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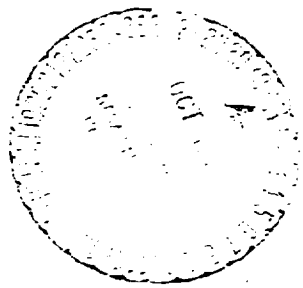
FRACTURE CONTROL METHODS FOR SPACE VEHICLES

Volume III

Space Shuttle Configurations

By
A.F. Liu and E.J. Mulcahy



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NASA Lewis Research Center
Contract NAS 3-16765

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Volume III
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A. F. Liu and E. J. Mulcahy

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Project Manager, Gordon T. Smith
NASA Lewis Research Center
Cleveland, OH 44135

16. Abstract

This volume contains Space Shuttle configuration drawings supplementary to the Space Shuttle structure described in Volume I.

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FOREWORD

The work described in this report was performed by the Space Division of Rockwell International Corporation under Contract NAS3-16765, Fracture Control Methods for Space Shuttle Vehicles, for the Lewis Research Center of the National Aeronautics and Space Administration. The investigation was conducted under the technical direction of Mr. Gordon T. Smith of NASA/LeRC. The project study manager at the Space Division of Rockwell International Corporation was Mr. A. F. Liu, with Dr. Paul C. Paris of Del Research Corporation and Dr. Matthew Creager of Del West Associates, Inc., acting as primary technical consultants.

This report consists of three volumes:

Volume I. Fracture Control Design Methods (prepared by A. F. Liu)

Volume II. Assessment of Fracture Mechanics Technology for Space Shuttle Applications (prepared by R. M. Ehret)

Volume III. Space Shuttle Configurations (prepared by A. F. Liu and E. J. Mulcahy)

Mr. James E. Collipriest, Jr., provided overall techanical guidance in the preparation of Volume II. Mr. Edward J. Mulcahy and Mr. A. S. Musicman contributed significantly to the preparation of Section 1.1 (Space Shuttle Vehicle Structural Description) of Volume I. Mr. John Mamon and Mr. F. Stuckenberg aided substantially in the preparation of the nondestructive evaluation sections in Volumes I and II. Mr. R. E. O'Brien and Mr. R. M. Ehret contributed, respectively, Section 2.2 (Prevention of Cracks and Crack-Like Defects in Shuttle Vehicle Structure) and Section 2.3.8 (Required Material Properties Data for Space Shuttle Fracture Mechanics Analysis) of Volume I. Dr. Matthew Creager contributed Section 2.3.6 (Failure Under Complex Loading Conditions) and Section 2.3.7.4 (Damage Tolerance Analysis for Pressure Vessels of Volume I and Section 2.2 (Thin Sheet Behavior) and a discussion of fracture behavior under combined in-plane loading in Section 1.2 (Linear Elastic Concepts of Fracture Behavior) of Volume II.

Mr. R. W. Westrup prepared the original proposal response to the RFP and established the basic frame work for the study program. The managerial guidance provided by Mr. R. P. Olsen, Engineering Manager, Materials and Processes, Space Division, is acknowledged by the authors.

This volume consists of the preliminary design drawings for the Space Shuttle vehicle structural components. The drawings represent the preliminary design configurations as of (on or before) June 1973.

Figures 1.1.1 to 1.1.4 present the general configuration and locations for major structural components. Figures 1.2.1 to 1.2.3 illustrate the structural parts for the solid rocket booster, and Figure 1.3.1 represents the external tank.

The Space Shuttle orbiter is conveniently divided into six component assemblies:

1. Mid fuselage (Figures 1.4.1 to 1.4.12)
2. Wing (Figures 1.5.1 to 1.5.4)
3. Forward fuselage and crew compartment (Figures 1.6.1 and 1.6.2)
4. Aft fuselage (Figures 1.7.1 to 1.7.5)
5. Vertical stabilizer (Figures 1.8.1 to 1.8.4)
6. Landing gear (Figures 1.9.1 and 1.9.2)

The maintenance accesses are shown in Figures 1.10.1 to 1.10.5.

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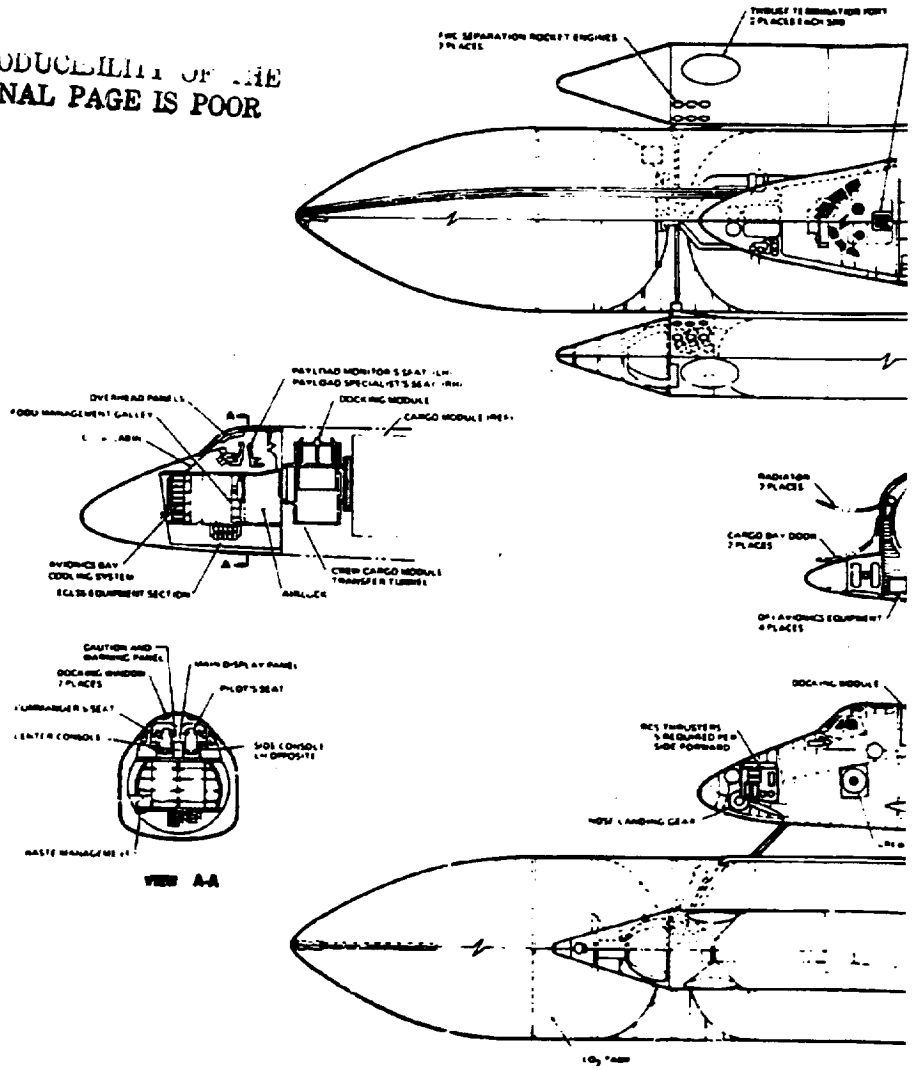
America's Space Shuttle transportation system is paramount in furthering this country's knowledge—bringing our tremendous advancements in space sciences back to Earth as direct be all.

The Shuttle orbiter—the delta-winged flying machine about the size of a medium-range je reusable, cargo-carrying, space airplane with workhorse capabilities. Each Shuttle orbiter can fly



VIEW A-A

country's scientific
direct benefits to us

-range jetliner—is a
can fly a minimum

of 100 missions and can carry to orbit as much as 65,000 pounds of payload and up to four crew members and six passengers. It can return 25,000 pounds of payload to Earth.

Rockwell International Corporation's Space Division is integrating the system and developing the Shuttle's payload-carrying orbiter stage under contract to the National Aeronautics and Space Administration.

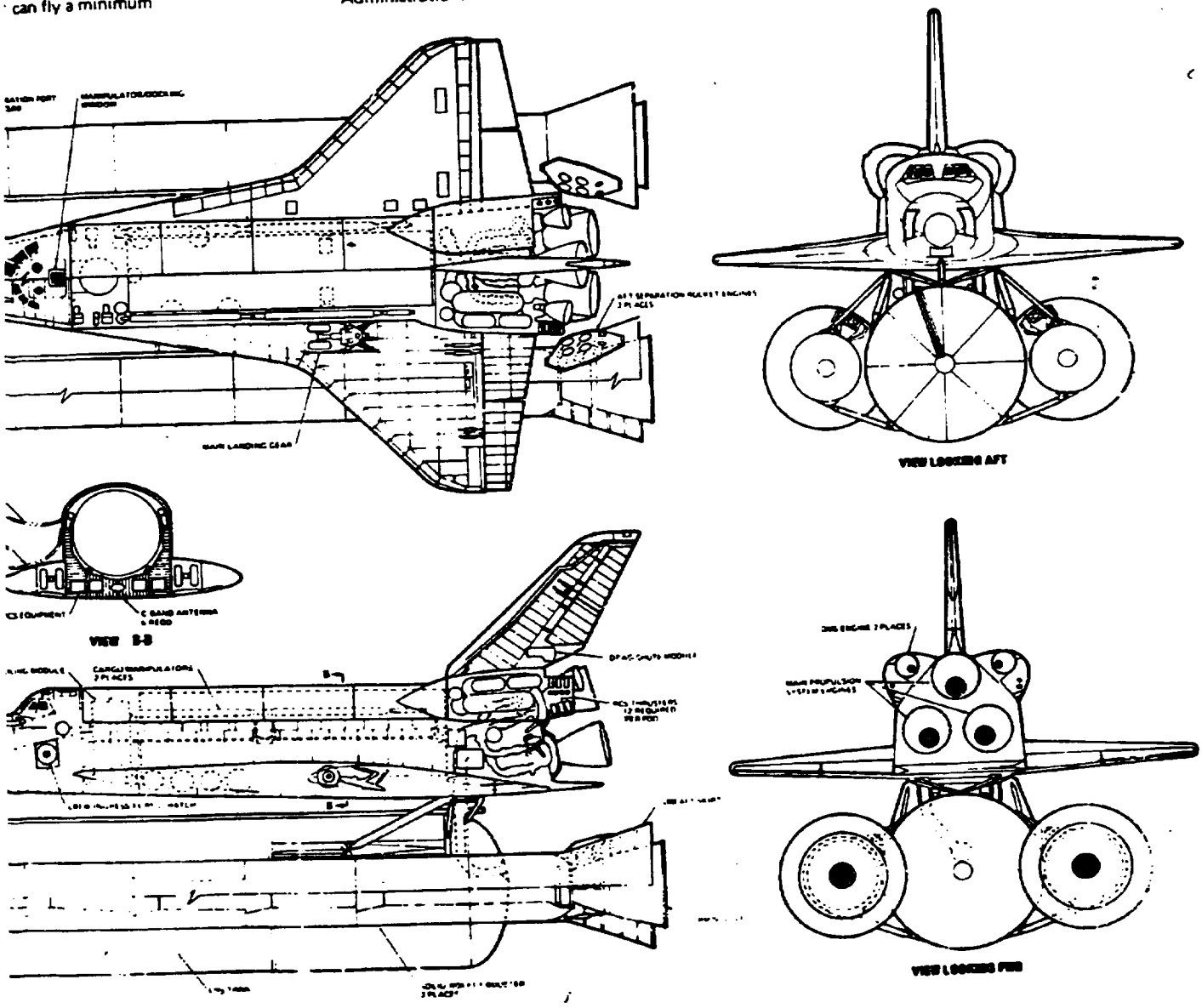
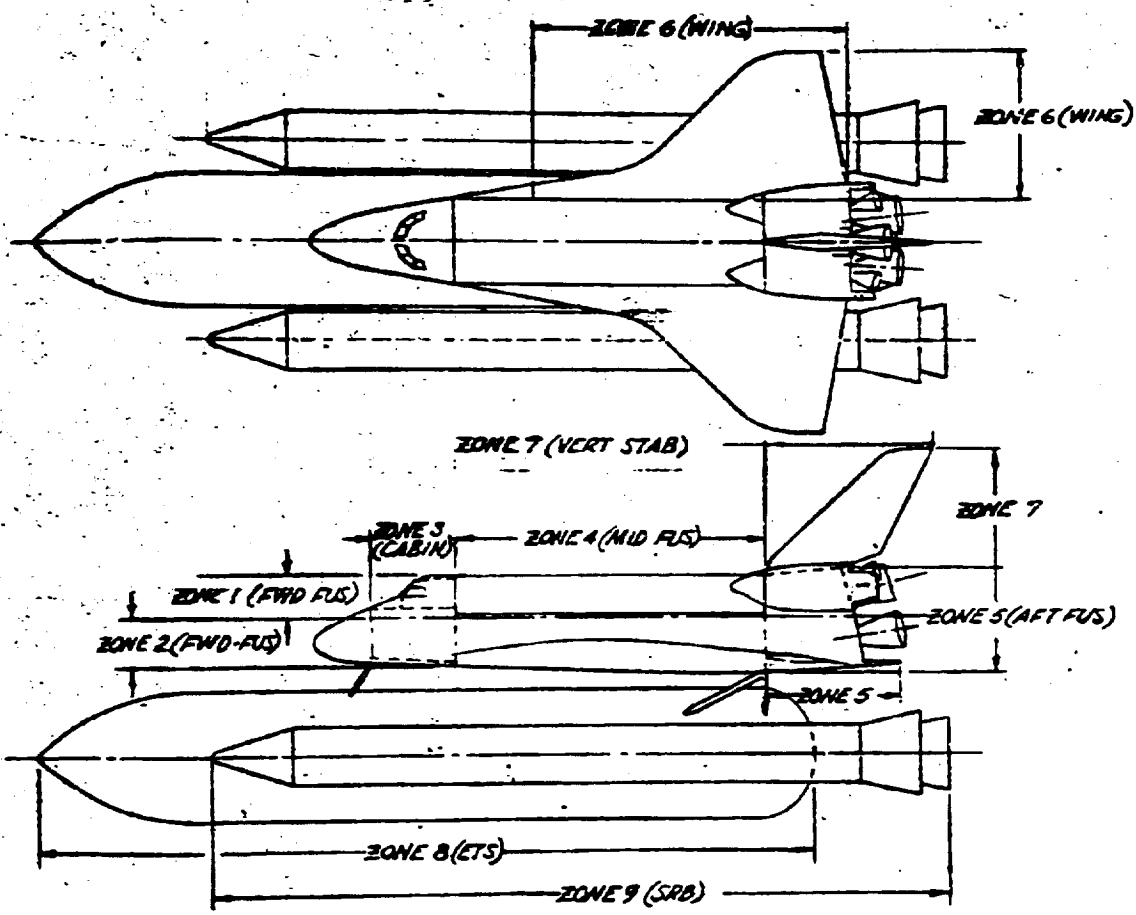


Figure 1.1.1. Space Shuttle System



SHUTTLE AREA ZONE BREAKDOWN

ZONE NU
9

REPRODUCIBILITY OF THE
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FOLDOUT FRAME

SYSTEMS & EQUIPMENT

NUMBER	NOMENCLATURE	REF DWG
	SRM BOOSTER	VL77-000035
901	SRB NOSE CONE	
902	SRB NOSE CONE CORK ABLATOR	
903	MORTAR SHROUD PILOT CHUTE & RISER	
904	MAIN PARACHUTE (96 FT DIA) 6 REQ'D)	
905	DROGUE CHUTE (62 FT DIA) 1 REQ'D	
906	DROGUE CHUTE RISER, ATTACH & DISC	
907	NOSE CONE SEP RELEASE	
908	AVIONICS EQUIPMENT	
910	RECOVERY EQUIP-SEQUENCER, BATTERY & FLASHLIGHT	
911	FWD SEP ROCKET ENG (4 REQ'D PER SRB)	
912	THRUST TERMINATION PORT (2 REQ'D PER SRB)	
913	SRB AFT SKIRT	
914	SRM NOZZLE	
915	GIMBAL HYD ACT (2 REQ'D PER SRM)	
916	GIMBAL ACT HYD RESERVOIR (8 IN. DIA) 1 PER SRM	
917	GIMBAL ACT PRESS TANKS (18 IN. DIA) 2 PER SRM	
918	AFT SEP ROCKET ENG (4 REQ'D PER SRB)	
919	NOSE CONE ATTACH BOLTS	VL77-000036

SYSTE

ZONE	NUMBER	NOM
7		ORBITER - VERTI
	708	DECELERATION C
	709	DECELERATION C
	710	DECELERATION C
	711	RUDDER/SPEED
	712	RUDDER/SP. BRK
	713	VERT APU EXHA
	714	VERT LH_2 EMERG
	715	APU VENT DUC
	716	DUAL MOTOR
	717	RUDDER ACTU
8		ORBITER MAIN PR
	802	ETS LH_2 SE FU
	803	LOX TANK OVERF
	804	LOX TANK GAS
	805	LOX TANK PRES
	806	CRUCIFORM BAFF
	807	ANTI-VORTEX B
	808	LOX FEEDLINE C
	809	LOX AFT TANK
	810	SEP SEQUENCE
	811	ETS - SRB ATT
	812	ETS - SRB ELEC
	813	ETS - SRB ELEC
	814	MULTIPLEXER
	815	BATTERIES -
	816	LH_2 TANK GAS
	817	LH_2 TANK PRES
	818	LH_2 FEEDLINE
	819	MPS ENG CUT
	820	ETS TANK G
	821	LOX OVERBOAR
	822	LH_2 TANK OVE
	823	ETS LOX SE

FRAME
2

SYSTEMS & EQUIPMENT	
NOMENCLATURE	REF DWG
-VERTICAL STABILIZER	VL70-007017
ATION CHUTE STOWAGE COMP	
ATION CHUTE	
ATION CHUTE MORTAR	
SPEED BRAKE HINGE	
SP BRK ELECT HARNESS & DISC	
EXHAUST DUCT	
H_2 EMERG VENT LINE & FLAME HOLDER	
NT DUCT	
MOTORS	VL70-007017
SA ACTUATOR	
MAIN PROP SYS-EXTERNAL TANK SYS	VL78-000091
SE PURGE LINE	
OVERBOARD VENT	
VK GAS DIFFUSER	
VK PROP LOADING PT SENSORS	
PN BAFFLE	
ORTEX BAFFLE	
DLINE OUTLET CONICAL SCREEN	
T TANK LOADING SENSORS	
QUENCER (2 REQ'D)	
RB ATTACH FITTINGS (2 REQ'D)	
B ELECT UMBIL & HARNESS NO. 1	
B ELECT UMBIL & HARNESS NO. 2	
PLEXER & SIG COND (2 REQ'D)	
RIES-LOGIC/PWR (2 REQ'D)	
VK GAS DIFFUSER	
VK PROP LOADING PT SENSORS	
EDLINE OUTLET SCREEN	
NG CUTOFF PT SENSORS	
VK GN_2 CAVITY PURGE LINE	
RBOARD VENT VLV	
VK OVERBOARD VENT LINE	
SE PURGE LINE	

SYSTEMS & EQUIPMEN		
ZONE	NUMBER	NOMENCLATURE
5		ORBITER-AFT FUSELAGE
	518	ECLSS AMMONIA BOILER UNIT
	526	AVIONICS COOLING SYS
	555	OMS FILL, DRAIN/VENT RECEPT
	556	RCS FILL, DRAIN/VENT RECEPT
6		ORBITER-WING
	617	NON-DESTRUCTIVE EQUIP PORTS
	618	ELEVON SEAL
	601	WING TO FUS ATTACH FITTING
	602	MAIN LANDING GEAR ASSY (2 REQ'D)
	603	WING LEADING EDGE ATTACH FITTI
	604	ILS ANTENNA NO. 2 (ANT ON RH STA
	605	ILS ANTENNA NO. 3 (ANT ON LH STA
	607	WING ACT ELECT HARNESS & DISC
	608	ELEVON HINGES LH & RH
	609	ELEVON ACT ASSY (2 PER WING)
	610	ELEVON HYD LINE
	611	MAIN SERVO ACT SYS
	612	MAIN LDG GR ELECT HARNESS & DISC
	613	MAIN LDG GR HYD LINES & DISC
	614	SERVO VALVE
	615	INSTR TERMINAL BOARD
	616	WING FRONT SPAR
7		ORBITER-VERTICAL STABILIZER
	701	VHF ANTENNA
	702	MECH ROTARY SPEED BRAKE A.
	703	DIFFERENTIAL GEAR BOX
	704	4 CHANNEL SERVO
	705	FLT RECORDER
	706	RIGHT ANGLE DRIVE
	707	RUDDER SPEED BRK ACT HYD LINES

FRAME 3

ENT		SYSTEMS & EQUIPMENT			
	REF DWG	ZONE	NUMBER	NOMENCLATURE	REF DWG
	VL70-005030	5		ORBITER-AFT FUSELAGE	VL70-006030
			550	WING HYDR INTERFACE PNL NO-2	
			551	MPS ENG HYD. ACTUATOR (2 PER ENG)	
			552	MPS ENG HT SHIELD (3 REQ'D)	
			553	APU EXHAUST DUCT	
			554	APU TURBOPOWER UNIT (4 PLACES)	
			555	APU GENERATOR (4 PLACES)	
	VL70-006077		556	HYD RELIEF VLV-FILTER MODULE (4 PLS)	
			557	HYD RESERVOIR (4 PLACES)	
			559	HYD CIRCULATION MTR PUMP	
			560	HYD WATER BOILER (4 PLACES)	
			~~561~~	~~HYD AIR/OIL COOLER (4 PLACES)~~	
			562	HYD ACCUM (4 PLACES)	
			563	APU FUEL (N_2H_4) TANK (4 REQ'D)	
			~~564~~	~~APU HELIUM TANK (4 REQ'D)~~	
			565	APU TANK FILL, DRAIN & VENT RECEPT	
			566	APU VLV BLEED DUCT	
			567	RADIATOR CONTROL PNL	VL70-005030
			568	OMS POD ATTACH FITTINGS	VL70-005076
			569	OMS HELIUM TANK (2 REQ'D)	
			570	OMS FUEL TANK (2 REQ'D)	
			571	OMS FUEL TANK VENT	
			572	OMS OXIDIZER TANK (2 REQ'D)	
			573	OMS OXIDIZER TANK VENT	
			574	OMS ENG NO. 1	
			575	OMS ENG NO. 2	
	VL70-007017		576	DELTA V KIT CROSSOVER LINE DISC	
			577	RCS THRUSTERS (12 PER POD)	
			578	RCS PROPELLANT TANK (2 PER POD)	
			579	RCS HELIUM TANK (2 REQ'D)	VL70-005076
			580	MPS ENG NO. 1	VL70-005030
			581	MPS ENG NO. 2	
			582	MPS ENG NO. 3	
	VL70-007017		583	MPS ELECT WIRING & DISC	VL70-009830

FRAME

REF DWG	SYSTEMS & EQUIPMENT				ZONE	N
	ZONE	NUMBER	NOMENCLATURE	REF DWG		
VL70-005030	5		ORBITER-AFT FUSELAGE	VL70-005030	4	
		516	AVIONICS BAY NO.4 (34x44.5x36)			
		517	AVIONICS BAY NO.5 (34x44.5x36)			
		518	AVIONICS BAY NO.6 (34x44.5x36)			
		519	PAYLOAD FUEL INTERFACE PNL			
		520	MPS LH_2 RECIRC. PUMP			
		521	MPS LH_2 UMBILICAL PNL			
		522	MPS LH_2 FILL & DRAIN DISC			
		523	MPS LH_2 TANK HELIUM PRE-PRESS DISC			
		524	MPS LH_2 TANK VENT DISC			
		525	MPS STATIC GRD JACK			
		526	GN_2 GRD PURGE VEHICLE CAVITIES DISC			
		527	GRD ELECT PWR DISC			
		528	SE FLYAWAY UMBIL COMM INSTR GN&C			
		529	MPS LH_2 DUMP LINE			
		531	MPS LOX UMBILICAL PNL			
		532	MPS LOX FILL & DRAIN DISC			
VL70-005030		533	MPS LOX TANK HELIUM PRE-PRESS DISC			
VL70-005076		534	MPS LOX DUMP LINE		5	
		535	MPS LOX OVERBOARD BLEED DISC			
		536	MPS HELIUM SUPPLY DISC			
		537	MPS GN_2 ENGINE PURGE DISC			
		538	GRD ELECT PWR DISC			
		539	SE FLYAWAY COMM INSTR GN&C			
		540	ETS-ORBITER AFT ATTACH MECH NO.1			
		541	ETS-ORBITER AFT ATTACH MECH NO.2			
		542	LH_2 FEEDLINE EMERG VENT LINE			
		543	LOX PRESS LINE & DISC (2 IN. DIA)			
		544	PNEUMATIC SUBSYS HELIUM TANKS (3 REQD)			
VL70-005076		545	APU FUEL TANK MODULE NO.1			
VL70-005030		546	APU FUEL TANK MODULE NO.2			
		547	WING ELECT INTERFACE PNL NO.1			
		548	WING ELECT INTERFACE PNL NO.2			
VL70-005030		549	WING HYDR INTERFACE PNL NO.1	VL70-005030		

FOLDOUT FRAME 5

SYSTEMS & EQUIPMENT

ZONE	NUMBER	NOMENCLATURE	REF DWG
4		ORBITER MID FUSELAGE	VL70-004032
	484	ECLSS GO_2 SUPPLY DISC	
	485	ECLSS COOLANT INLET NO. 1	
	486	ECLSS COOLANT INLET NO. 2	
	487	ECLSS COOLANT RETURN NO. 1	
	488	ECLSS COOLANT RETURN NO. 2	
	489	ECLSS FUEL CELL LOX FILL NO. 1	
	490	ECLSS FUEL CELL LOX FILL NO. 2	
	491	ECLSS FUEL CELL LOX VENT NO. 1	
	492	ECLSS FUEL CELL LOX VENT NO. 2	
	493	FLOOD LIGHT (2 REQ'D)	
	494	TV CAMERA (2 REQ'D)	
	495	PURGE & VENT LINES	
	496	ECLSS HYD & ELECT PWR SYS LINES (LH & RH	
	498	AFT FUS-WING ATTACH FITTING	VL70-004032
5		ORBITER - AFT FUSELAGE	VL70-005030
	501	MPS LH_2 FEEDLINE	
	502	MPS LOX FEEDLINE	
	503	MPS ENG NO. 1 LH_2 FEED MANIFOLD	
	504	MPS ENG NO. 1 LOX FEED MANIFOLD	
	505	MPS ENG NO. 2 LH_2 FEED MANIFOLD	
	506	MPS ENG NO. 2 LOX FEED MANIFOLD	
	507	MPS ENG NO. 3 LH_2 FEED MANIFOLD	
	508	MPS ENG NO. 3 LOX FEED MANIFOLD	
	509	WING PURGE DUCT (LH & RH REQ'D)	
	510	FWD CARGO BAY PURGE DUCT (5 IN DIA)	
	511	MPS LH_2 RECIRC LINE	
	512	MPS LH_2 VENT/PRESS LINE & DISC	
	513	MPS ORBITER - ETS ELECT HARNESS	
	514	MPS ETS-OMS LOX DUCT SEP INTERFACE UMBIL	
	515	MPS ETS-OMS LH_2 DUCT SEP INTERFACE UMBIL	VL70-005030

ZONE	NUMBER	
4		ORBITE
	452	C-BA
	453	C-BA
	454	CARG
	455	MAN
	456	MAN
	457	MANI
	458	DOCK
	459	CARG
	460	CARG
	461	CARG
	462	CARG
	463	CARG
	464	PAYL
	465	PAYL
	466	RADI
	467	RADI
	468	RADI
	469	RADI
	470	RADI
	471	RADI
	472	RADI
	473	RADI
	474	RADI
	475	HT S
	476	TPF
	477	CARG
	497	ECLS
	478	ECLS
	479	ECL
	480	ECL
	481	ECL
	482	ECL
	483	ECL

FOLDOUT FRAME 6

SYSTEMS & EQUIPMENT	
NOMENCLATURE	REF DWG
ORBITER MID FUSELAGE	VL70-004033
C-BAND ANTENNA NO.5	
C-BAND ANTENNA NO.6	
~~CARGO SERVICING PNL NO.2~~	
MANIPULATOR	
~~MANIPULATOR NO.2~~	
MANIPULATOR LATCHES	
DOCKING MODULE	
CARGO BAY DOOR LATCHES (16 REQ'D)	
CARGO BAY DOOR HINGE ACT	
CARGO BAY DOOR HINGE DRIVE UNIT	
CARGO BAY DOOR HINGE	
CARGO BAY TORQUE TUBE	
PAYLOAD RESTRAINT ATTACH MECH.	
PAYLOAD RETENTION DRIVE UNIT	
RADIATOR PANEL NO. 1	
RADIATOR PANEL NO. 2	
RADIATOR PANEL NO.3	
RADIATOR PANEL NO.4	
RADIATOR PANEL NO.5	
RADIATOR PANEL NO.6	
RADIATOR PANEL NO.7	
RADIATOR PANEL NO.8	
RADIATOR PNL HINGES	
HT SINK INTAKE/OUTLET ORIFICE (10 PLACES)	
RF TUNNEL - CARGO MODULE	
CARGO MODULE (REF)	
ECLSS GROUND COOLANT CONN	
ECLSS GH_2 SUPPLY DISC	
ECLSS FUEL CELL LH_2 VENT NO.1	
ECLSS FUEL CELL LH_2 VENT NO.2	
ECLSS HYDROGEN RELIEF	
ECLSS FUEL CELL LH_2 FILL NO.1	
ECLSS FUEL CELL LH_2 FILL NO.2	VL70-004032

SYSTEMS & EQUIP		
ZONE	NUMBER	NOMENCLATURE
4		ORBITER MID FUSELAGE
	418	ECLSS FREON VLV MODULE
	419	H_2 MANIFOLD VLV MODULE
	420	O_2 MANIFOLD VLV MODULE
	421	H_2 MANIFOLD VLV MODULE
	422	O_2 MANIFOLD VLV MODULE
	423	BLKHD LINES FEED THROUGH U
	424	BLKHD LINES FEED THROUGH U
	425	BLKHD LINES FEEDTHROUGH U
	426	BLKHD LINES FEED THROUGH U
	427	ECLSS UMBILICAL PNL
	428	~~ECLSS UMBILICAL PNL NO.2~~
	429	CARGO SERVICING PNL
	430	L-BAND ANTENNA
	431	VHF ANTENNA
	432	WASTE MGT VACCUUM VENT
	433	AVIONICS BAYS PRESS RELI
	434	NITROGEN PRESS RELIEF
	435	WATER PRESS RELIEF
	436	URINE DUMP NO.1
	437	URINE DUMP NO.2
	438	PGS SUPERCRITICAL LOX T
	439	PGS SUPERCRITICAL LH_2 TA
	440	PGS SUPERCRITICAL LOX TA
	441	PGS SUPERCRITICAL LH_2 TA
	443	CARGO BAY LINER
	444	DFI AVIONICS EQUIP RACK NO
	445	DFI AVIONICS EQUIP RACK NO.
	446	DFI AVIONICS EQUIP RACK NO
	447	DFI AVIONICS EQUIP RACK N
	448	C-BAND ANTENNA NO. 1
	449	C-BAND ANTENNA NO.2
	450	C-BAND ANTENNA NO.3
	451	C-BAND ANTENNA NO.4

ENT		SYSTEMS & EQUIPMENT			
	REF DWG	ZONE	NUMBER	NOMENCLATURE	REF DWG
	VL70-004032	3		CREW CABIN	
			367	WASTE COLLECTOR	VL70-000291 SH 1
2.1			368	POTABLE WATER TANK NO. 1	
21			369	POTABLE WATER TANK NO. 2	
NO.2			370	WASTE LIQUID SEP SYS	
NO.2			371	ECLSS COOLANT PUMP SYS	
BIL NO.1			372	WASTE WATER TANKS (3 REQ'D)	
BIL NO.2			373	CABIN AIR RETURN DUCT	
BIL NO.3			374	CABIN AIR SUPPLY DUCT	VL70-003[illegible]
BIL NO.4			375	ELECT WIRING HARNESS & CONN	
		4		ORBITER MID FUSELAGE	VL70-004032
			401	ECLSS FUEL CELL PWR PLANT NO.1	
			402	ECLSS FUEL CELL PWR PLANT NO.3	
			403	ECLSS FUEL CELL PWR PLANT NO.2	
			404	ECLSS PAYLOAD HT EXCHANGER	
VK NO.1			405	ECLSS FREON PUMPS & ACCUM MODULE	
K NO.1			406	ECLSS SUBLIMATOR NO.1	
VK NO.2			407	ECLSS SUBLIMATOR NO.2	
K NO.2			408	ECLSS FREON VLV MANIFOLD	
			409	ECLSS INTERCHANGER	
.1			410	ECLSS FUEL CELL HT EXCH	
2			411	ECLSS FUEL CELL SERVICE PNL	
3			412	ECLSS GSE HT EXCH	
24			413	ECLSS HIGH PRESS O_2 TANK NO.1	
			414	ECLSS HIGH PRESS N_2 TANK NO.1	
			415	ECLSS HIGH PRESS N_2 TANK NO.2	
			416	ECLSS HIGH PRESS N_2 TANK NO.3	
	VL70-004032		417	EPS VLV MODULE (4)	VL70-004032

SYSTEMS & EQUIPMENT

ZONE	NUMBER	NOMENCLATURE	REF DWG
3		CREW CABIN	
	334	PILOT'S DOCKING OBSERVATION WINDOWS	
	335	CMDR'S "	
	338	PAYLOAD MONITOR DISPLAY PNL, SIDE	
	339	MISSION SPEC DISPLAY PANEL, SIDE	
	340	PAYLOAD MONITOR'S SEAT	
	341	MISSION SPECIALIST'S SEAT	
	342	PAYLOAD MONITOR VERT PNL	
	343	MISSION SPEC VERT PNL	
	344	PAYLOAD MONITOR CTR CONSOLE	
	345	PAYLOAD MONITOR LH SIDE CONSOLE	
	346	PAYLOAD MONITOR RH SIDE CONSOLE	
	347	CARGO MANIPULATOR CONTROLS	
	348	~~CARGO BAY OBSERVATION WINDOW~~	
	349	SPEED BRAKE CONTROL	
	350	ROTATION CONTROL LEVEL (2 REQ'D	
	351	MASTER POWER CONTROL LEVEL	
	352	TRANSLATION CONTROL LEVEL	
	353	AVIONICS BAY NO. 3	
	354	AVIONICS BAY NO. 2	
	355	AVIONICS BAY NO. 1	
	356	AIRLOCK	
	357	WASTE MANAGEMENT & HYGIENE FAC	
	358	FOOD MANAGEMENT GALLEY	
	359	LIOH CANISTERS STOWAGE (28 REQ'D)	
	360	LIOH CANISTERS-ACTIVE (2 REQ'D)	
	361	CABIN TEMP CTRL & CO_2 ABSORBER ASSY	
	362	AVIONICS BAY NO. 2 COOLING SYS	
	363	AVIONICS BAY NO. 1 COOLING SYS	
	364	AVIONICS BAY NO. 3 COOLING SYS	
	365	AVIONICS BAY AIR RETURN DUCT (4 REQ'D)	
	366	AVIONICS BAY AIR INLET DUCT (3 REQ'D)	

