- strut trunnion and drag brace is such that they are interchangeable between right and left side.

The main landing gear design is shown in Drawing SK600-0052. The landing gear doors are lightweight composite/honeycomb sandwich construction. The main gear doors close and complete the contour of the wing-fuselage area when the gear is retracted. The inboard doors, conversely, open while the main gear is being retracted. It is possible to open the inboard doors, when the aircraft is on the ground, for access to the wheel well when the main gear is extended. The leading edges of the doors are positively locked to avoid partial opening under airloads.

3.2 Nose Landing Gear

The nose gear assembly includes a shock absorber strut with steering and shimmy damping capability, single nose wheel, drag brace, gear locking device, hydraulic retraction actuator and door operating mechanisms. The shock absorbing unit is of the conventional air/oil type. An over center A-frame drag brace locks the nose gear in the extended position. The gear is held in the retracted position by an internal locking hydraulic actuator. Normal actuation of the locks and gear is accomplished by hydraulic power.

A single tubeless 20 x 5.5 (10 ply rating) tire is installed on the nose gear axle. Drawing SK600-0016 shows the nose gear design.

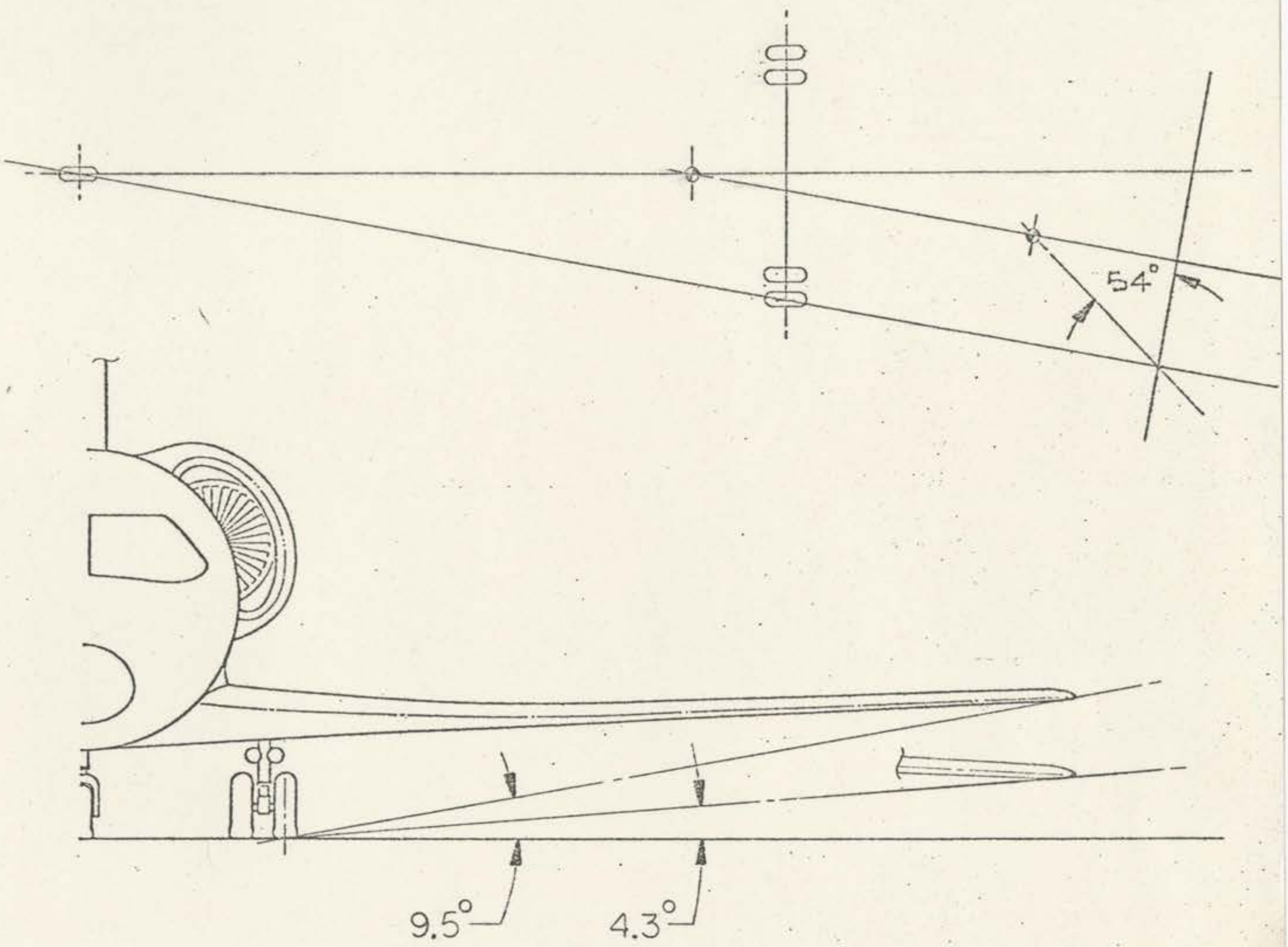
Nose gear steering is powered by two unbalanced actuators. Both actuators work in unison, one extending, the other retracting, until the retracting actuator bypasses at the fully retracted position. It remains bypassed for the remainder of the turn. Valving is accomplished by rotating valves installed on the actuator trunnions. Both actuators are controlled by a common valve module containing a dual coil electro-hydraulic valve (EHV) and a bypass valve. Hydraulic pressure is obtained from the landing gear down line thus precluding steering with the nose gear retracted. Refer to the systems Document for detailed figures.

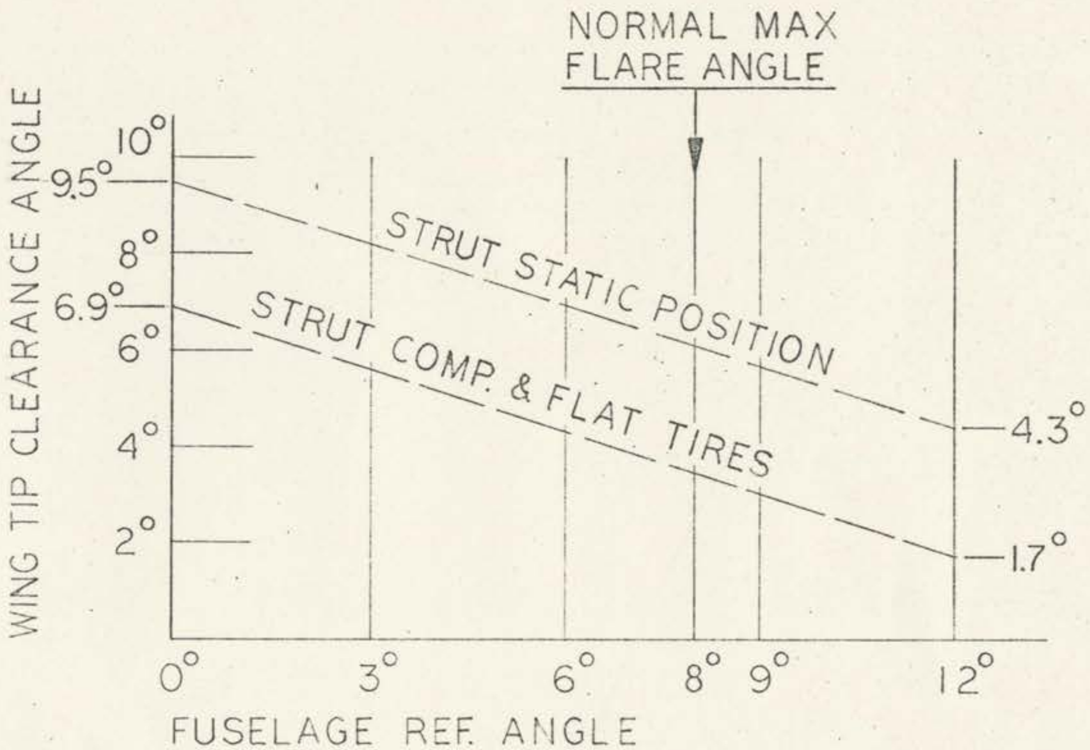
3.3 Brake Control System

The rudder pedal controlled brakes are hydraulically operated by either the pilot or co-pilot. Brake system pressure is modulated from zero to maximum by means of master cylinder brake control valves. In the event that all power fails or has not been turned on, limited braking capability is provided by the master cylinders. The skid control system is equivalent to a hydro-aire Mark III master cylinder system utilizing individual wheel control with touch-down and locked-wheel protection. The system is controlled by master brake cylinders and with all power off, it automatically reverts to the manual mode which provides ground handling and parking brake capability.

A parking brake control valve is installed in the flight compartment for setting the parking brakes.

3.4 Roll Over Angles





4.0 Fuel Bays and Volume

The fuel for the LearStar 600-106 is carried in the wings and wing structure.

The arrangement is shown on Drawing SK600-0028 and provides for six separate tanks.

1. Main center-section, located between wing/body intersection ribs.
2. Aft center-section, located aft of the rear spar
3. Inboard wing, L.H.
4. Inboard wing, R.H.
5. Outboard wing, L.H.
6. Outboard sing, R.H

The fual management is accomplished automatically and is shown in detail in the System Document. (LR 1.103)

The fuel volume was estimated by computing the external volume,and applying a factor to account for structure, expansion, and unuseable fuel.

The center fuel bay volume calculations were made by Sandaire Engineering from detail drawing analysis. Wing volume was calculated by ASTEC Engineering, using the Boeing Master Dimension Computer integration of wing rib area between front and rear spars.

Tabulation of fuel volume is summarized in Table 4-1.

TABLE 4-1 - FUEL VOLUME

Tank	External Volume ft^3	Space Factor	Useable Fuel Volume ft^3
Center Bay	139.42	.92	128.27
L.H. Inboard Wing	56.98	.88	50.14
R.H. Inboard Wing	56.98	.88	50.14
L.H. Outboard Wing	14.33	.85	12.18
R.H. Outboard Wing	14.33	.85	12.18
Rear Center Bay	27.40	.92	25.21

Total Volume = 278.12
Assumed Fuel Dessity = 50.87 lb/ft^3 (6.8 lb/gal)
Fuel Weight = 278.12 x 50.87 = 14,148.0 lb.

5.0 Engine Installation

The engines for the LearStar 600-106 are semi-submerged in the aft fuselage. The engine centerline is canted 8° from the airplane centerline to provide a more direct path for the engine inlet air. This also allows the exhaust outlets to be near the center of the airplane which minimized asymmetric thrust during one engine out operation.

A large engine access door is provided on each side of the aft fuselage for engine removal. A small engine accessory door is located in the nacelle below the engine for normal maintenance.

5.1 Engine Mounting

The engines are mounted on three brackets. The upper inboard attach carries the vertical, thrust and lateral reactions. The lower inboard attach reacts the lateral and thrust loads while the third attachment, being aft of the other two and on the horizontal centerline, reacts only lateral loads.

The two forward engine attach brackets are machined fittings. They extend between two fuselage frames where the loads are sheared into the fuselage skins and stringers. The main loads in the aft fuselage are carried forward to the pressure bulkhead through two relatively large channel shaped longerons on each side of the fuselage. These longerons are near the intersection of the basic fuselage and the nacelle shape. Stringer stiffened skins of a concave shape form the area between the engines and serve as a firewall as well.

Drawings SAE77-262 Sheet 1 and Sheet 2

5.2 Engine Burst Containment

Engine position in the fuselage exposes the R.H. engine to some disc fragments from the L.H. bursting engine and vice-versa. Also, certain aircraft equipment and control system elements are located within the burst disc fragment threat envelope. The containment philosophy employed by LearAvia is to provide the minimum shielding weight which will just enable local aircraft structure to absorb the exit energy required to bring a fragment to a complete stop before it can reach aircraft components on the opposite engine. Redundancy of local airframe structure assures aircraft structural integrity.

Lycoming Report No. LYC 75-92, entitled "Blade Containment Report for Avco Lycoming ALR 502 Engines" has been accepted by the Department of Transportation, Federal Aviation Administration, New England Region, as satisfying the containment requirements of FAR 33.19 for the model ALF 502 engine. According to the Lycoming analysis, any blade (or series of blades) shed by any (or all) stage(s) of the ALF 50-model engine will be contained within the engine casing. Only in the unlikely eventuality of engine disc burst will any fragments penetrate the engine casing with significant energy. Disc fragments of only certain stages will penetrate. Minimum shielding weight will

be achieved by placing efficient shielding material adjacent to the energy source (bursting engine disc) only in the threat path to potential targets (local aircraft structure, component and system elements). Fragment paths that do not threaten vital aircraft elements are protected only by the incidental energy absorption capability of local structure.

The shielding material selected is DuPont "Kevlar 49" laminated within a thermosetting "Epoxy" resin system. Absorption capability to match local exit energy threat requirement is achieved by tailoring the shielding material thickness. (The Kevlar-Epoxy laminate is applied in an engineered thickness pattern designed to leave only enough energy in the fragment to match the energy absorption capability of the local structure to which the shielding material is attached. The end result is that a burst disc fragment will be brought to a complete stop at the inboard side of the local structure which supports the shield, protecting other structural elements, aircraft control system elements, aircraft accessories, and the opposite engine).

Drawing SK600-0022 shows detail for the Kevlar-Epoxy laminate installation. The laminates are pre-made and mechanically attached to Titanium "Stress Skin" panels which form the structural side of the fuselage in the area between the engines.

6.0 Thrust Reverser

The "Learverser" (Patent pending) is a totally self-contained thrust reverser that is installed as a segment in series with the engine tailpipe. The tailpipe or duct portion contains triangular elements hinged at the aft end for deployment as a cone within the total discharge stream. Thus the hot core and fan discharge is diverted through a series of cascades located outside the petal type elements. The cascades are supported between two frames that match the exterior loft lines of the nacelle.

Any petal segment may be closed off to prevent gas discharge within its circular arc and the distance between the two frames may be changed varying the exit area. Engine matching may be accomplished by trimming the tip ends of the petals that form the apex of the cone. This allows a lesser portion of the hot core gases to be diverted.

The petals are deployed through an interconnecting mechanical linkage activated by two hydraulic actuators either of which is capable of total deployment. Although a positive pressure is available within the tailpipe, a mechanical locking system will prevent deployment except on command.

The "Learverser's" simplicity of design and minimal number of moving parts provides a significant weight reduction over conventional cascade or "bucket" reversers. It is anticipated that maintenance costs of this unit will also be substantially reduced relative to the older systems.

Drawing SK600-0090 and SK600-0091 provide design details.

EFFECTIVENESS OF THRUST REVERSER

TOTAL FLOW VERSUS FAN ONLY

Thrust Component	Engine Component		
	Fan	Cone	Totals
Normal Thrust	+80% (1)	+20% (1)	+100%
Reversed Thrust (2)	-40%	-10%	--
Fan Only Reversed	-40%	+20%	-20%
Fan and Core Reversed	-40%	-10%	-50%

Conclusion: Ratio of reversed thrust for fan and core to fan only 250%

(1) Approximate division of total engine thrust

(2) Assumes 50% effective thrust in reversed mode

7.0 High Lift Devices

Leading edge high lift devices acting in conjunction with trailing edge fowler flaps, increase wing area slightly (approx. 16 sq. ft./aircraft) and have a significant effect on aircraft C_L max. These effects combine to assist in permitting lower landing, takeoff and tip stall velocities.

7.1 Leading Edge Flaps

The leading edge devices are located on the outboard wing leading edge between the tip fairing and the outboard contour break of the inboard glove section. Each wing panel is equipped with four segments of nearly equal span (spprox. 42 in.). Approximately eight square feet of leading edge flap is deployed from the outboard wing on each side of the aircraft. Flap chord is constant at 6". When retracted, these flap chord lengths are reduced to fit ahead of the front spar position by folding a nose portion of the flap during retraction travel. When retracting, the flap body section contour is shaped to match the wing leading edge lower contour. Drawing SK600-0077 provides design details.

7.1.1 Actuation

Each flap segment is driven by two actuator cylinders supplied with 2850 psig local hydraulic pressure. Flap drive stations are located at quarter-length positions inboard from each end of the individual flap segment. The flap body section is pivoted at approximately 0.02c, very close to the upper contour. The drive cylinder pistons act upon body channel rib reaching from the pivot to the flap body segment. The mechanism scheme for the flap body pivot action is a simple rotation brought about by extension travel of the piston rod.

The folding nose of the flap is pivoted on the flap body segment edge which faces forward when the flap is in the extended position. The mechanism which unfolds the nose to its extended position is a four-bar linkage of which one link is formed by an angled continuation of the piston rod.

7.2 Trailing Edge Flaps

The trailing edge flaps for this airplane are plain fowler type, there are three segments, two outboard and one inboard. They are deployed in a conical movement along wing element lines. The first position is for takeoff (12°)* while the landing position is 42°.* Every flap is supported on each end with a wheeled carriage which in turn is guided by a track. The track is attached to the lower surface of the wing, extends aft and is shaped to provide the required flap position at various stages of deployment. The flap track is covered by a fixed fairing with an aft fairing attached to the flap itself which deploys with the flap. Details of this design are shown on Drawings SAE77-083, SAE77-084 and SAE77-085.

Flap actuation and timing is provided by a linkage--bell crank arrangement attached directly to the rear spar and extending inboard to the center line of the airplane, where both sides are connected, and a single high actuator is located. Drawings SAE77-081, SAE77-086 and SAE77-087 show these details.

*Current aerodynamic performance analysis indicates that 15° and 30° are the proper flap settings for takeoff and landing respectively.

8.0 Cockpit

The cockpit crew compartment extends aft from the forward pressure bulkhead at FS 176.5 to the crew compartment structural bulkhead at FS 273.0, a 20-inch wide door in this bulkhead provides cockpit access.

The adjustable pilots seats are mounted on rails attached to a balsa cored aluminum faced structural floor. A depressed 20-inch wide walkway stretches forward from the aft crew compartment access door to the aft end of the center control console. This affords good headroom for flight crew on entry and exit. The flooring is supported by transverse beams and tied to fuselage frame sides together with vertical vectored struts down to the lower fuselage frame structure.

In configurations requiring a lockable flight crew compartment door there is an emergency evacuation hatch for crew egress. The hatch is designed to open inwardly after cabin depressurization, and consists of an aluminum skinned hatch located in a framed sill which in turn is tied into the upper fuselage stiffened skin structure.

Radio and electronics equipment is racked behind the pilots seats and fastened to the floor and cockpit bulkhead. The pilots side consoles are situated outboard of the seat stations, and are secured to the floor and frame structure.

A non-structural instrument panel is mounted vertically on Frame FS 195.8, being tied into the aft face of the frame web. A transverse beam, carries the foot pedal control assembly. A dual control column assembly is mounted below the floor to the floor structure. Drawing SK600-0012 shows the cockpit arrangement and SK600-0013 shows the nose structure.

9.0 Windshield

The windshield transparency is fabricated from three polycarbonate laminates with internal and external face laminates of cast acrylic. The design is consistent with the requirements of FAR 25.775 and the objectives of AS 580A.