ZONE	NUMBER	
3		CREV
	301	CUPO
	302	CUPO
	303	CUPO
	304	CRT
	305	OVE
	306	OVE
	307	OVE
	308	MAIN
	309	CAUT
	310	CENT
	311	LH
	312	RH
	313	DSI
	314	PIL
	315	CMD
	316	PILO
	317	CM
	318	TRN
	319	LH
	320	RH
	321	FLT
	322	DISI
	323	DSI
	324	CTRL
	325	CTRL
	326	RH
	327	LH
	328	RH
	329	LH
	330	OVE
	331	CAB
	332	FUS
	333	LH

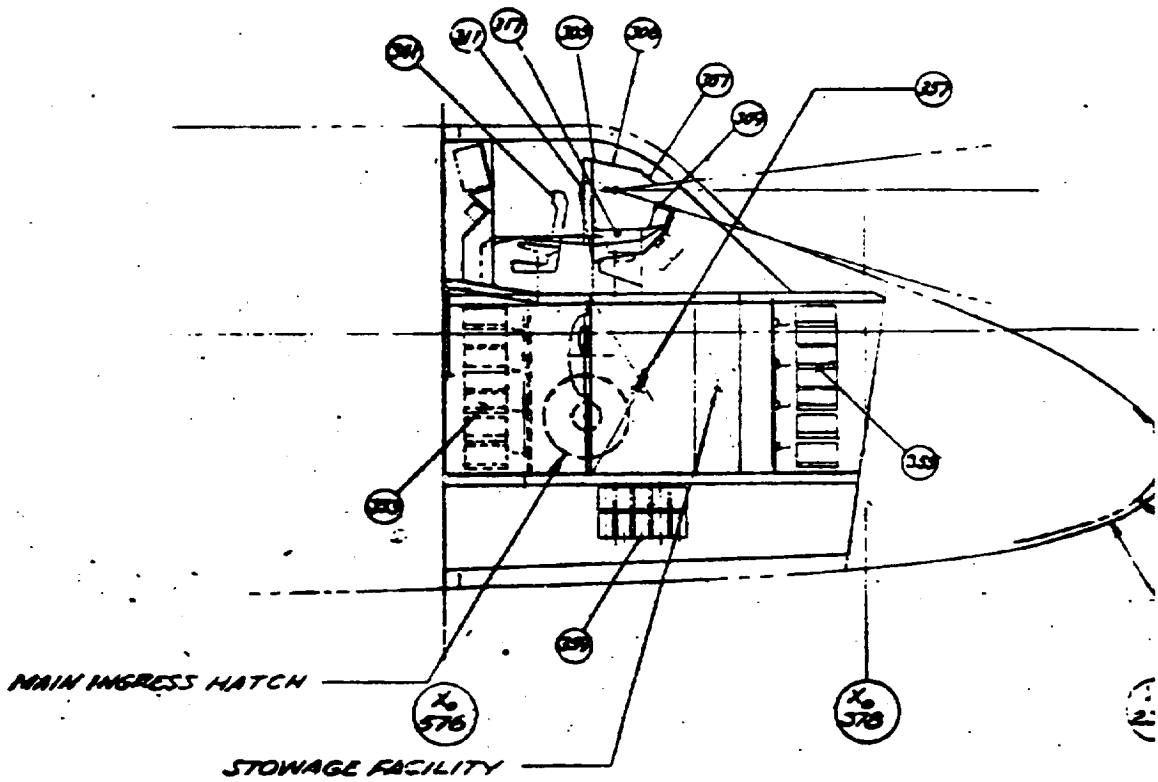
SYSTEMS & EQUIPMENT	
NOMENCLATURE	REF DWG
CREW CABIN	VL70-003018 VL70-003217 VL70-003218
~~CUPOLA AFT OBSERVATION WINDOW~~	
~~CUPOLA FWD OBSERV/EMERG EGRESS HATCH~~	
~~CUPOLA SIDE WINDOWS (LH & RH)~~	
CRT DISPLAY HOUSING (2 REQ'D)	
OVERHEAD AFT CONSOLE	
OVERHEAD FWD CONSOLE	
OVERHEAD EYEBROW CONSOLE	
MAIN DISPLAY PANEL	
CAUTION WARNING PANEL	
CENTER CONSOLE	
LH SIDE CONSOLE	
RH SIDE CONSOLE	
DISPLAY PROCESSOR (3 REQ'D)	
PILOT'S RUDDER PEDALS	
CMDR'S RUDDER PEDALS	
PILOT'S SEAT	
CMDR'S SEAT	
TRANSVERSE AIR DUCTING	
LH VERTICAL PANEL	
RH VERTICAL PANEL	
FLT CONTROL	
DISPLAY/COUPLER DRIVER UNIT (RH INSTL)	
DISPLAY/COUPLER DRIVER UNIT (LH INSTL)	
CTRL ENCODER/COUPLER UNIT (RH INSTL)	
CTRL ENCODER/COUPLER UNIT (LH INSTL)	
RH CIRCUIT BREAKER & SWITCH PNL	
LH CIRCUIT BREAKER & SWITCHES/CTRL	
RH SIDE CONSOLE SWITCHES & CONTROLS	
LH SIDE CONSOLE SWITCHES & CONTROLS	
OVERHEAD CONSOLE SW & CTRL UNIT	
CABIN INTERNAL WINDOWS	
FUSELAGE FWD THERMAL WINDOWS	
LH SIDE PANEL	

SYSTEMS & E		
ZONE	NUMBER	NOMENCLA.
1		ORBITER - UPPER FWD
	101	RCS - FILL, DRAIN & VE
	102	INERTIAL MEASUREMEN
	103	PITOT STATIC PRESS
	104	STARTRACKER (3 REQ'
	105	L-BAND ANTENNA (L
	106	C-BAND ANTENNA (A
	107	S-BAND ANTENNA (L
	108	S-BAND ANTENNA (L
	109	OVERHEAD OBSERVATI
	110	VHF ANTENNA NO.
	111	VHF ANTENNA NO.
	112	PITOT STATC PRESS
2		ORBITER - LOWER FWD
	201	NOSE LANDING GEAR
	202	ILS ANTENNA
	203	RCS THRUSTERS (6 REQ'D.
	204	RCS PROPELLANT T
	205	RCS HELIUM TANKS (
	206	HATCH-CREW TO CABI
	207	HATCH ACTUATOR AS
	208	HATCH HINGE ASSY
	209	HATCH LATCHES
	210	HATCH MANUAL DRIV
	211	S-BAND ANTENNA (L
	212	S-BAND ANTENNA (L
	213	AUDIO UMBIL PHONE
	214	GROUND ELECT PWR CO
	215	RCS MODULE ATTACH
	216	NOSE RCS DEPLOY DOO
	217	NOSE RCS PROP DISC
	218	NOSE RCS VLV INSTL

Figure 1. I. 2. Space St

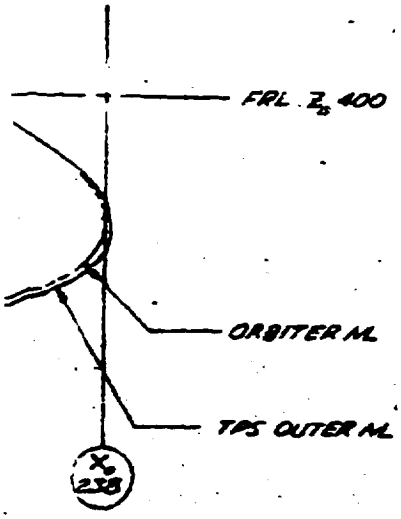
SYSTEMS & EQUIPMENT			
ZONE	NUMBER	NOMENCLATURE	REF DWG
1		ORBITER - UPPER FWD FUSELAGE	VL70-001043
	101	RCS - FILL, DRAIN & VENT RECEPTACLE	
	102	INERTIAL MEASUREMENT UNIT	
	103	PITOT STATIC PRESS TUBE NO. 1	
	104	STARTRACKER (3 REQ'D)	
	105	L-BAND ANTENNA (LH SIDE)	
	106	L-BAND ANTENNA (RH SIDE)	
	107	S-BAND ANTENNA (LH SIDE)	
	108	S-BAND ANTENNA (RH SIDE)	
	109	OVERHEAD OBSERVATION WINDOW	
	110	VHF ANTENNA NO. 2	
	111	VHF ANTENNA NO. 1	
	112	PITOT STATC PRESS TUBE NO. 2	
2		ORBITER - LOWER FWD FUSELAGE	VL70-001062
	201	NOSE LANDING GEAR & SYSTEMS	
	202	ILS ANTENNA	
	203	RCS THRUSTERS (8 REQ'D PER SIDE)	
	204	RCS PROPELLANT TANKS 4 REQ'D	
	205	RCS HELIUM TANKS (2 REQ'D)	
	206	HATCH - CREW TO CABIN INGRESS/EGRESS	
	207	HATCH ACTUATOR ASSY	
	208	HATCH HINGE ASSY	
	209	HATCH LATCHES	
	210	HATCH MANUAL DRIVE GEAR BOX	
	211	S-BAND ANTENNA (LH SIDE)	
	212	S-BAND ANTENNA (RH SIDE)	
	213	AUDIO UMBIL PHONE JACK	
	214	GROUND ELECT PWR CONN	
	215	RCS MODULE ATTACH BOLTS	
	216	NOSE RCS DEPLOY DOOR HINGES	
	217	NOSE RCS PROP DISC	
	218	NOSE RCS VLV INSTL	

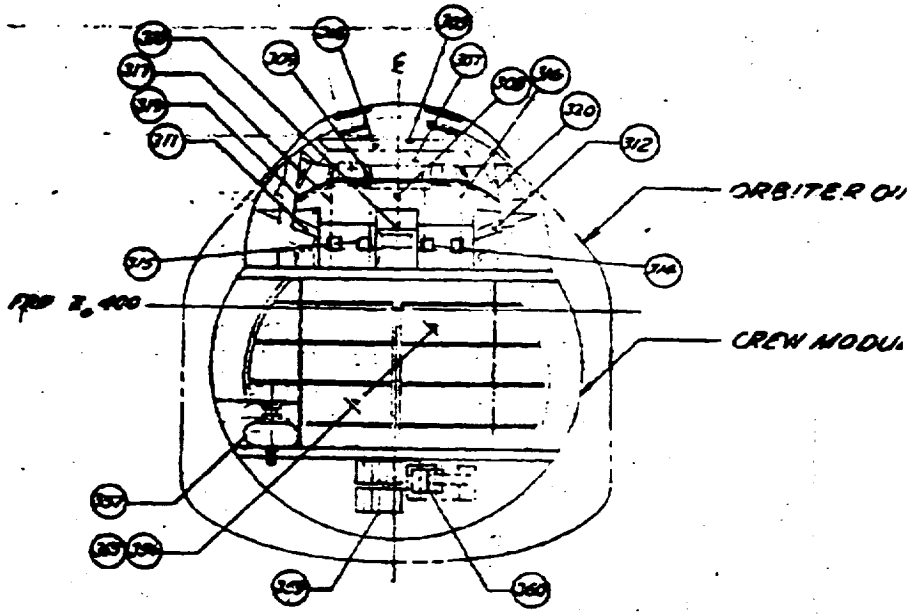
Figure 1. I. 2. Space Shuttle System



VIEW F - F

JT FRAME





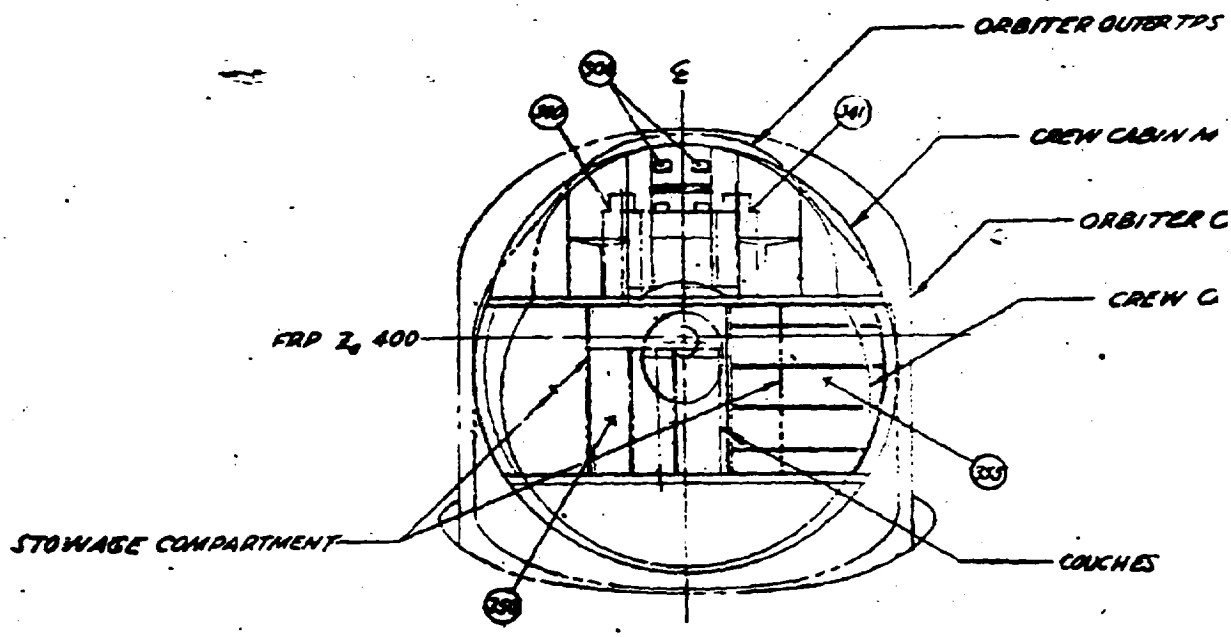
VIEW H-H 26

FOLDOUT FRAME

2

BITER OUTER TPS M AT STA X,500 REF

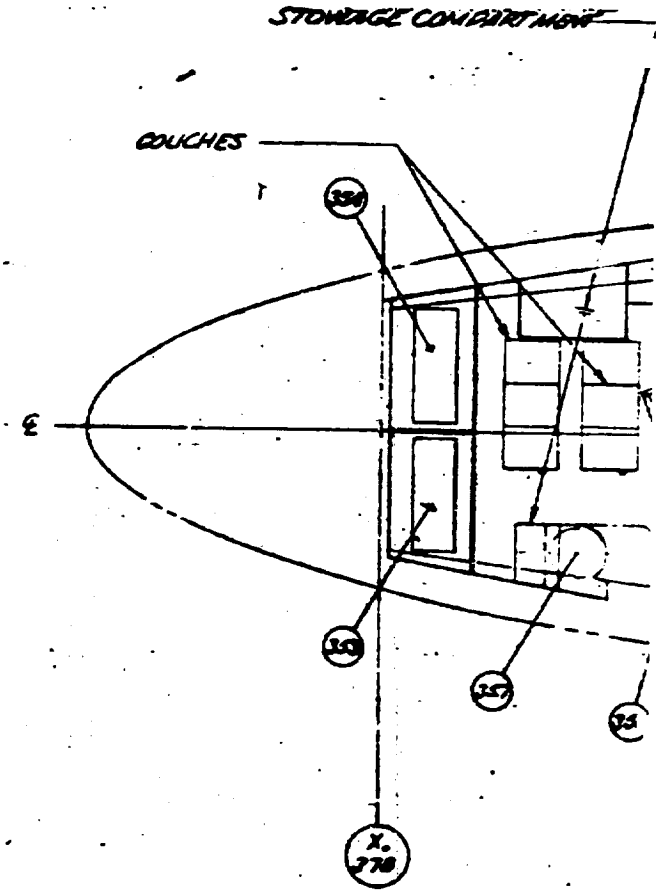
REW MODULE ML AT STA X,500



VIEW G-G

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

OUTBOARD FRAME



VIEW E-E 56

TPS ML REF @ STA X_o 500

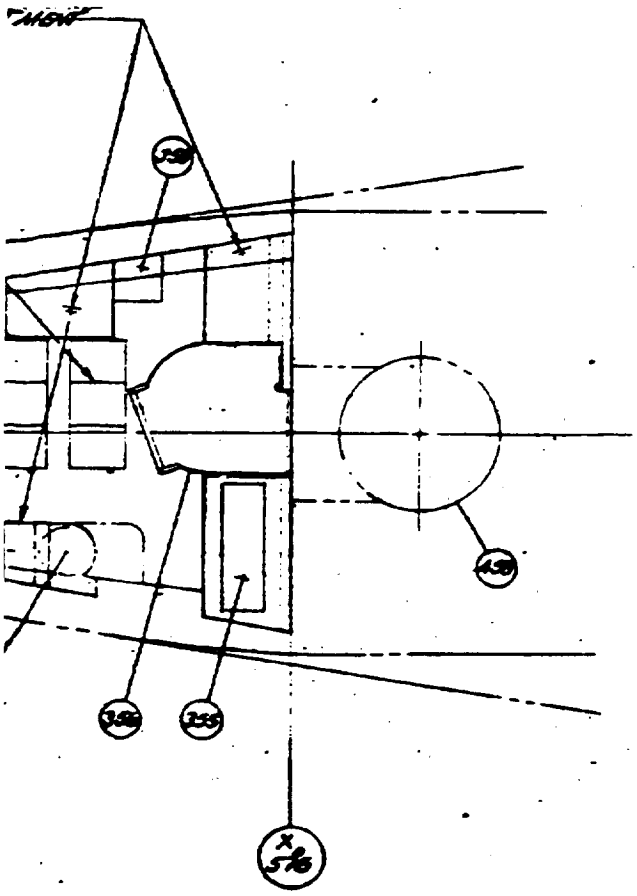
MODULE ML AT STA X_o 576

OUTER TPS ML REF AT X_o 560

CABIN MODULE ML AT STA X_o 500

UT FRAME

4



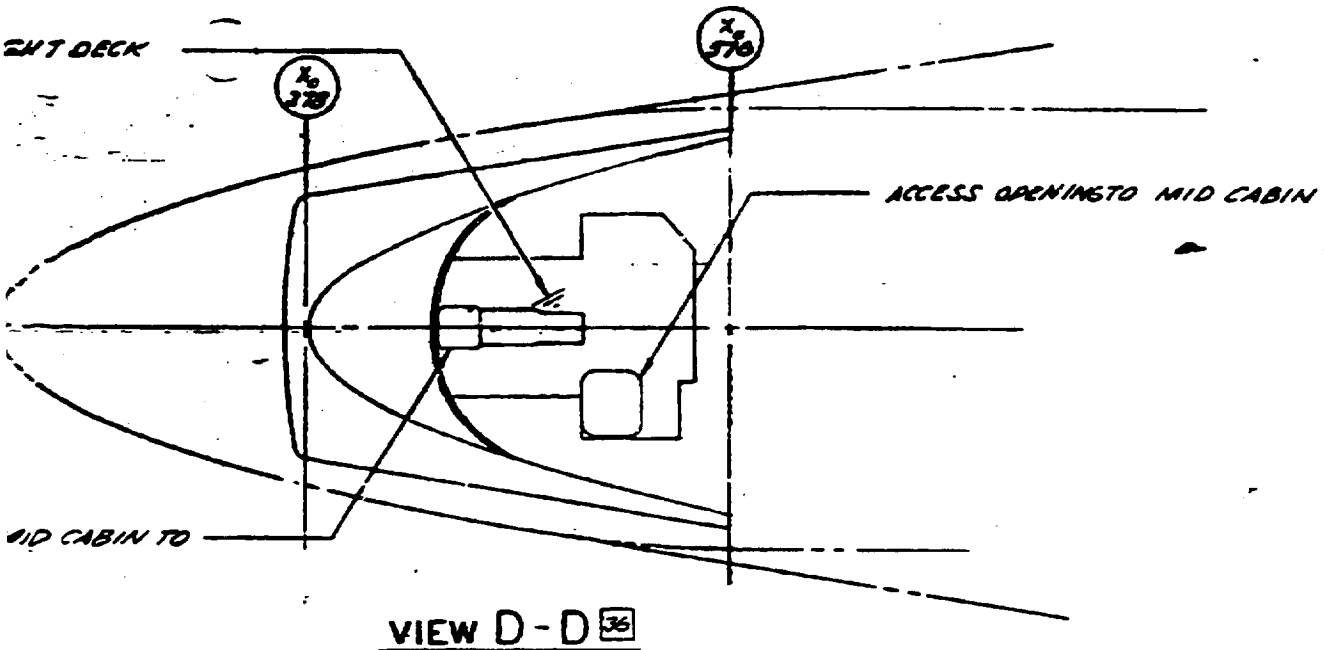
FLIGHT

ACCESS OPENING FROM MID AFT MAIN INSTR PNL

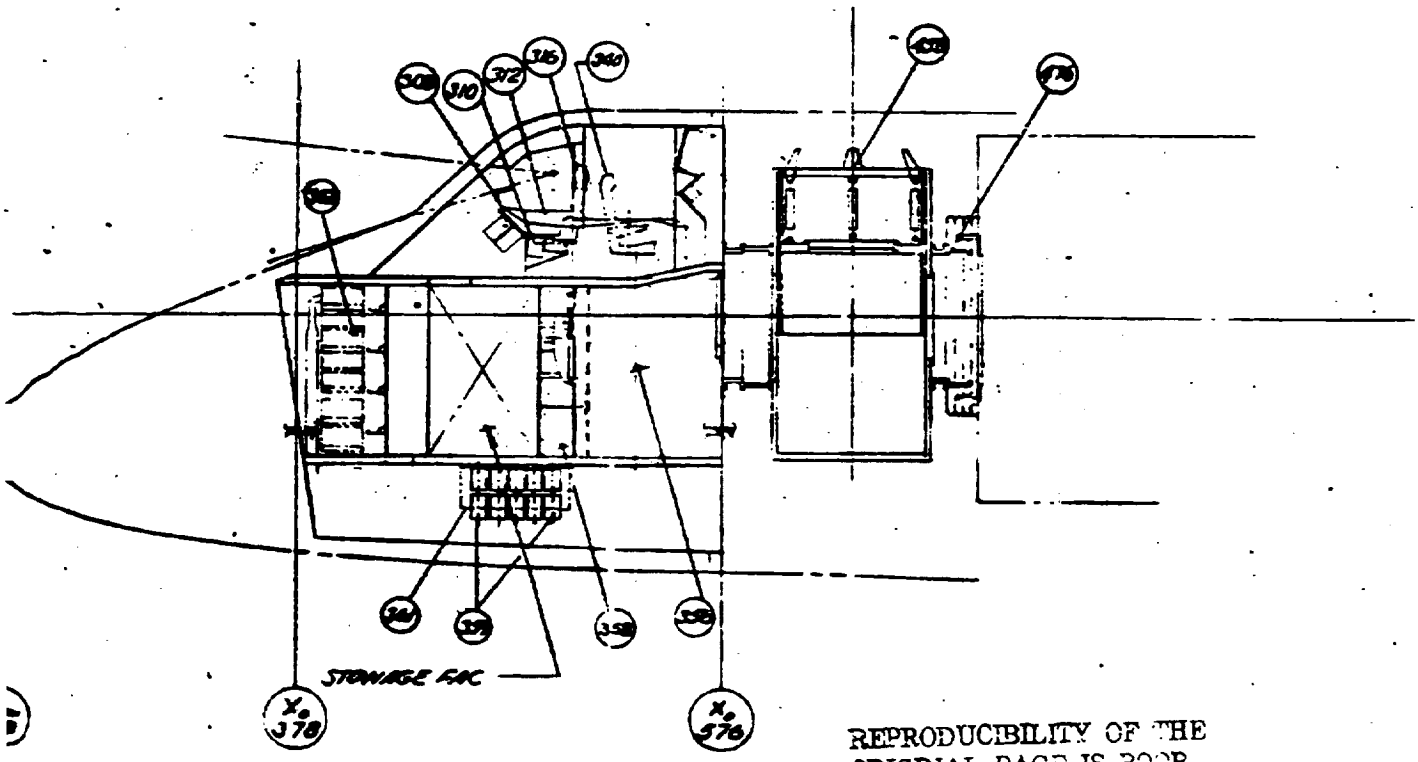
FRL 2400

X 258

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR



VIEW D-D [36]



VIEW C-C [36]

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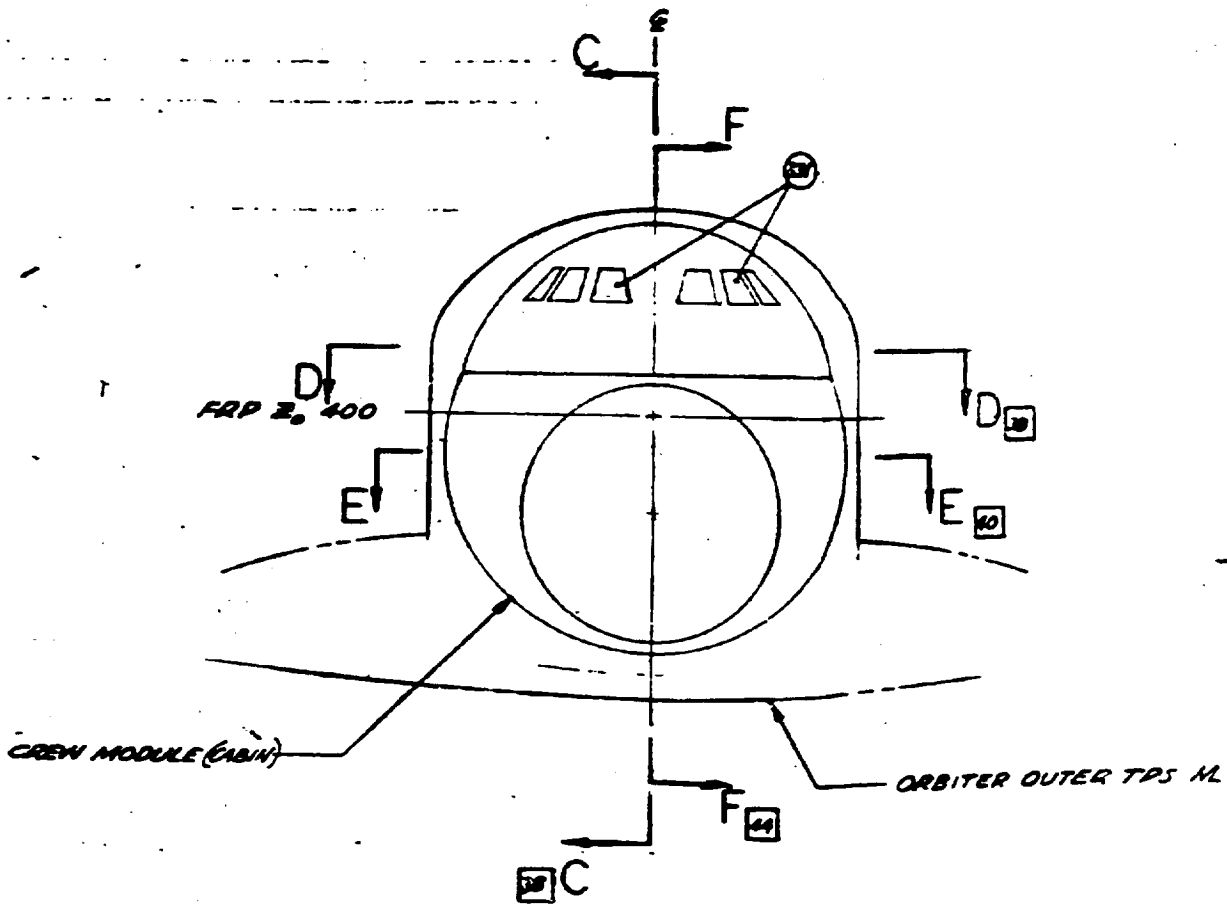


VIEW CREW MODULE LOOKING AFT

Figure 1. 1. 3.

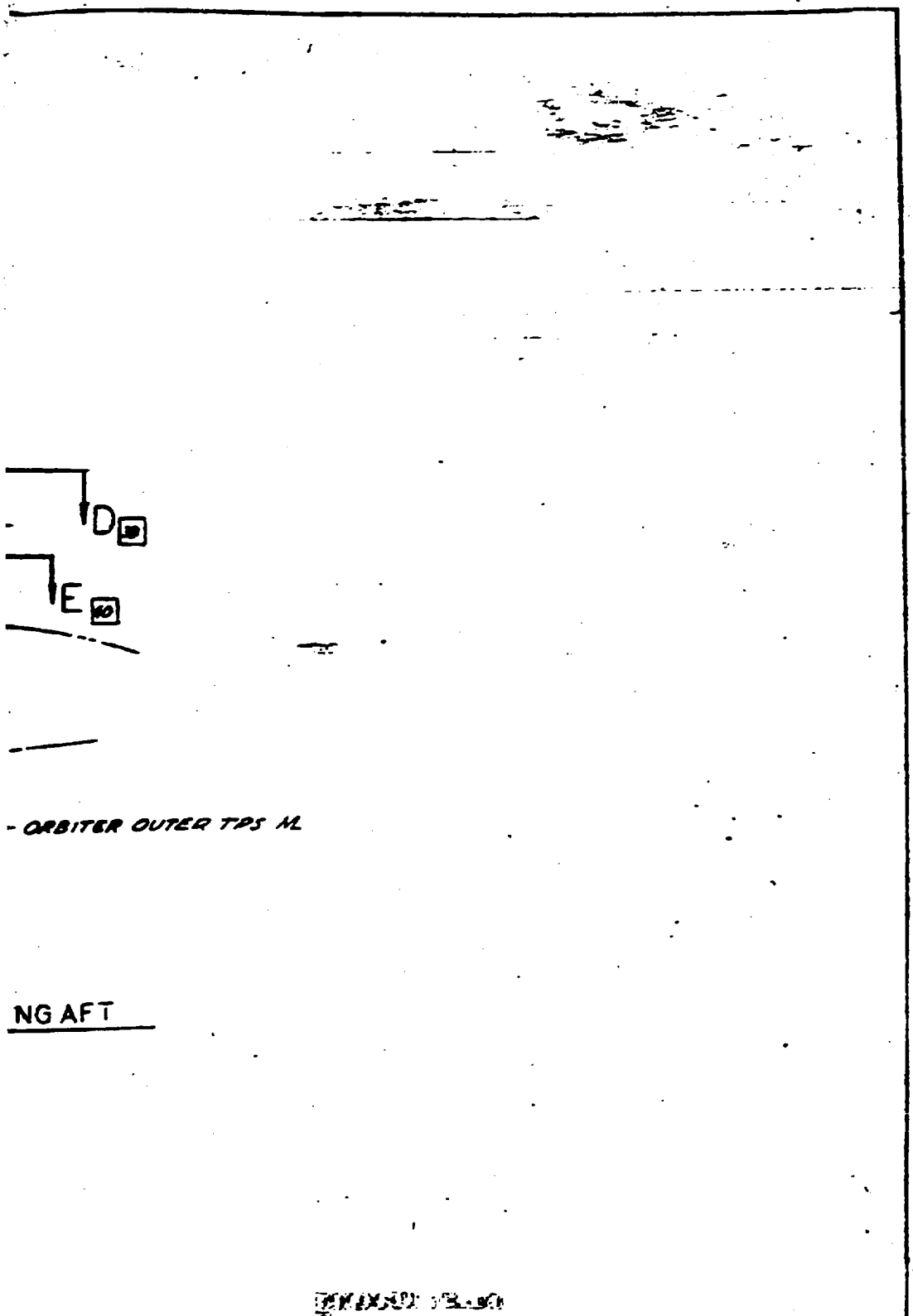
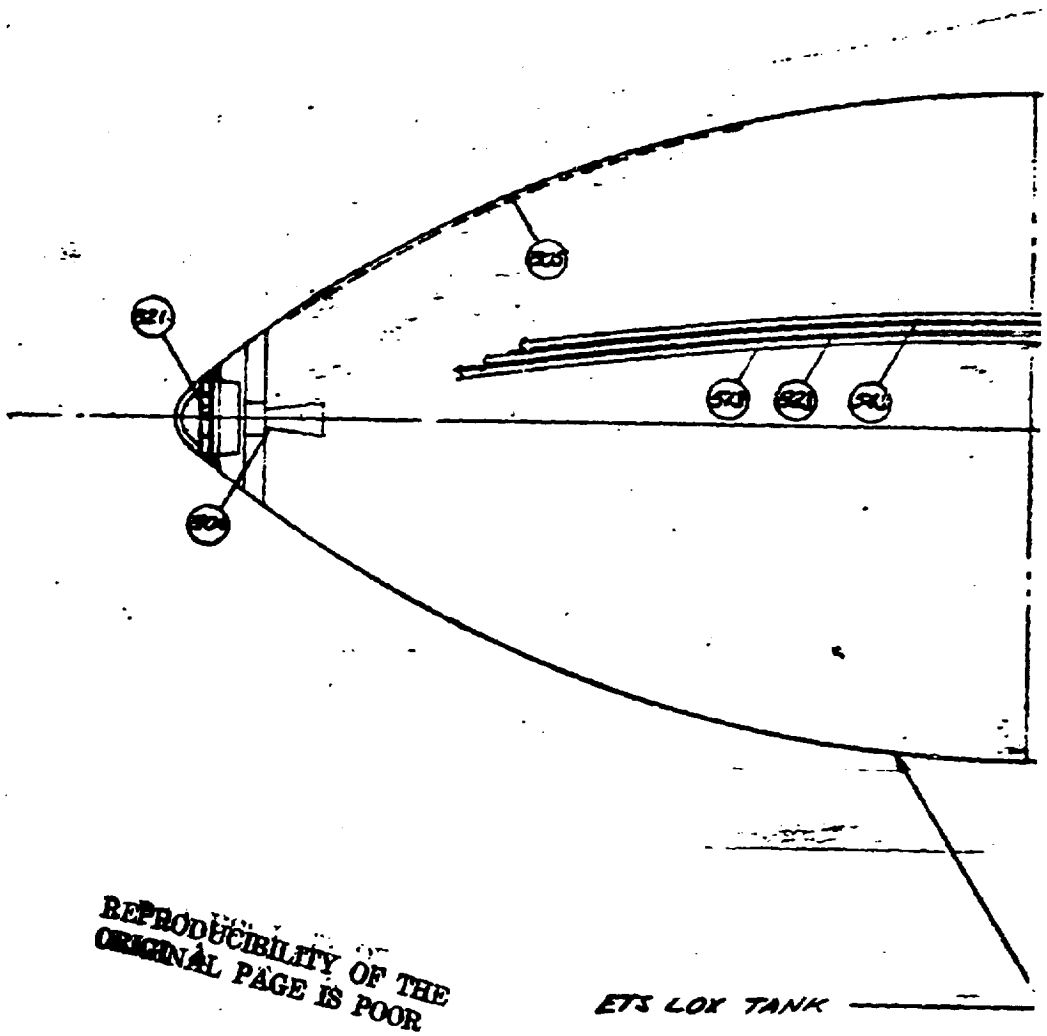


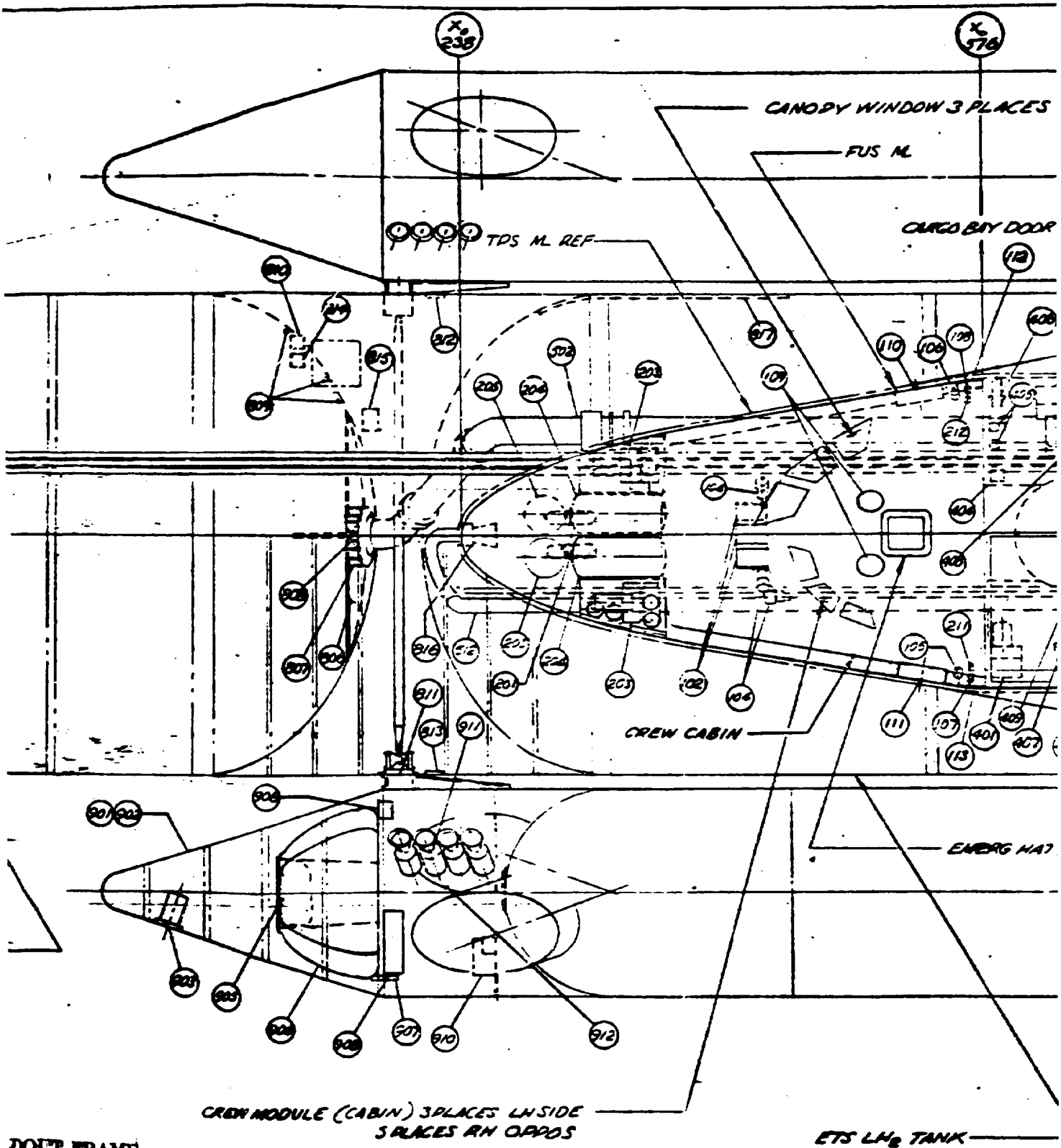
Figure 1.1.3. Space Shuttle System.



REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

ETS LOX TANK

FOLDOUT FRAME



DOUT FRAME

REPRODUCIBILITY OF THE
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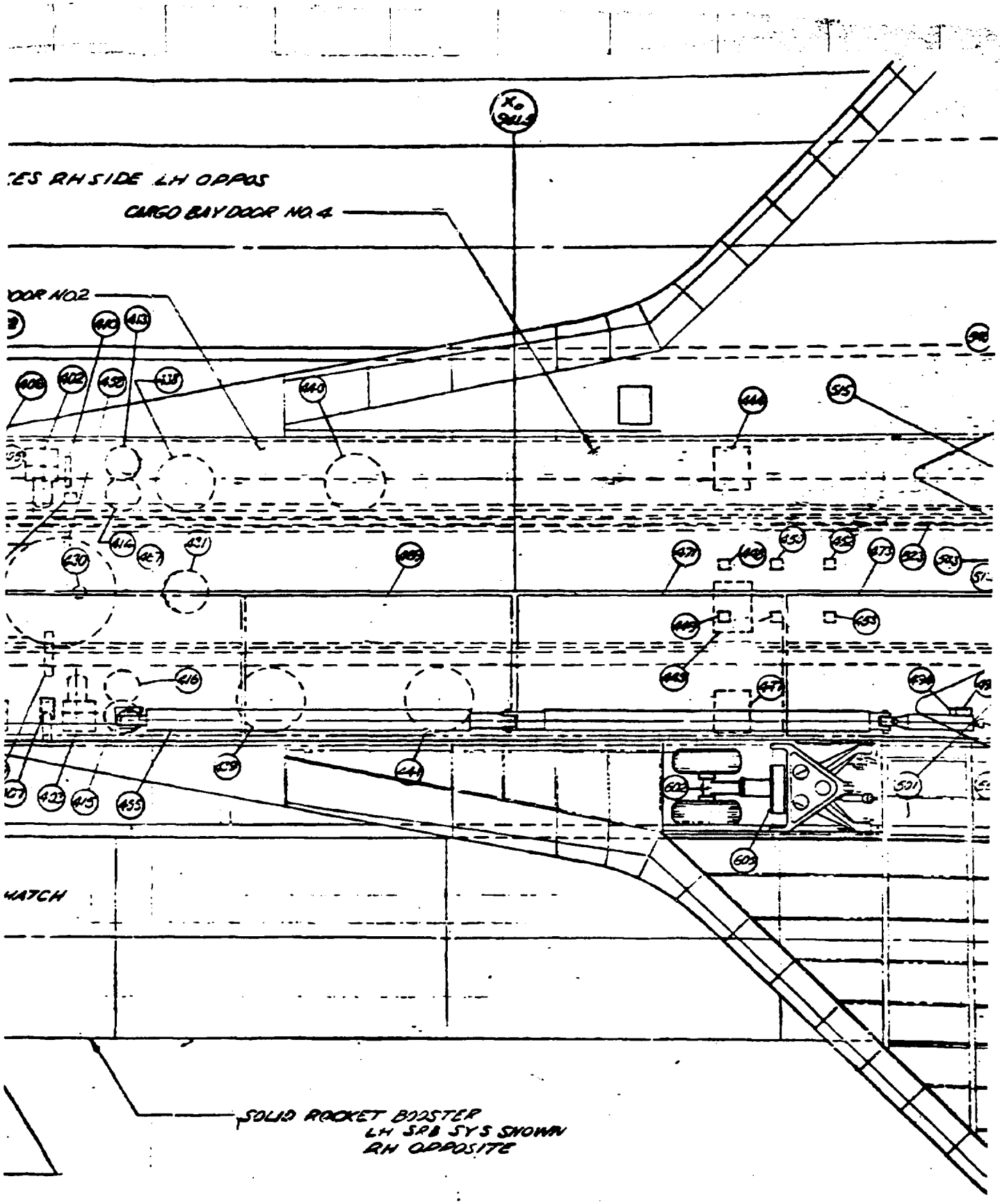
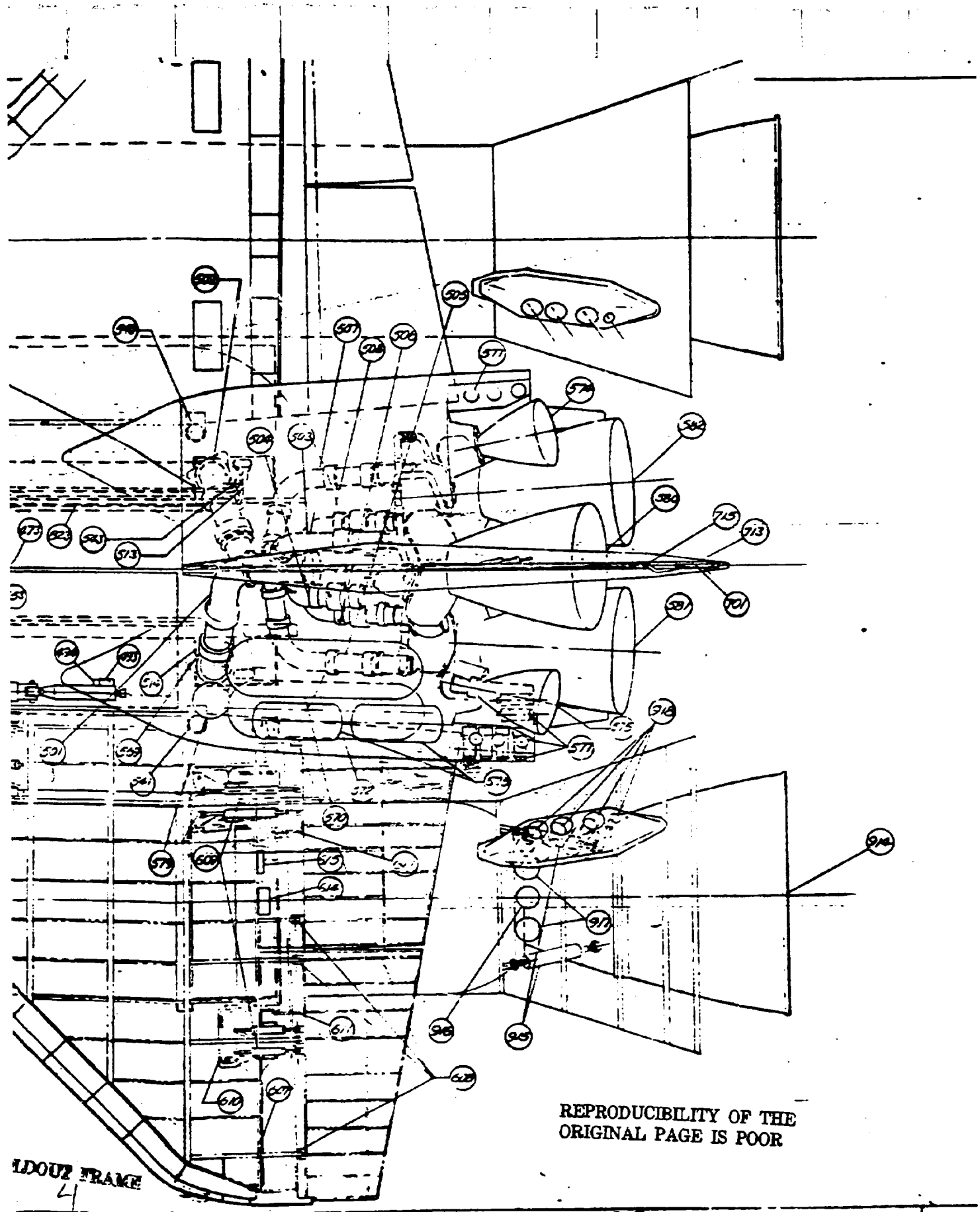

CES RH SIDE LH OPPOS
CARGO BAY DOOR NO 4
DOOR NO2
HATCH
SOLID ROCKET BOOSTER
LH SRB SYS SHOWN
RH OPPOSITE

JT FRAME

3



REPRODUCIBILITY OF THE
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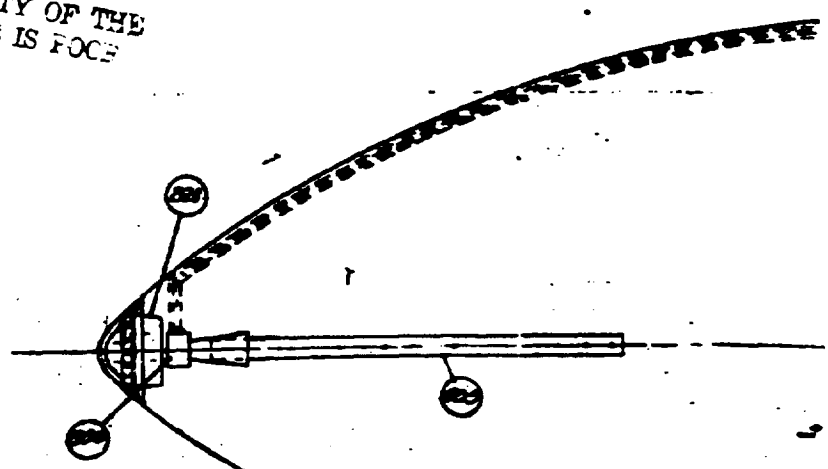
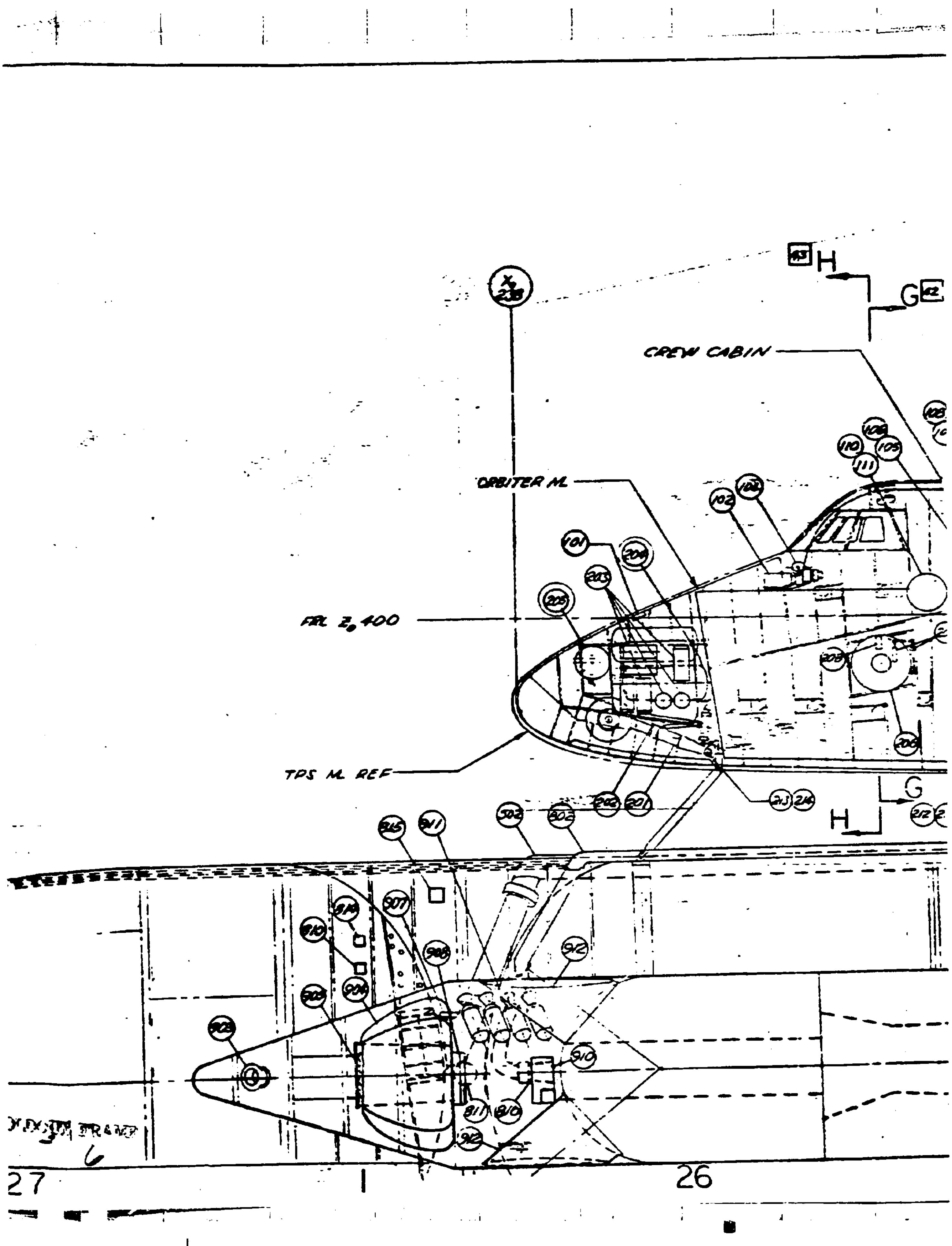
LDOUT FRAME
4