The windshield support structure consists of joggeled frame and external transparency retainer. Transparency loads are transmitted via rubber/metal/rubber bushings, edge fasteners in double shear, frame and retainer to the skin structure.

Transparency interchangeability is achieved by using matched drill tooling for edge fastener hole locations in transparency, frame and retainer. Normal hole location tolerances are absorbed by the transparency edge fastener bushings.

Details of the design of the windshield and its attachment are shown on Drawing SK600-0024

9.1 Windows

The window installation used in the LearStar 600-106 is a "plug in" type.

This design is a "fail safe" concept and has been used on many successful airplane programs, i.e. 747, 727, etc.

This design uses an outer window of stretched acrylic; .315 inch thickness while the inner window is .187 inches thick. The outer window is sized for fatique while the inside pane is sized for strength. A small hole is provided in the inner window to allow the outside window to experience primary cycle pressure loads. Drawing SK600-0033 shows details of installation.

10.0 Loft Lines

The airplane external contours were developed by mathematically defining all of the surfaces using digital master dimension computer programs. The surfaces were drawn using a Gerber Flatbed automatic drafting machine.

The wing numerical definitions were developed by Boeing Computer Service.

See drawings: ASTEC 77-402 Loft Line, Y_W 60, 75, 92.5, 110.1, 127.6, 154
ASTEC 77-404 Loft Line Front Spar
ASTEC 77-407 Loft Line Ribs-Out'bd Panel
ASTEC 77-408 Loft Line Canted Ribs Y_W 127.6, 154
ASTEC 77-409 Loft Line Out'bd Tip

The fuselage was developed by Teledyn Ryan.

See drawings: MLO 600-0079 Basic Lines Fus. Afterbody
MLO 600-0080 Basic Lines Fwd. Fus. Struct. Locations
MLO 600-0081 Basic Lines Fwd. Fuselage
MLO 600-0082 Basic Lines Aft Fuselage
MLO 600-0083 Basic Lines Engine Air Duct
MLO 600-0084 Windshield Flap Wrap

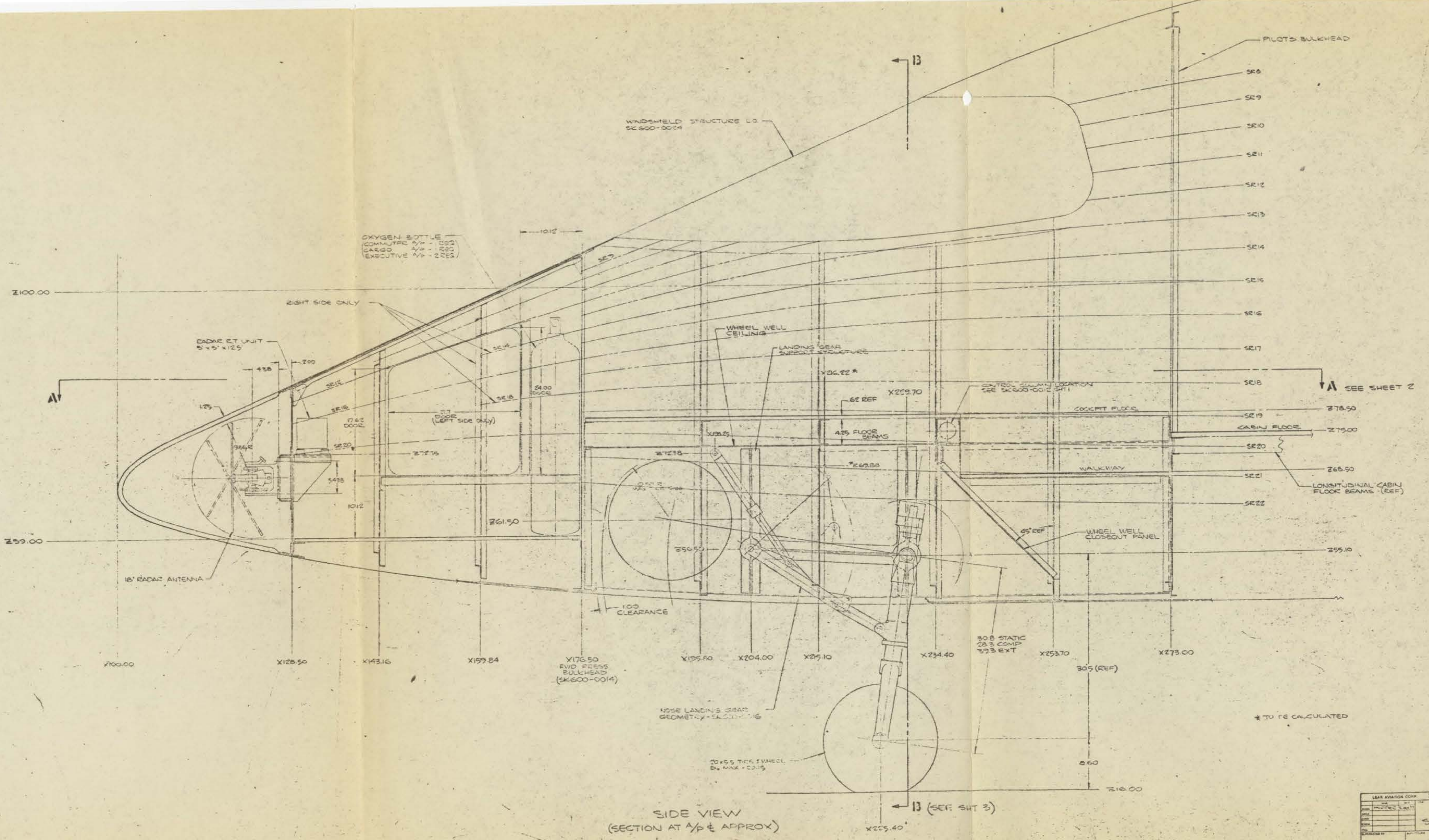
The loft lines are stored on computer tapes or discs, and available for accessing as needed.

11.0 Index of Drawings

Drawing No.	No. of Sheets	Title
SAE 77-251	1	Forward Fuselage
SAE 77-252	1	Aft Fuselage
SAE 77-253	1	Fwd Stringer
SAE 77-254	1	Aft Stringer
SAE 77-260	1	Fwd Pressure Bulkhead
SAE 77-256	1	Bhd Sta 234
SAE 77-257	1	Pass or Cargo Door Frame
SAE 77-258	1	Frame at Front Spar
SAE 77-259	1	Frame at Rear Spar
SAE 77-255	1	M.L.G. Bhd (Fittings)
SAE 77-261	1	Aft Press. Bhd
SAE 77-263	1	Vert. Tail Attach, Fwd
SAE 77-264	1	Pressure Floor
SAE 77-265	1	Vert. Tail Attach, Aft
SAE 77-266	1	Frame Sta 721
SAE 77-267	1	Frame Sta 533
SAE 77-268	1	Bhd Sta 273
SAE 77-269	1	Door, Nacelle
SAE 77-270	1	Nacelle Structure
SK600-0013	3	Nose Structure
SK600-0012	3	Cockpit Arrangement
ML0600-0079	1	Basic Lines Fus. Afterbody X_f = 310 to 938
ML0600-0080	1	Basic Lines Fwd Fuse. Struct. Locations
ML0600-0081	1	Basic Lines Fwd Fuselage X_f = 100 to 333
ML0600-0082	1	Basic Lines Aft Fus. Nac. Struct. Sec.
ML0600-0083	1	Basic Lines Engine Air Duct (Duct Sys)
ML0600-0084	1	Windshield Flat Wrap
SK600-0086	2	Composite Materials Applications - Current Aircraft State-of-the-art
SK600-0087	1	Composite Mtls. Appl. - Fus. 2/Add. Cert.
SK600-0024	1	Windshield Structure L/O
SK600-0077	1	Concept L/O, Flap Mechanism, Leading Edge
SK600-0033	1	Concept L/O, Struc. Provision, Pass. Window
SK600-0043	1	Stringer Dia. Fwd. Section

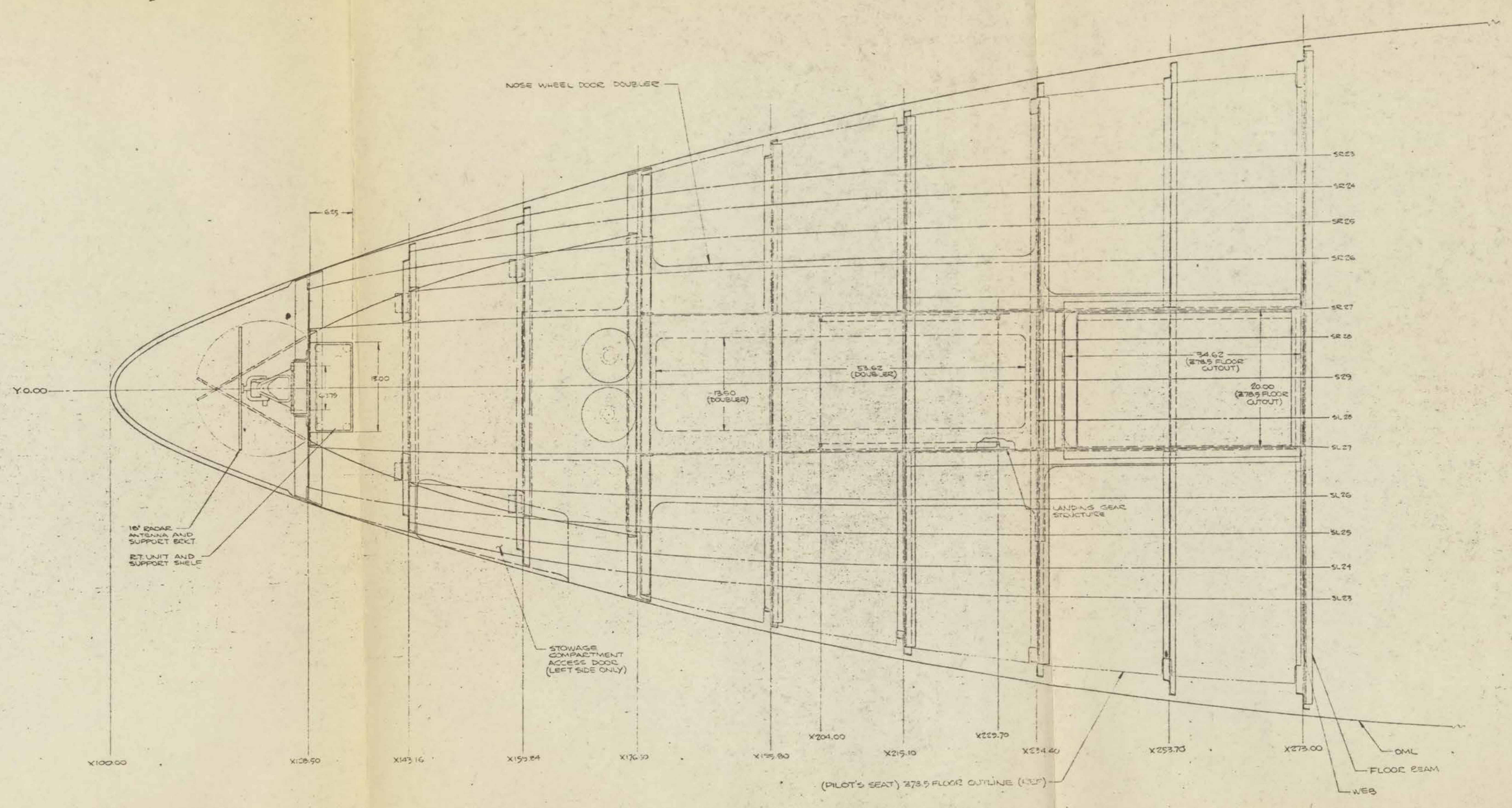
Drawing No.	No. of Sheets	Title
SK600-0044	1	Stringer Diagram 10,00 X_f Sta,
SK600-0016	1	Nose Landing Gear Geometry
SK600-0028	1	Fuel Tank Arrangement
SK600-0052	1	Main Landing Gear Geometry
SK600-0046	1	Gen, Arrangement Cargo Configuration
SK600-0047	1	Gen, Arrangement Passenger Configuration
SK600-0067	1	Gen, Arr, Long Range Exec, Config,
SK600-0048	1	Gen, Arr, Long Range Exec, Config,
SK600-0049	1	Onboard Cargo Handling System
SAE 77-262	2	Engine Mount
SK600-0090	1	Thrust Reverser, Concept L/O
SK600-0091	1	Thrust Reverser, Pictorial Review
SK600-0042	1	Basic Dimensional Information
SK600-0098	1	LearStar 600-106 3-View
SAE 77-088	1	Wing, Planform Lower Surface
SAE 77-089	1	Wing, Trailing Edge Assy
SAE 77-090	1	Wing, Fitting - Upper Surface Splice
SAE 77-091	1	Wing, Rib at Y_W 92,50
SAE 77-092	1	Wing, Intermediate Flap L/O
SAE 77-093	1	Wing, Aileron
SAE 77-094	1	Wing, Spoiler, Inboard
SAE 77-095	1	Wing, Front Spar
SAE 77-096	1	Wing, Aft & Ctr Fuel Tanks
SAE 77-009	1	Wing, Machined Rib Y_W 223,30
SAE 77-012	1	Wing, Lower Surface Access Door
SAE 77-016	1	Wing, Tip Assy, & Rib 291.5
SAE 77-017	1	Wing, Rib Y_W 170.5 Panel Splice
SAE 77-021	1	Wing, Stringer Details - Outb'd Panel
SAE 77-022	1	Wing, Stringer Details - Inb'd Panel
SAE 77-002	1	Wing, Rib Cut at Y_W 274,45
SAE 77-050	2	Wing, Rib at 45,20 Spar Splice
SAE 77-052	1	Wing, Planform Upper Surface
SAE 77-056	1	Wing, Loads Model
SAE 77-059	1	Wing, Y_W 45,00 Rib
SAE 77-060	1	Wing, Leading Edge with De-Icing System
SAE 77-077	1	Wing, Wing/Fuse Intersection 10% Increase
SAE 77-081	1	Flap Actuator

Drawing No.	No. of Sheets	Title
SAE 77-083	1	Flap Deployment Geometry Sta. 205.7
SAE 77-084	1	Flap Carriage Sta 154 & 205.7
SAE 77-085	1	Flap Deployment Geometry Sta. 254.7
SAE 77-086	1	Flap and Spoiler Actuation Mech. Outb'd Flap
SAE 77-087	1	Flap and Spoiler Control Systems
SAE 77-098	1	Kinematic Study Trailing Edge Flaps
SK600-0023	1	33° Wing Geometry
ASTEC 77-403	1	Loft Line Y_W 60, 75, 92.5, 110.1, 127.6, 154
ASTEC 77-404	1	Loft Line, Front Spar
ASTEC 77-407	1	Loft Lines, Ribs - Outb'd Panel
ASTEC 77-409	1	Loft Lines, Outb'd Tip
SK600-0025	1	Vertical Tail Geometry
SK600-0015	1	Horizontal Tail Geometry
SK600-2001	3	Vertical Fin. and Stabilizer support L/O
SK600-2002	4	Horiz. Stab. L/O Conventional vs Composite Construction
ASTEC 77-408	1	Loft Lines, Canted Ribs Y_W 127.6, 154



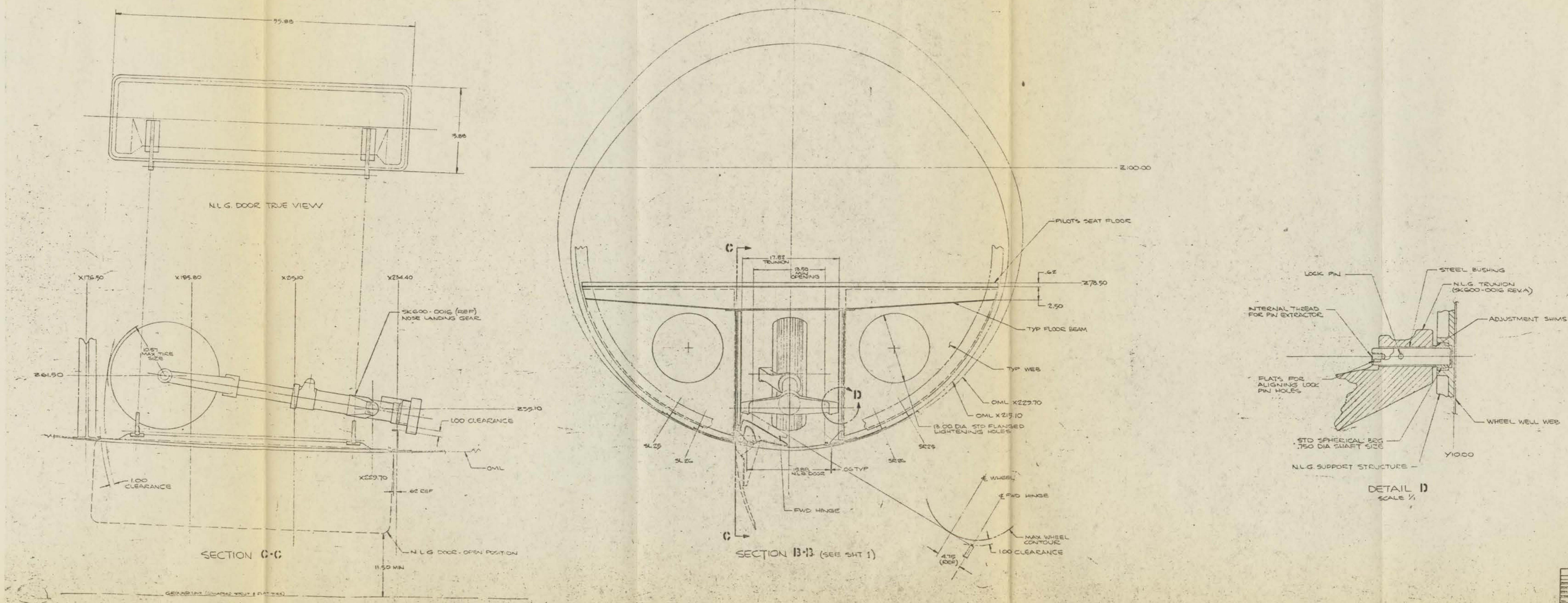
SIDE VIEW
(SECTION AT A/P ℄ APPROX)

LEAR AVIATION CORP.	LearStar ECO
NOSE STRUCTURE	



VIEW A-A (SEE SHEET 1)
(PLAN VIEW: FLOOR SHOWN REF FOR CLARITY)

LEAR AVIATION CORP	
NOSE STRUCTURE	LearStar 600
SCALE 1/4	5?600-00



LEAR AVIATION CORP.

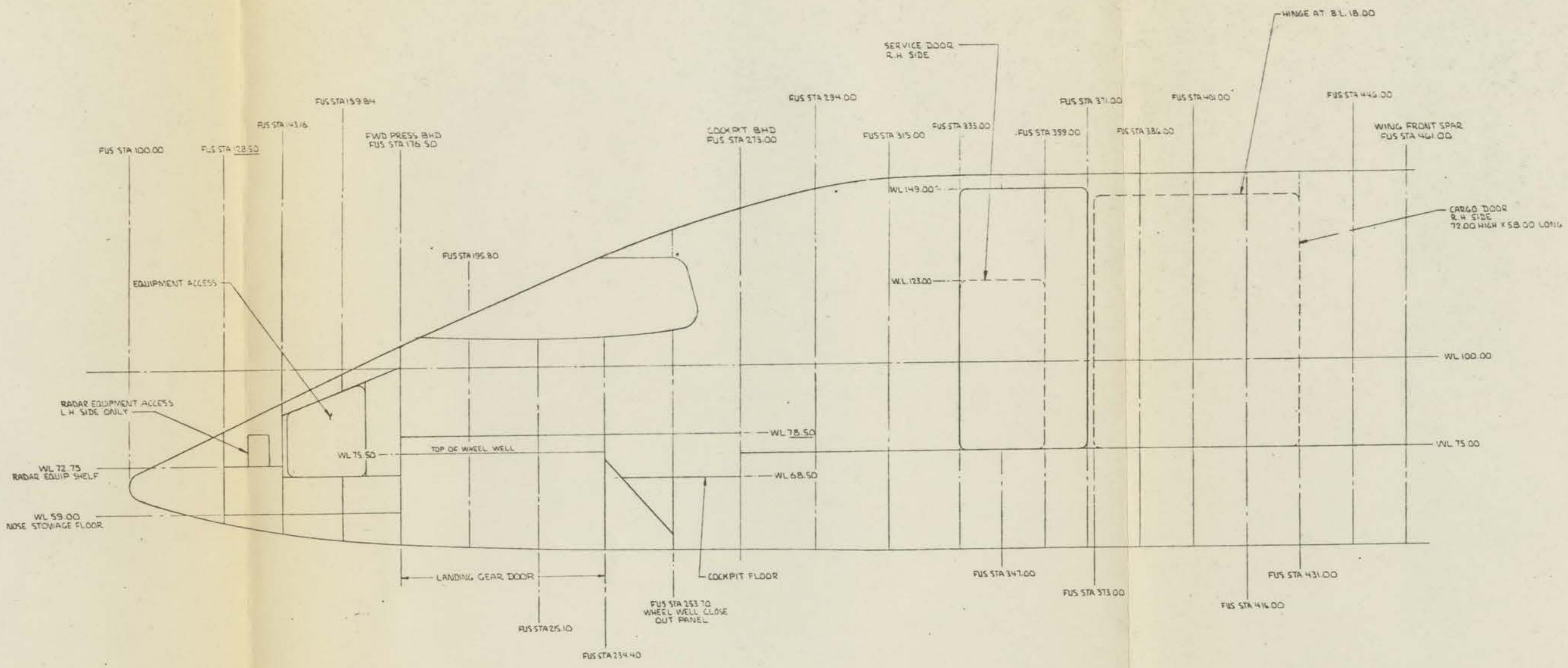
NOSE STRUCTURE

LearStar 600

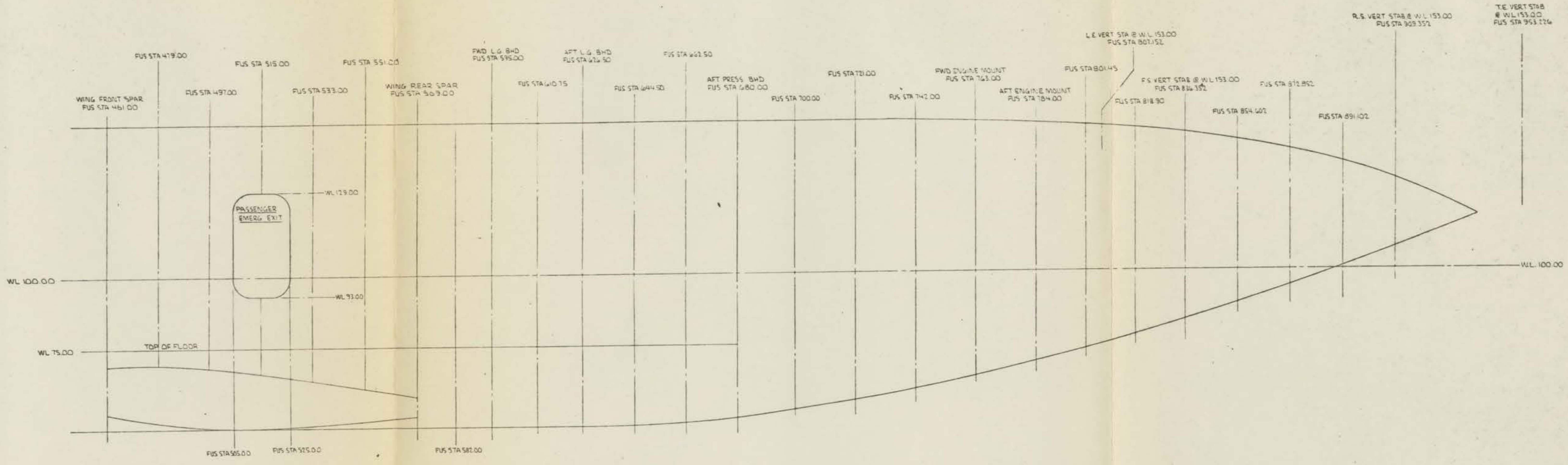
SK600-0013

SCALE 1/4 & 1/1

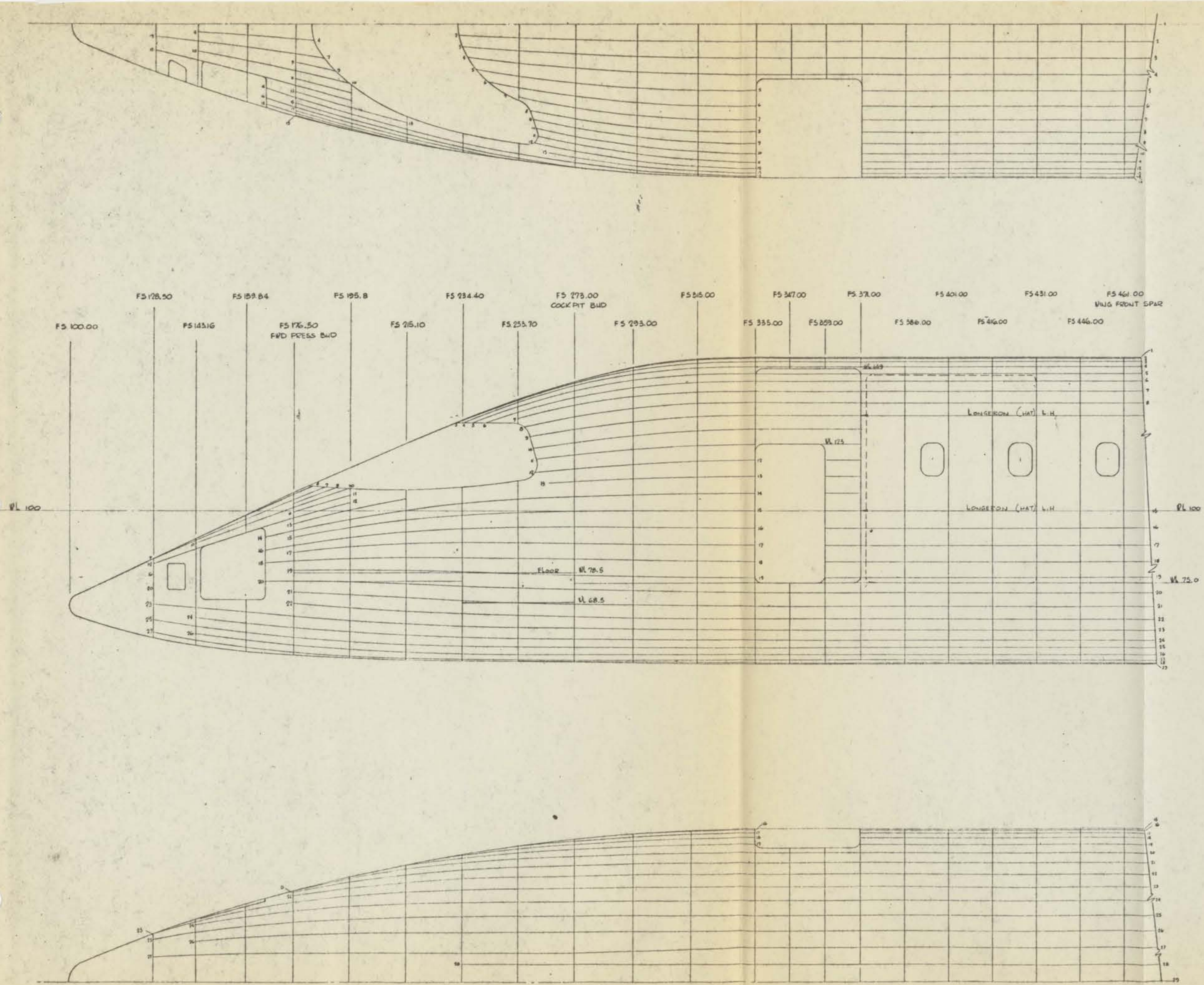
SHEET 3 OF 3



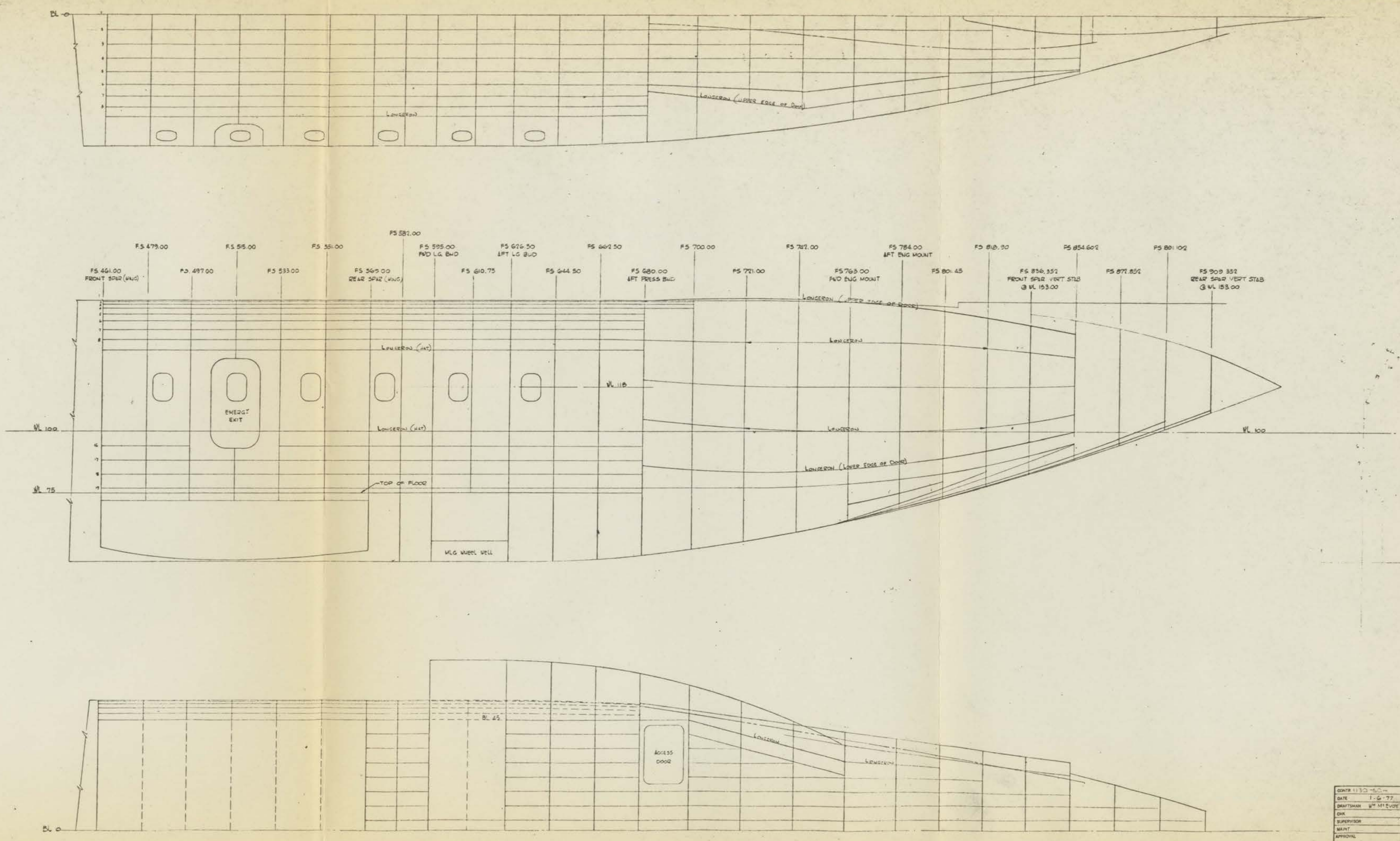
CONTR 1130-604	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO CALIFORNIA
DATE 1-5-71	
DRAFTSMAN WHITE	FWD FUSELAGE
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE / CODE IDENT NO 25727 / SAE 77-251
APPROVAL	SCALE / CALC WT LB / SHEET



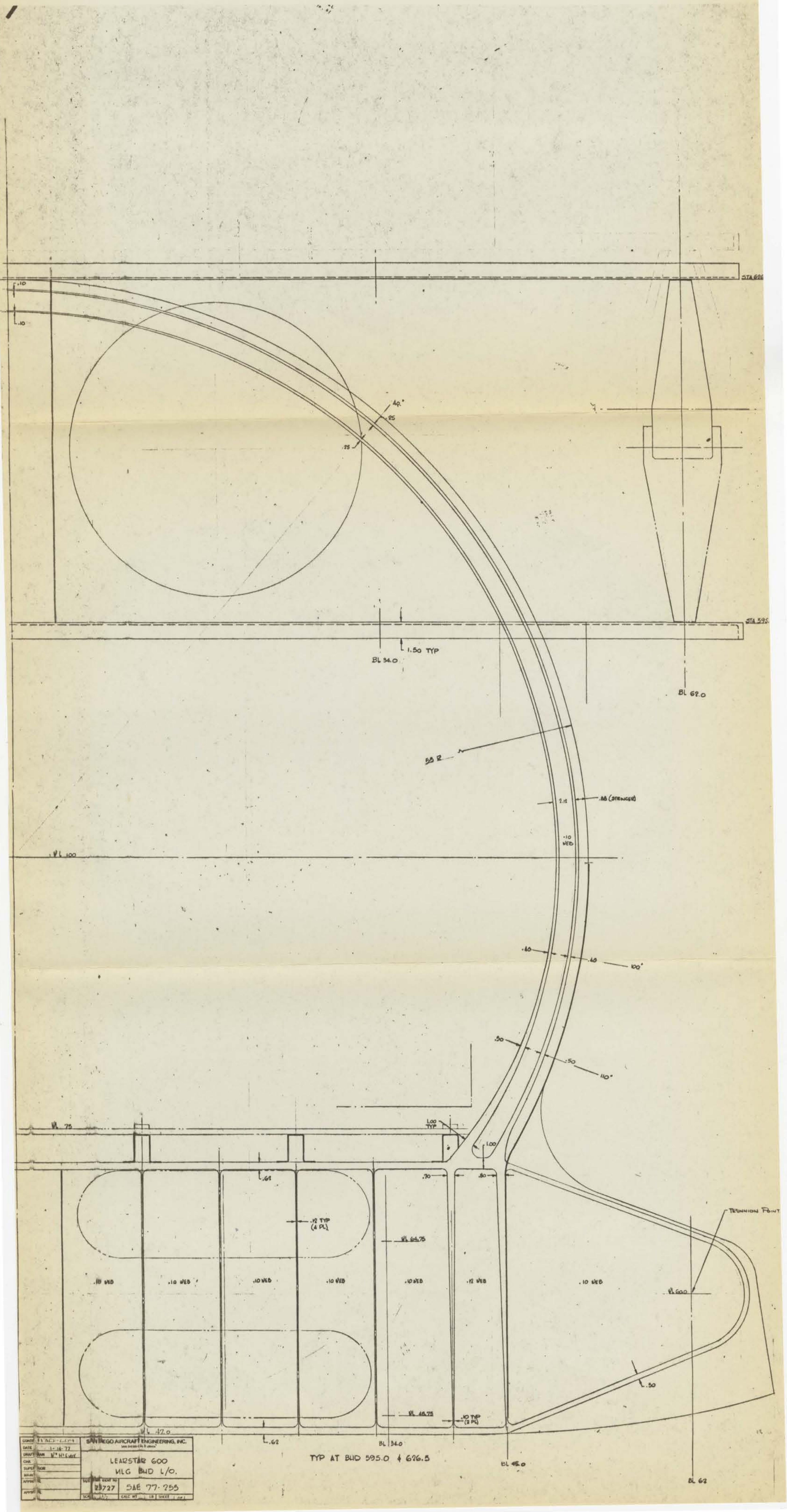
CONTR 1130-80+	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO, CALIFORNIA
DATE 1-3-77	
DRAFTSMAN WHITE	AFT FUSELAGE
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE / CODE IDENT NO 25727 / SAE 77-250
APPROVAL	SCALE / CALC WT / LB