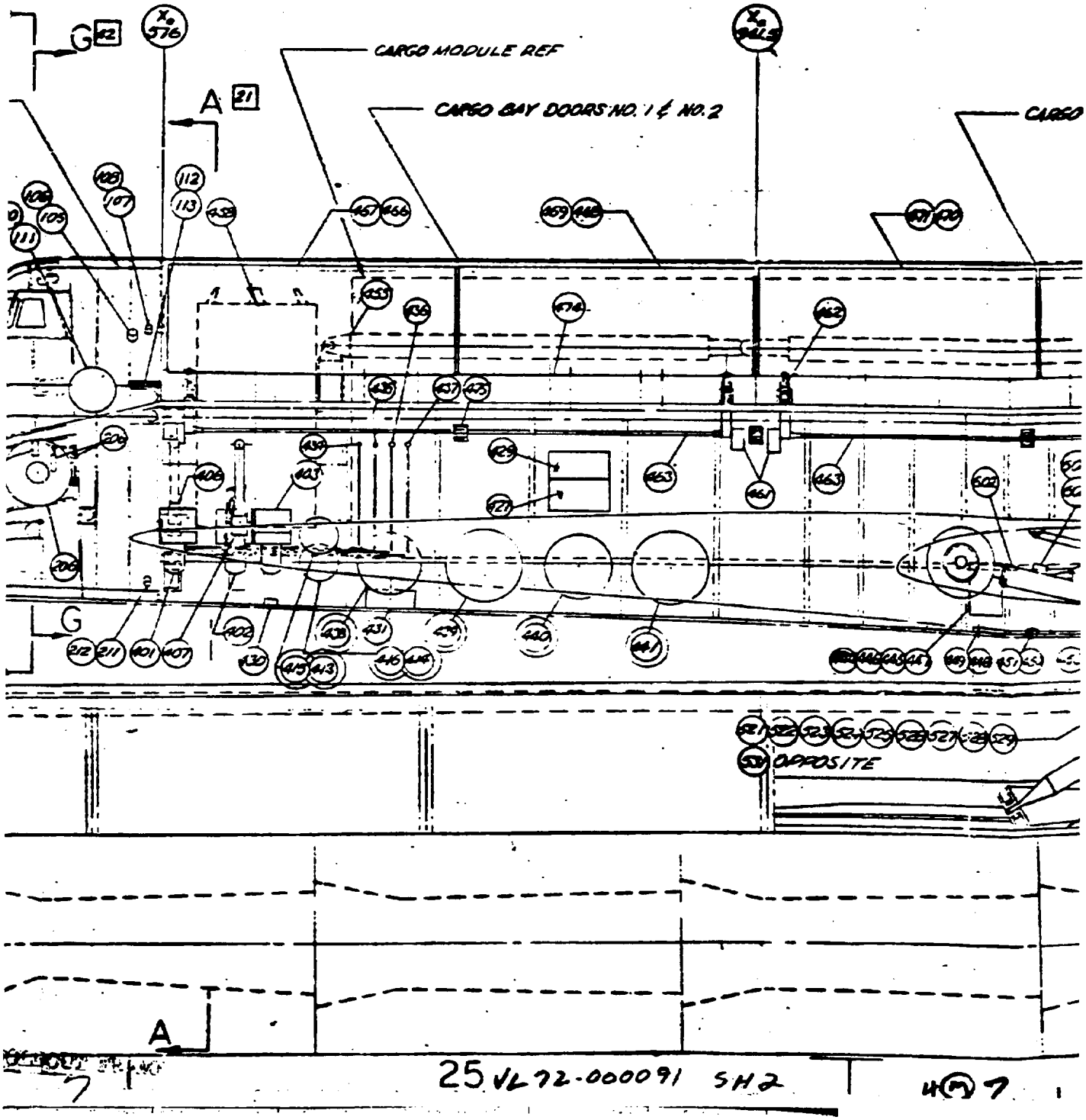


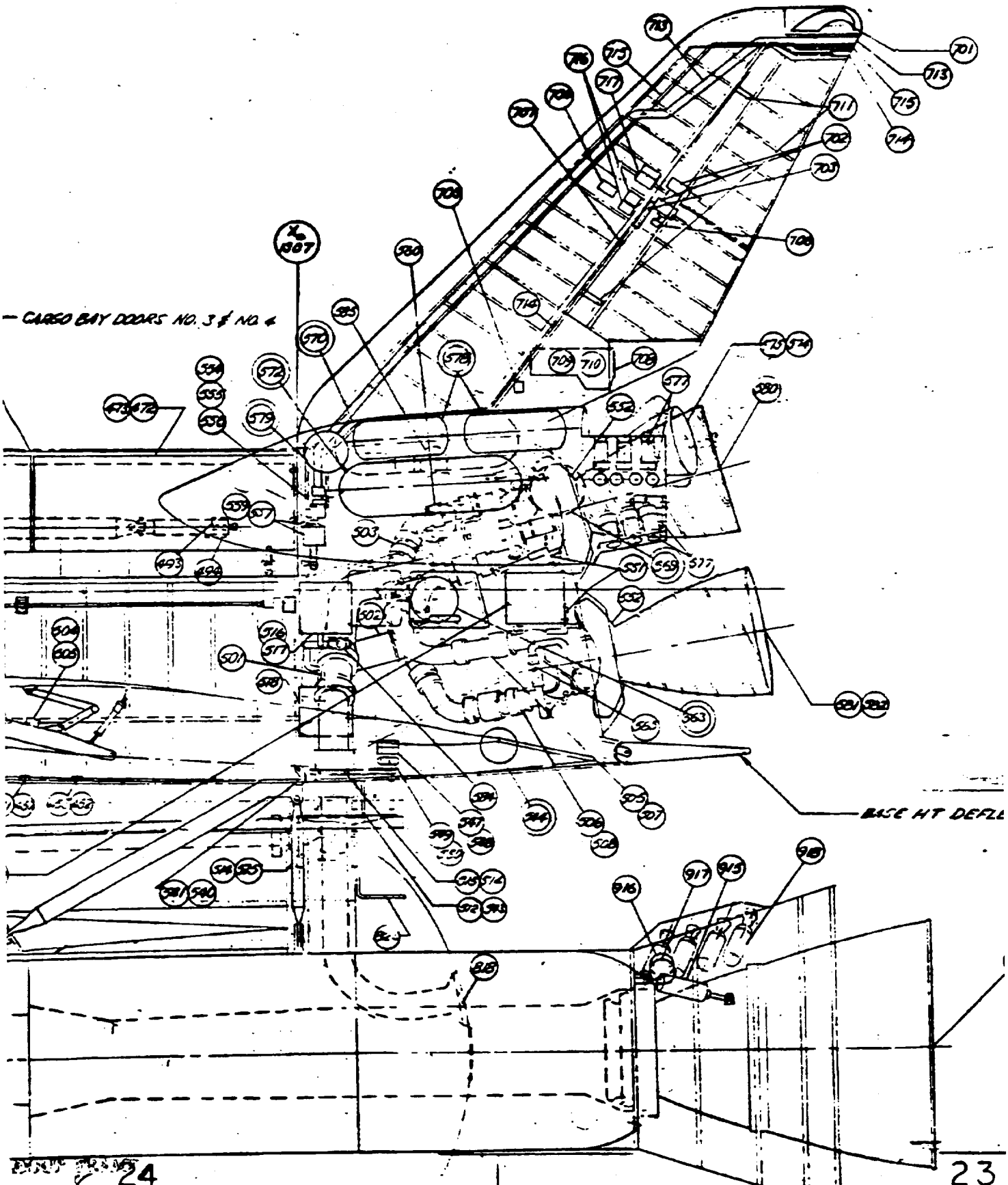
OUT FRAME

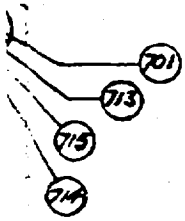


CREW CABIN
ORBITER M.L.
FRL Z, 400
TPS M.L. REF
H
G
26
27

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR




CARGO BAY DOORS NO. 3 & NO. 4
BASE HT DEFL



FRP 2

VLV MANIFOLD

ORBITER OUTER TPS ML AT X,576

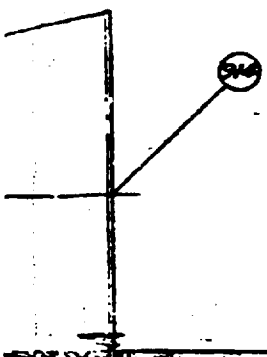
ORBITER OUTER TPS ML AT X,670

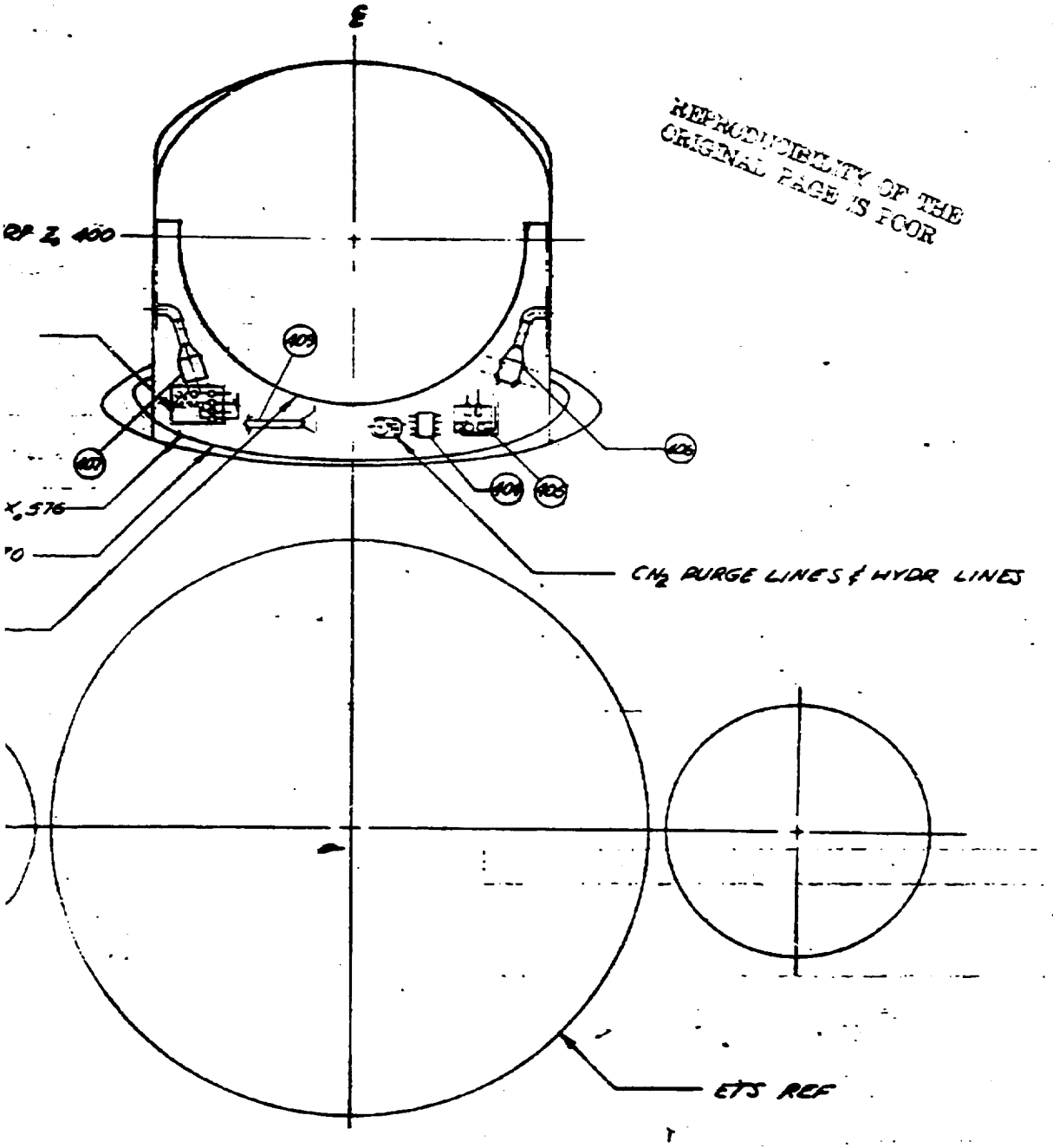
CARGO BAY LINER

582

BASE HT DEFLECTOR

SRB REF

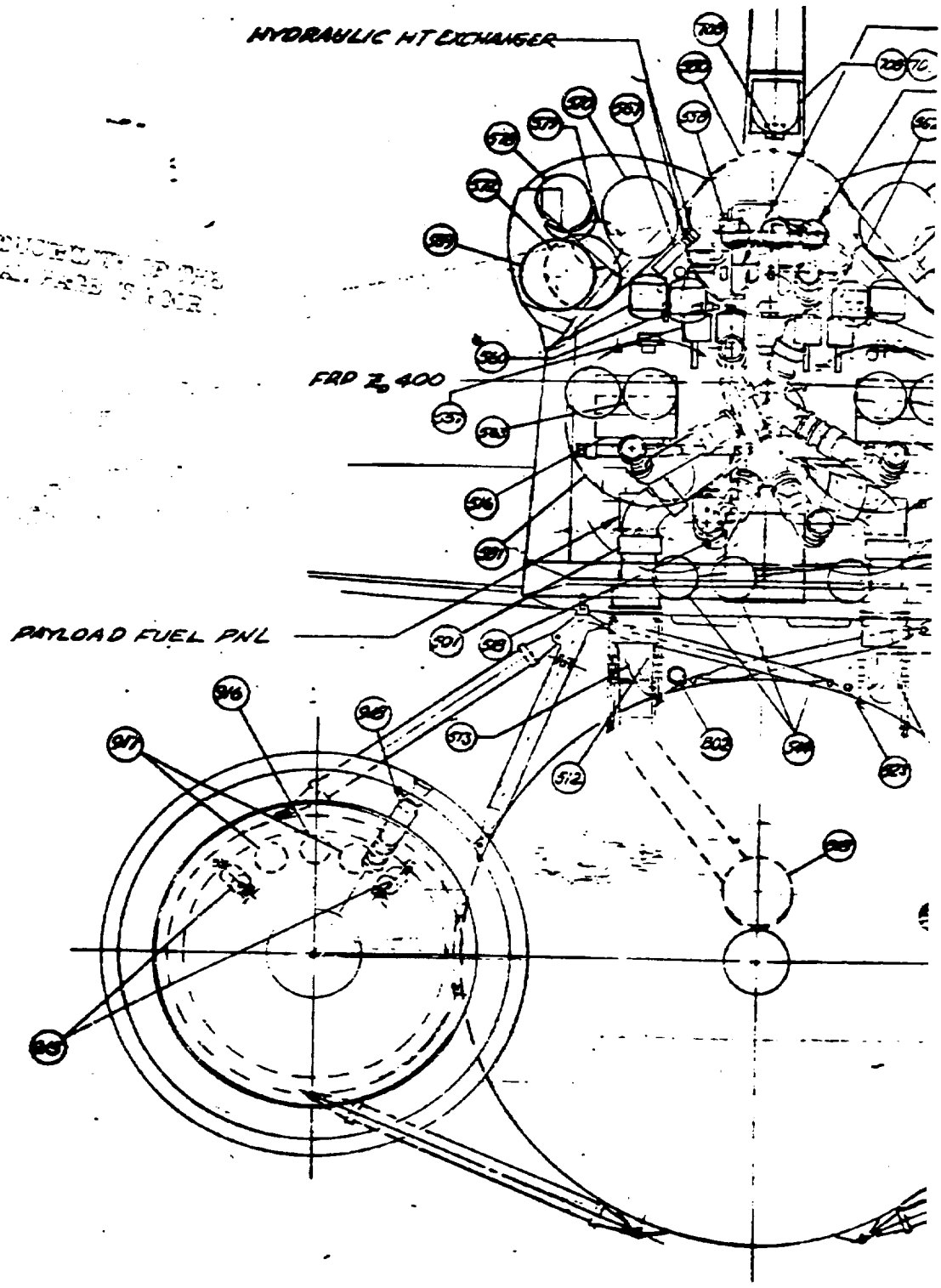




VIEW A - A

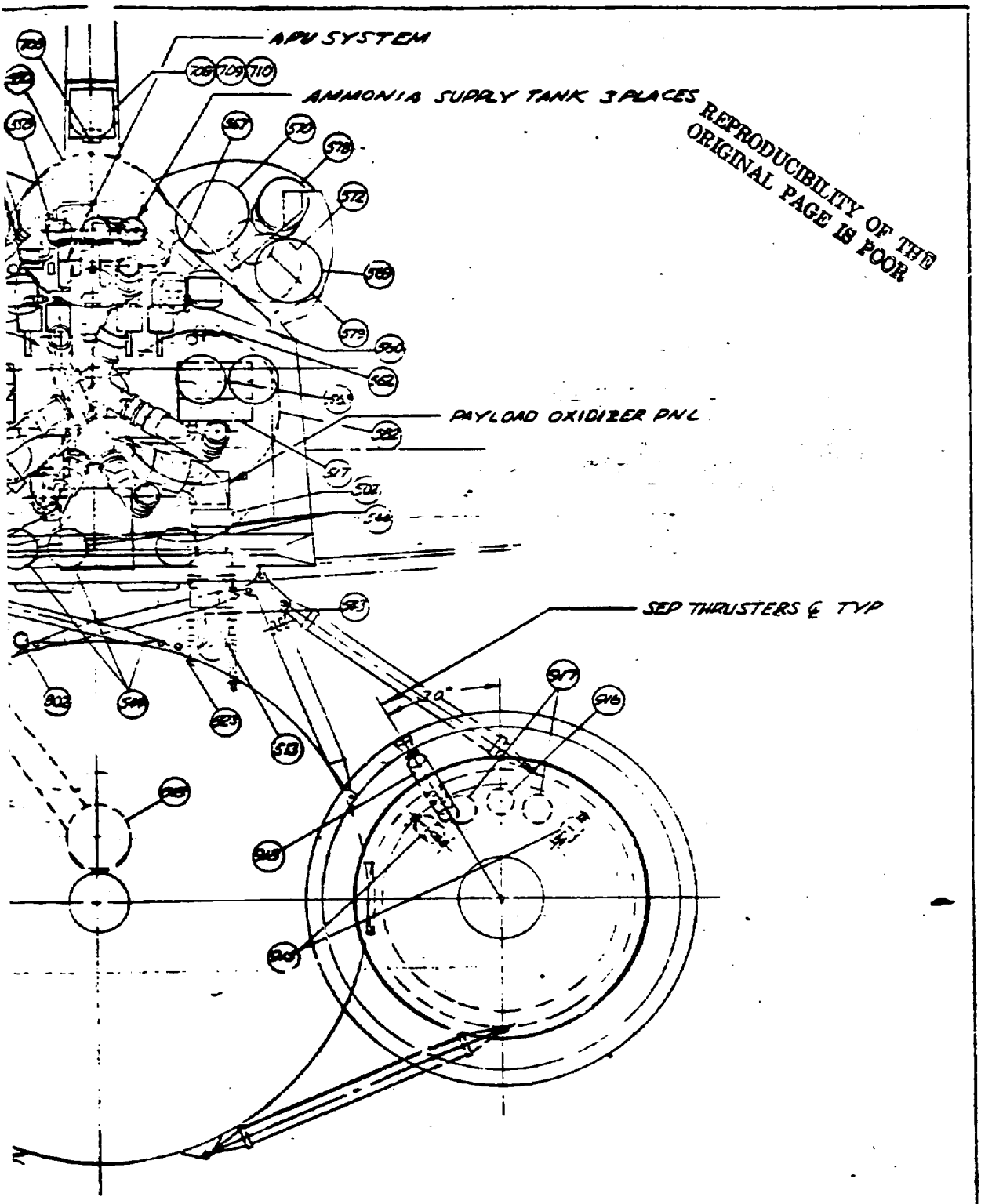
FRAME

10



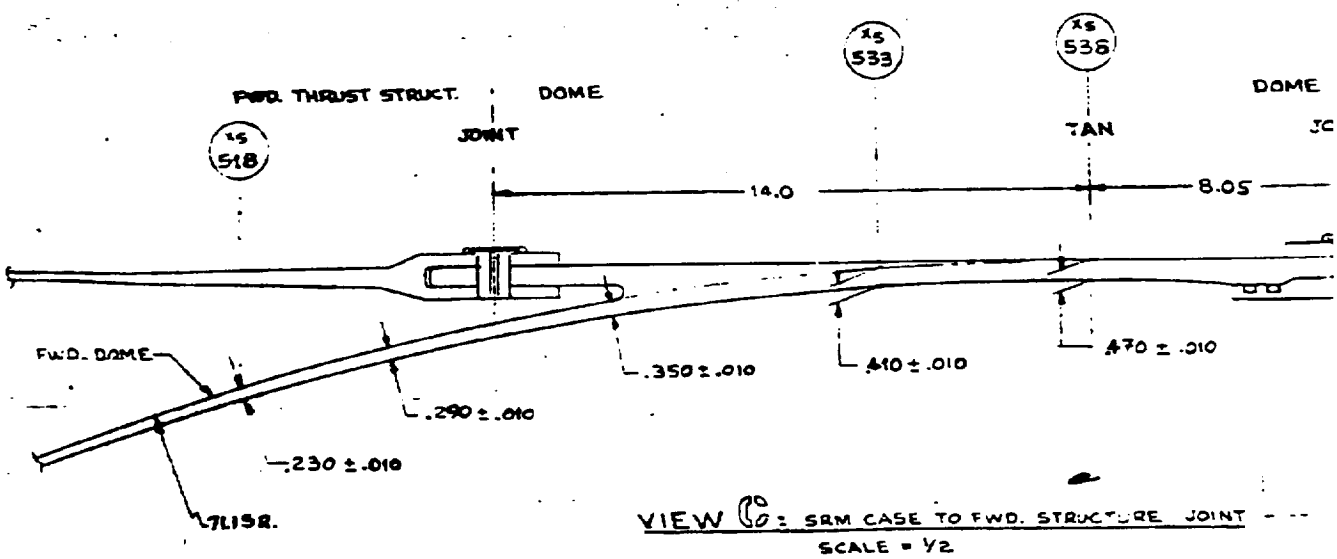
BLOWOUT FRAME

VIEW LOOKING FWD TO BLKH



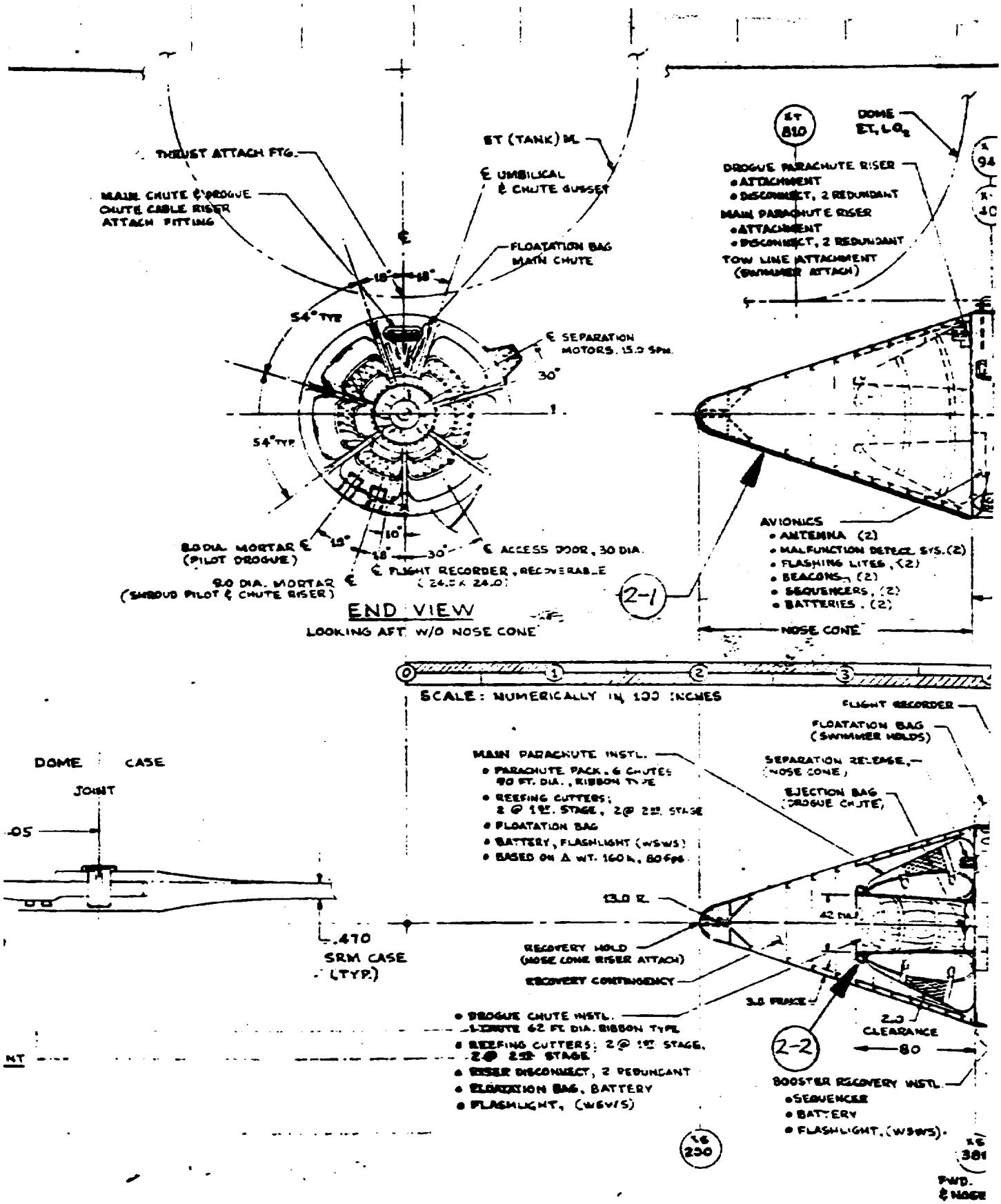
FOLDOUT FRAME 1/2

Figure 1.1.4. Space Shuttle System



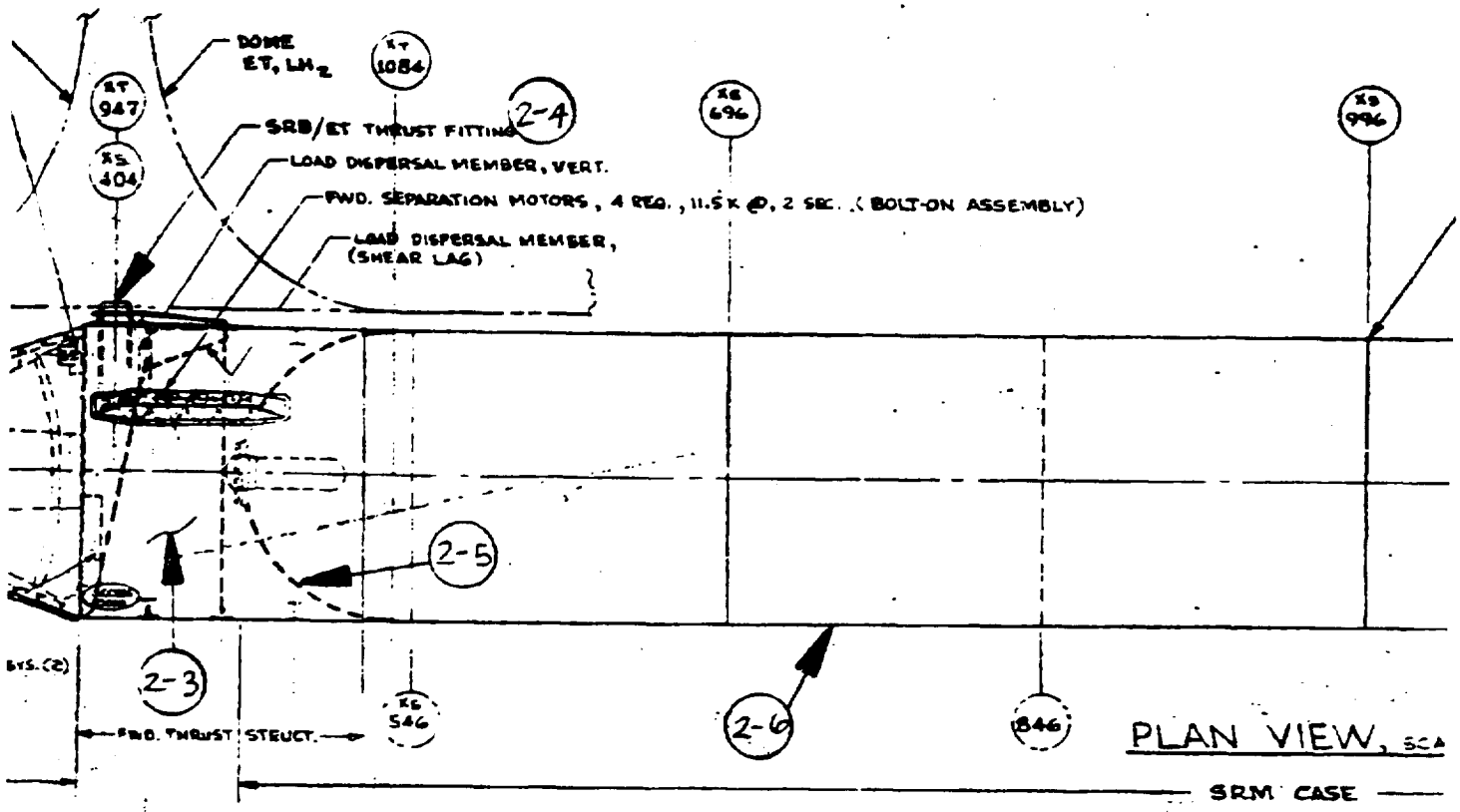
VIEW C: SRM CASE TO FWD. STRUCTURE JOINT
SCALE = 1/2

T FRAME

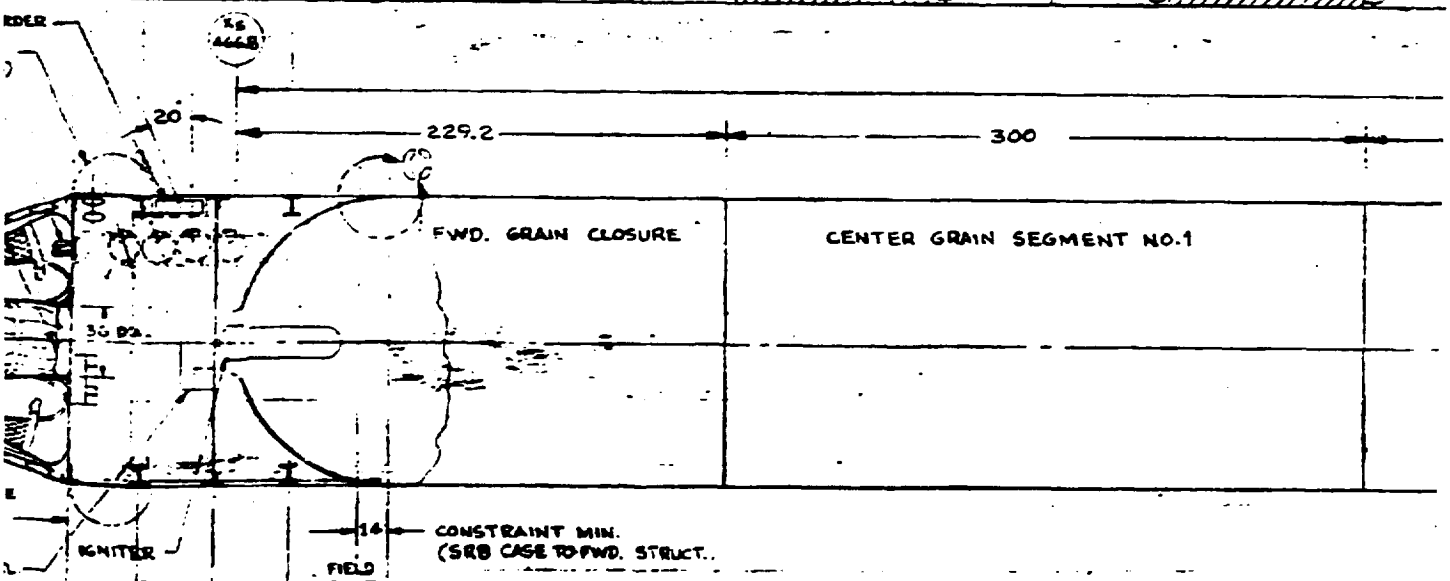


1DOUT FRAME

2



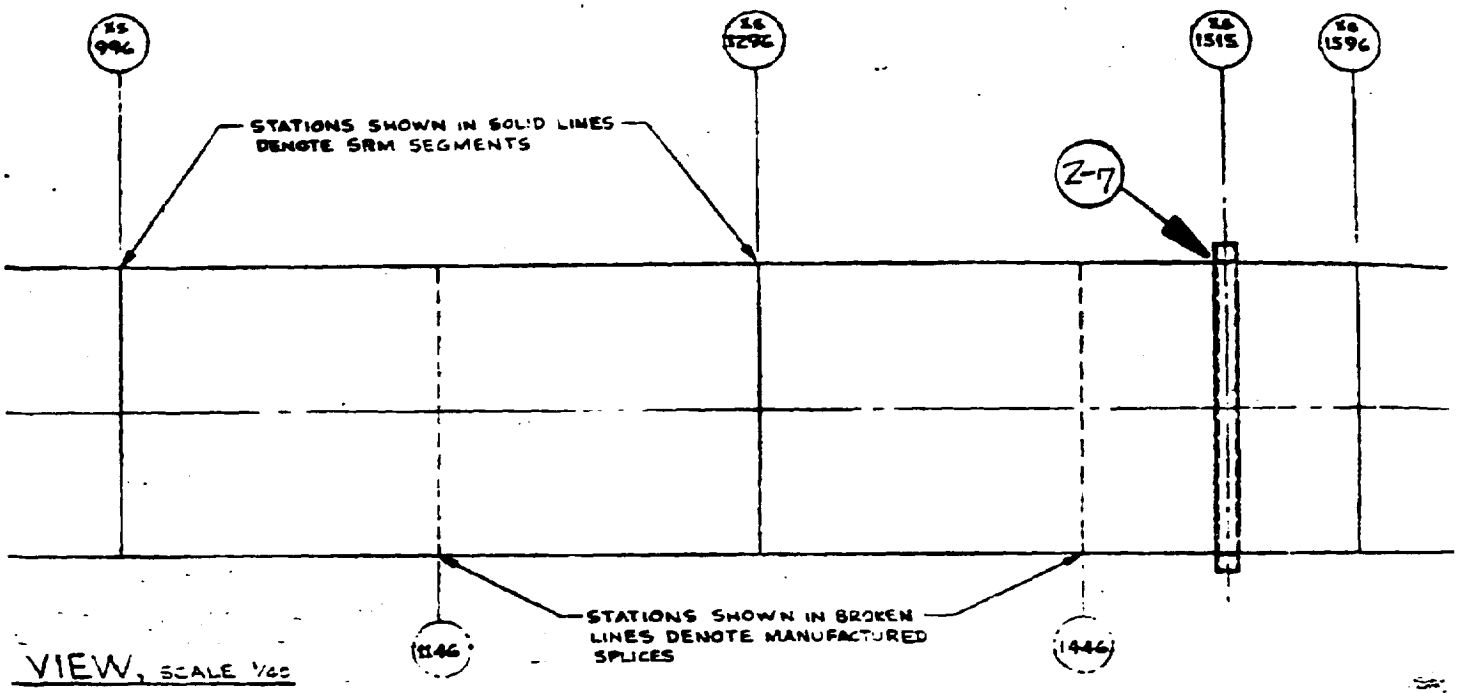
PLAN VIEW, SCA



SOLID RO

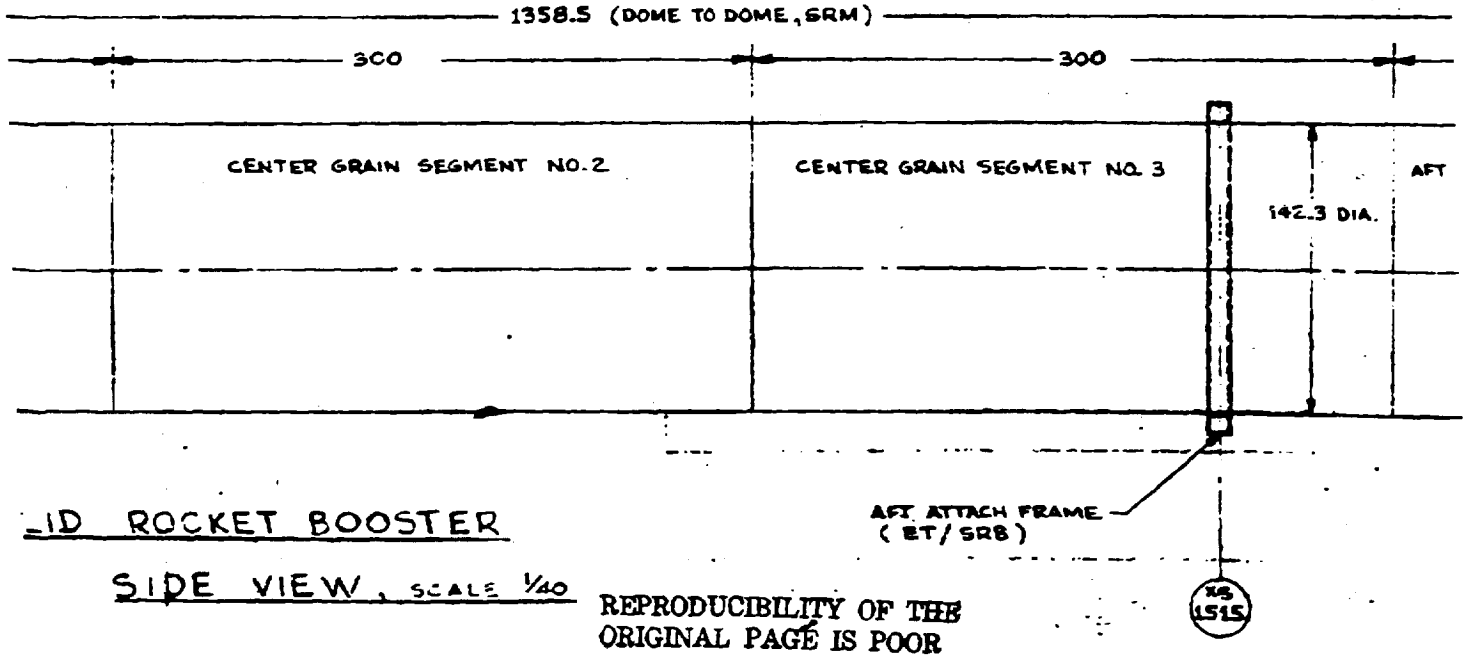
SID

BOUT FRAME



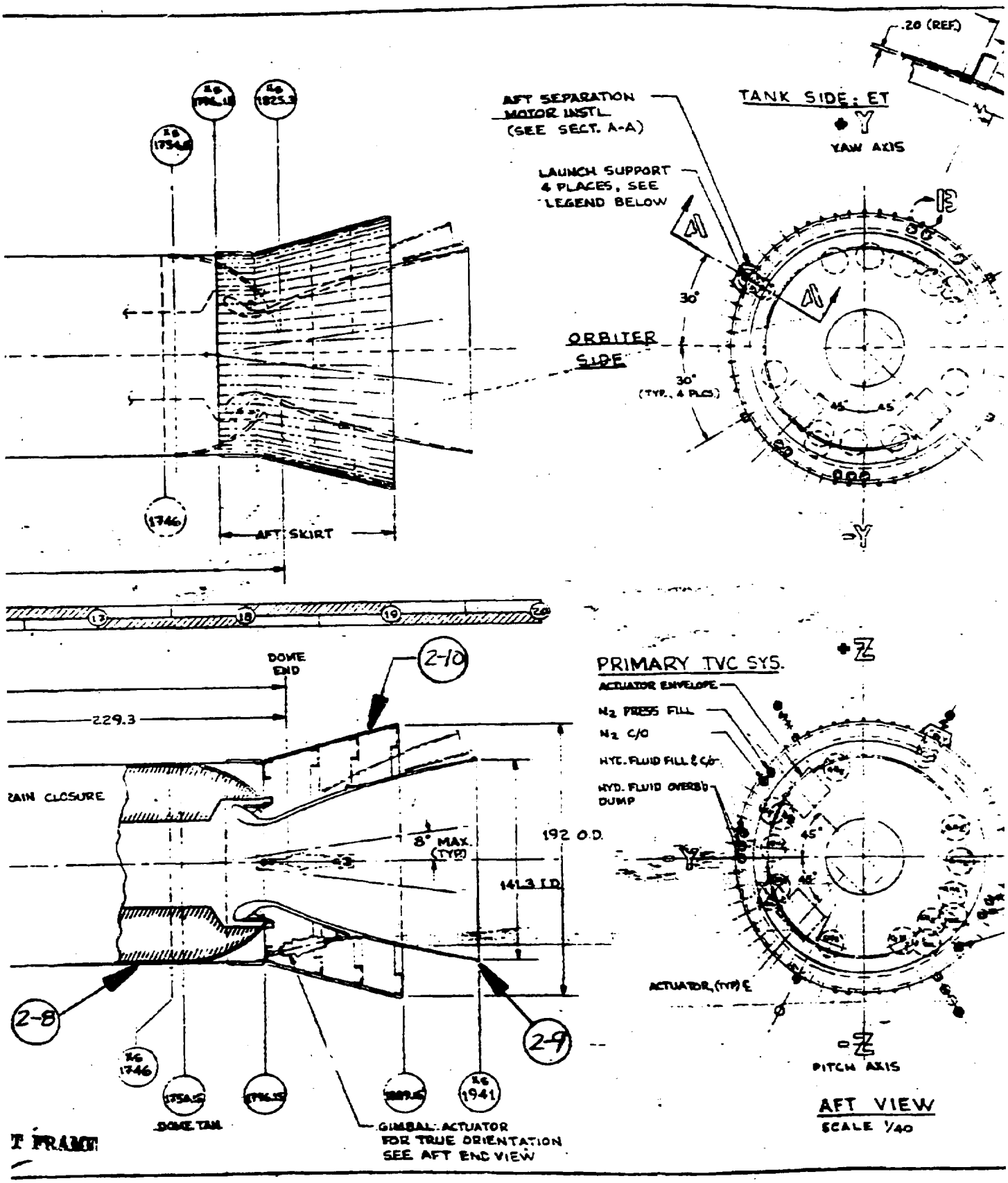
VIEW, SCALE 1/40

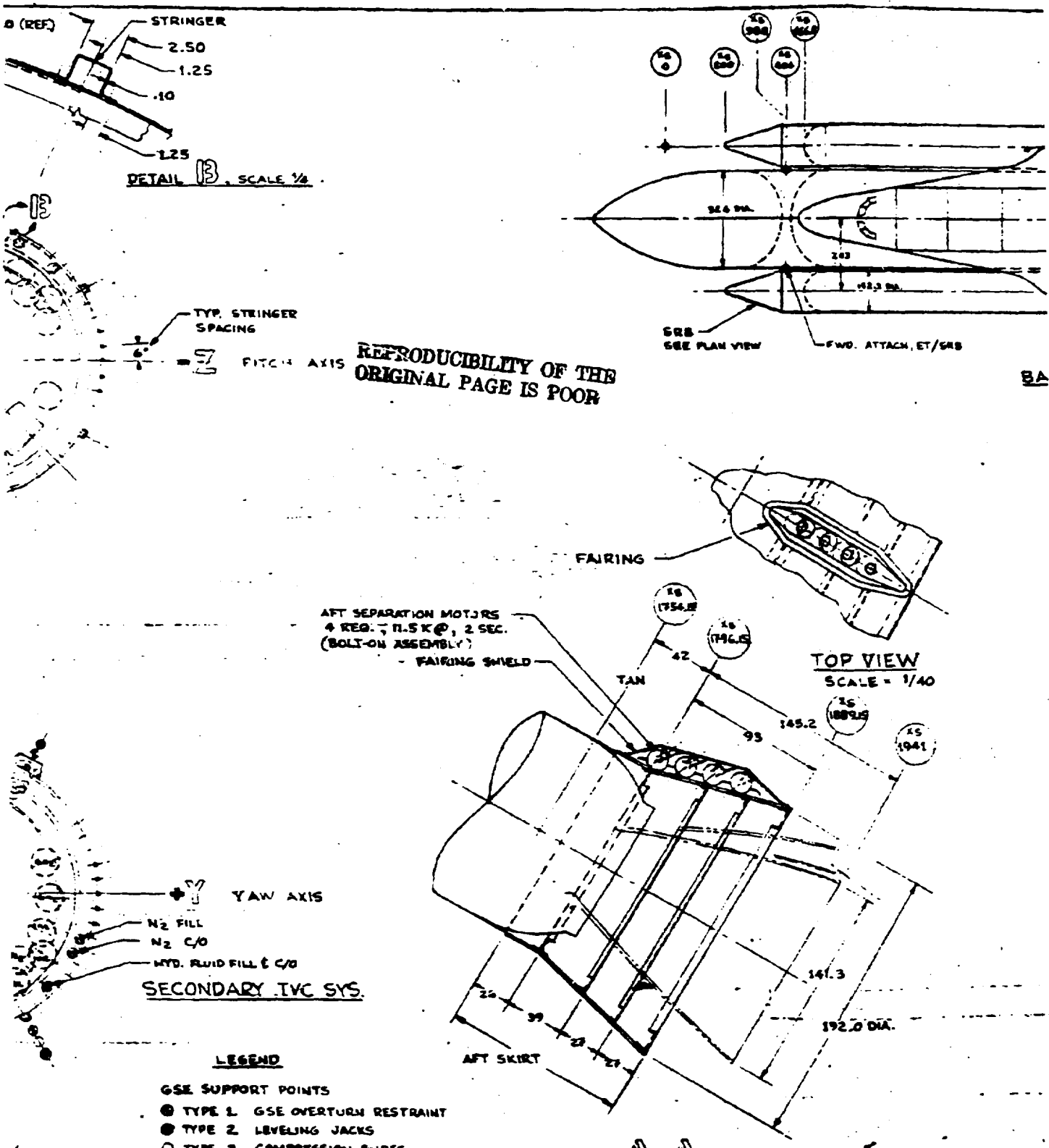
VI CASE



ID ROCKET BOOSTER

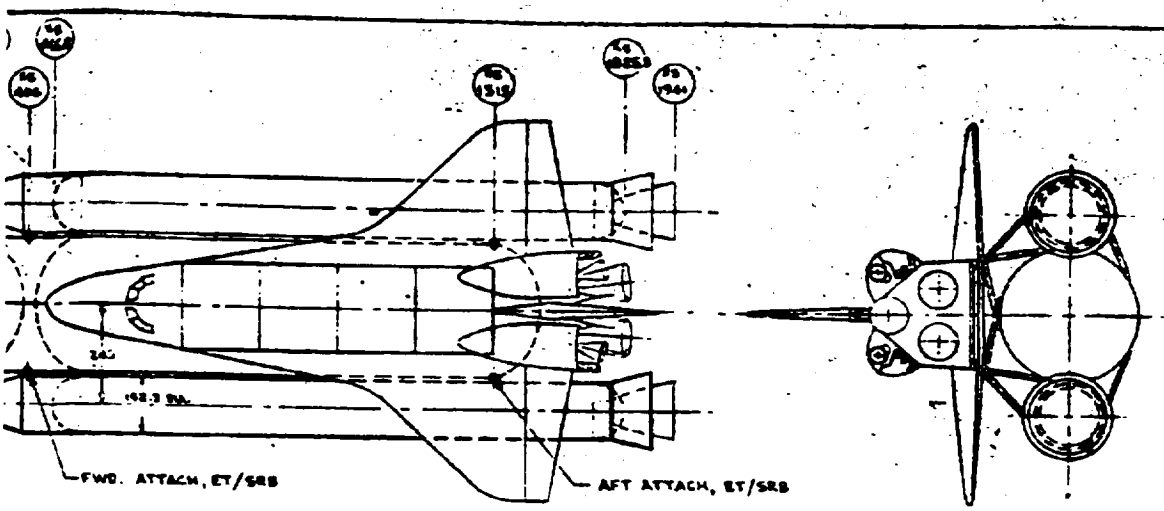
SIDE VIEW, SCALE 1/40


.20 (REF.)
AFT SEPARATION MOTOR INSTL (SEE SECT. A-A)
TANK SIDE: ET
YAW AXIS
LAUNCH SUPPORT 4 PLACES, SEE LEGEND BELOW
ORBITER SIDE
30°
30° (TYP., 4 PLCS)
45°
45°
AFT SKIRT
1746
DOME END
229.3
2-10
MAIN CLOSURE
8° MAX. (TYP)
192 O.D.
141.3 I.D.
2-8
2-9
DOME TAN
GIMBAL ACTUATOR FOR TRUE ORIENTATION SEE AFT END VIEW
PRIMARY TVC SYS.
ACTUATOR ENVELOPE
N_2 PRESS FILL
N_2 C/O
HYD. FLUID FILL & C/O
HYD. FLUID OVERBD DUMP
ACTUATOR, (TYP) ℄
PITCH AXIS
AFT VIEW
SCALE 1/40
T FRAME

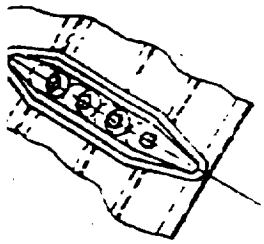


BOUT FRAME

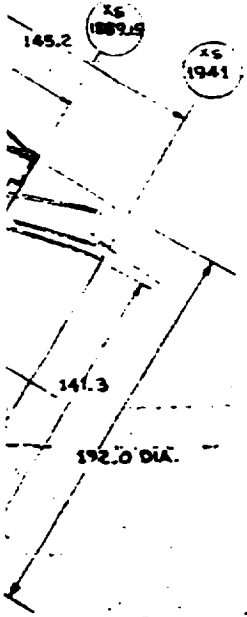
Figu



BASIC LAUNCH CONFIGURATION
SCALE = 1/200



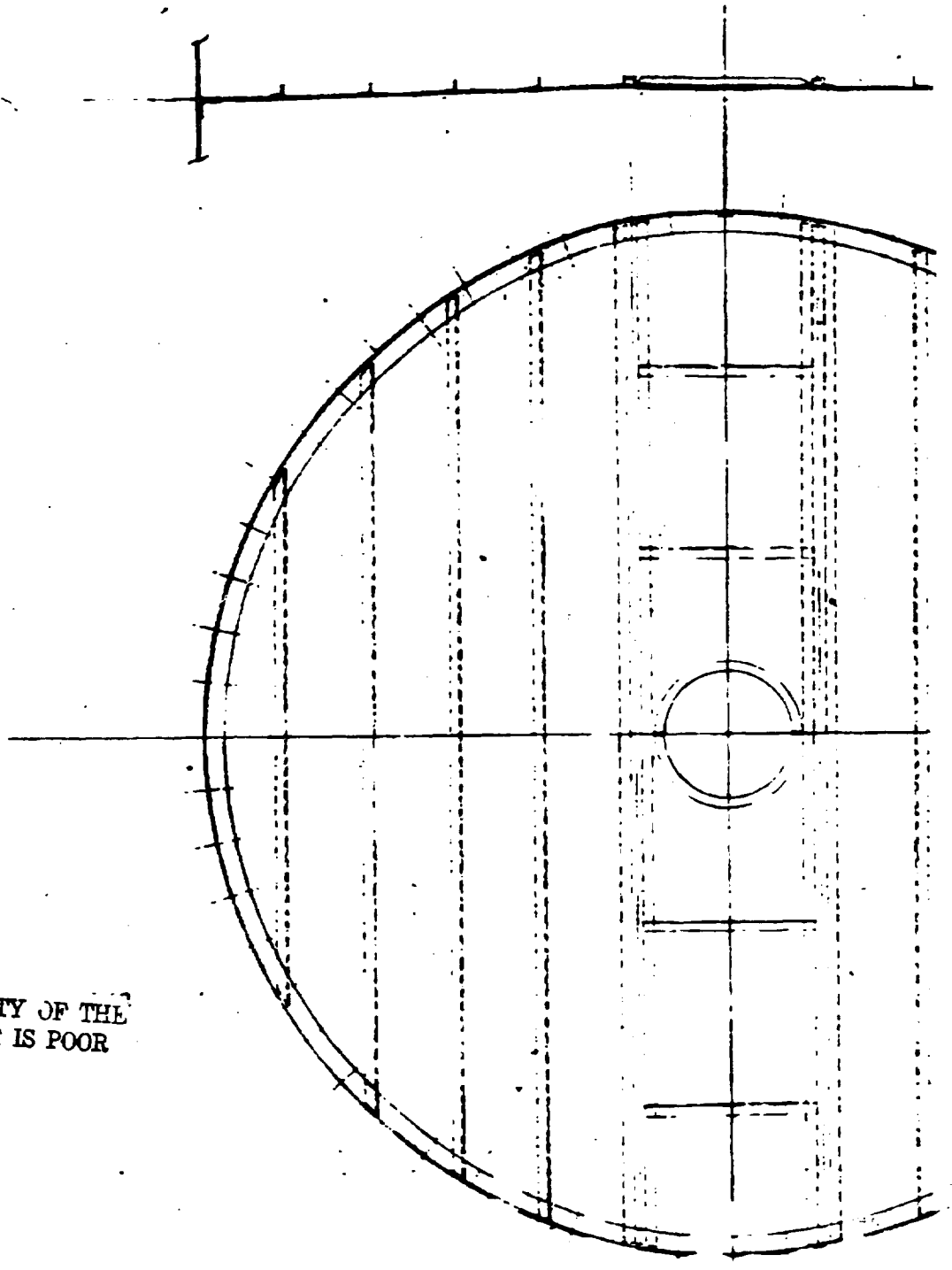
TOP VIEW
SCALE = 1/40



E = 1/40
ORS, 4 REQ.