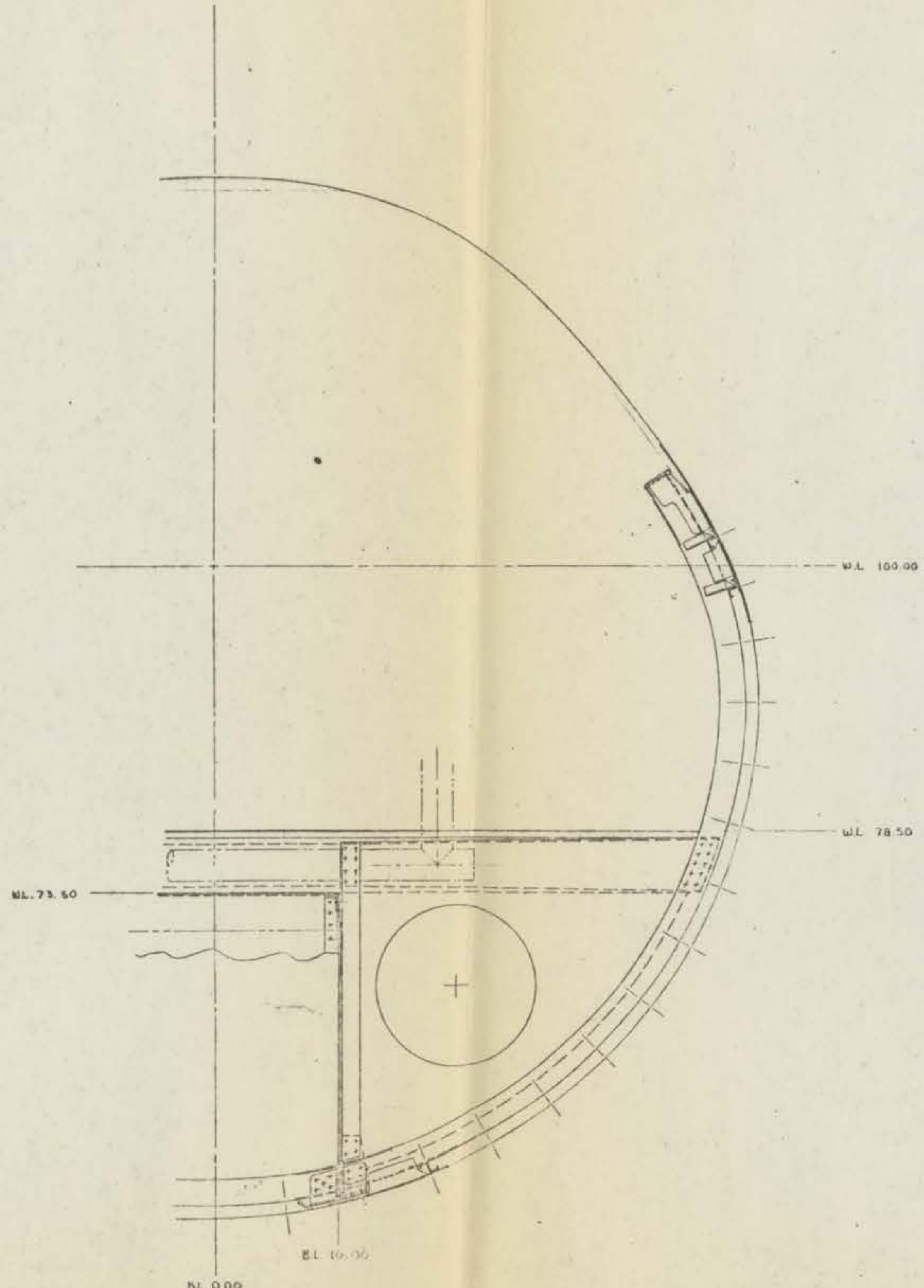


CONTR 1130-6.04	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO CALIFORNIA
DATE 1-18-77	LEARSTAR 600 FWD STRINGER L/O
DRAFTSMAN	
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE / CODE IDENT NO 25727 / SAE 77-253
APPROVAL	SCALE / CALC WT / SHEET



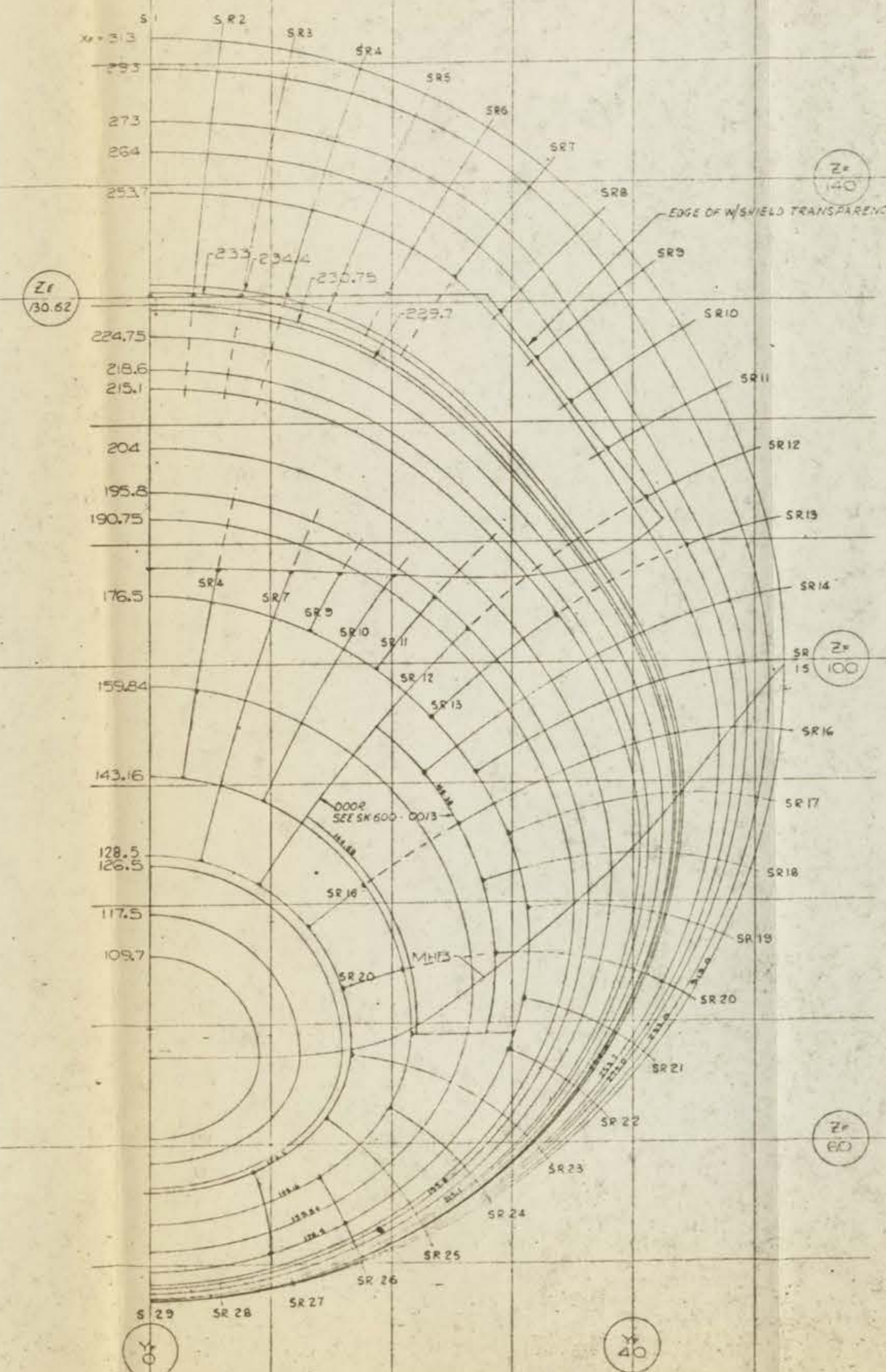
CONTR 1132-60-	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO CALIFORNIA
DATE 1-6-77	LEARSTAR 600 AFT STRINGER L/O
DRAFTSMAN Wm McEvoy	
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE · CODE IDENT NO 25727 · SAE 77-254
APPROVAL	SCALE 1/10 · CALC WT LB · SHEET 1 OF 1


STA 626.5
STA 595.0
BL 62.0
BL 34.0
1.50 TYP
.10
40°
.25
55 R
2.12
.88 (STRINGER)
.10 WEB
WL 100
100°
.60
110°
.50
1.00 TYP
1.00
.70
.80
WL 75
.61
.12 TYP (4 PL)
WL 64.75
.10 WEB
.12 WEB
WL 60.0
TRUNNION POINT
.50
WL 48.75
.10 TYP (2 PL)
WL 47.0
.62
BL 34.0
BL 45.0
BL 62
TYP AT BHD 595.0 & 626.5
DATE 1-14-77
SAN DIEGO AIRCRAFT ENGINEERING, INC.
LEARSTAR 600
MLG BHD L/O.
23727
SAE 77-255



VIEW LOOKING AFT LH SIDE
AT STA 234.40

CONTR 1130 G-9	SAN DIEGO AIRCRAFT ENGINEERING, INC.
DATE 1-7-77	
DRAFTSMAN V. RAKESTRAW	FRAME - STA 234.40
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE / CODE IDENT NO 25727 / SAE 77-256
APPROVAL	SCALE [illegible] / CALC WT [illegible] LB / SHEET [illegible]



NOTES:-

1. LINES ARE TO OML
2. ⟼ INDICATES EXTENTS OF STRINGER
3. — — — INDICATES STRINGER DATUM EXTENDED. (MOCK UP PURPOSES ONLY)
4. SEE SK-600-0027 & SK-600-0044
5. TABLE OF OFFSETS FOR STRINGER LOCATIONS AT .125" INSIDE OML IS AVAILABLE.

LEAR AVIATION CORP.

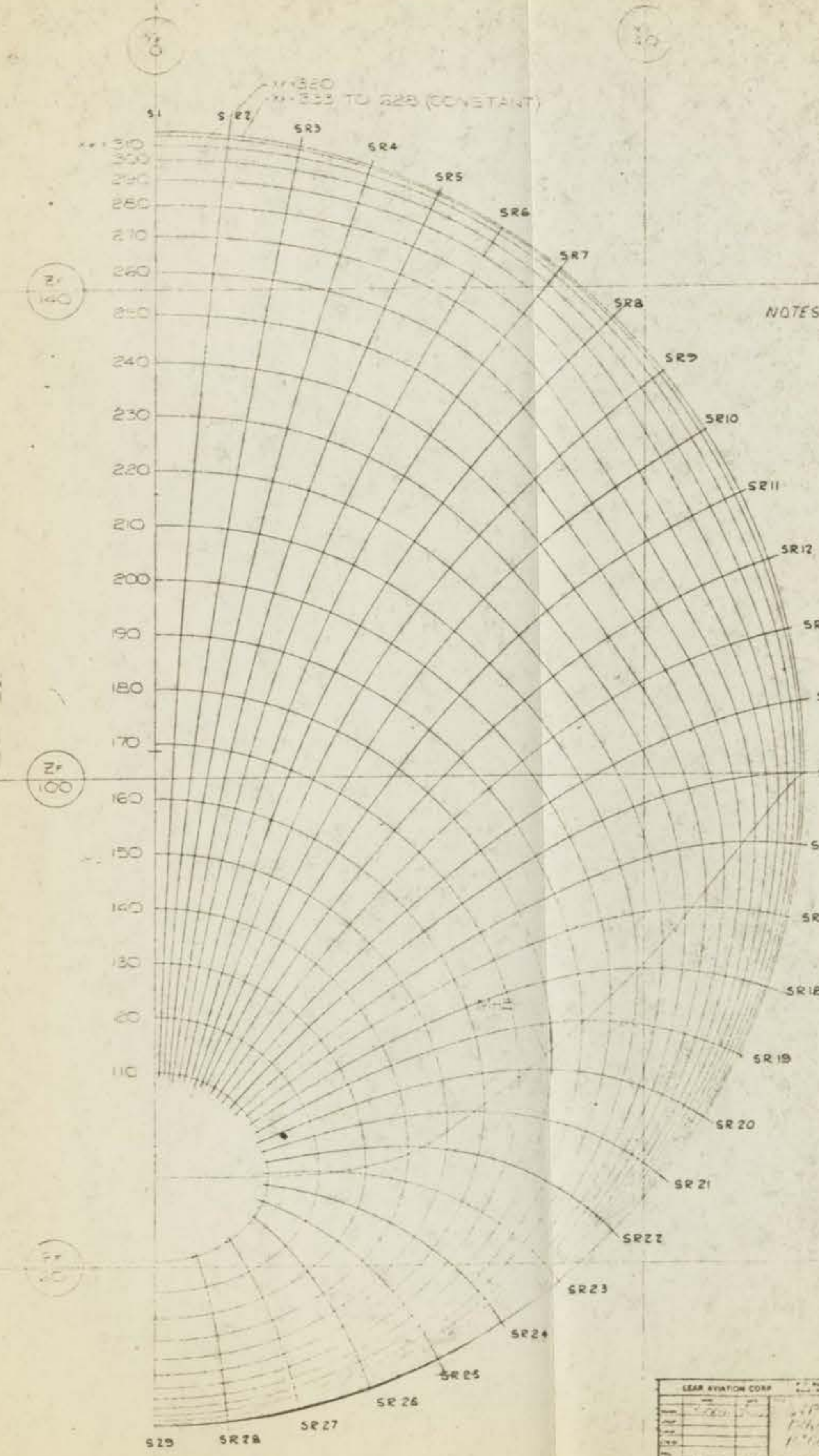
STRINGER DIAGRAM - FWD SECTION

LearStar 600

SK-600-0043

SCALE 1/4

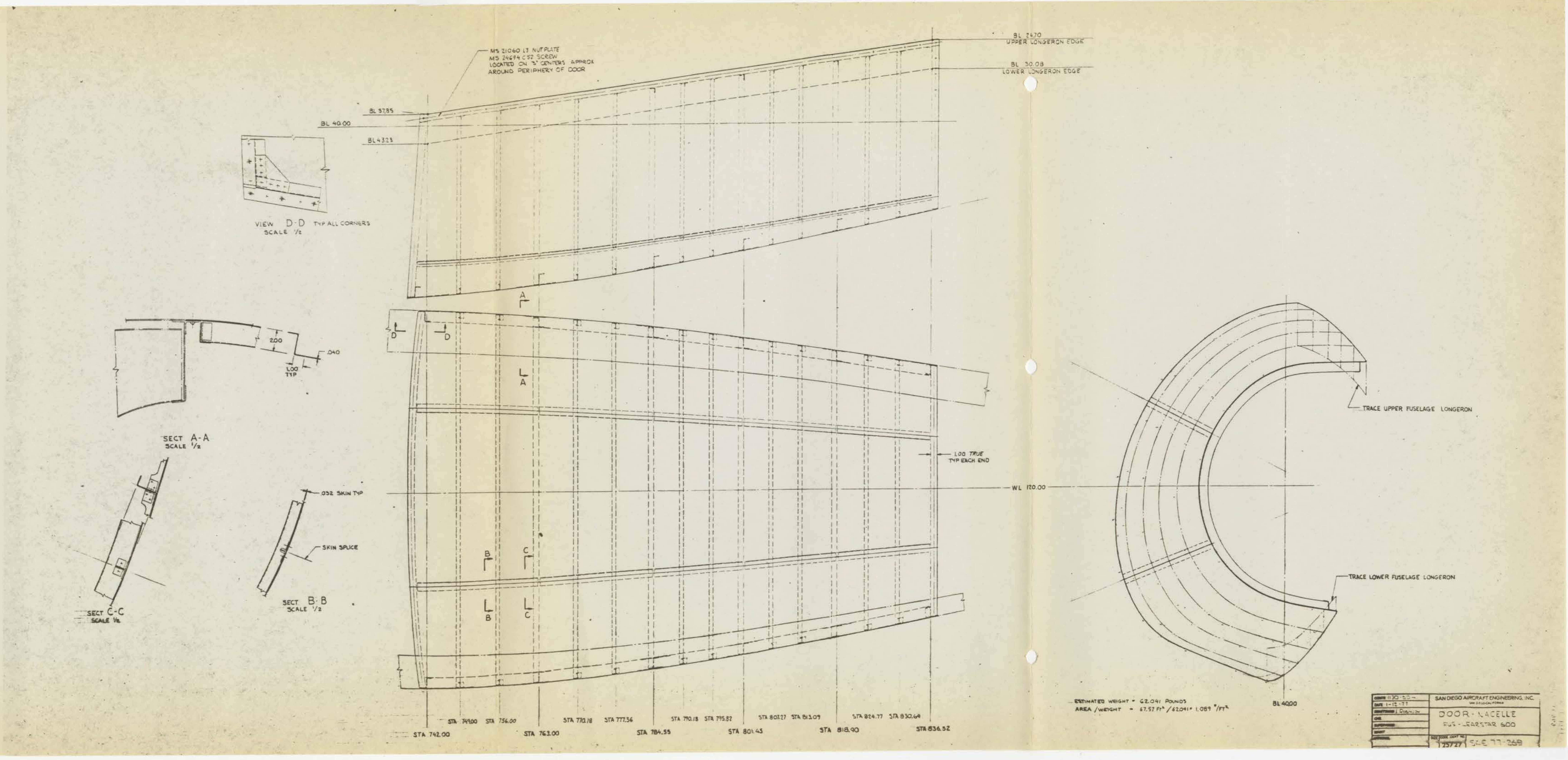
SHEET 1 OF 1



NOTES -

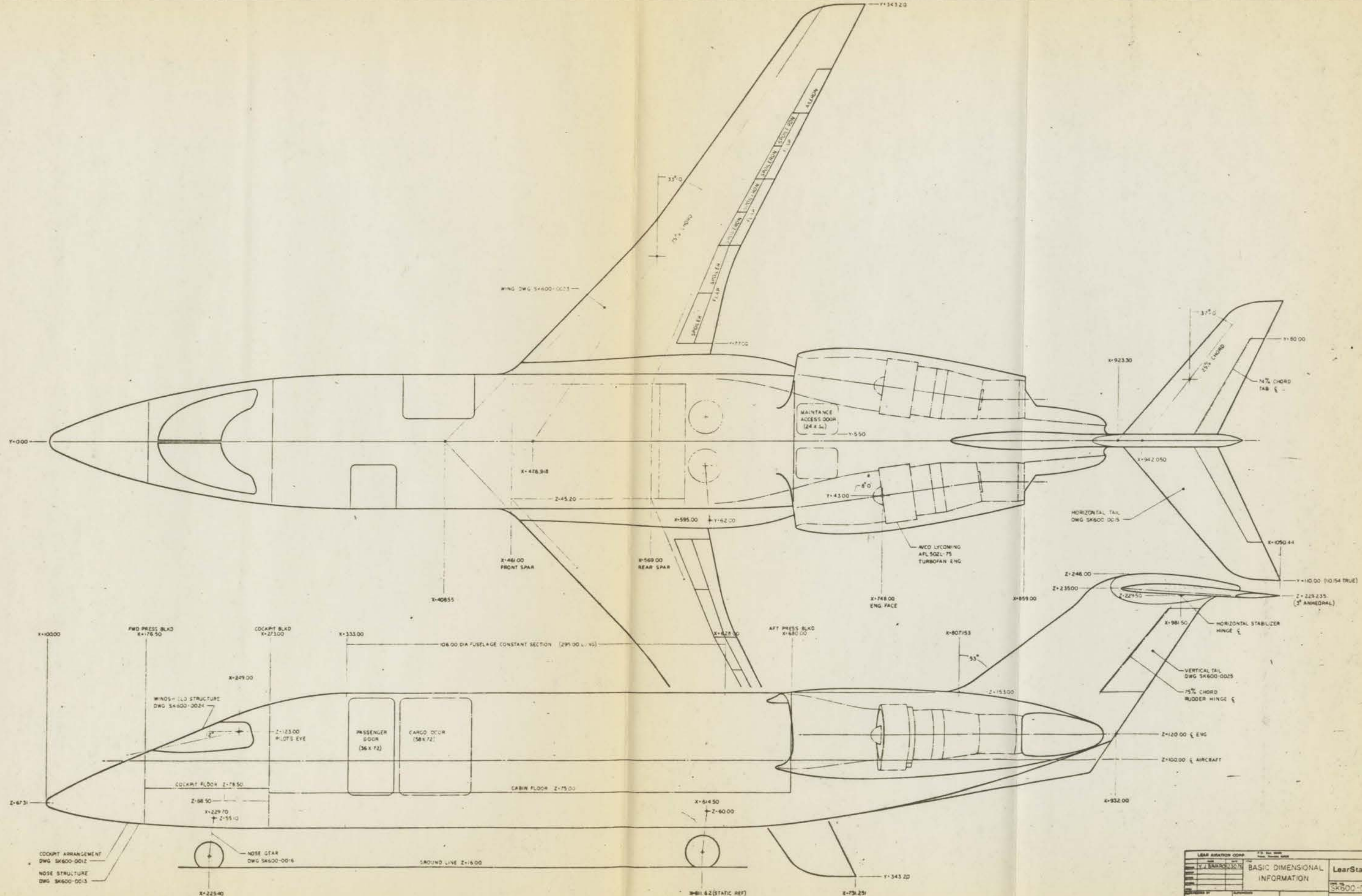
1. SEE SK 600-0043 STRINGER DIAGRAM FWD SECTION. NOTE DEVIATIONS OF OF STRINGER DATUMS 9, 10 & 11 BETWEEN 176.50 & 135.80
2. SEE SK 600-0027 "FUS STRINGER ARRANGEMENT" FOR BASIC INFO AT CONSTANT SECTION

LEAR AVIATION CORP	
STRINGER DIAGRAM ... XA STATIONS	LearStar 600
	SK 600-0044
SCALE 1/4	SHEET 1 OF 1

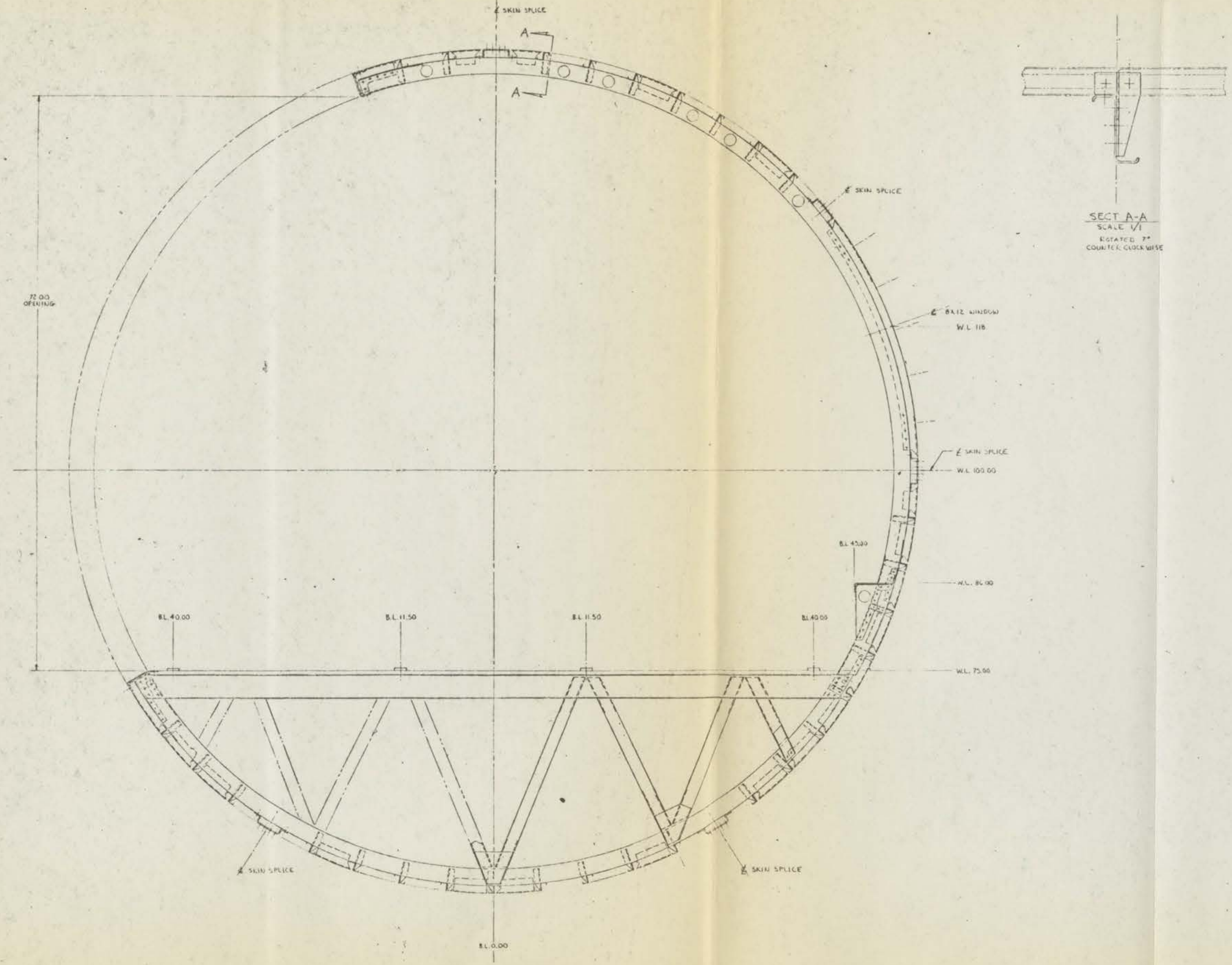

MS 21060 L3 NUTPLATE
MS 24694 C52 SCREW
LOCATED ON 3" CENTERS APPROX
AROUND PERIPHERY OF DOOR
BL 24.70
UPPER LONGERON EDGE
BL 30.08
LOWER LONGERON EDGE
BL 37.85
BL 40.00
BL 43.23
VIEW D-D TYP ALL CORNERS
SCALE 1/2
2.00
.040
1.00
TYP
SECT A-A
SCALE 1/2
.032 SKIN TYP
SKIN SPLICE
SECT C-C
SCALE 1/2
SECT B-B
SCALE 1/2
1.00 TRUE
TYP EACH END
WL 120.00
TRACE UPPER FUSELAGE LONGERON
TRACE LOWER FUSELAGE LONGERON
ESTIMATED WEIGHT = 62.041 POUNDS
AREA / WEIGHT = 67.57 FT² / 62.041# 1.089 #/FT²
BL 40.00
STA 742.00
STA 749.00
STA 756.00
STA 763.00
STA 770.18
STA 777.36
STA 784.55
STA 790.18
STA 795.82
STA 801.45
STA 807.27
STA 813.09
STA 818.90
STA 824.77
STA 830.64
STA 836.52
CONTR 1130-55-
DATE 1-12-77
DRAFTSMAN J. ROBINSON
CHK
SUPERVISOR
STRESS
APPROVAL
SAN DIEGO AIRCRAFT ENGINEERING, INC.
SAN DIEGO, CALIFORNIA
DOOR - NACELLE
FUS - LEARSTAR 600
SIZE CODE IDENT NO.
25727
SCE 77-269

ESTIMATED WEIGHT 61.78 # / NACELLE

CONTR 1130-601	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO, CALIFORNIA
DATE 1-18-77	FUSELAGE LEARSTAR 600 NACELLE STRUCTURE
DRAFTSMAN J. Robertson	
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE / CODE IDENT NO / SAE 77-270
APPROVAL	SCALE ¼ / CALC WT LB / SHEET

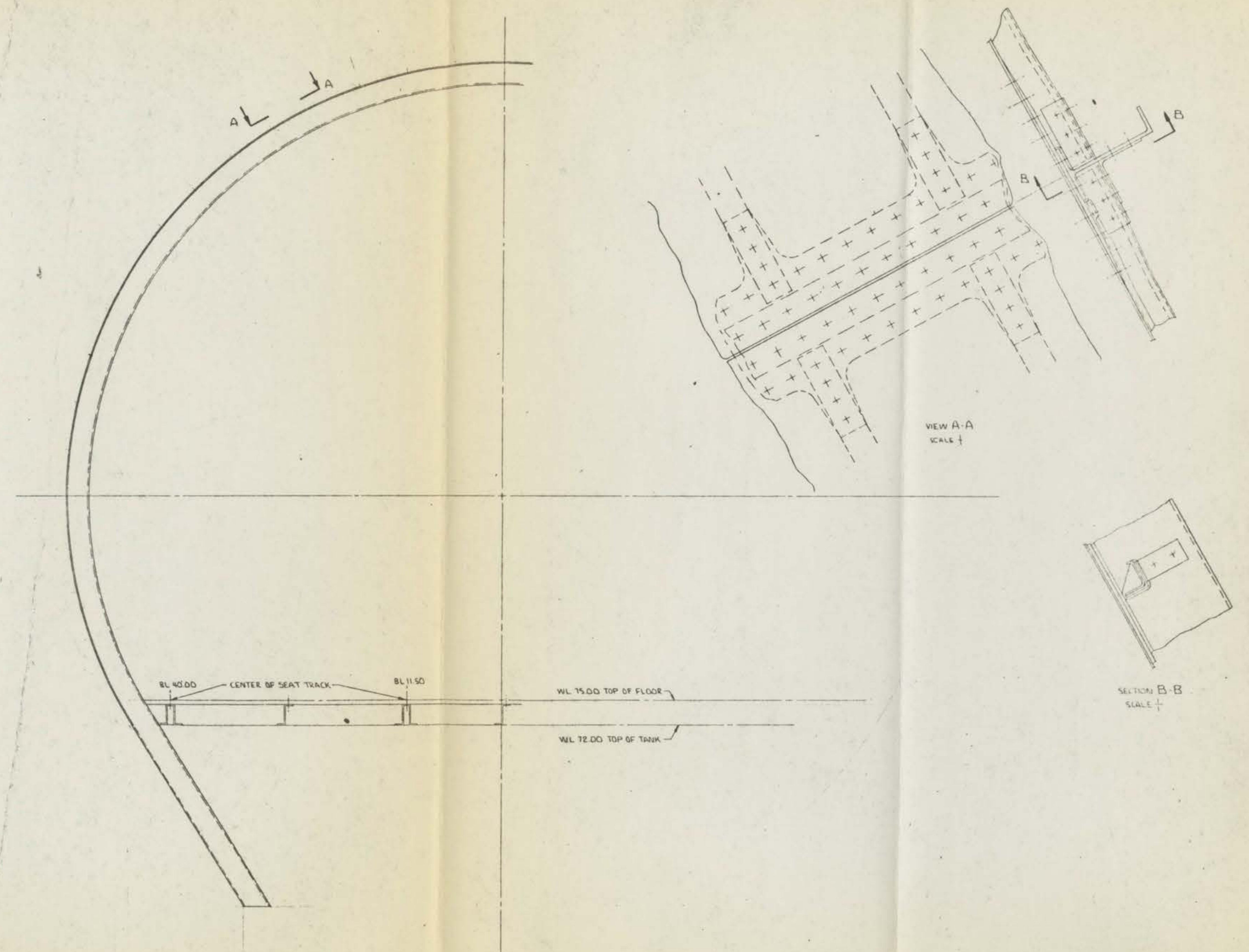


LEAR AVIATION CORP.		
V. J. SMARKS 2-30-79	BASIC DIMENSIONAL INFORMATION	LearStar 600
		DWG. NO. SK600-0042



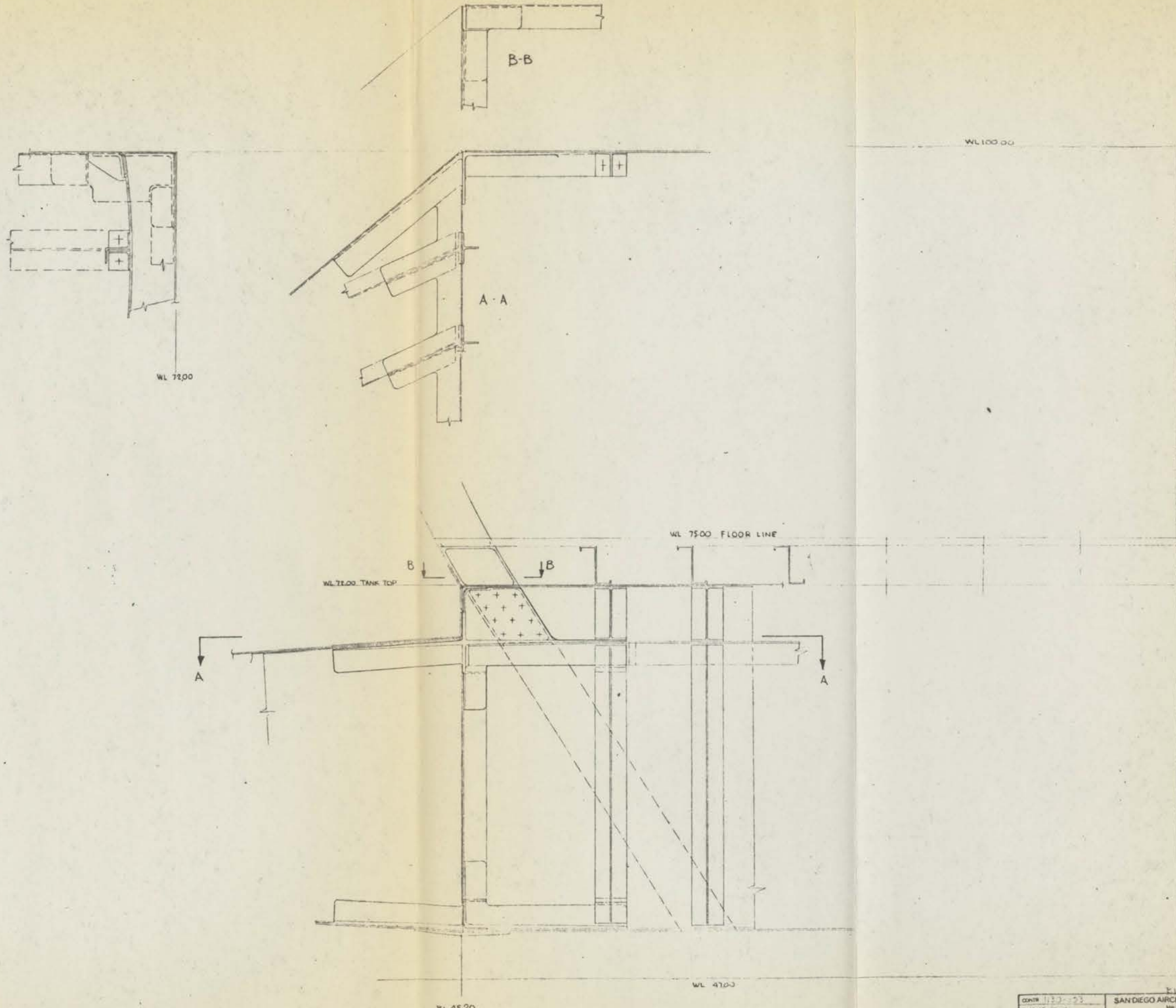
VIEW LOOKING AFT
AT STA 386.00
SCALE 1/4

CONTR 1130-400	SAN DIEGO AIRCRAFT ENGINEERING, INC.		
DATE 1-7-77	FRAME - STA'S 386.00, 401.00 & 416.00 THRU CARGO [illegible] OPENING		
DRAFTSMAN [illegible]			
CHK			
SUPERVISOR			
MAINT			
APPROVAL	SIZE	CODE IDENT NO 25727	SAE 77-257
APPROVAL	SCALE	CALC WT	SHEET