BOLDOUT FRAME

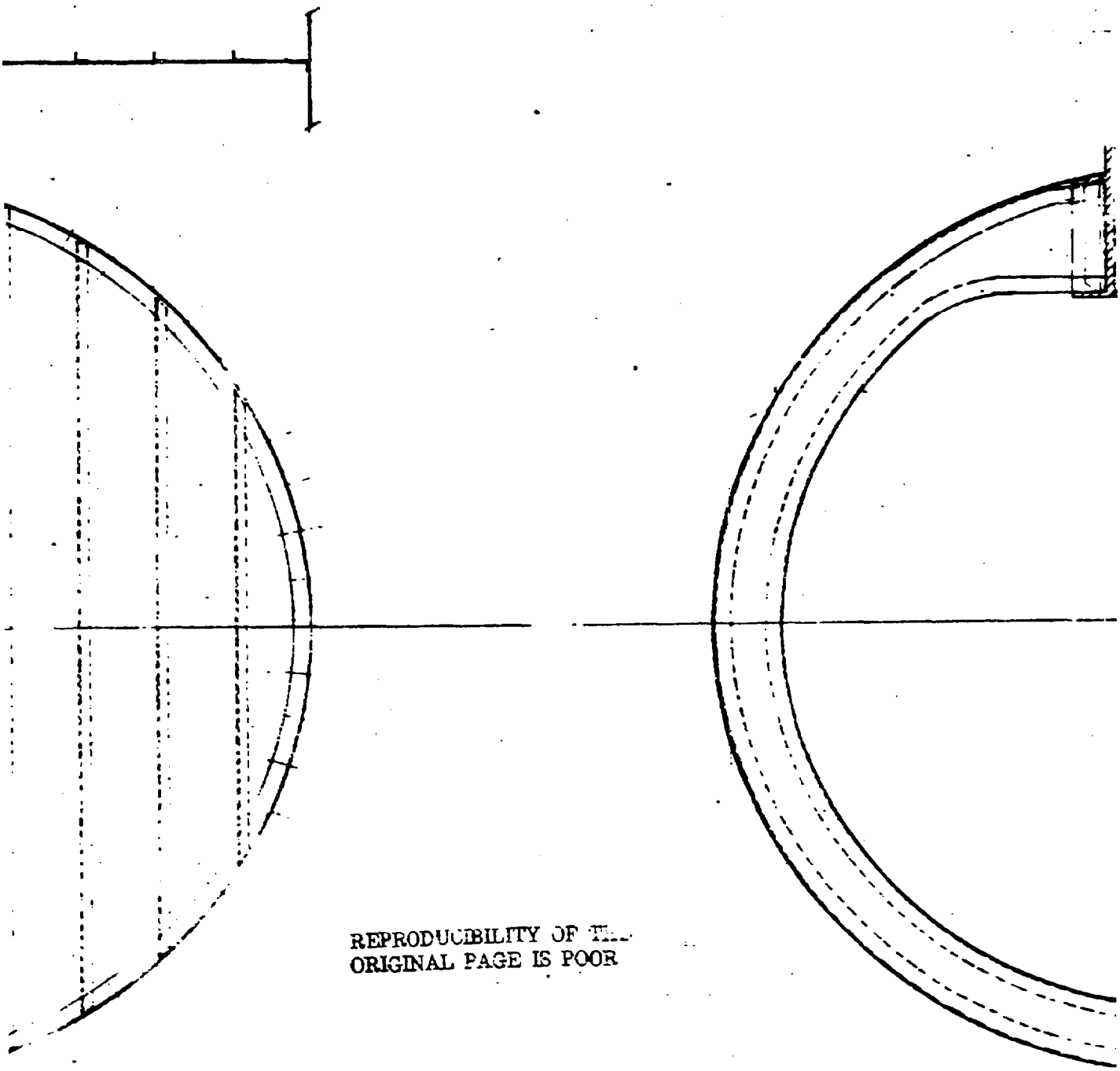
Figure 1.2.1. Solid Rocket Motor Assembly

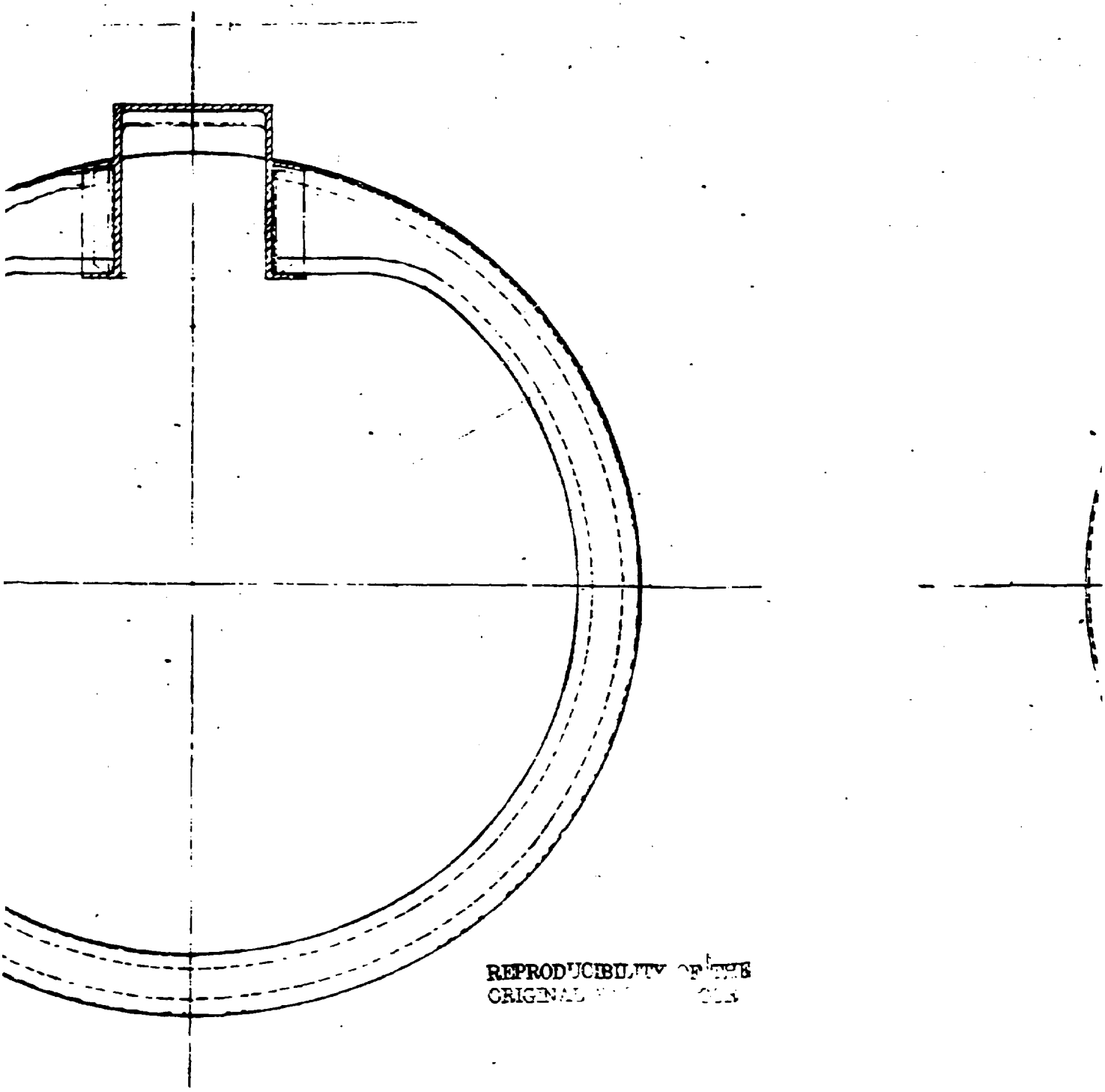


SECTION B - B

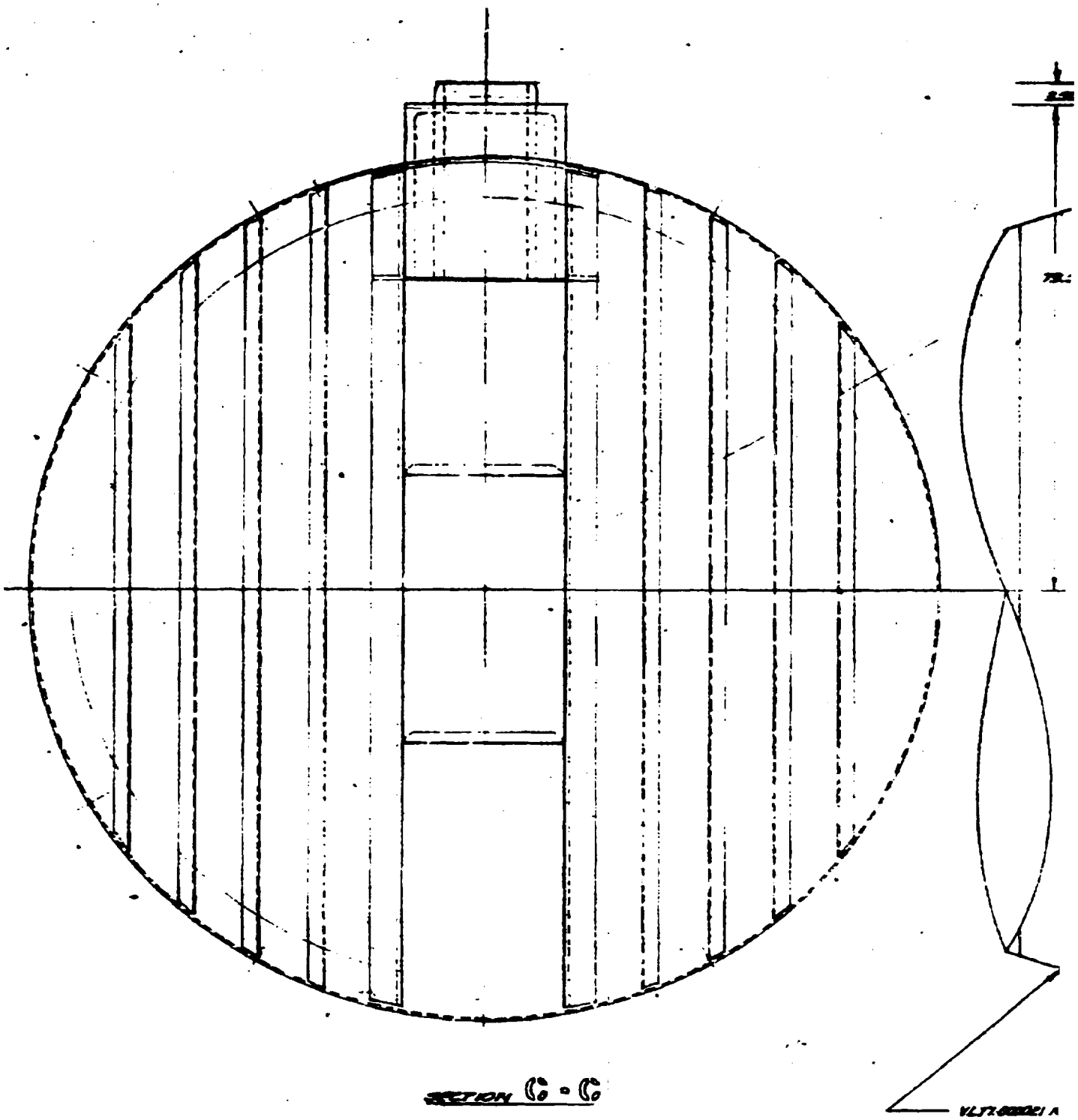
REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

BOLDOUT FRAME





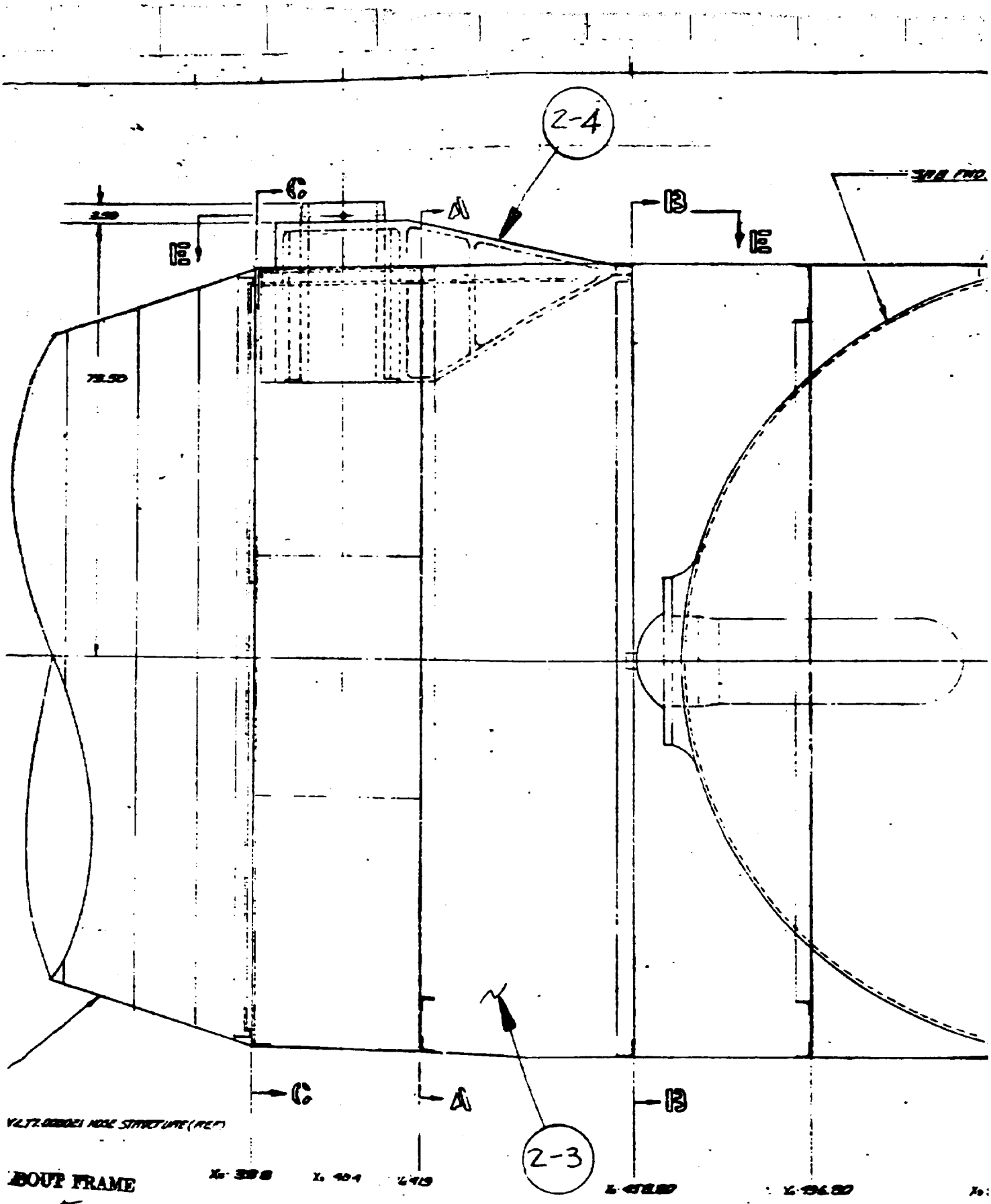
SECTION A-A

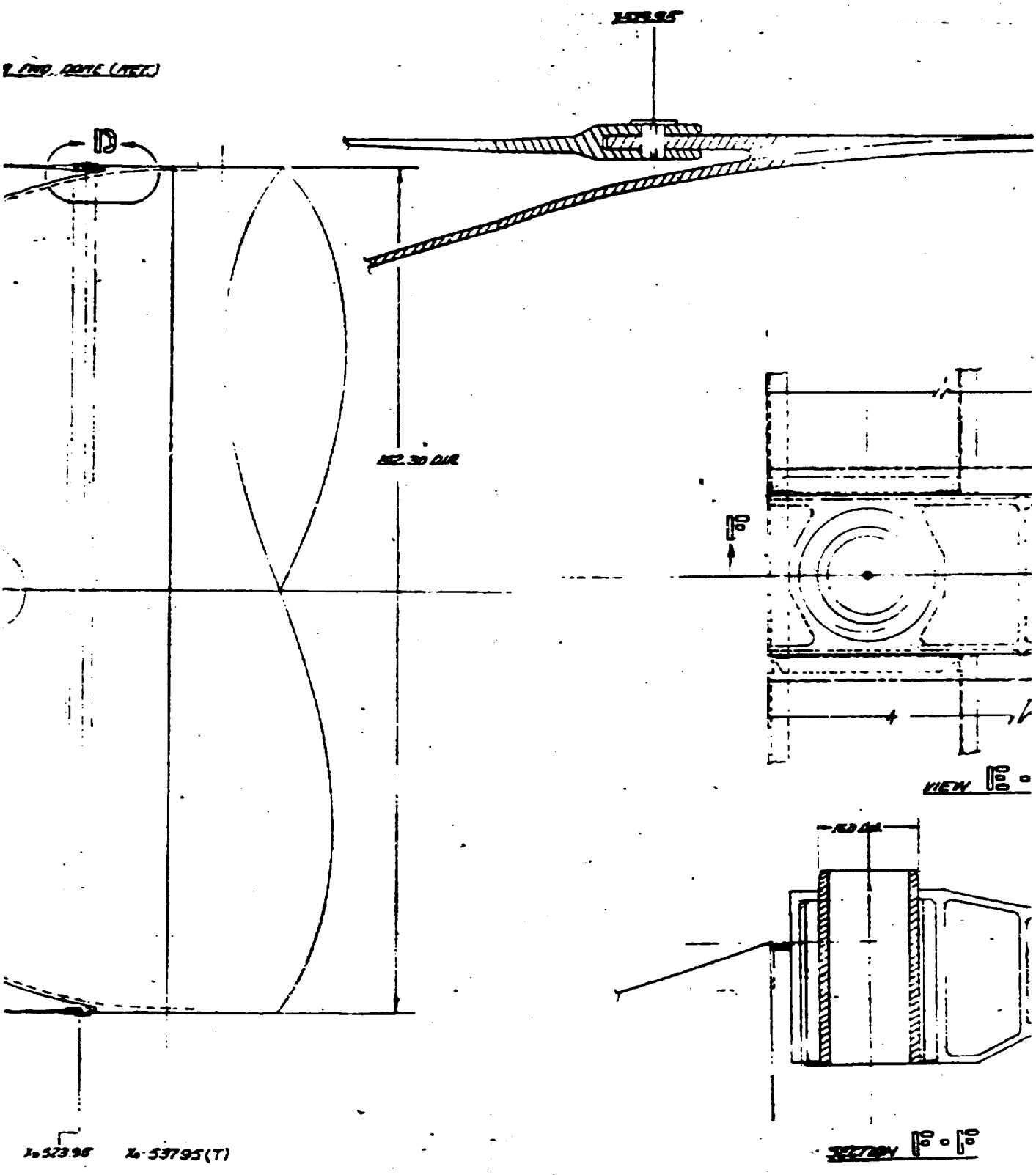


SECTION C - C

P FRAME

4/ 3mk


2-4
C
A
B
B
C
A
B
2-3
BOUT FRAME



JT FRAME

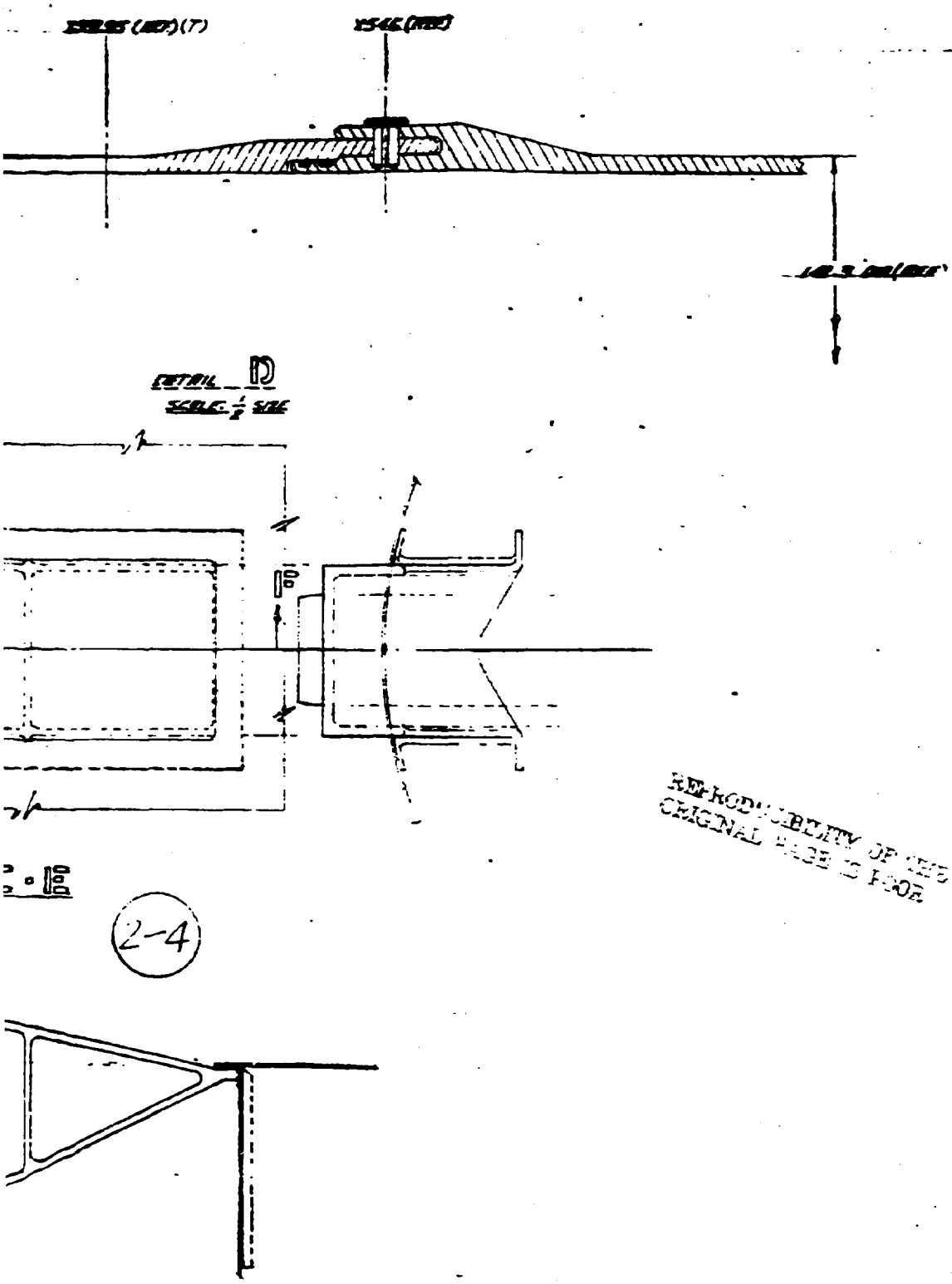
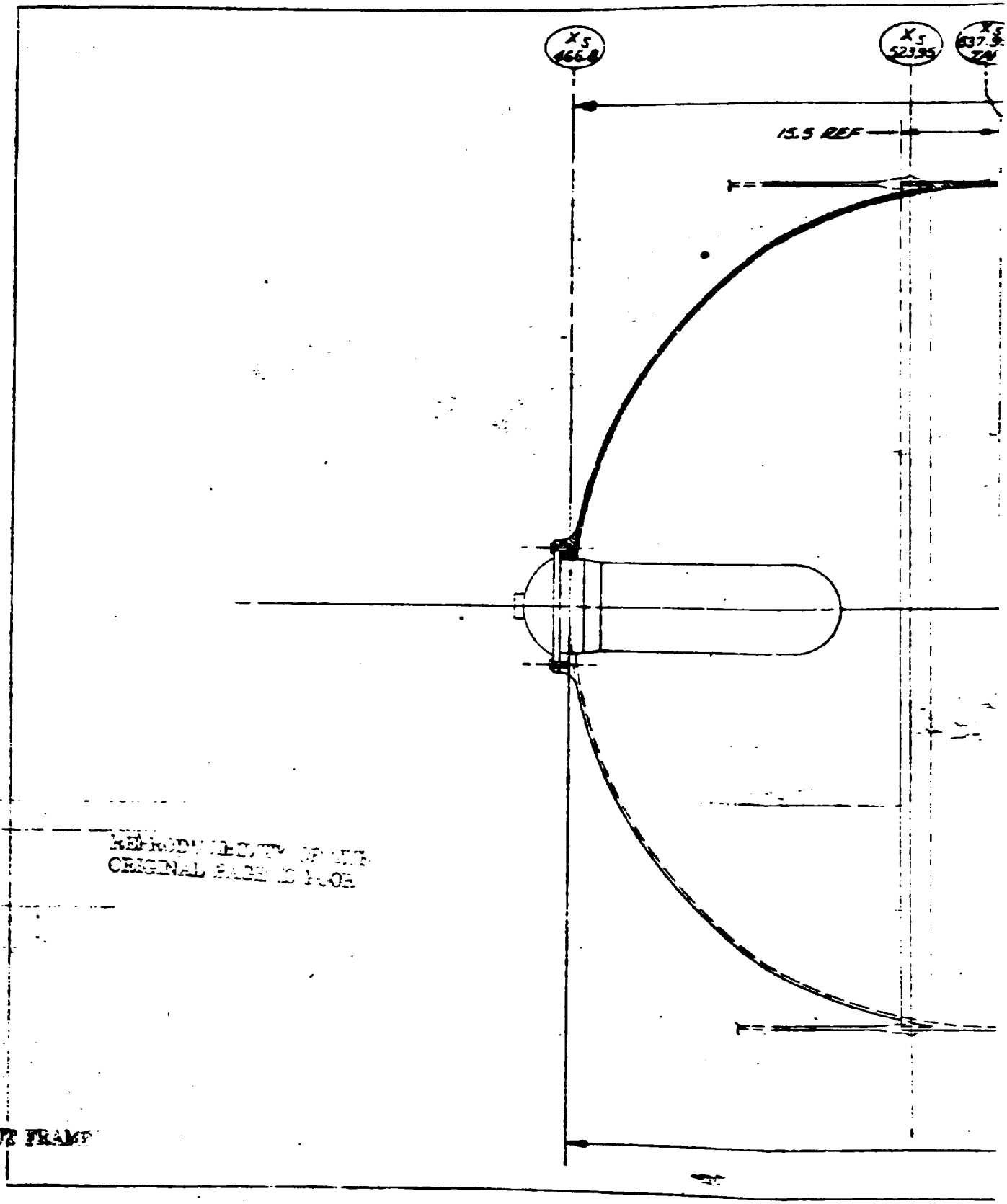
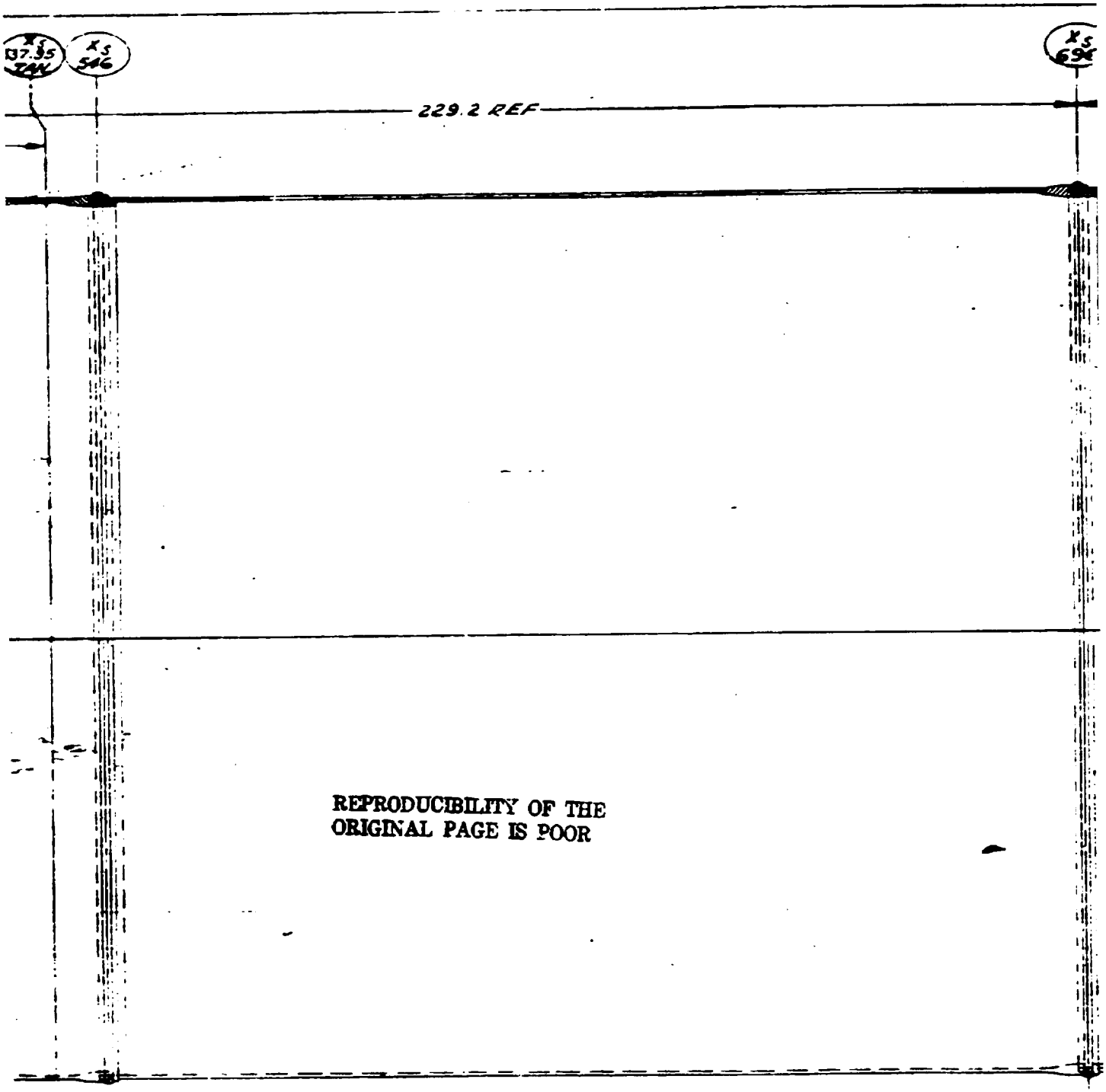
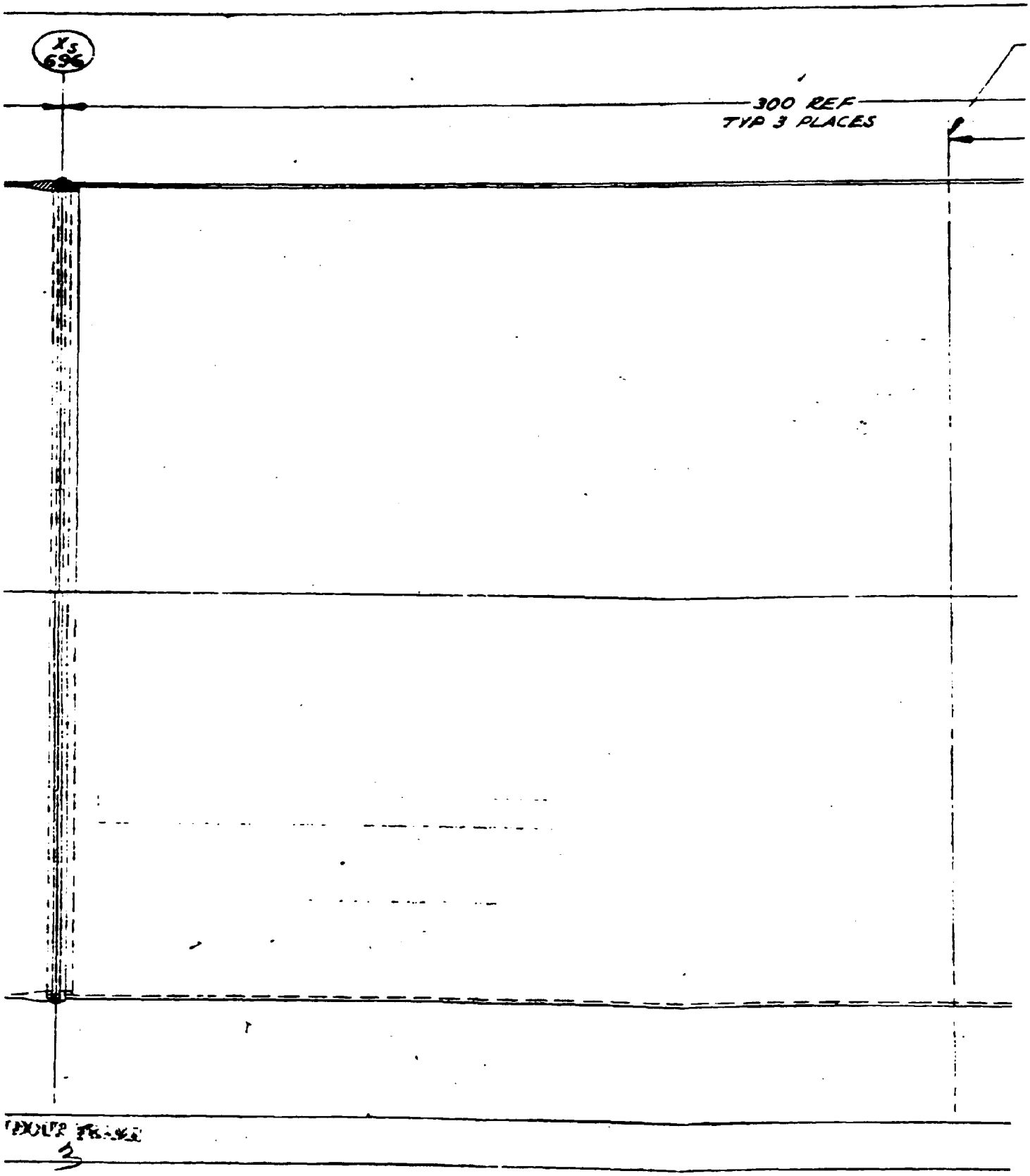


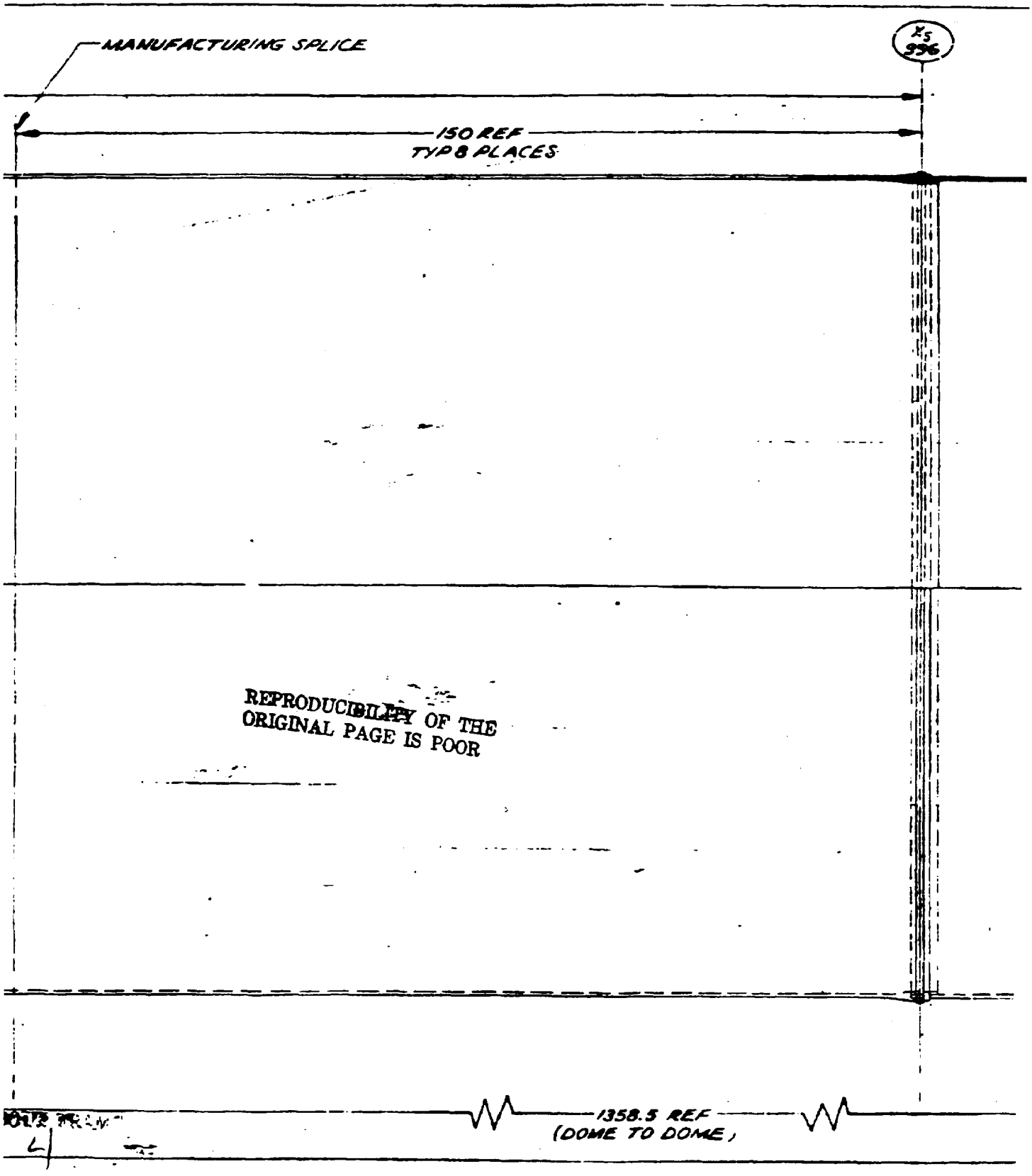
Figure 1. 2. 2. Solid Rocket Motor Forward Skirt