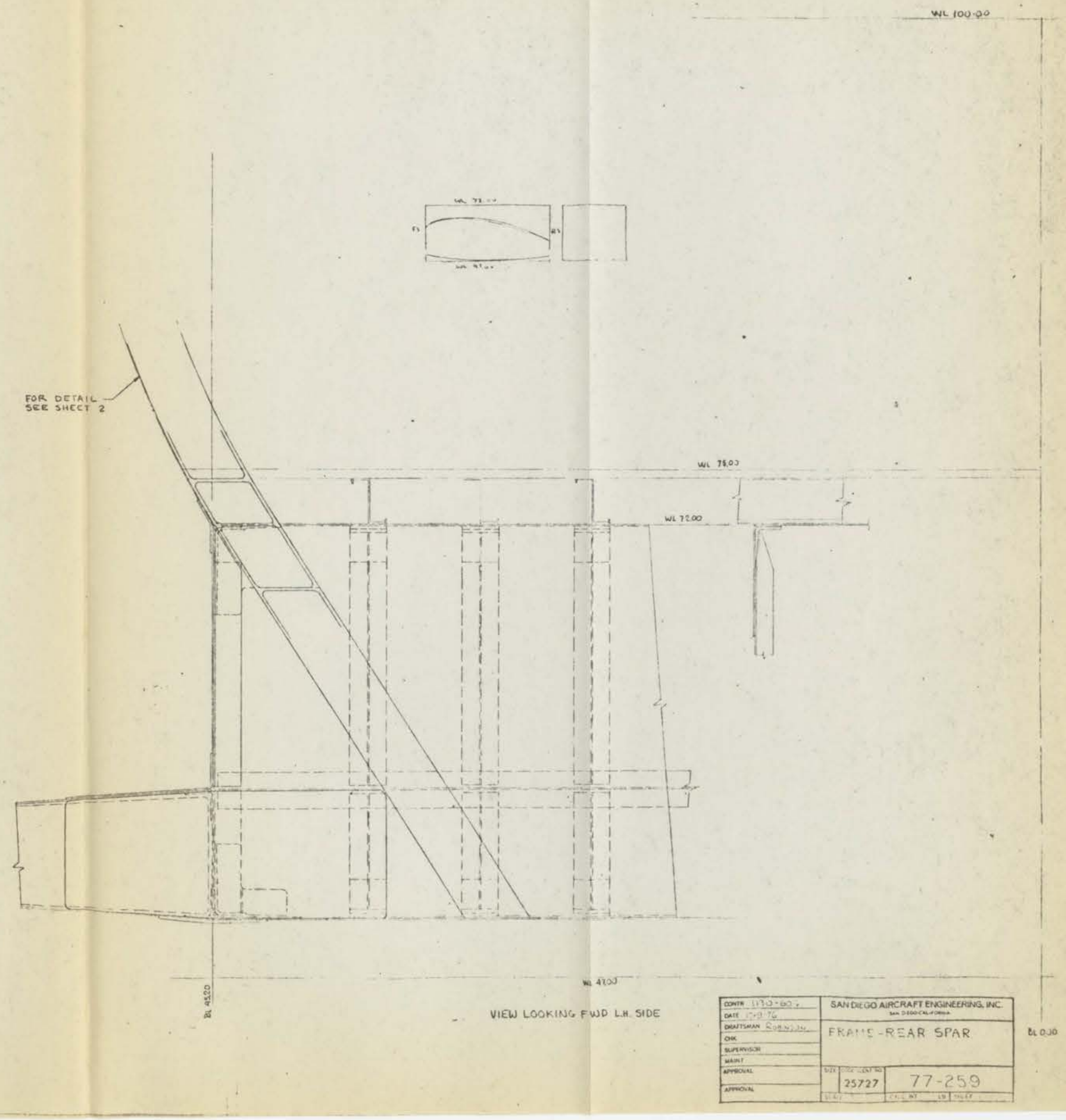


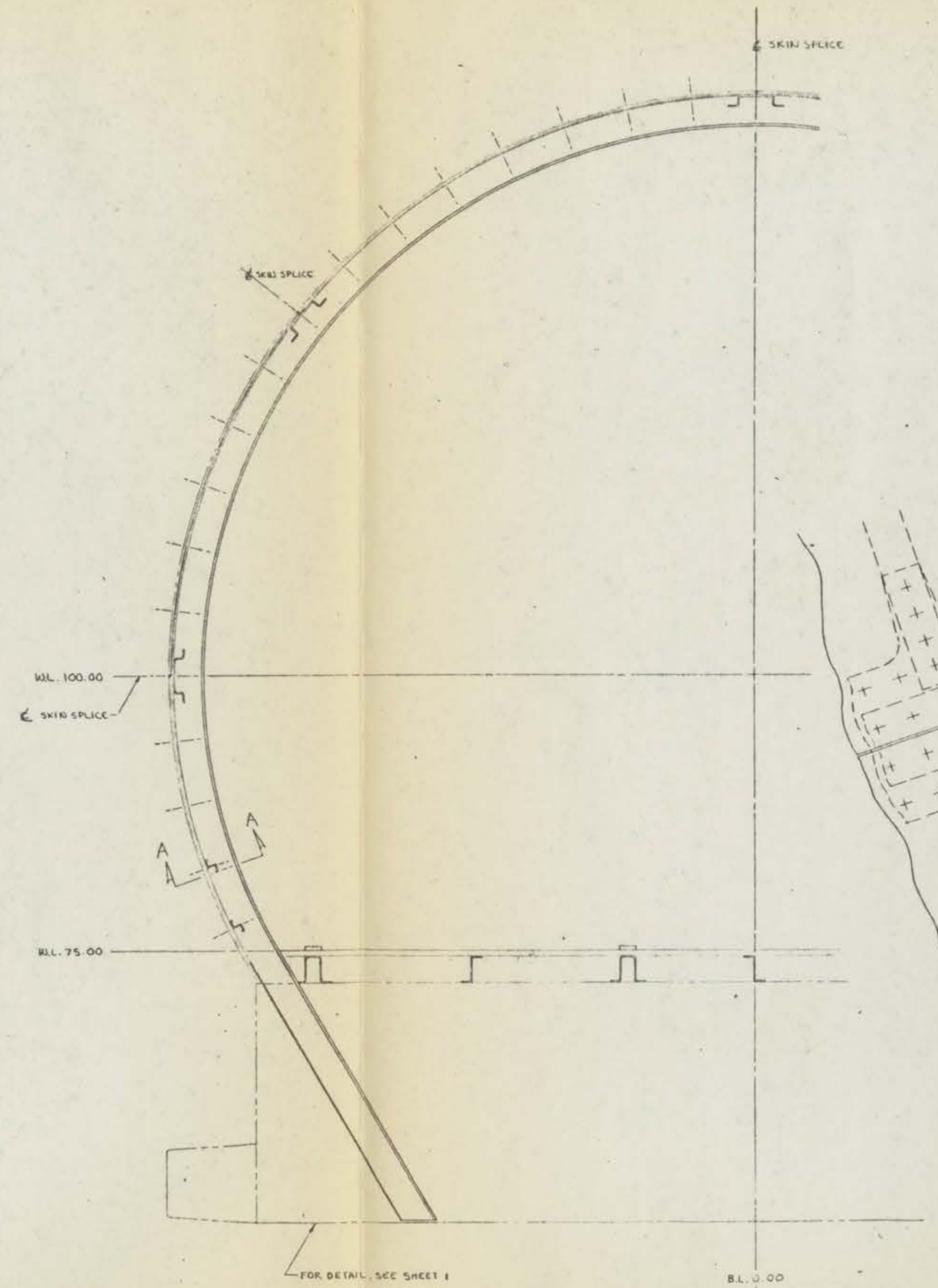
VIEW LOOKING FWD

CONTR 1130-604	SAN DIEGO AIRCRAFT ENGINEERING, INC.
DATE 1-5-77	
DRAFTSMAN V. WHITE	FUS FRAME & WING FRONT SPAR
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE / CODE IDENT NO 25727 / SAE 77-258
APPROVAL	SCALE

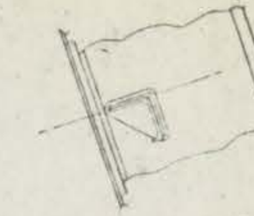


CONTR	SAN DIEGO AIRCRAFT ENGINEERING, INC.
DATE	FRONT SPAR
DRAFTSMAN	VIEW LKG FWD
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE / CODE IDENT NO 25727
APPROVAL	

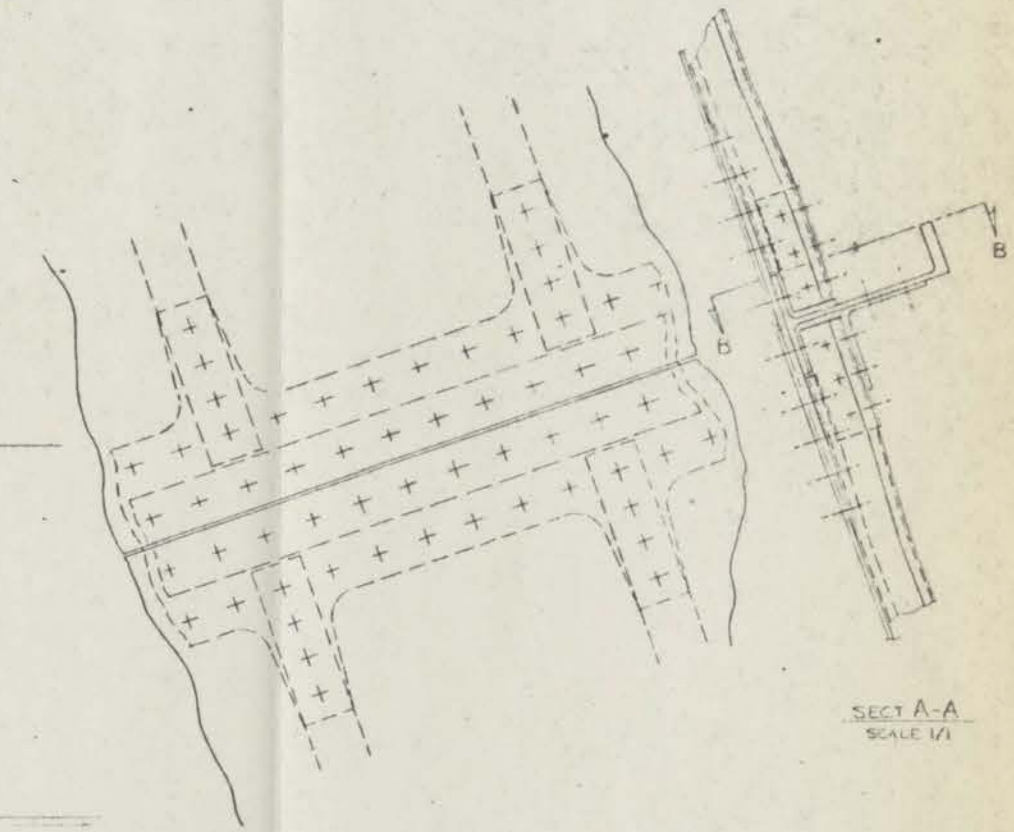

WL 100.00
FOR DETAIL
SEE SHEET 2
WL 78.00
WL 72.00
BL 41.20
VIEW LOOKING FWD L.H. SIDE
BL 0.00
CONTR 1130-607
DATE 12-9-76
DRAFTSMAN ROBINSON
CHK
SUPERVISOR
MAINT
APPROVAL
APPROVAL
SAN DIEGO AIRCRAFT ENGINEERING, INC.
SAN DIEGO CALIFORNIA
FRAME - REAR SPAR
25727
77-259



VIEW LOOKING FWD L.H. SIDE
AT STA 569.00

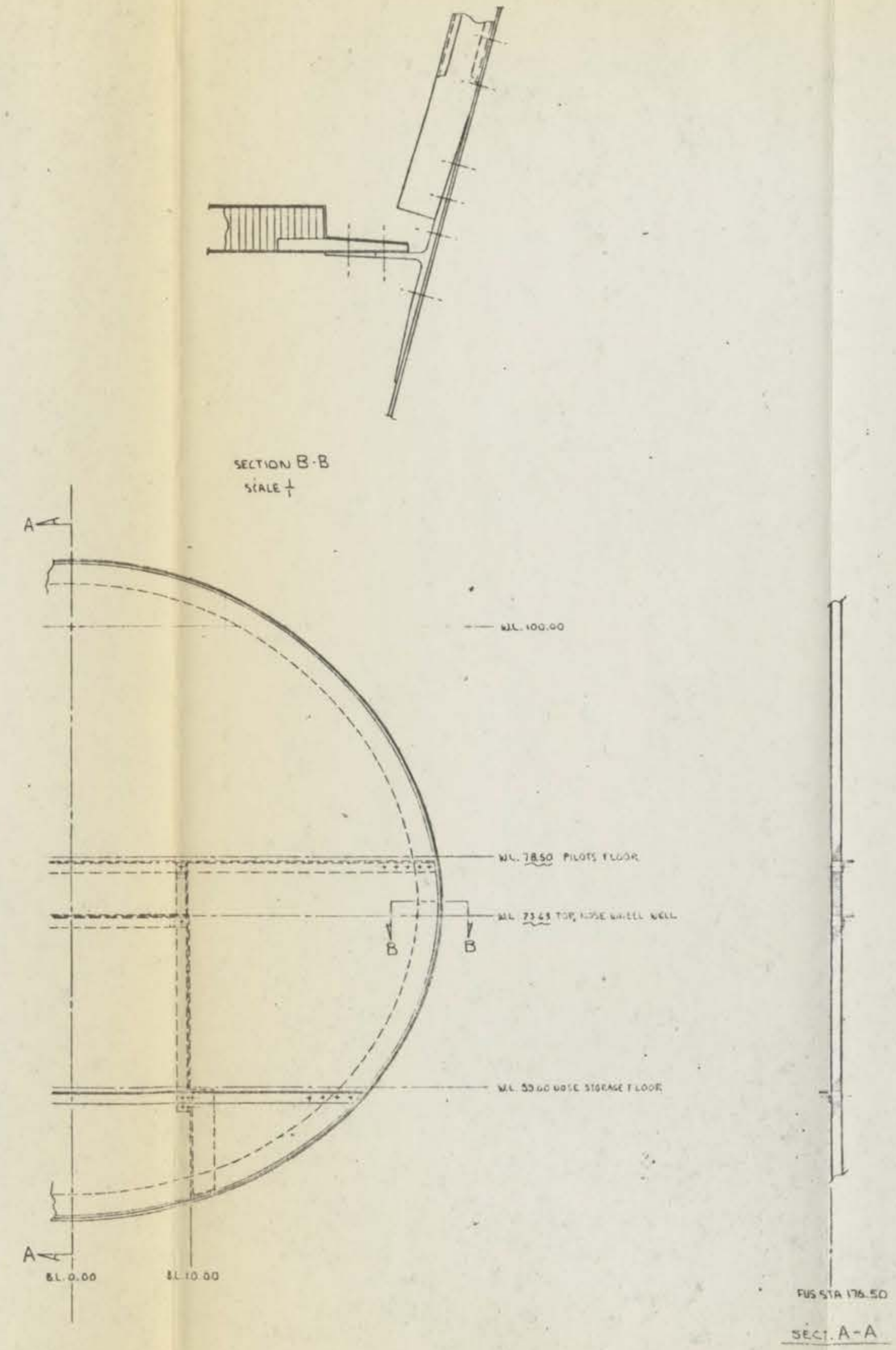


SECT B-B
SCALE 1/1

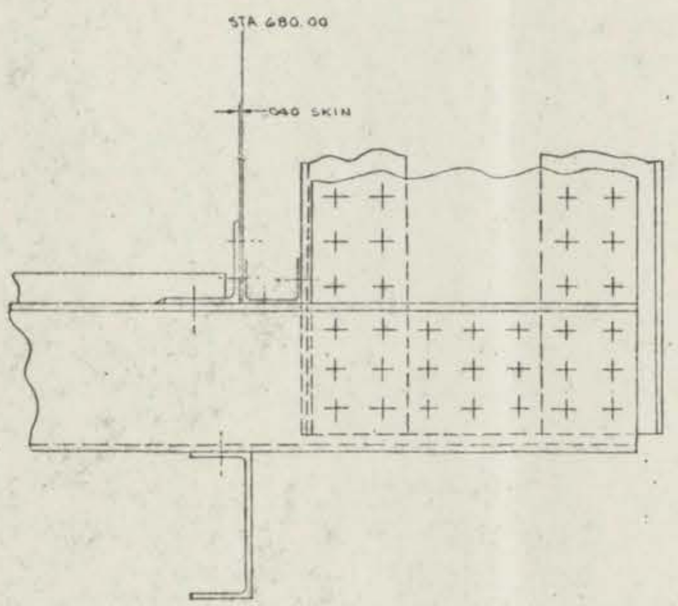


SECT A-A
SCALE 1/1

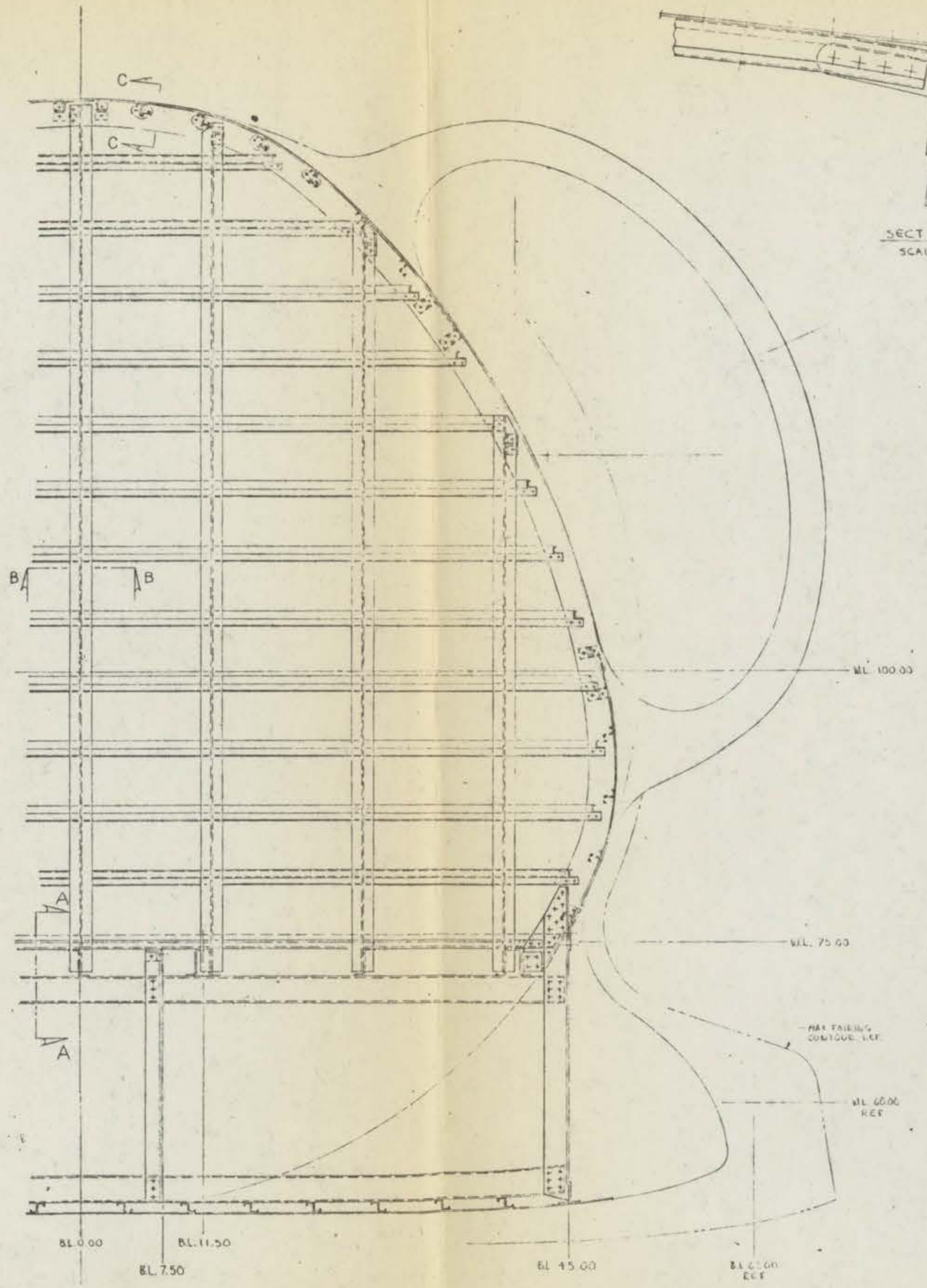
CONTR 1133-60-4	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO CALIFORNIA		
DATE 1-7-77			
DRAFTSMAN V. KAKESH	FRAME - REAR SPAR		
CHK			
SUPERVISOR			
MAINT			
APPROVAL	SIZE	CODE IDENT NO. 25727	77-259
APPROVAL	SCALE	CALC WT LB	SHEET 2 OF



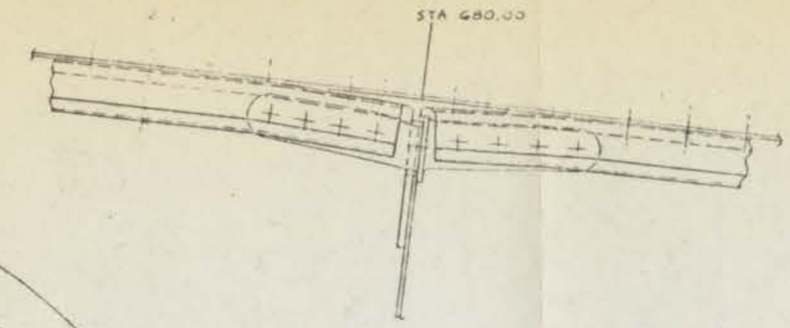
CONTR 1130-604	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO-CALIFORNIA		
DATE 1-7-77			
DRAFTSMAN	FORWARD PRESSURE BULKHEAD		
CHK			
SUPERVISOR			
MAINT			
APPROVAL	SIZE	CODE IDENT NO 25727	SAE 77-260
APPROVAL			
	SCALE	CALC WT LB	SHEET