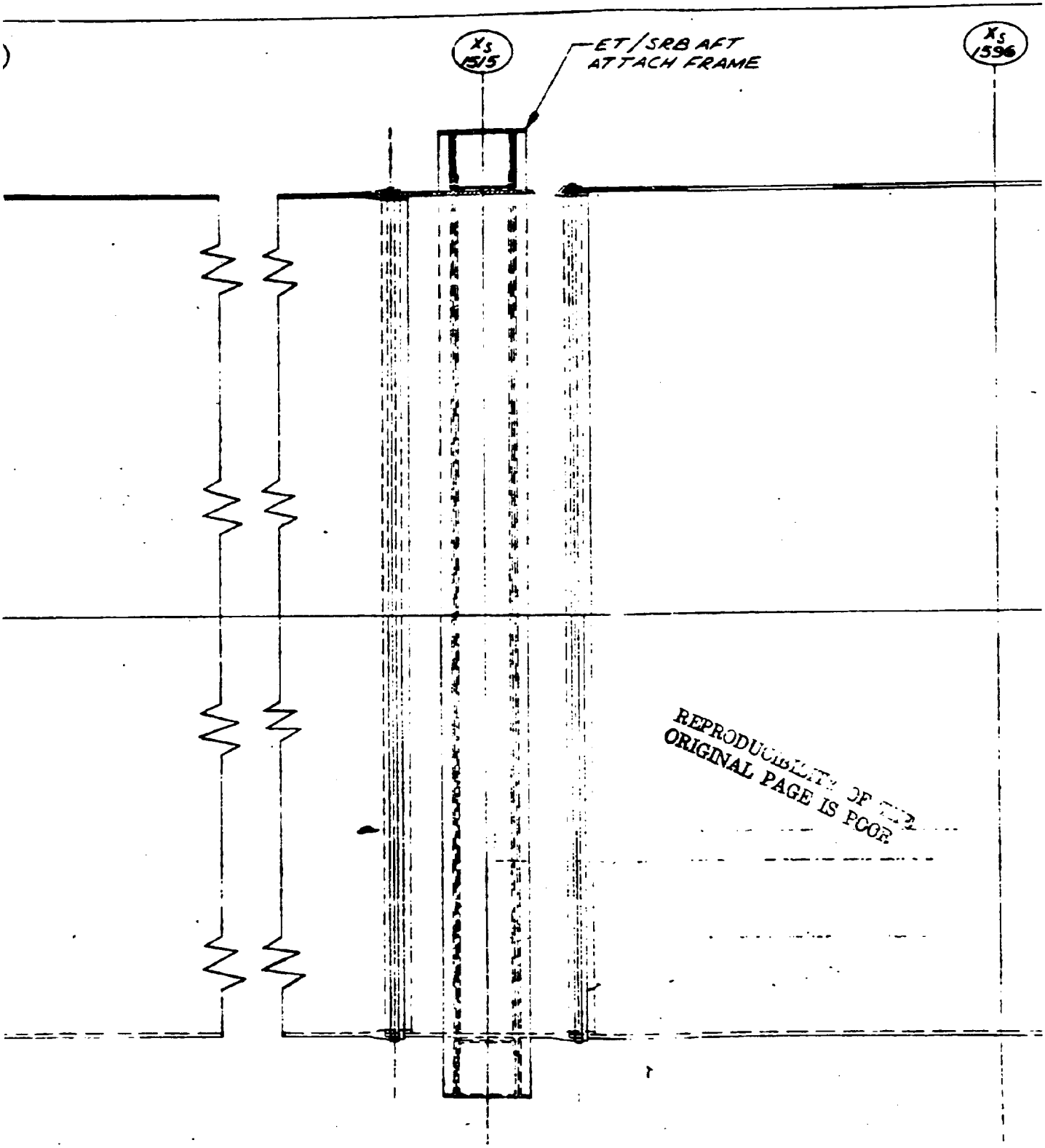


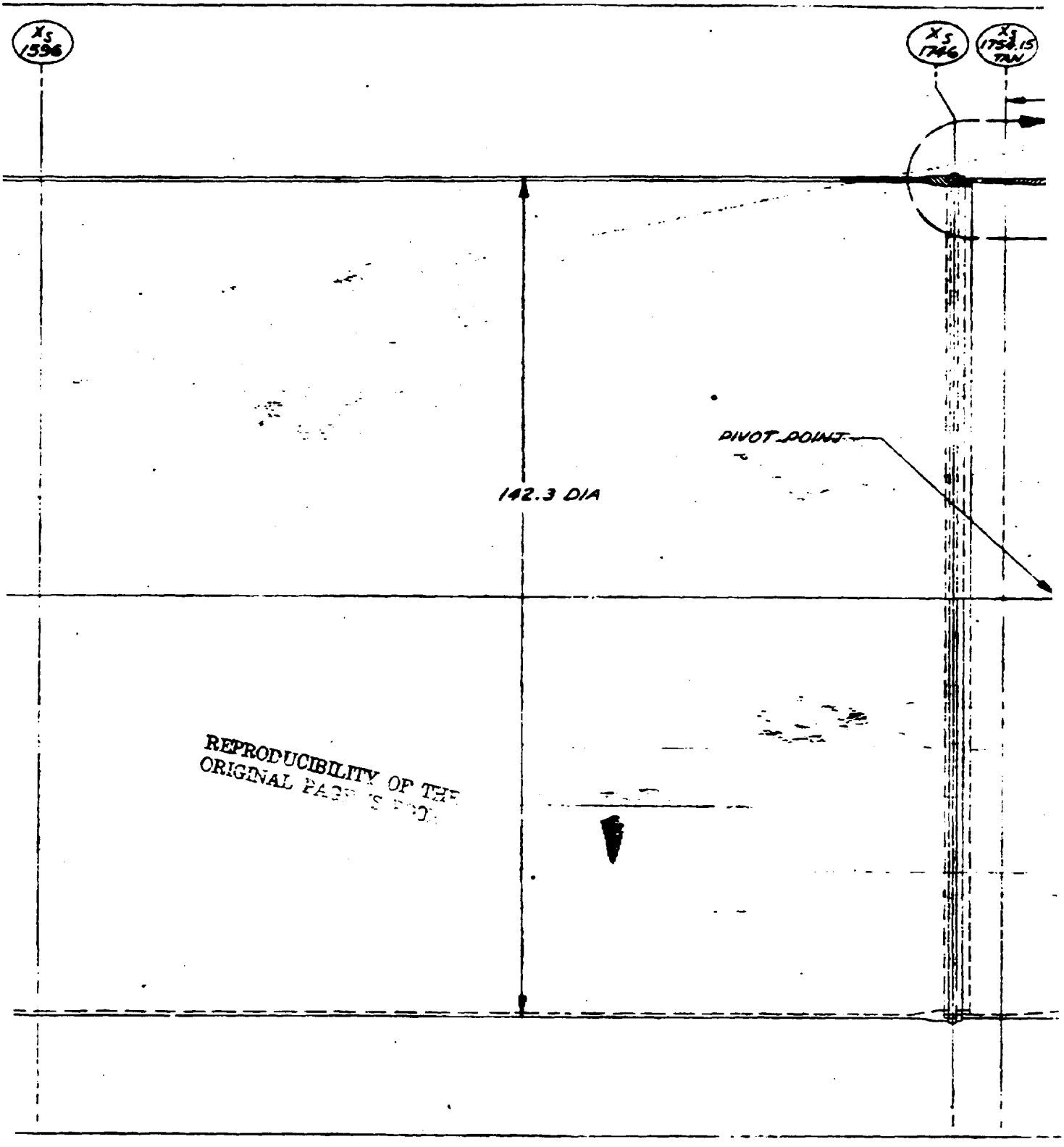
OUT FRAME

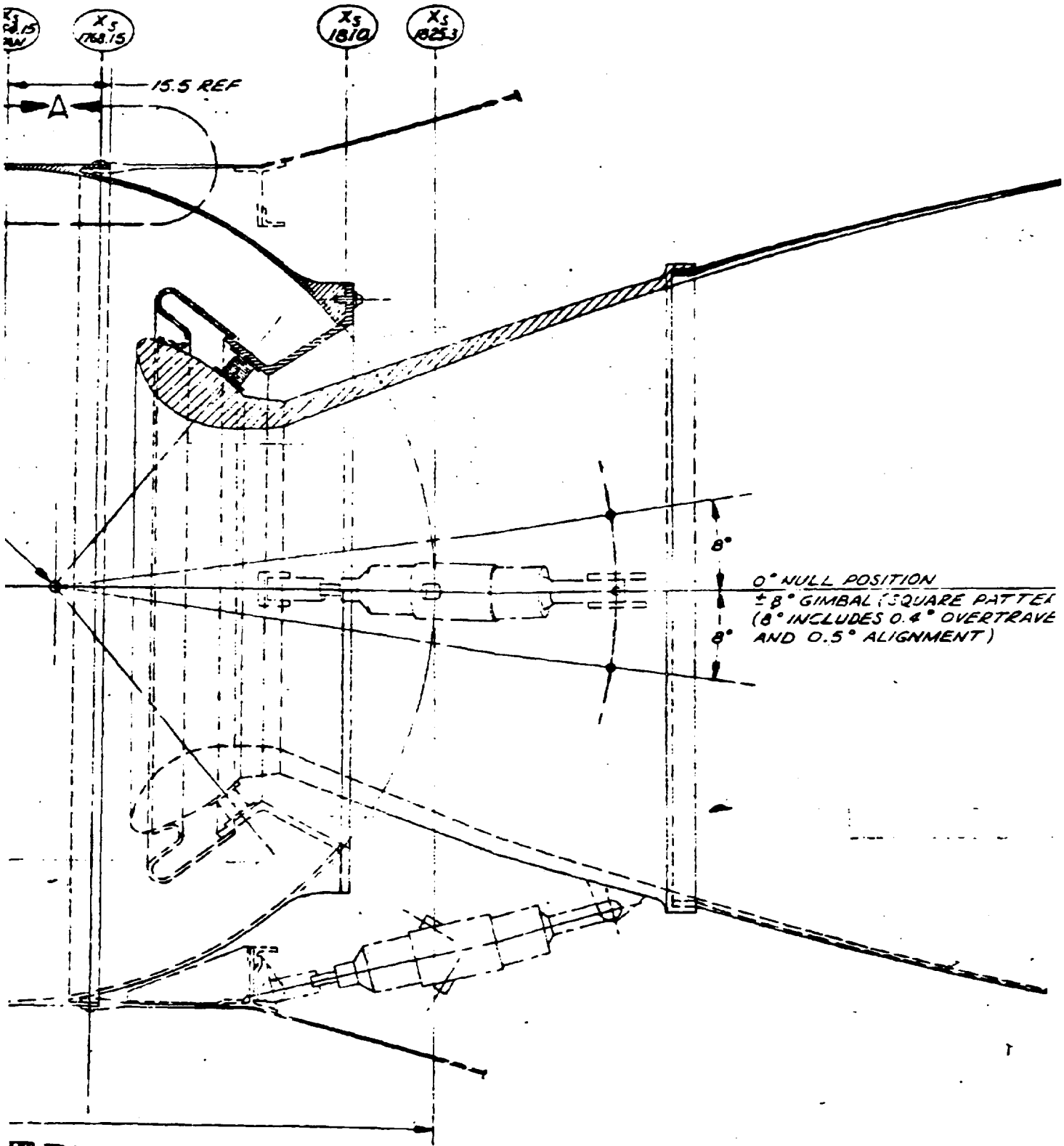



XS 696
300 REF
TYP 3 PLACES

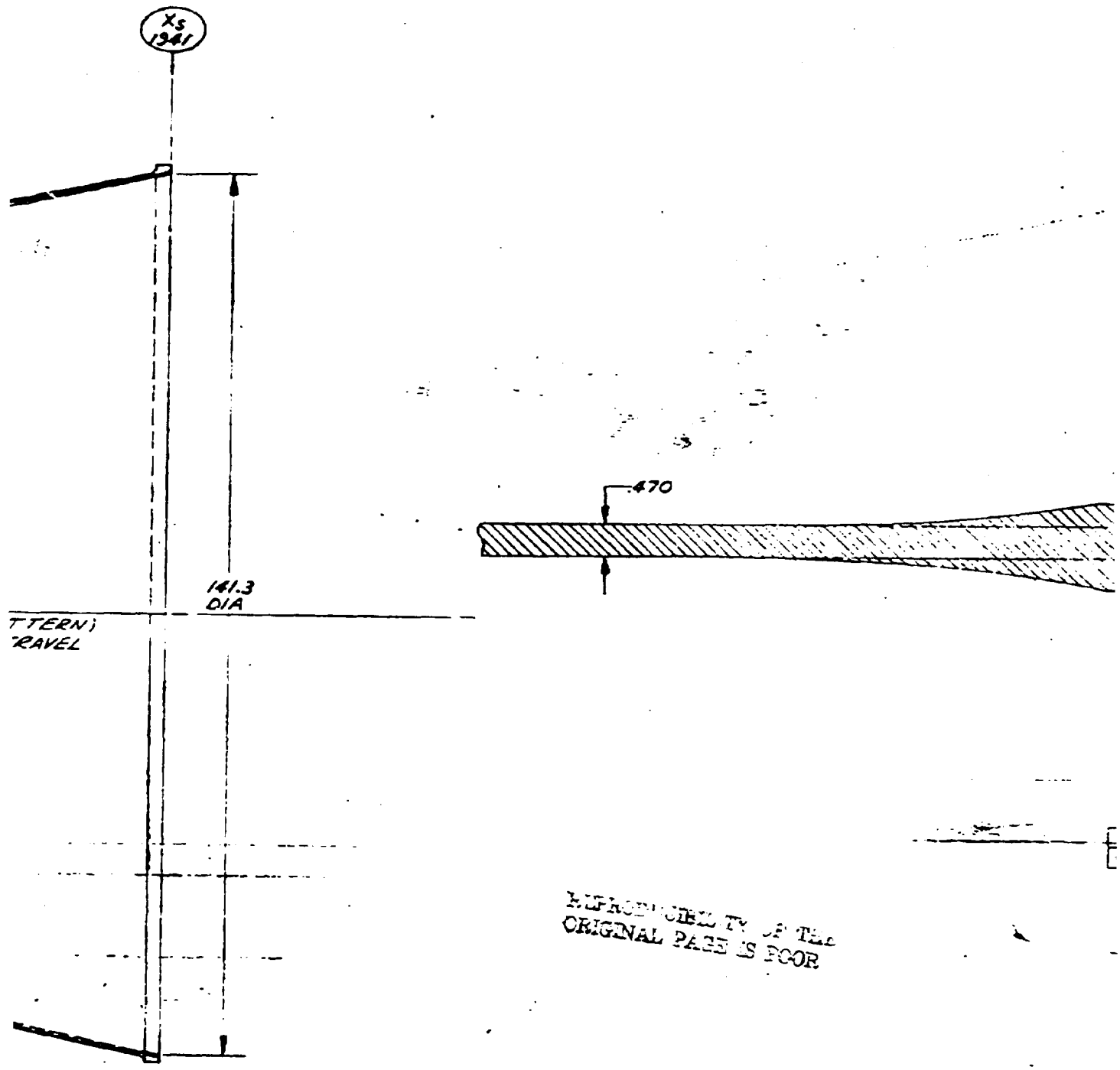




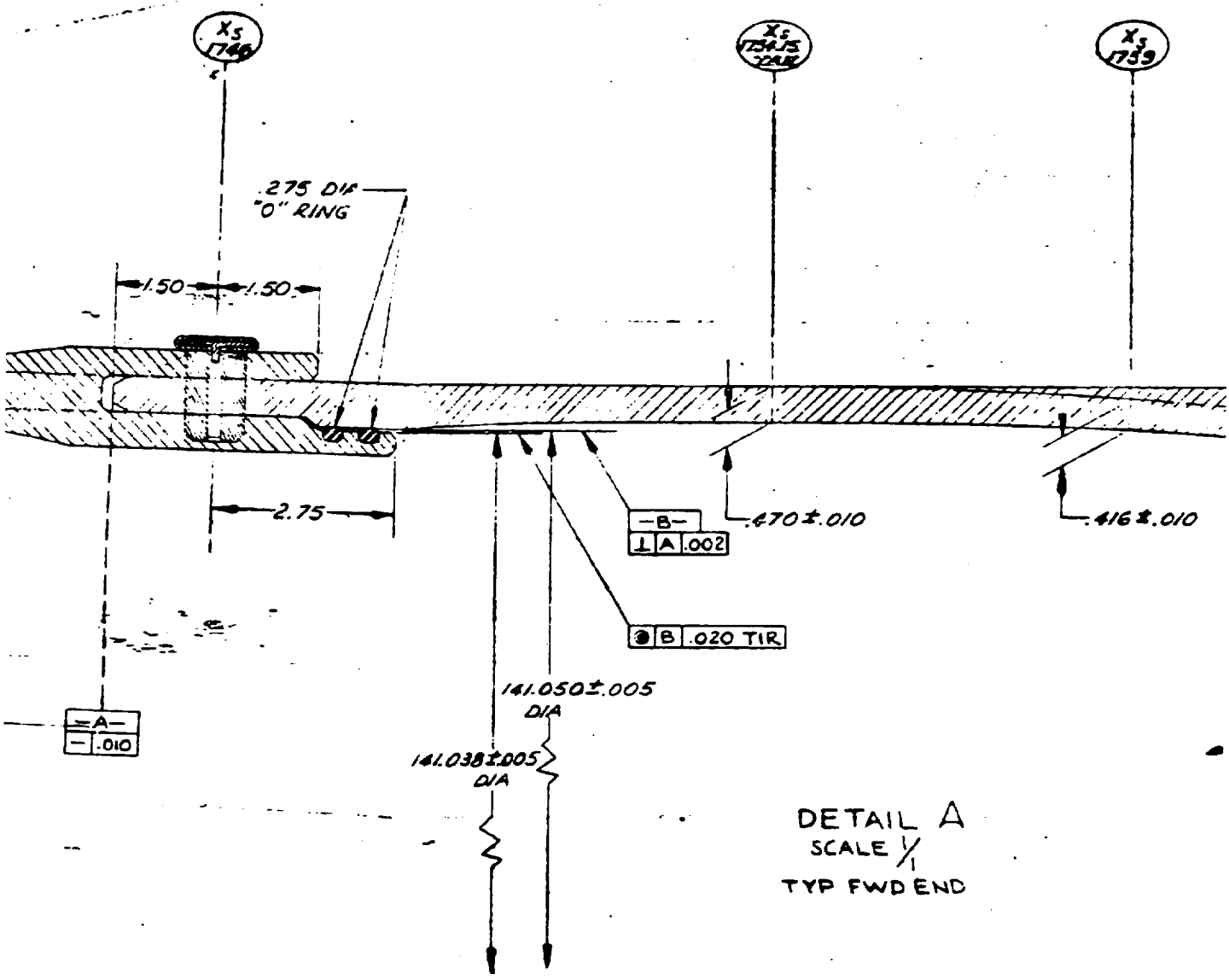



X5 1768.15
X5 1810
X5 1825.3
15.5 REF
A
8°
8°
0° NULL POSITION
± 8° GIMBAL (SQUARE PATTE
(8° INCLUDES 0.4° OVERTRAVE
AND 0.5° ALIGNMENT)

UT FRAME



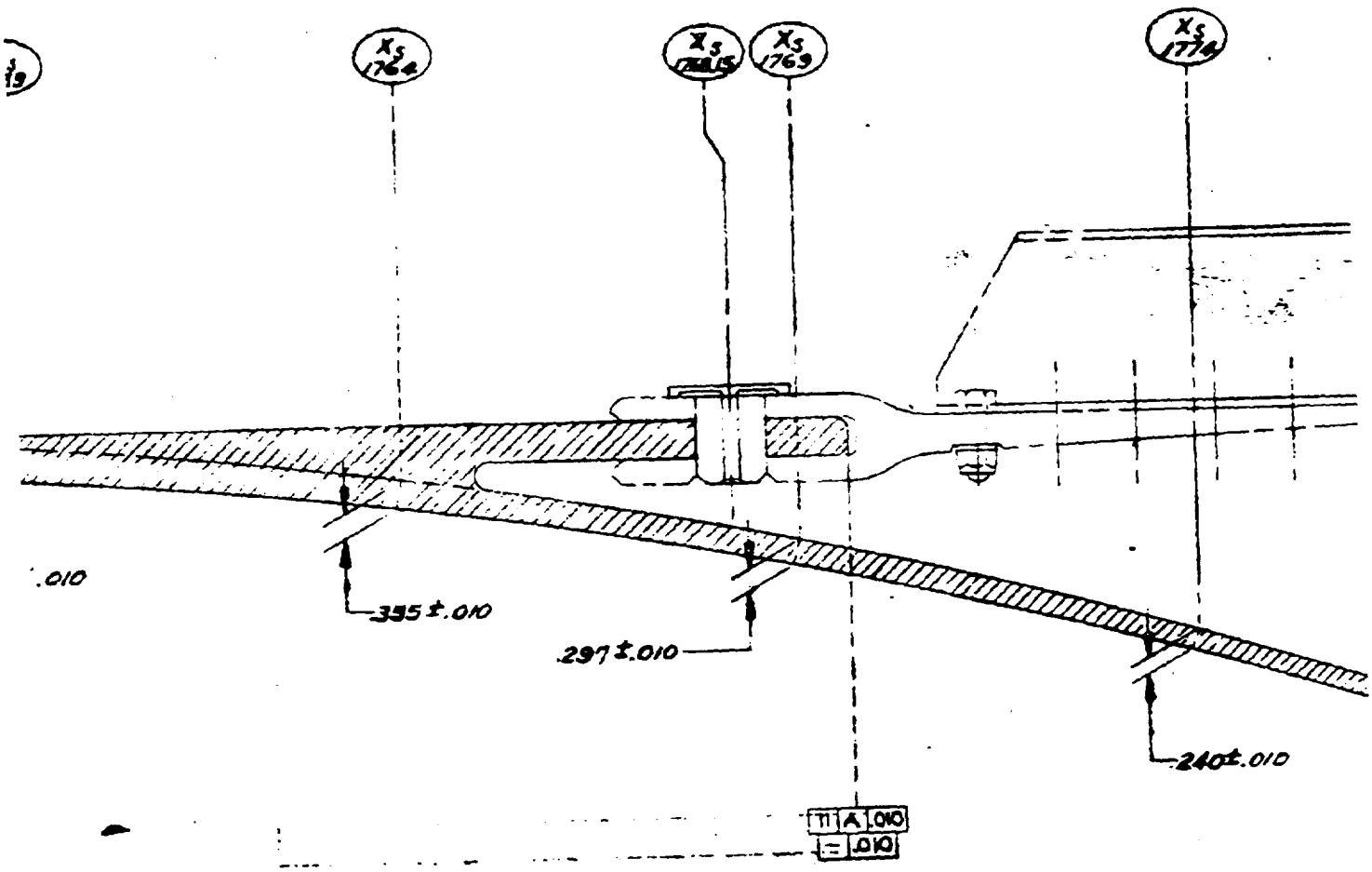
OUT FRAME



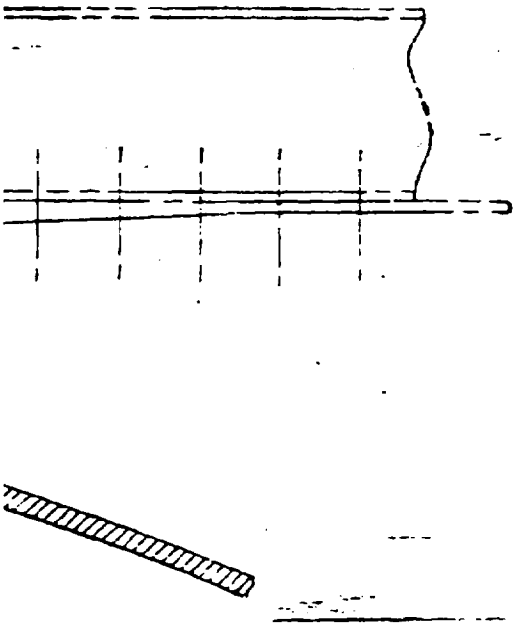
DETAIL A
SCALE 1/1
TYP FWD END

~~OUT FRAME~~

9



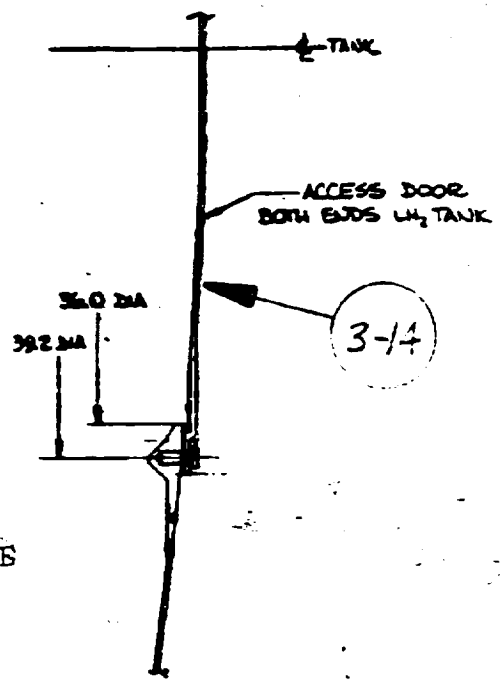
NEXT FRAME
10



REQUIREMENTS

1. WEIGHT MARGIN INCLUDED IN CONTROL WEIGHT 2% ON SRM INERT WEIGHT
2. NOZZLE CANT ANGLE = ZERO
3. NOZZLE EXPANSION RATO 7:1 CONTOURED; T/W AT LIFTOFF = 1.5
4. I_{SP} VAC = 266.3 SEC INITIAL, NOZZLE EROSION EFFECT TO BE INCLUDED
5. NOZZLE P_c = 737 PSI @ 60° F GRAIN TEMPERATURE AND MEOP = 900 PSI
6. MACHINED SURFACES:
   - CASE 125
   - CLEVIS 63
   - "O" RING SURFACES & GROOVES 32

Figure 1.2.3. Solid Rocket Motor Case



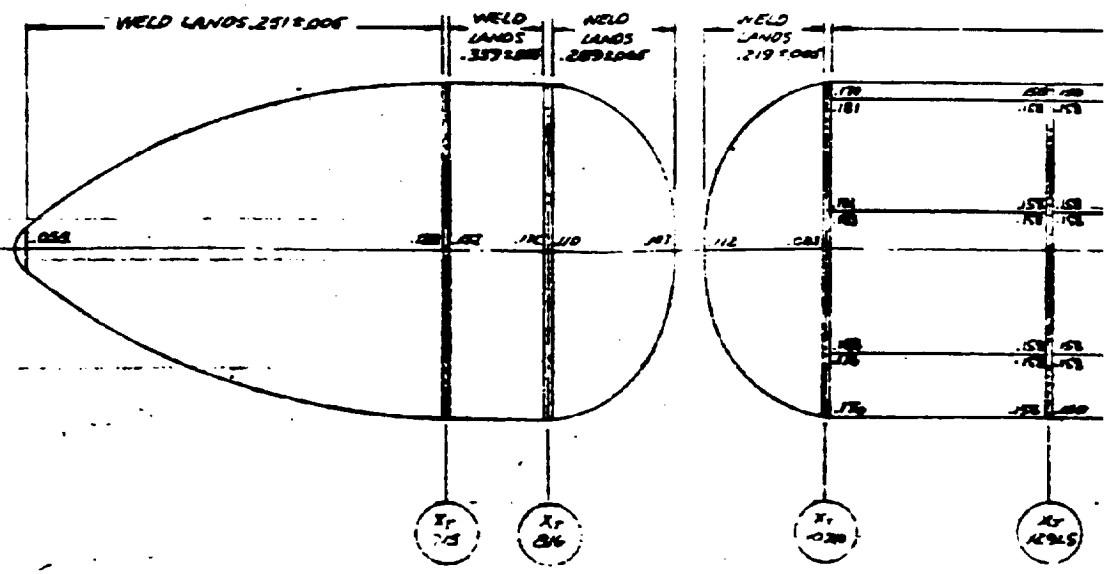
SECTION P-P SCALE 1/4

DETA

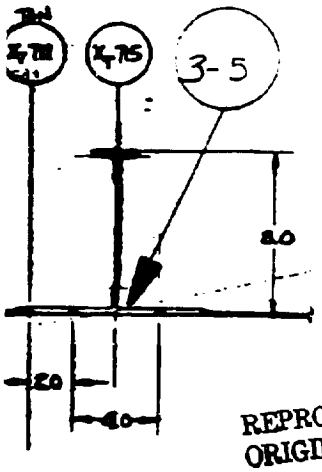
MONOCOQUE

T SKINS TAPER BE

2 SKIN THICKNES

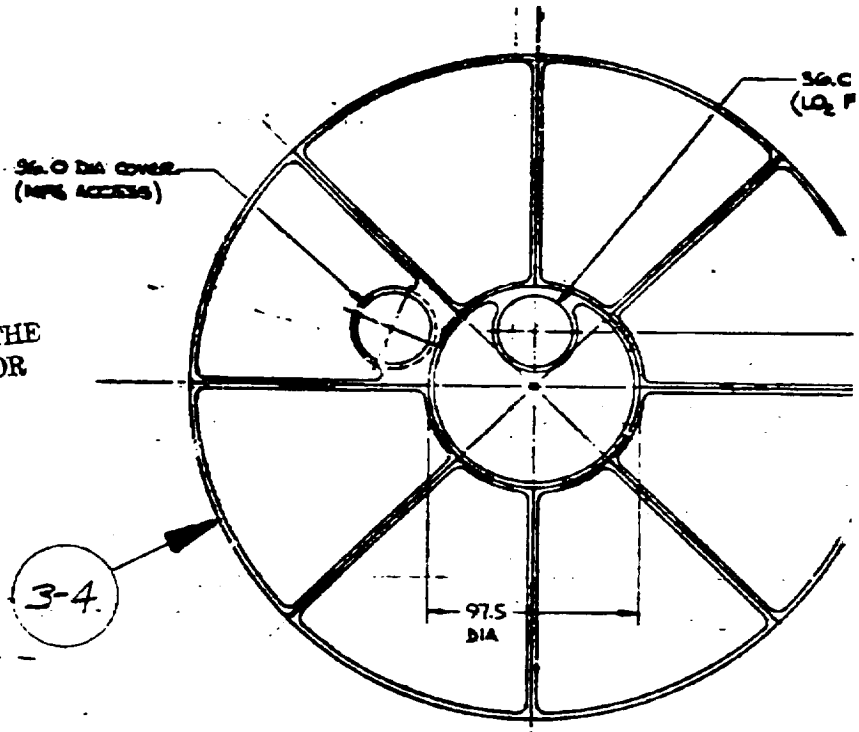


UE FRAME

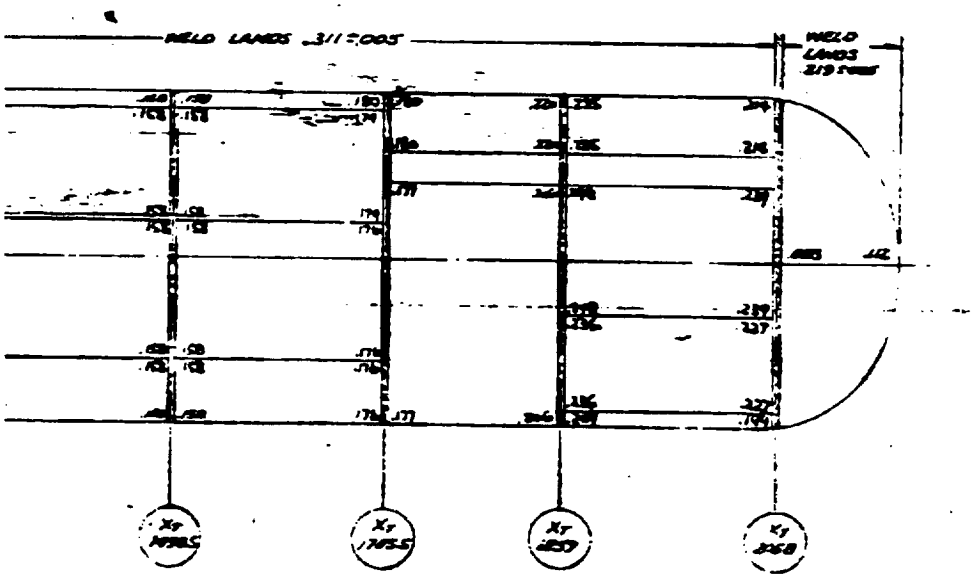


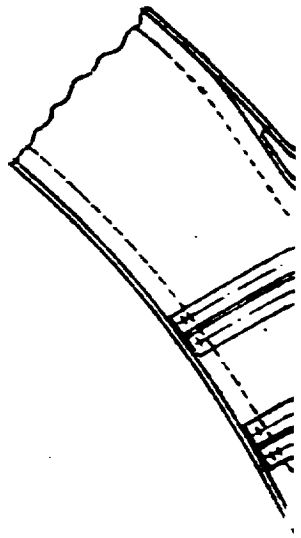
IL N SCALE: 1/4

SKIN THICKNESS DIAGRAM
TWEEN DIMS SHOWN
IS TOLERANCE ±.005



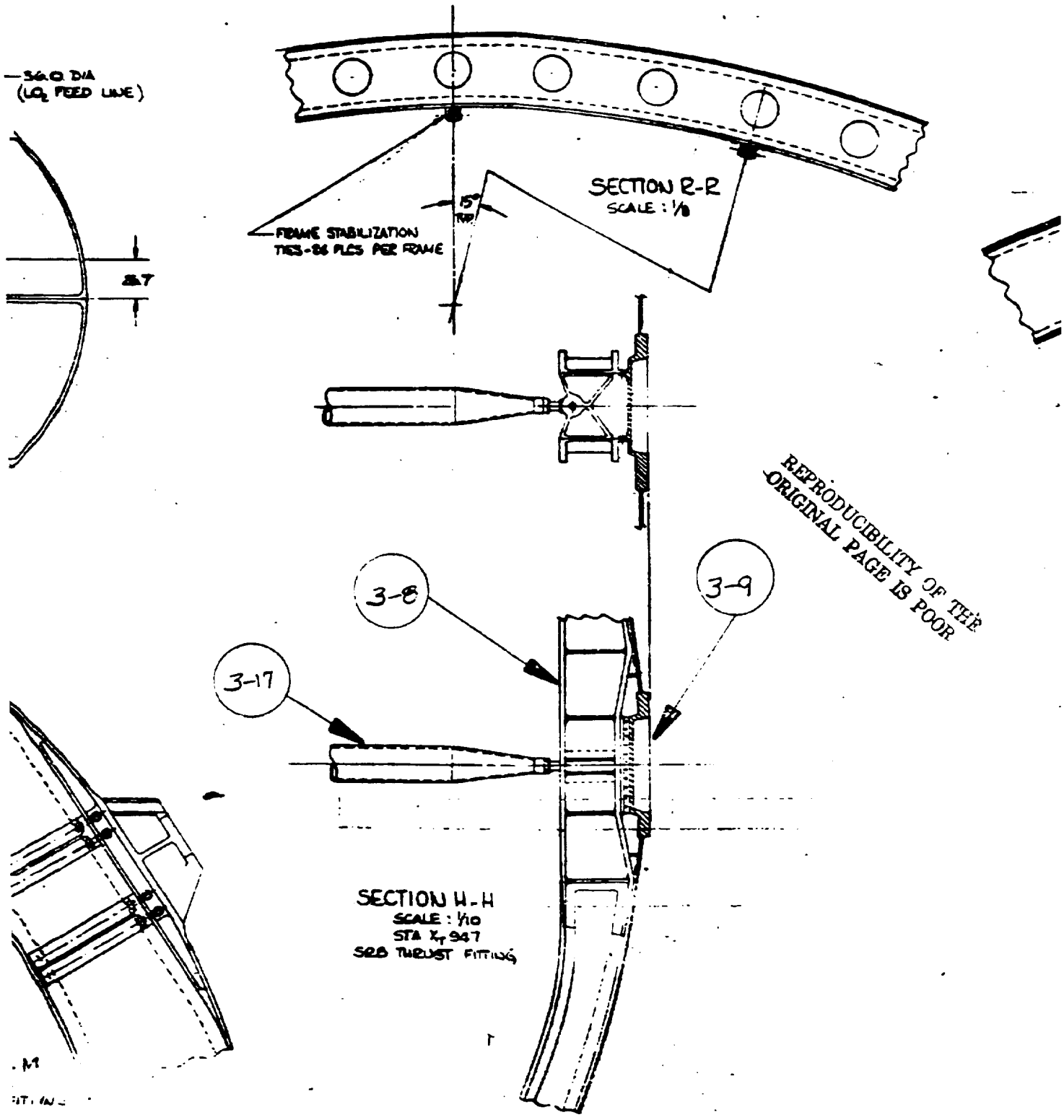
SECTION L-L
SCALE: 1/40
AFT DOME - LO_2 TANK





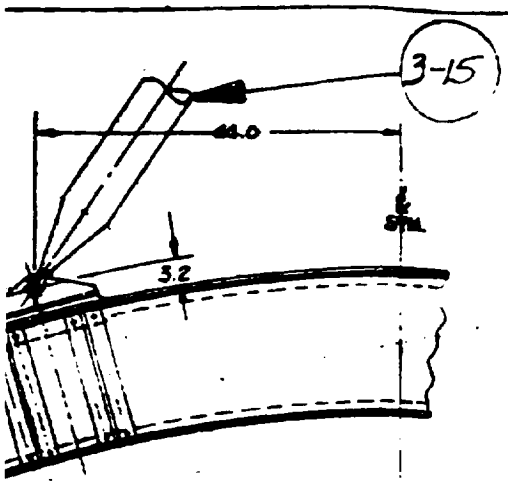
SECTION M-M
SCALE: 1/10
ORBITER THRUST FITTING
STA X_T 1859

AME

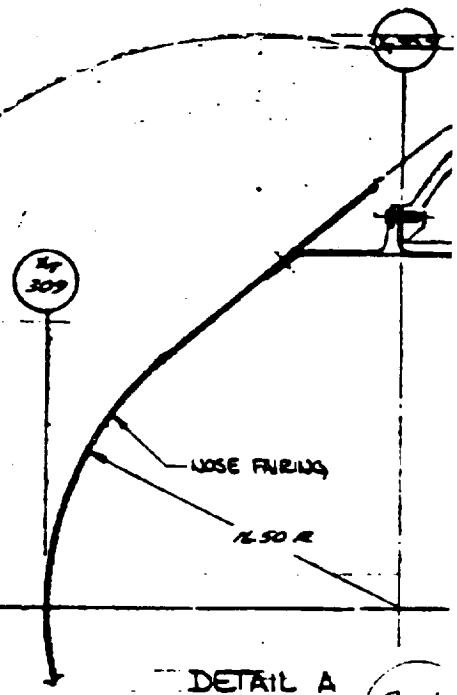


OUT FRAME

3

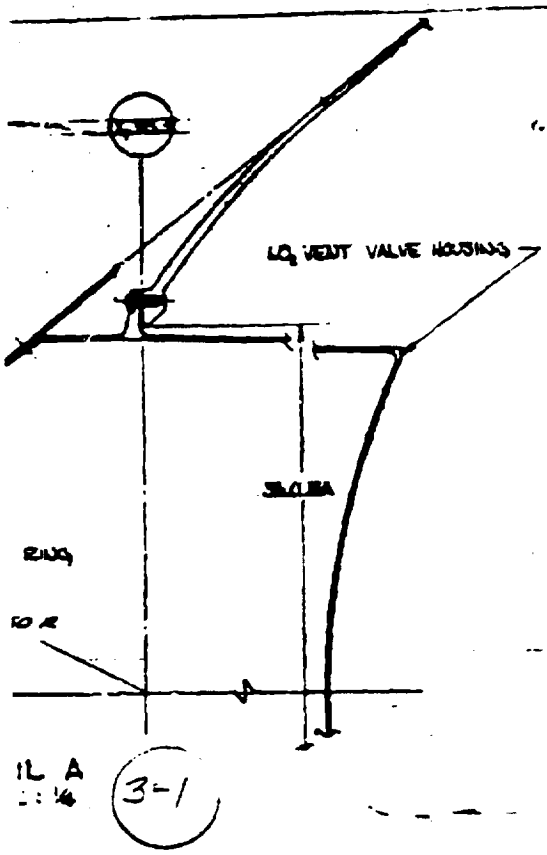


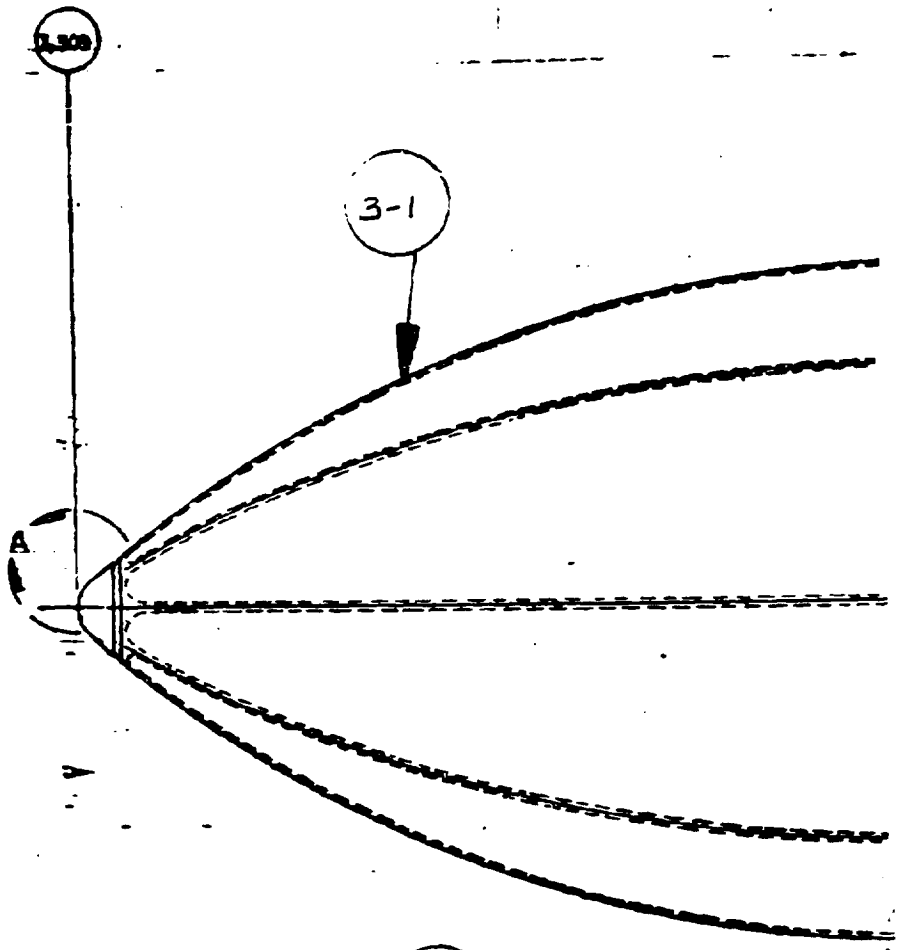
SECTION J-J SCALE: 1/10

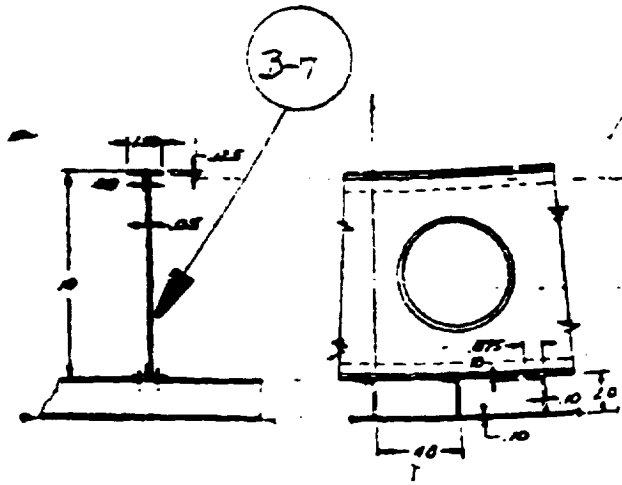


DETAIL A
SCALE: 1/4

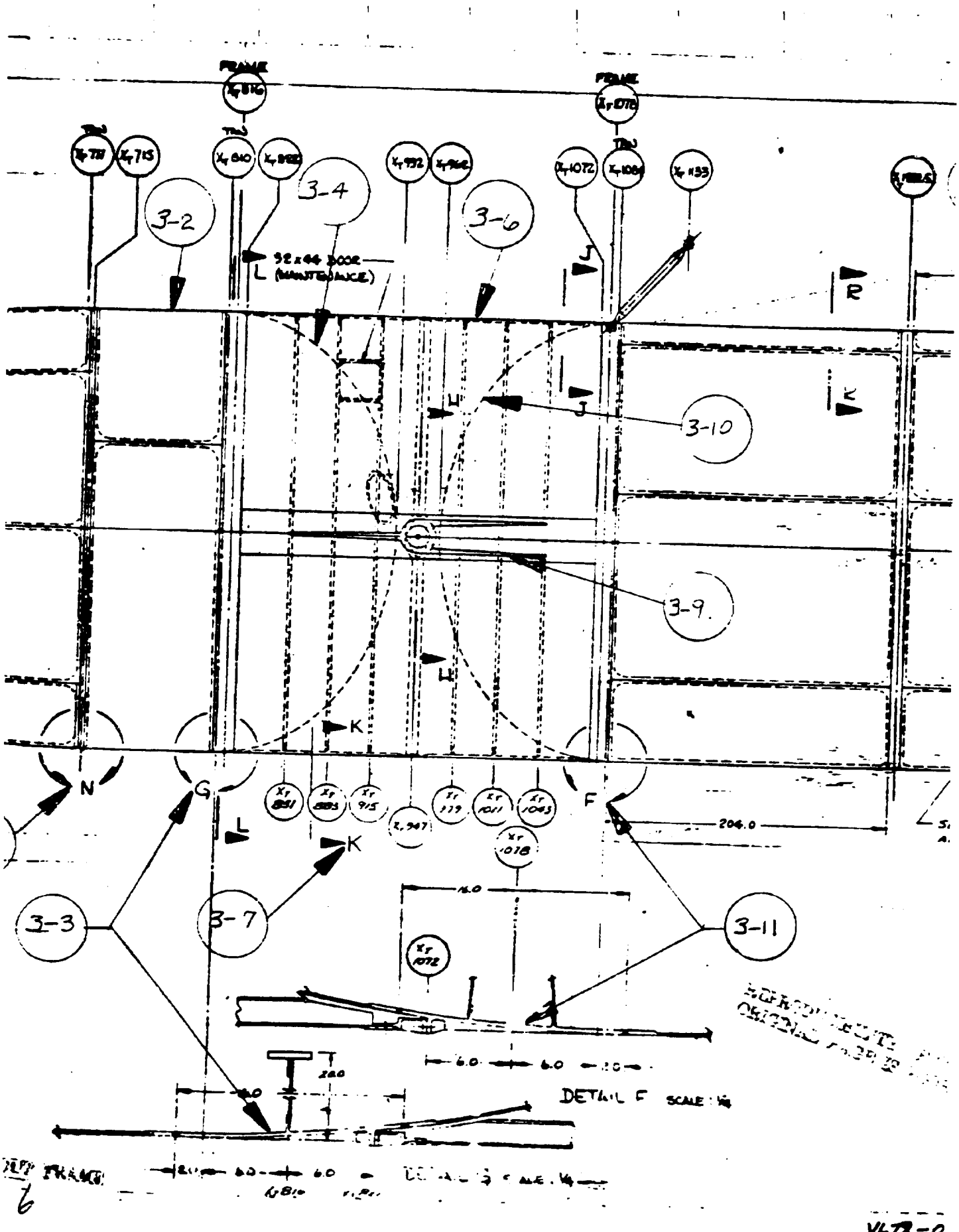
3-1



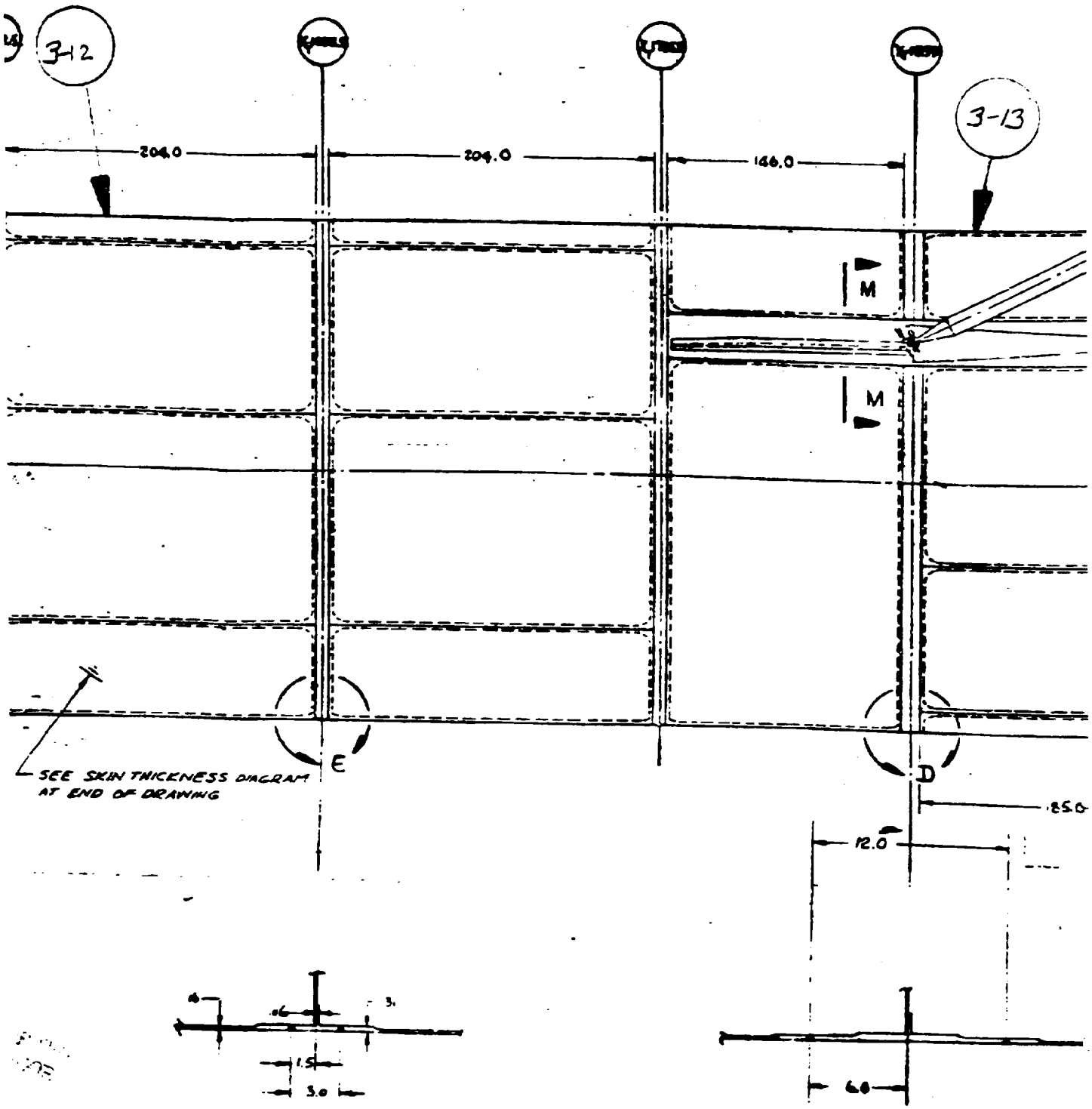




SECTION K-K
SCALE: 1/8
INTERTANK STRUCTURE


3-2
3-4
3-6
3-10
3-9
3-3
3-7
3-11
32x44 DOOR
L (MAINTENANCE)
J
R
K
L
N
G
F
204.0
DETAIL F SCALE:
6.0
6.0

VL78-0

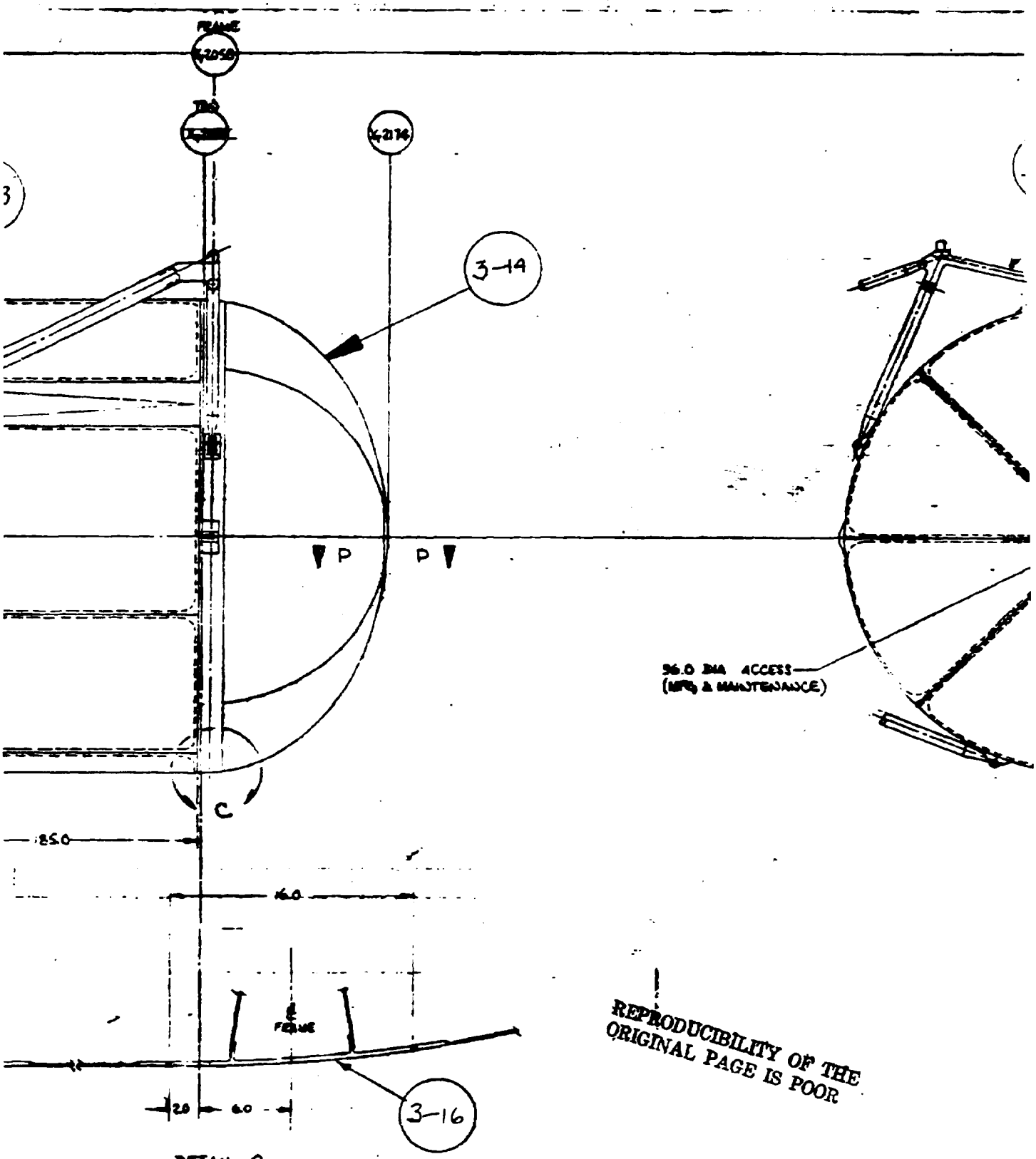


DETAIL E SCALE: 1/4

DETAIL D SCALE: 1/4

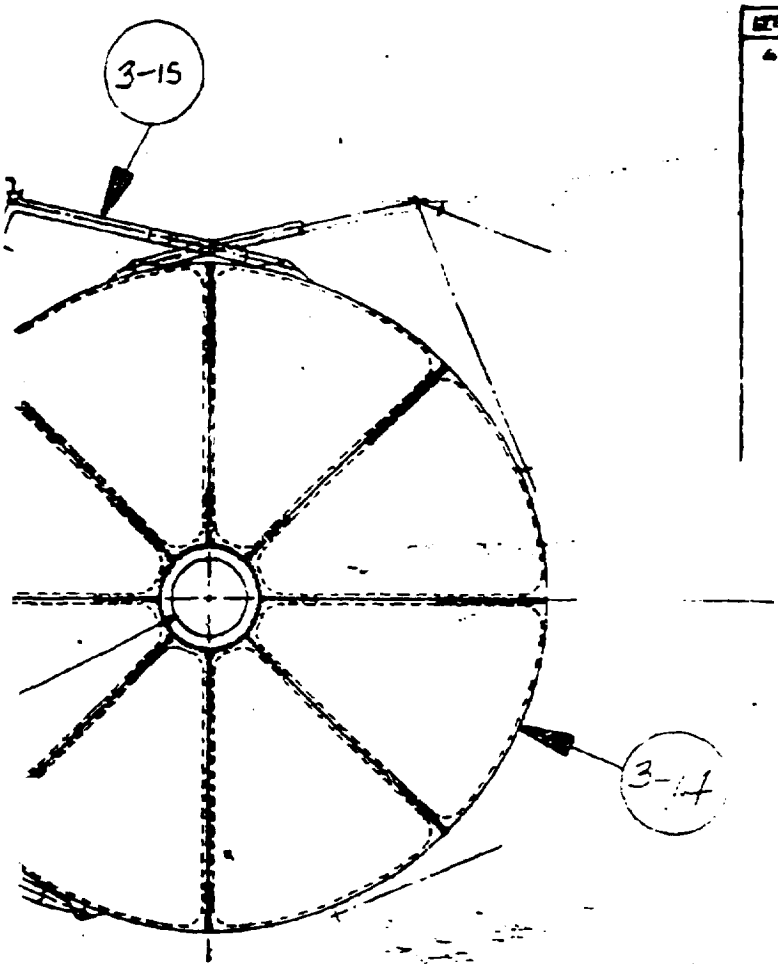
-000024 A

2M5



DETAIL C SCALE 1/4

FRAME



LTR	CHANGE
A	1. ADDED SECTIONS & DETAILS [illegible] THRU R-R 2. ADDED FRAME STABILIZATION TIES IN LH_2 TANK. 3. RELOCATED ACCESS DOOR IN INTERTANK. 4. ADDED REQUIREMENT NOTE 7 5. REMOVED DEORBIT MOTOR FROM NOSE FAIRING DETAIL A & DELETIONS, SECTION B-B 6. REVISED THICKNESSES IN SKIN THICKNESS DIAGRAM. 7. REVISED PANEL NUTMS & FRAME STATIONS IN LH_2 TANK. 8. REMOVED AFT SKIRT & HEATSHIELD SUPPORT. 'A' BASELINE DATA AUTHORIZED PER MCR 0200 REV. 1 DATED 5-16-73

REQUIREMENTS/ASSUMPTIONS

1. 324 IN. DIA EXTERNAL TANK
2. SRB TO E/T THRUST ATTACHMENT IN E/T INTERTANK AT [illegible]
3. SRB TO E/T AFT ATTACHMENT AT X_T 2058
4. ORBITER TO E/T FWD ATTACHMENT AT X_T 1078
5. ORBITER TO E/T AFT THRUST ATTACHMENT AT X_T 2058.
6. MONOCOQUE CONSTRUCTION FOR LO_2 & LH_2 TANKS
7. UNSUPPORTED ORBITER CONCEPT
8. LO_2 & LH_2 TANKS - 2219-1ST ALUM ALLOY
9. INTERTANK - 2024 ALUM. ALLOY

Figure 1.3.1. External Tank Structural Assembly

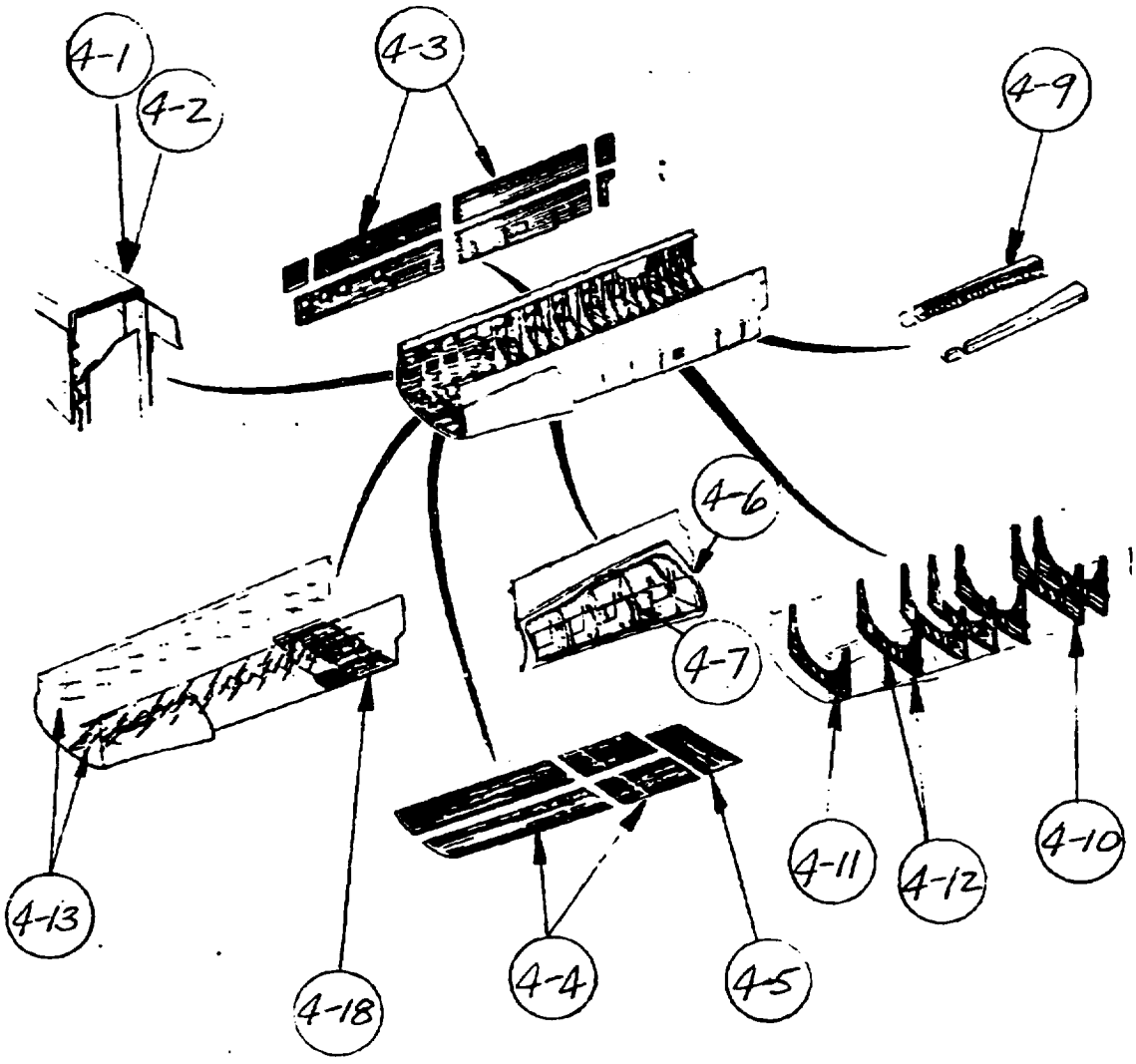
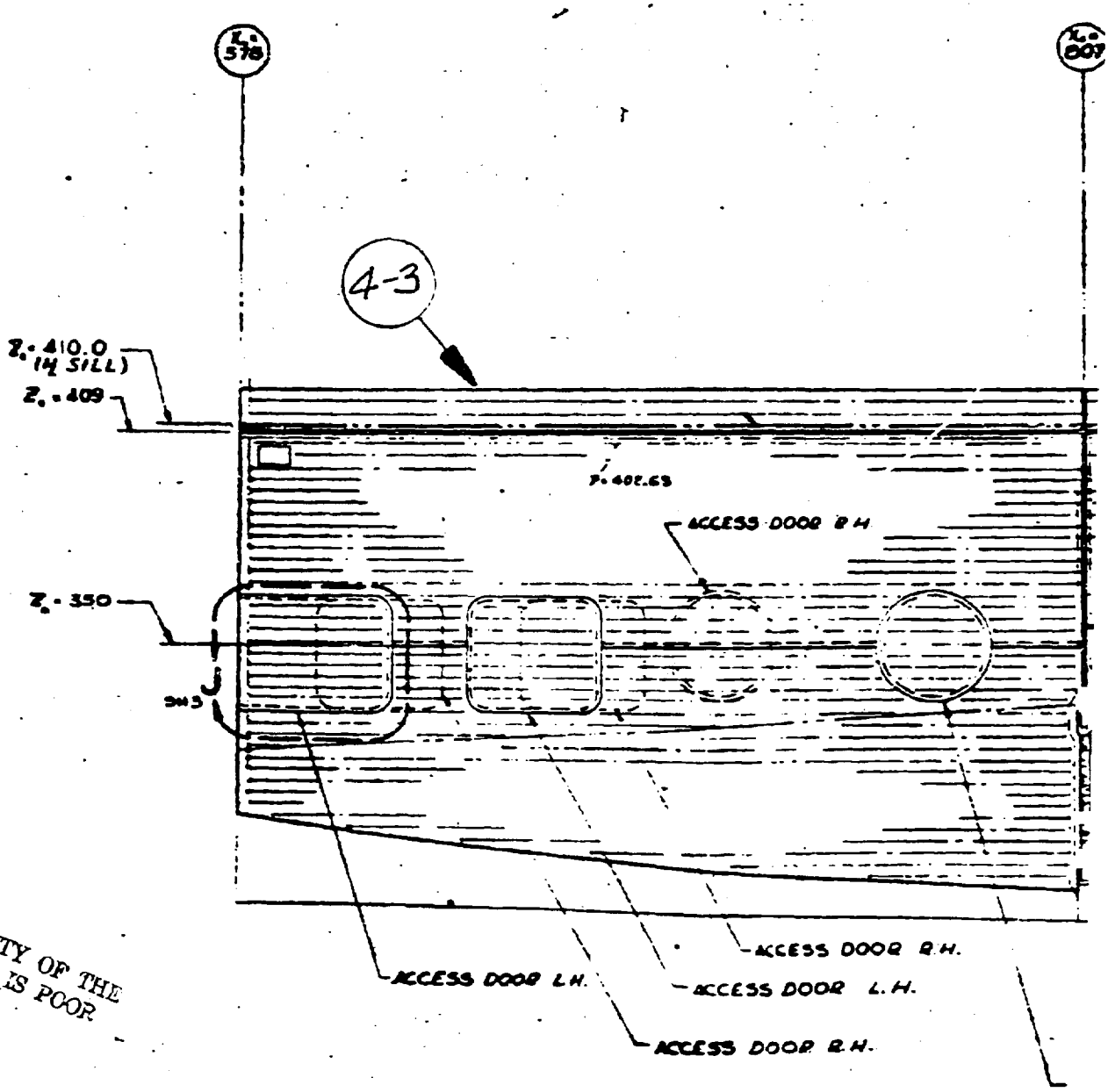
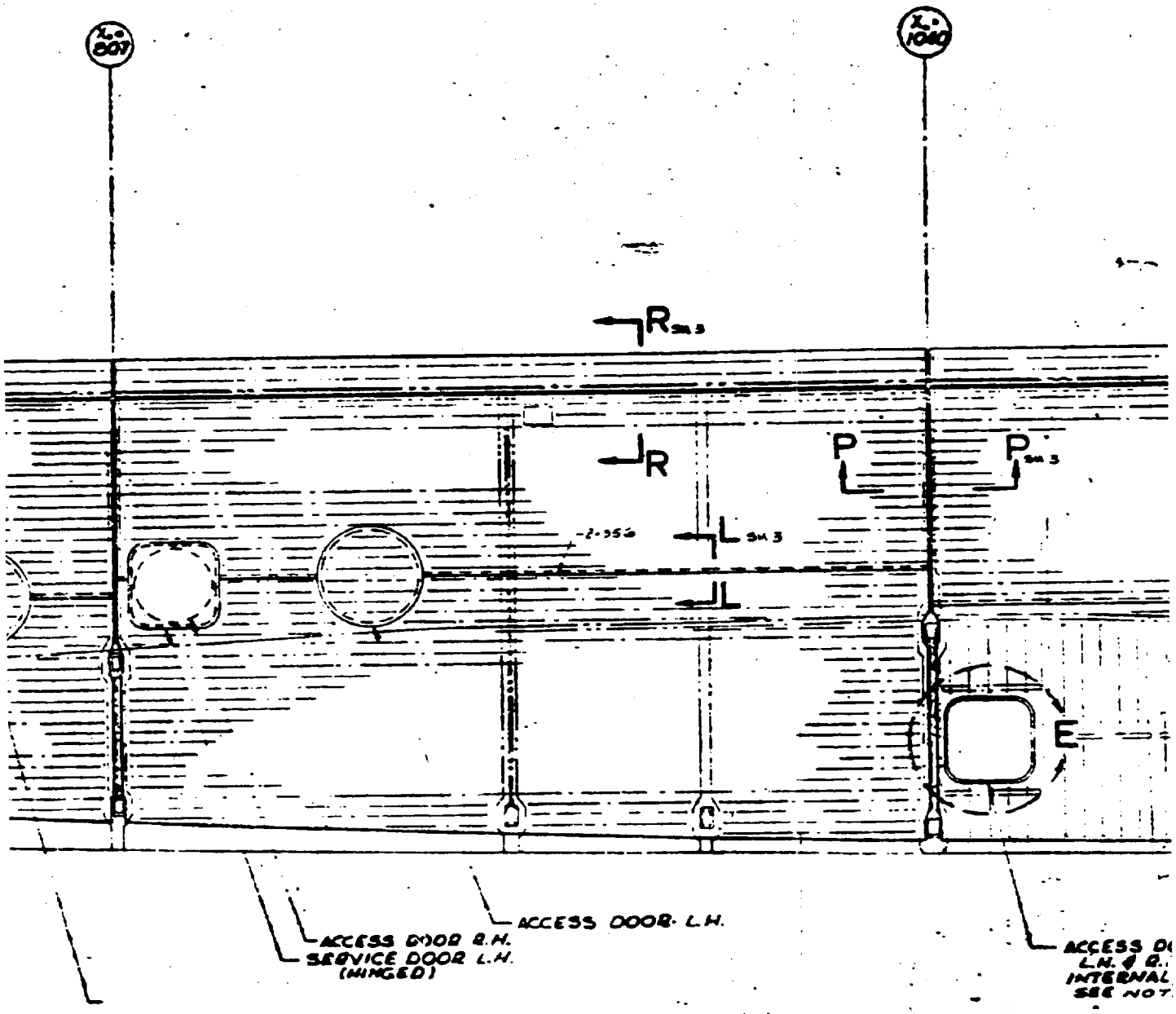