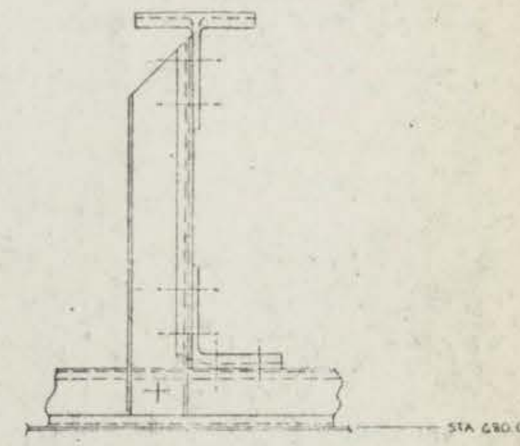
SECT. A-A
SCALE 1/1



VIEW LOOKING FWD RH SIDE

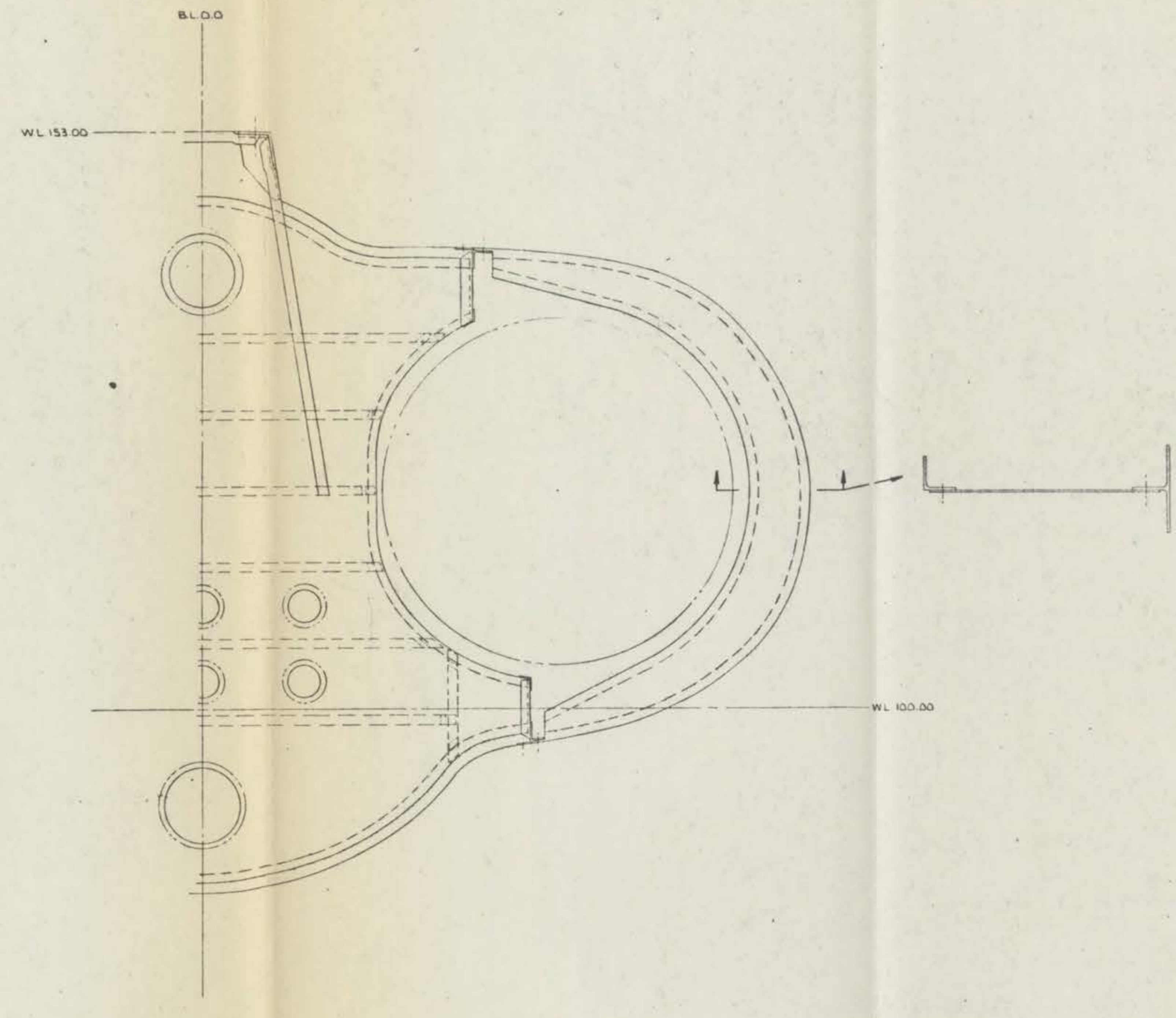


SECT C-C
SCALE 1/1



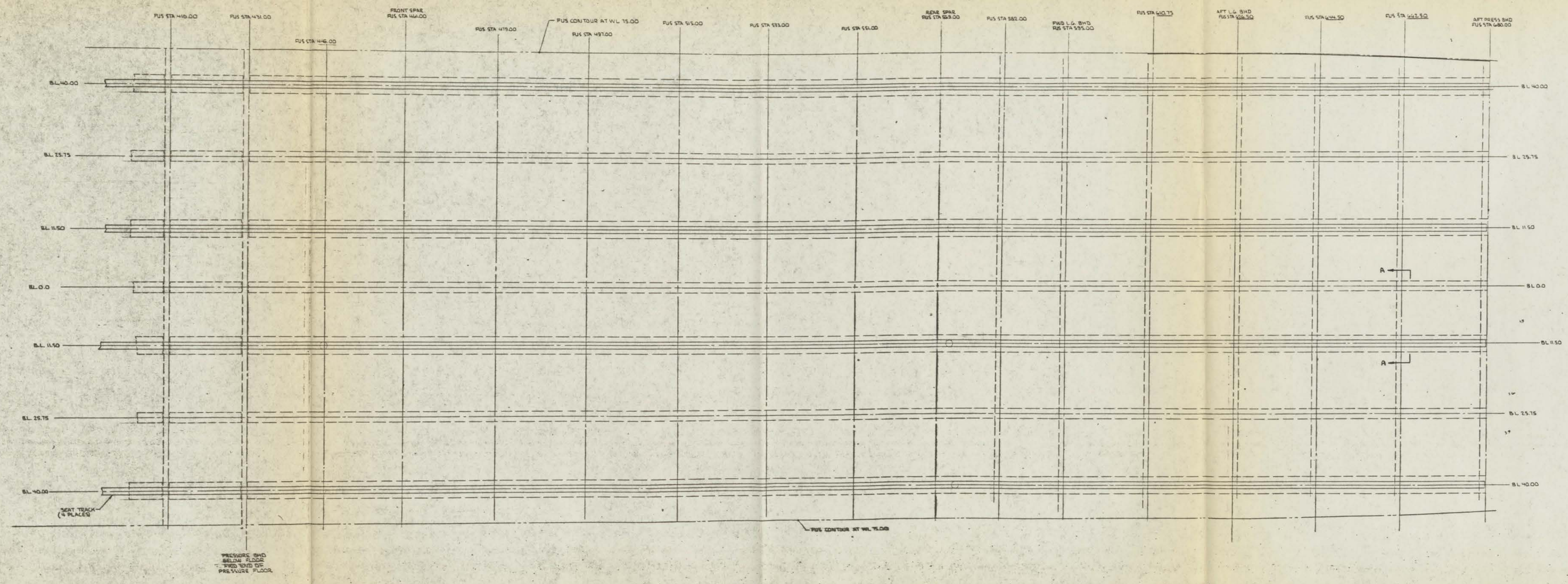
SECT B-B
SCALE 1/1

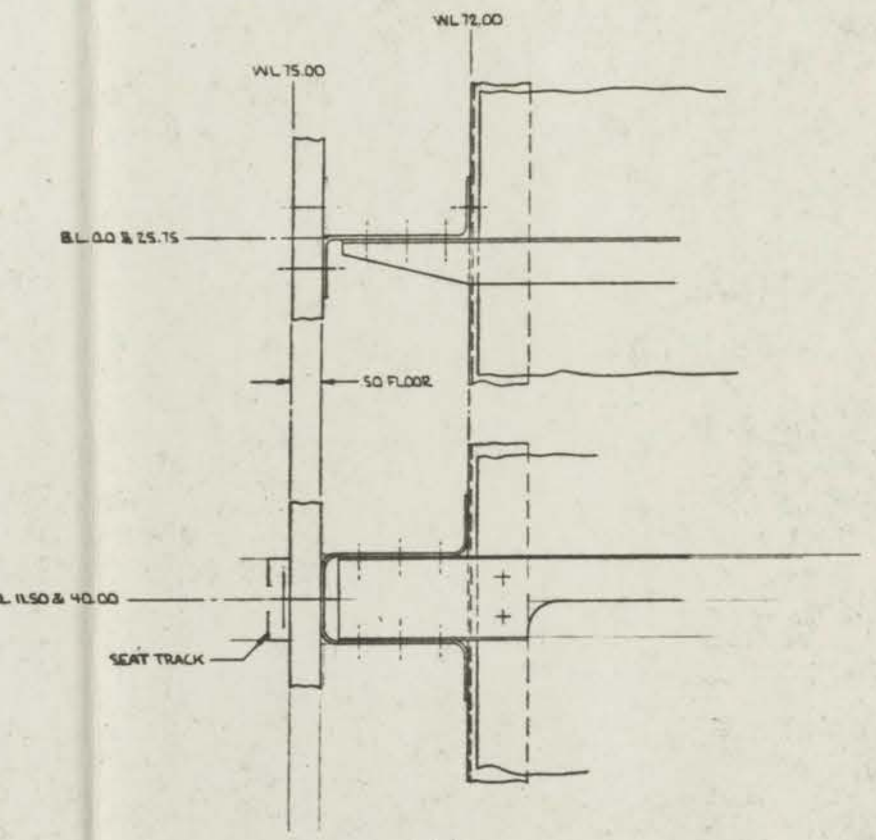
CONTR	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO CALIFORNIA	
DATE		
DRAFTSMAN	AFT PRESSURE BULKHEAD	
CHK		
SUPERVISOR		
MAINT		
APPROVAL	SIZE / CODE IDENT NO 25727	SAE 77-261
APPROVAL	SCALE	CALC WT LB / SHEET



VIEW LOOKING FWD
R.H. SIDE
FUS STA 836.352

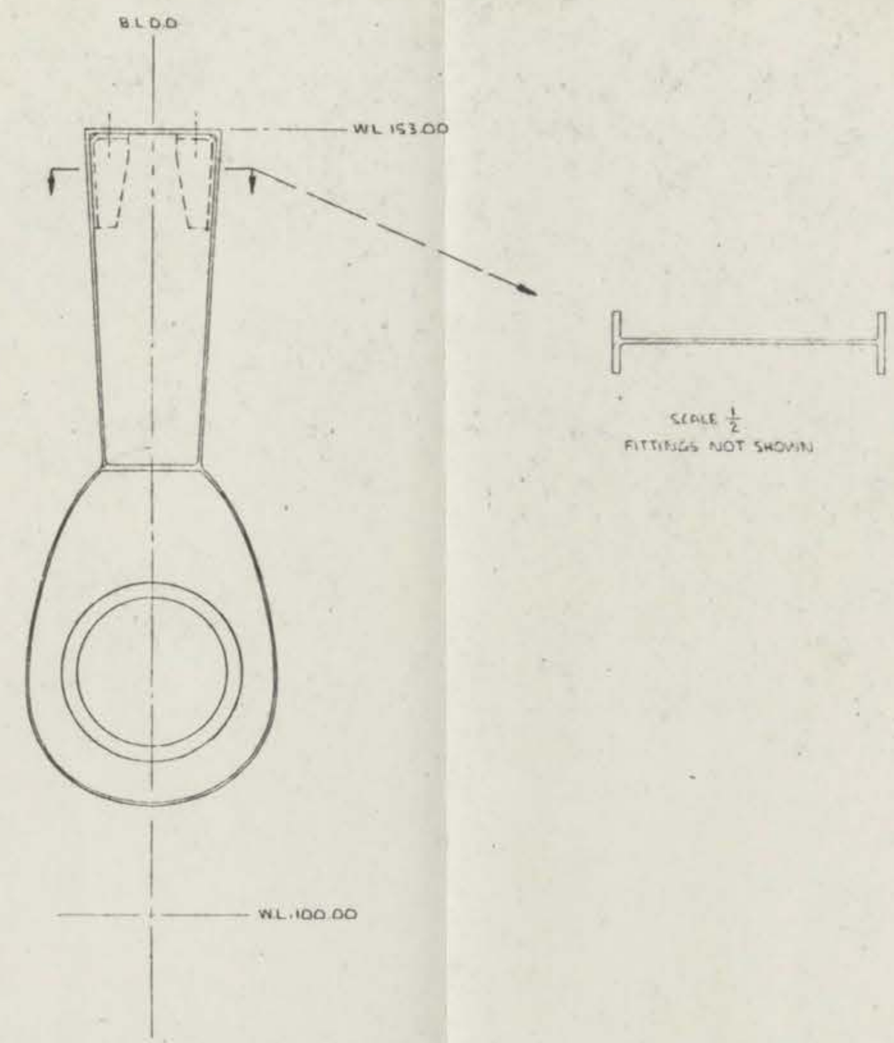
CONTR 1130-604	SAN DIEGO AIRCRAFT ENGINEERING, INC.
DATE 1-6-77	VERT TAIL ATTACH FWD F.S 835.35
DRAFTSMAN WHITE	
CHK	
SUPERVISOR	
WGHT	
APPROVAL	SIZE / CODE IDENT NO 25727 / SAF 77-253
APPROVAL	



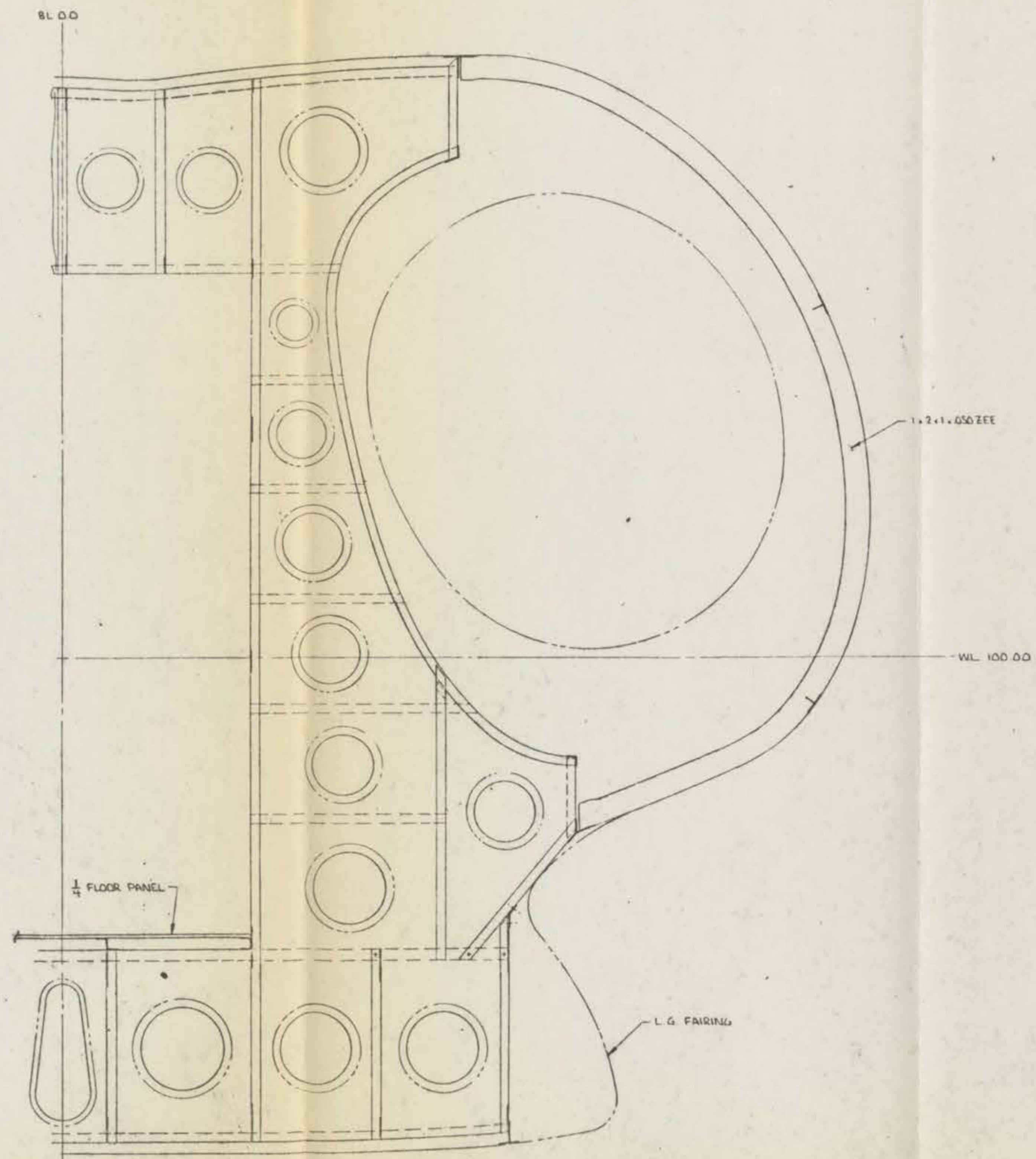


SECTION A-A
SCALE 1/4

CONTR 1130-604	SAN DIEGO AIRCRAFT ENGINEERING, INC.	
DATE 1-7-77	LEARSTAR 600 PRESSURE FLOOR	
DRAFTSMAN WHITE		
CHK		
SUPERVISOR		
MAINT		
	25727	SAE 77-264
APPROVAL	SCALE 1/4	CALC WT LB SHEET

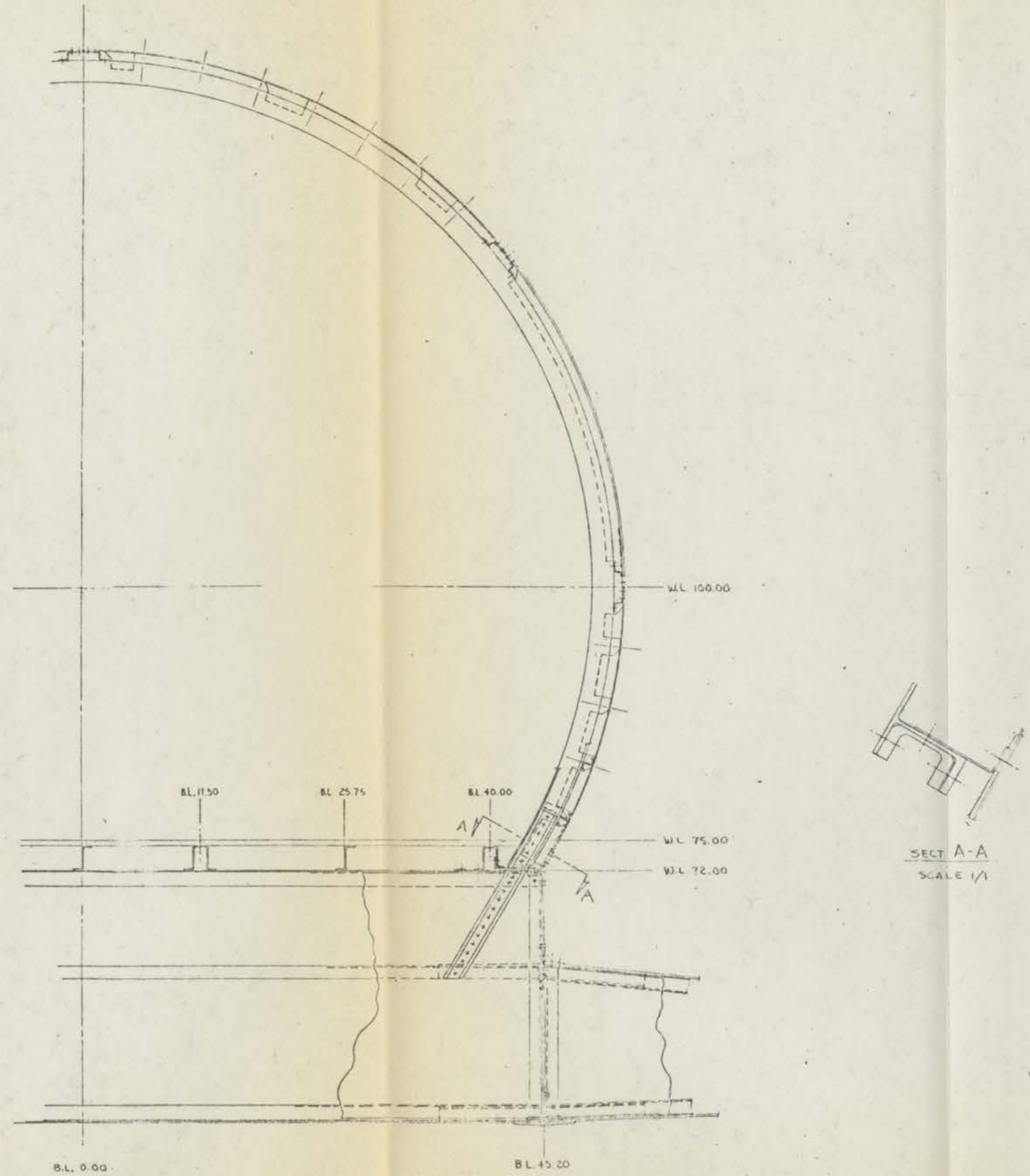


CONTR	SAN DIEGO AIRCRAFT ENGINEERING, INC.
DATE	LEARSTAR 600
DRAFTSMAN	VERT TAIL ATTACH-AFT
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE / CODE IDENT NO 25727 / SAE 17-265
APPROVAL	



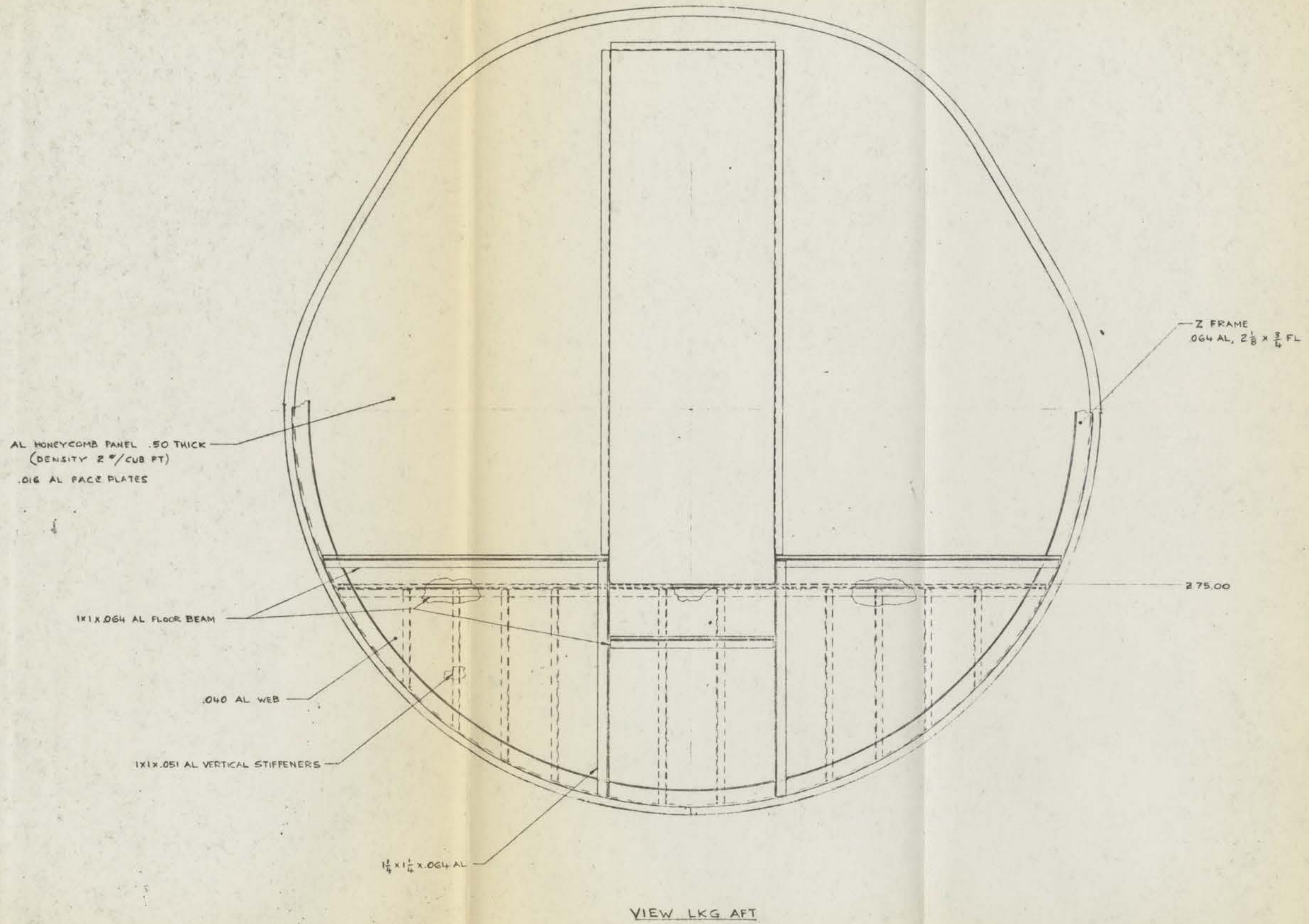
VIEW LOOKING FWD
R.H. SIDE

CONTR 1130-604	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO, CALIFORNIA
DATE 1-6-77	
DRAFTSMAN WHITE	LEARSTAR 600
CHK	FRAME - FUS STA 721.00
SUPERVISOR	
MAINT	
APPROVAL	SIZE / CODE IDENT NO 25727 / SAE 77-266
APPROVAL	SCALE / CALC WT / SHEET

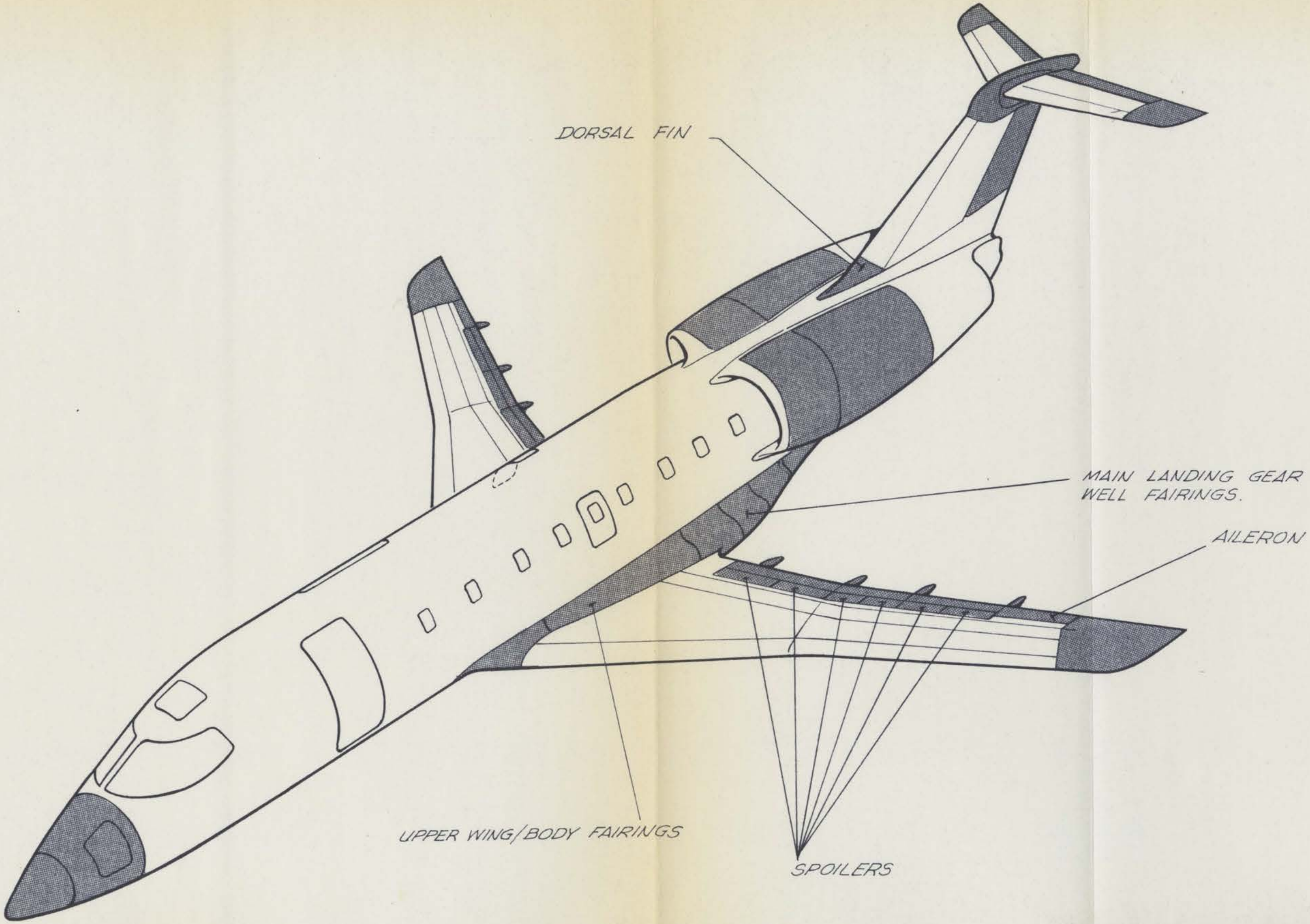


VIEW LOOKING AFT L.H. SIDE
AT STA 533.00

CONTR	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO CALIFORNIA
DATE 1-4-77	FRAME - STA 533.00
DRAFTSMAN	
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE / CODE IDENT NO. 25727 / SAE 77-267
APPROVAL	SCALE / CALC WT LB / SHEET



CONTR	SAN DIEGO AIRCRAFT ENGINEERING, INC. SAN DIEGO CALIFORNIA
DATE 1-13-77	FUSELAGE LEARSTAR 600
DRAFTSMAN HAYES	BULKHEAD X273.00
CHK	
SUPERVISOR	
MAINT	
APPROVAL	SIZE J · CODE IDENT NO 25727 · 77-268
APPROVAL	SCALE · CALC WT LB · SHEET

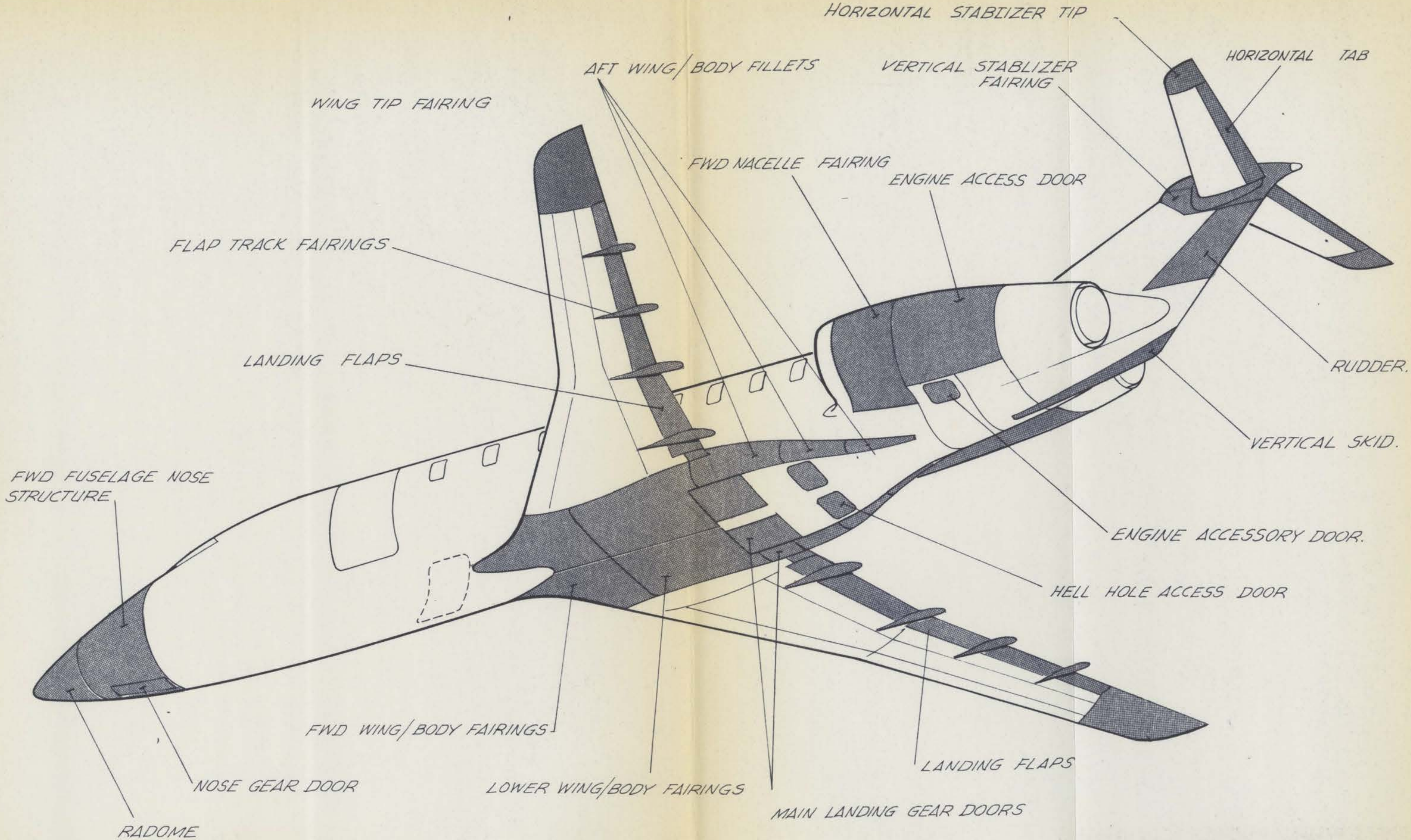


LEAR AVIATION CORP.			
	NAME	DATE	TITLE
DRAWN	R.V. COLLINS	1/25/7	COMPOSITE MATERIALS APPLICATIONS - CURRENT AIRCRAFT STATE-OF-ART
GROUP			
CHECK			
STRESS			
PROJ.			
SUPERSEDED BY	SUPERSEDES SK600-	SCALE	

LearStar 600

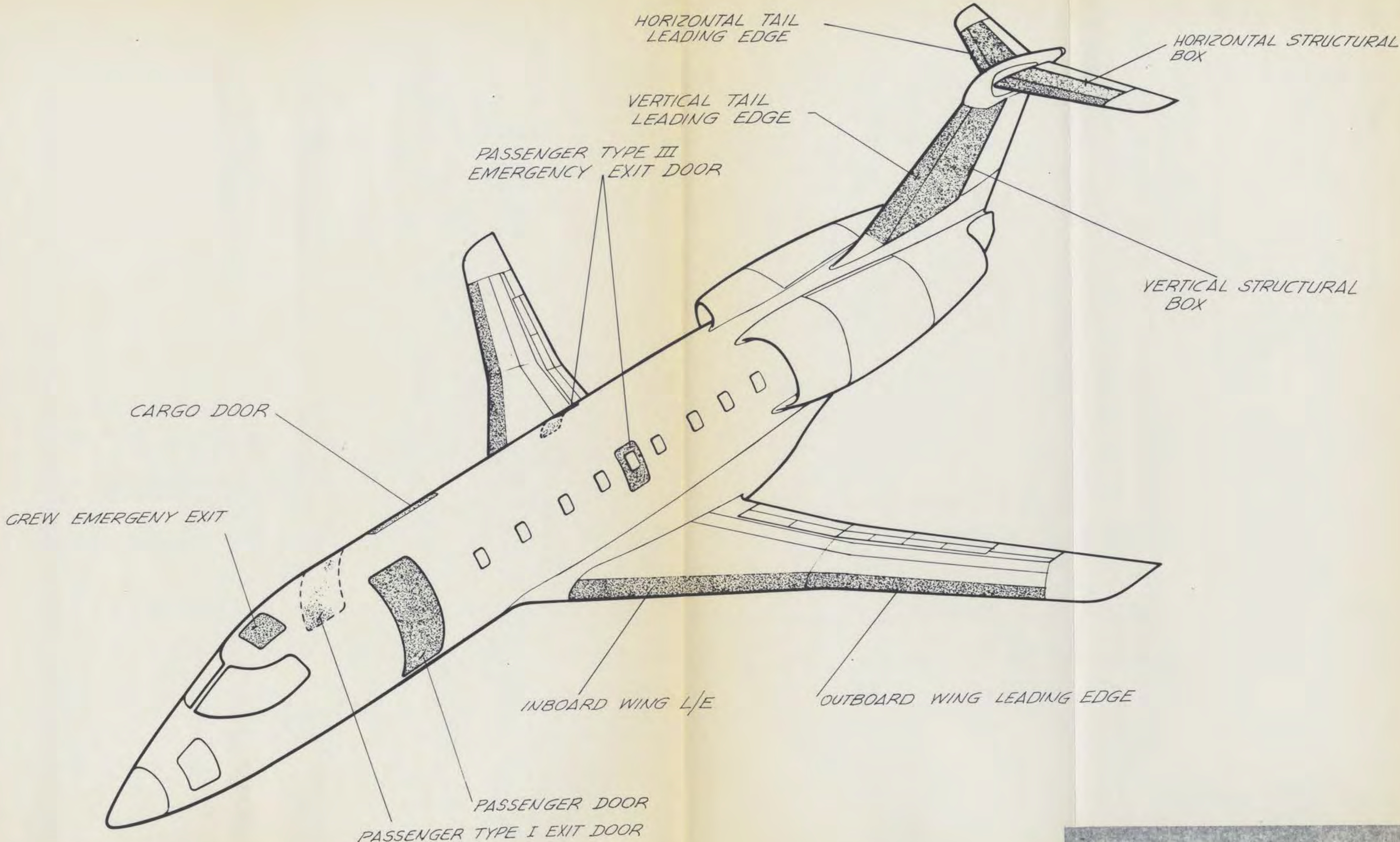
DWG. NO SK600-0086

SHEET 1 OF 2



LEAR AVIATION CORP.

DRAWN	W. COLLINS	1/25/77	COMPOSITE MATERIALS APPLICATION-CURRENT AIRCRAFT STATE OF ART	LearStar 600
GROUP				
CHECK				
STRESS				DWG. NO SK600-0086
PROJ				
SUPERSEDED BY	SUPERSEDES SK600-	SCALE ~		SHEET 2 OF 2



LEAR AVIATION CORP.				
	NAME	DATE	TITLE	
DRAWN	W. COLLINS	25/1/77	COMPOSITE MATERIALS APPLICATIONS-FUSELAGE WITH ADDITIONAL CERTIFICATION	LearStar 600
GROUP				DWG. NO SK600-0087
CHECK				
STRESS				
PROJ				
SUPERSEDED BY	SUPERSEDES SK600-	SCALE		SHEET 1 OF 1