Figure 1.4.1. Mid Fuselage Structure





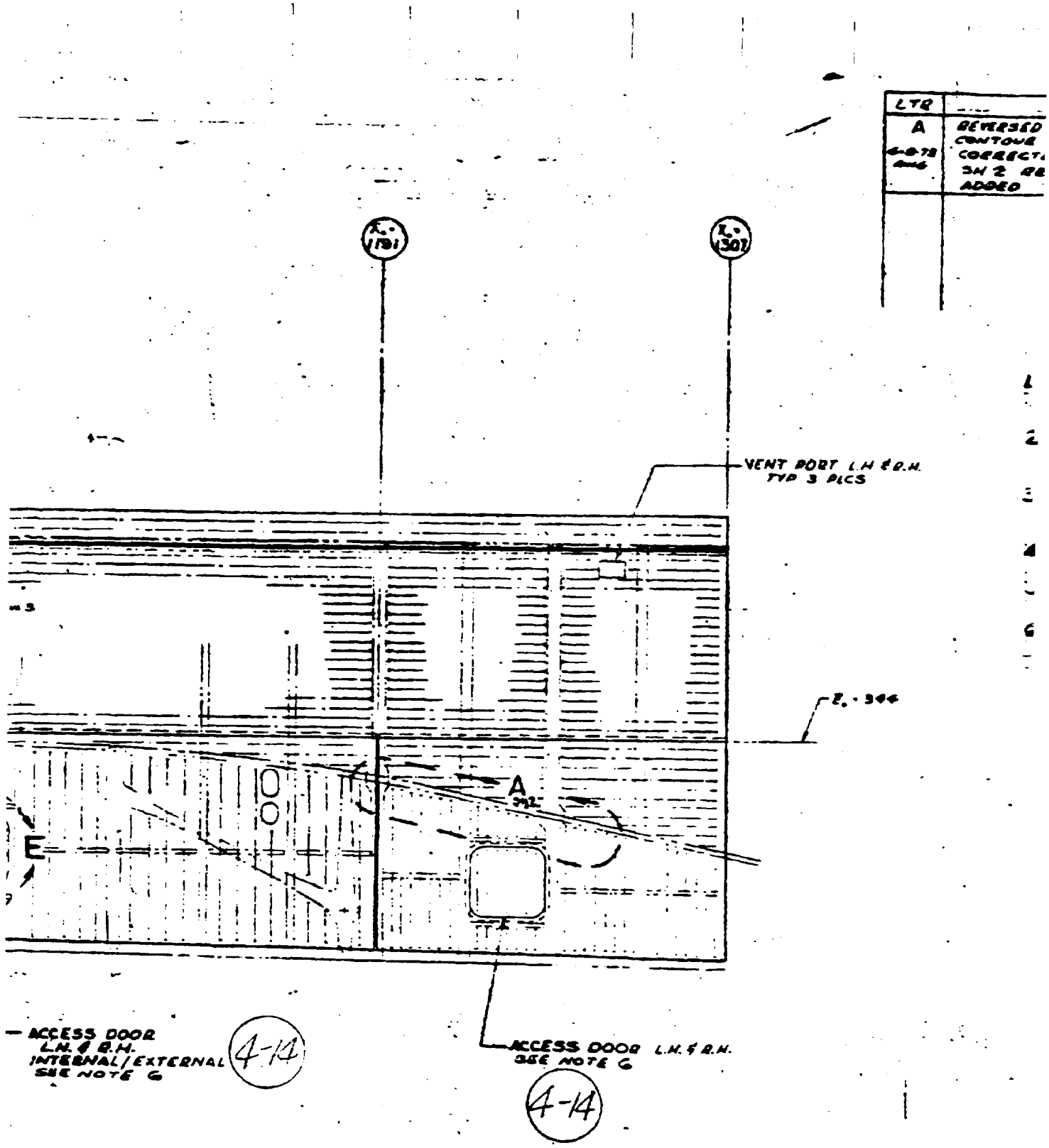


Figure 1.4.2. Mid

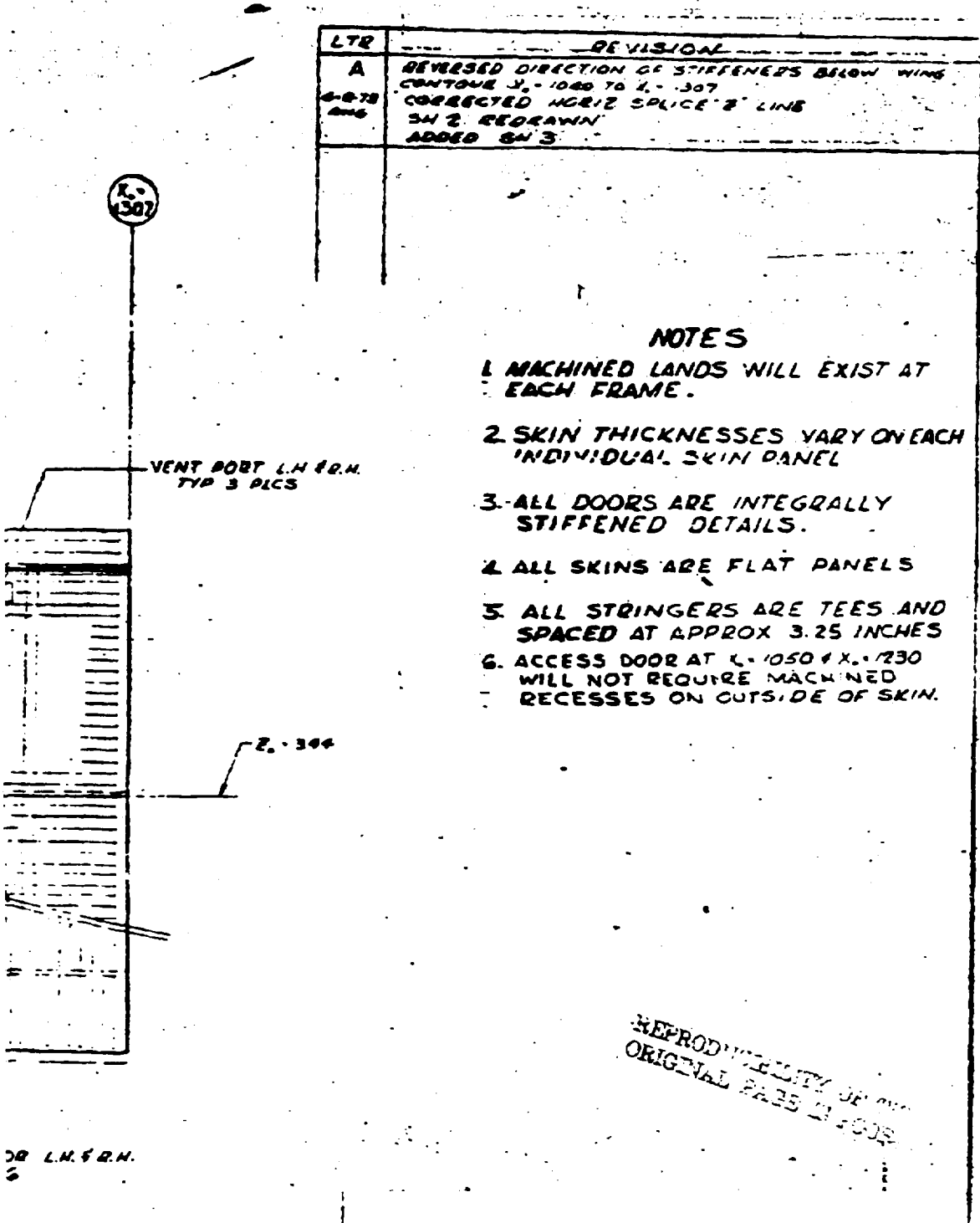
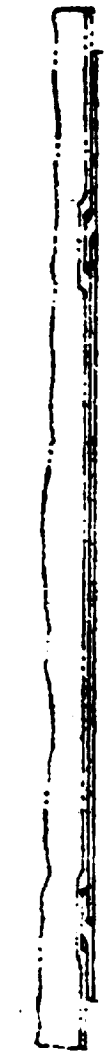
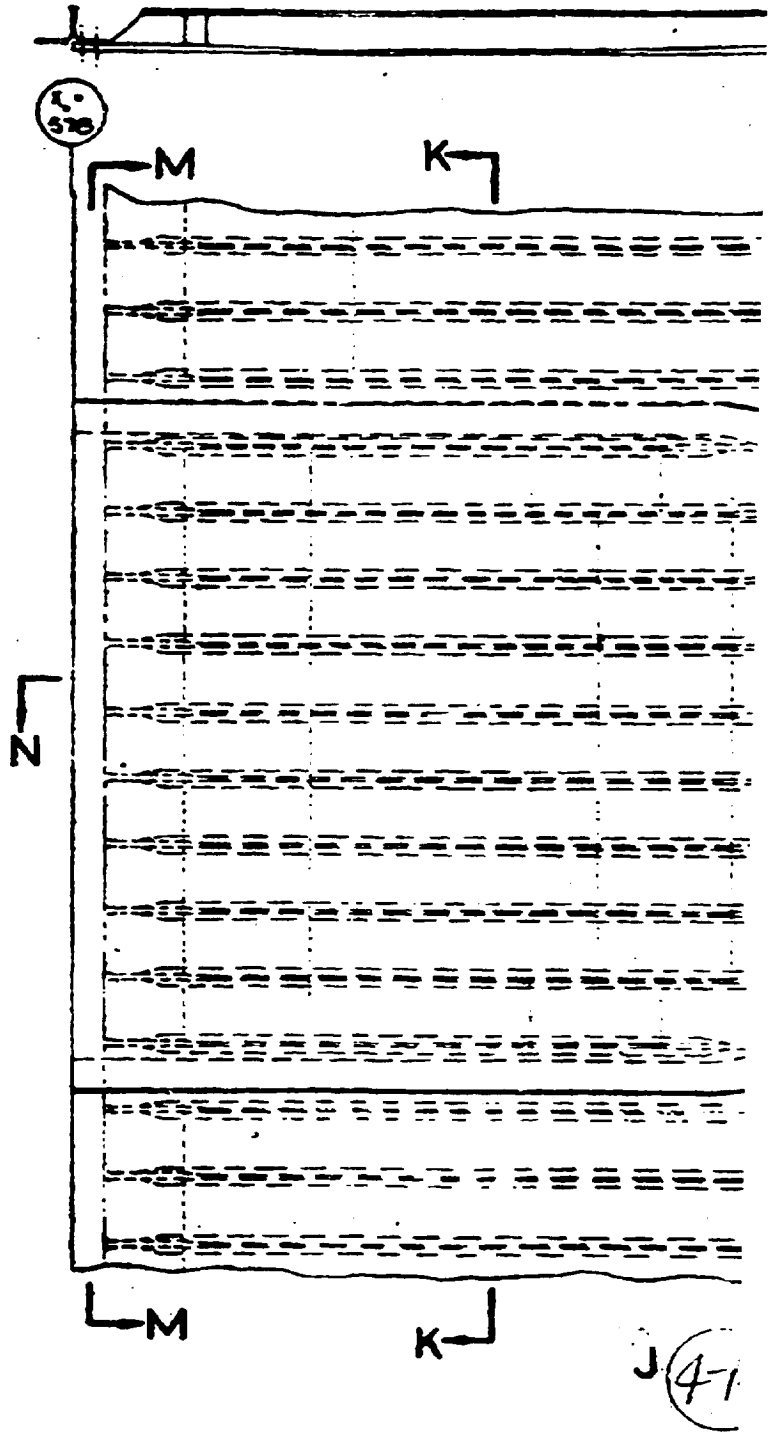


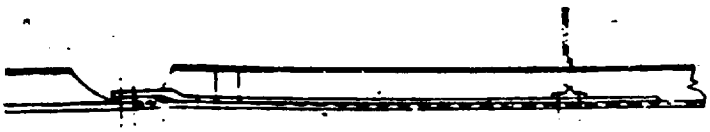
Figure 1.4.2. Mid Fuselage Side Panels



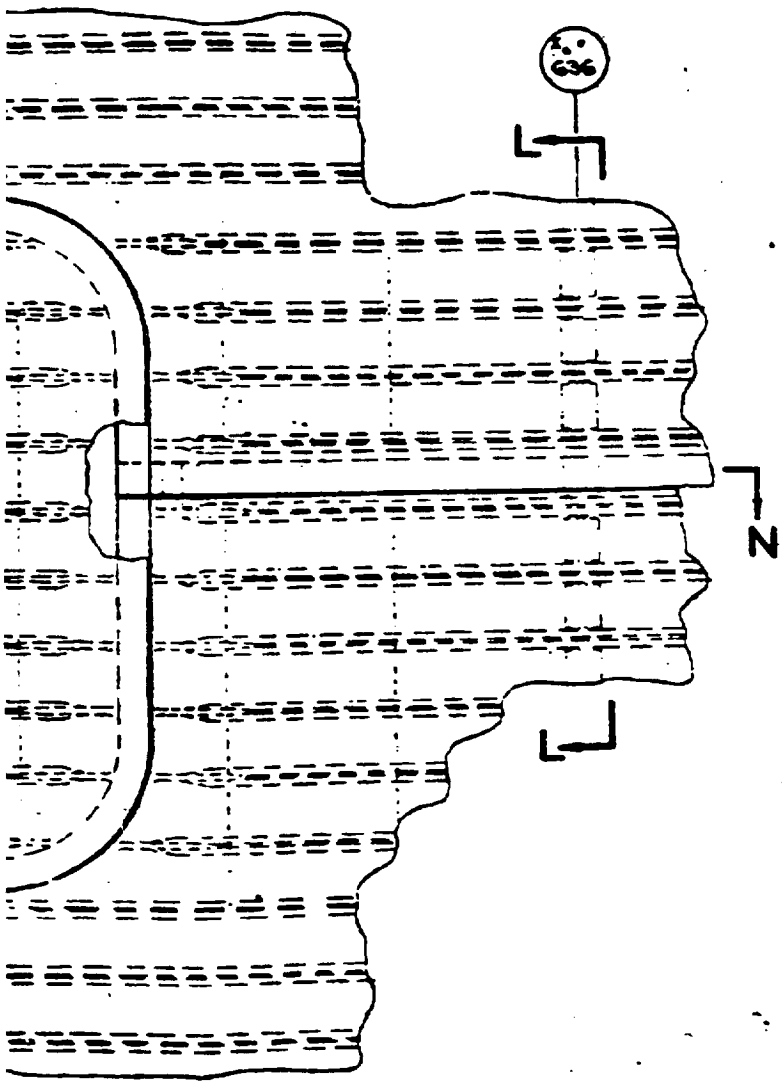
M-M

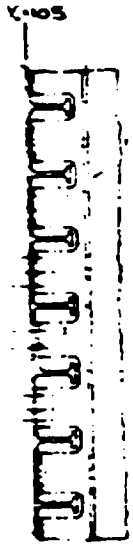


FOLDOUT FRAME



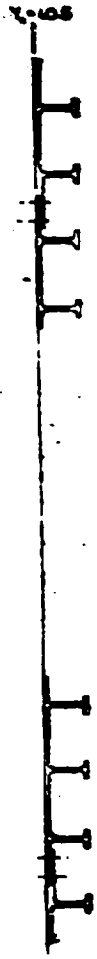
N-N





L-L

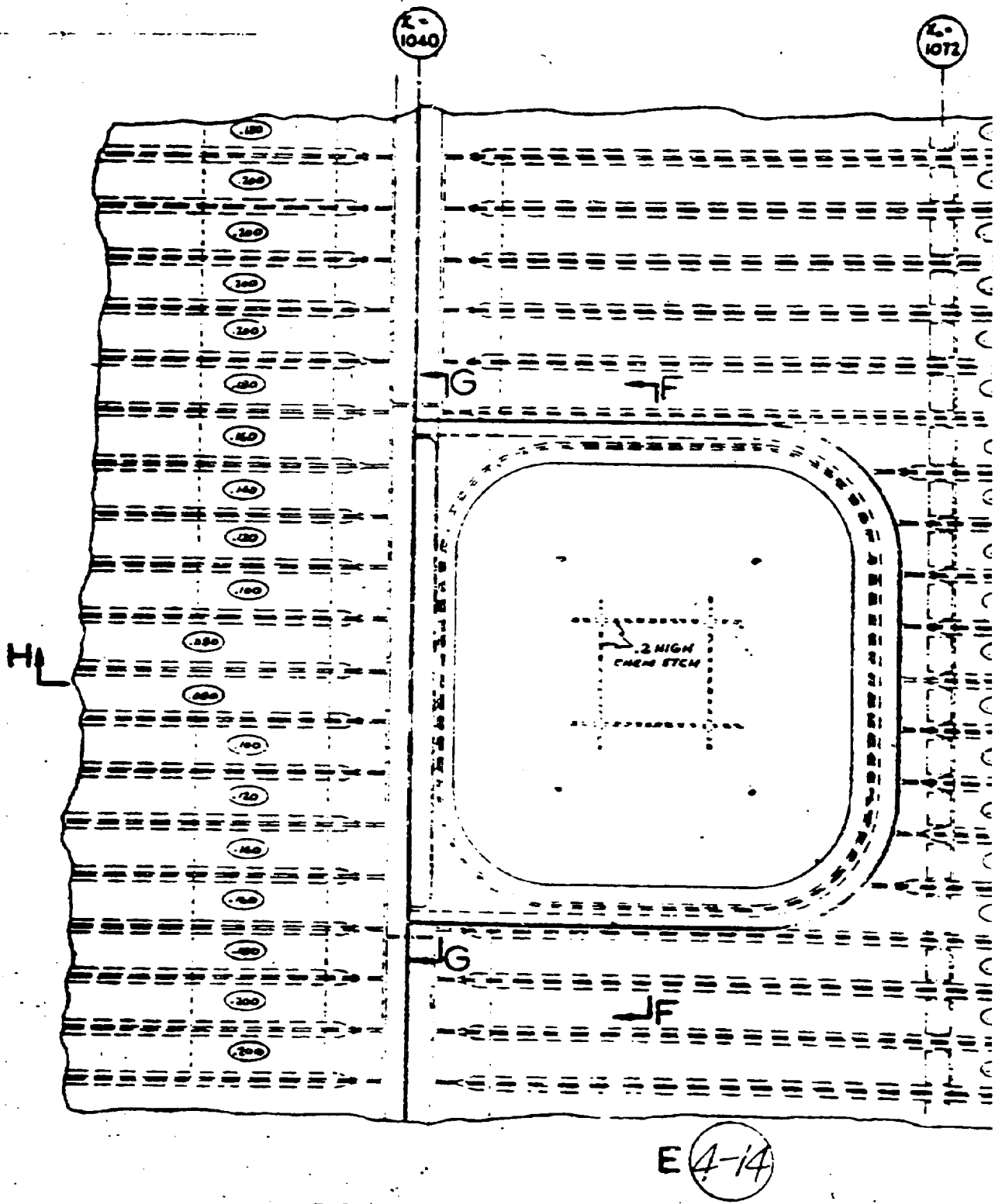
TYP HORIZ SPLICE



K-K

14

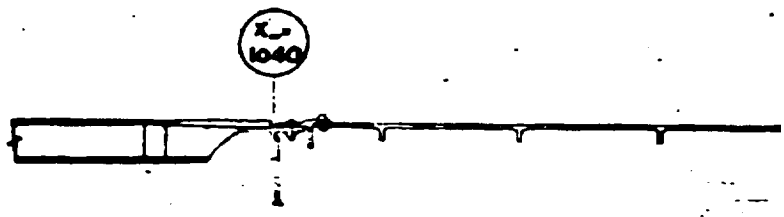
FRAME



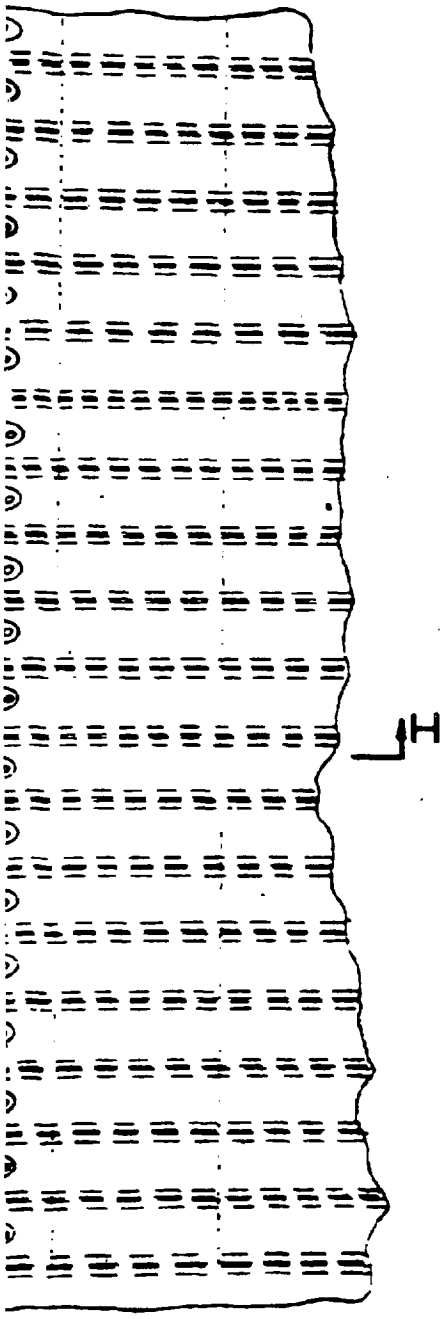
E 4-14

T FRAME

3



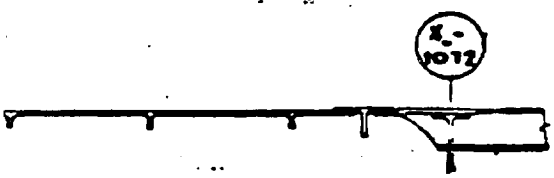
H-H



F-F

G

RAME



-H

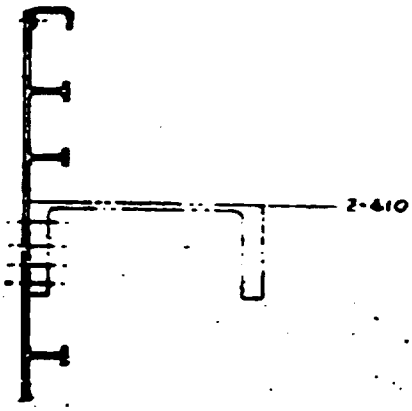
G-G

S

S

P-P

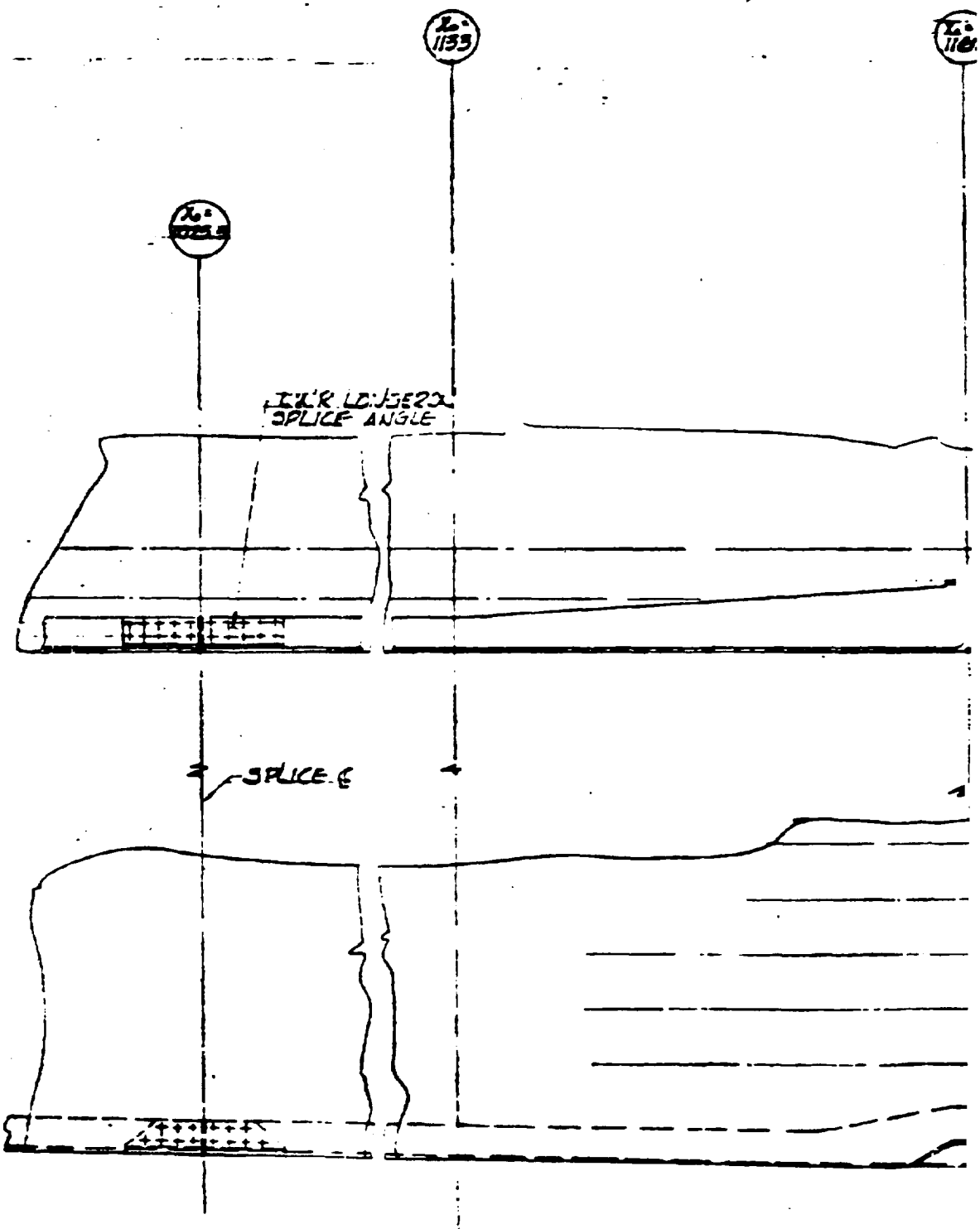
TYP VERTICAL SPLICE

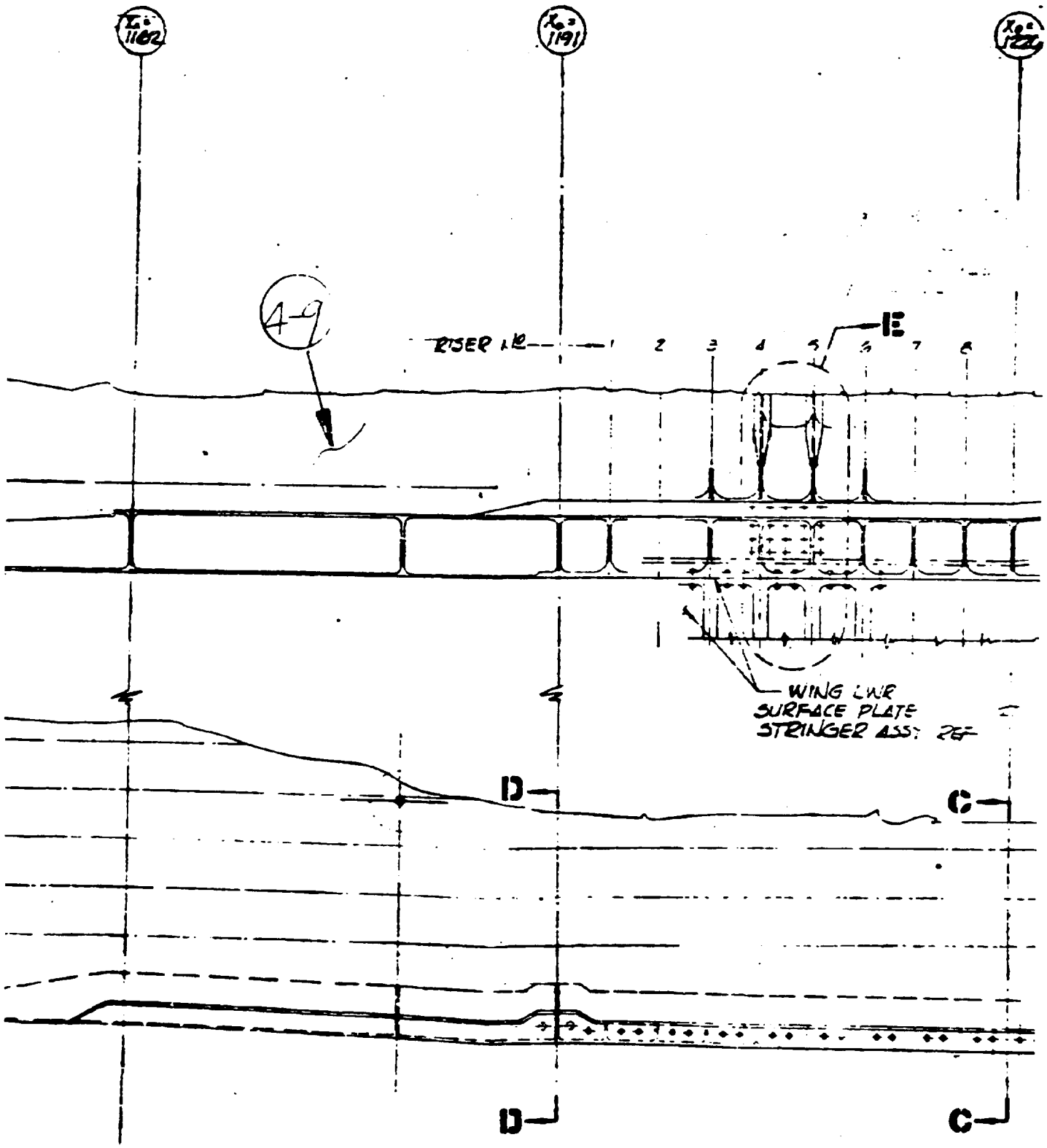


R-R

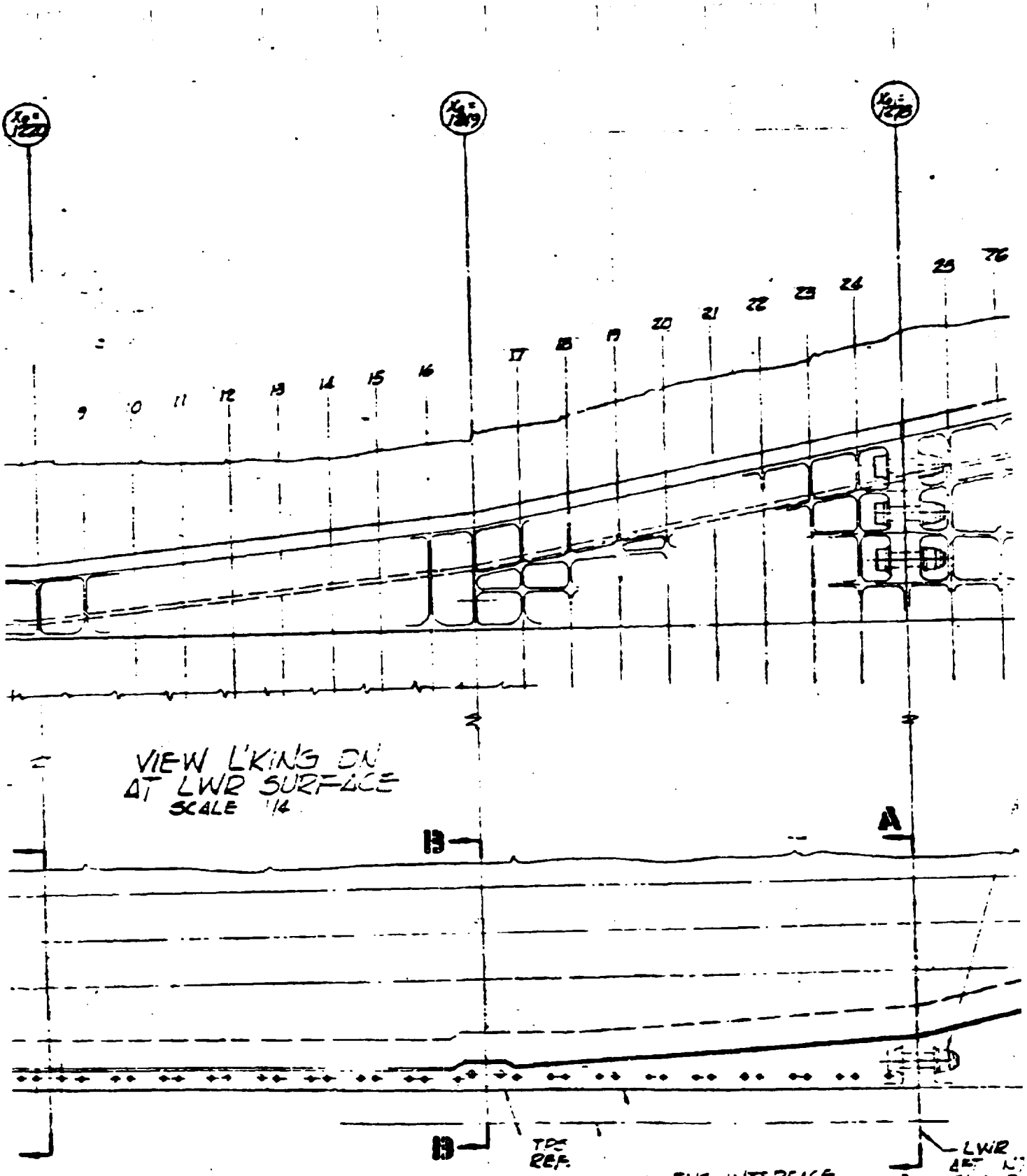
- 2-410

Figure 1.4.3. Mid Fuselage Side Panels




X.S. 1162
X.S. 1191
X.S. 1220
4-9
RISER LIC
1
2
3
4
5
6
7
8
E
WING LWR
SURFACE PLATE
STRINGER ASSY 2F
D
C
D
C

2


VIEW L'KING DN
AT LWR SURFACE
SCALE 1/4
B
A
B
TDC
REF.
LWR
ART
PLANE
FUS INTERFACE
MOLD LINE @ Y=0.0
OUTER MOLD LINE
VIEW L'KING
AT L-H SIDE SCALE 1/4

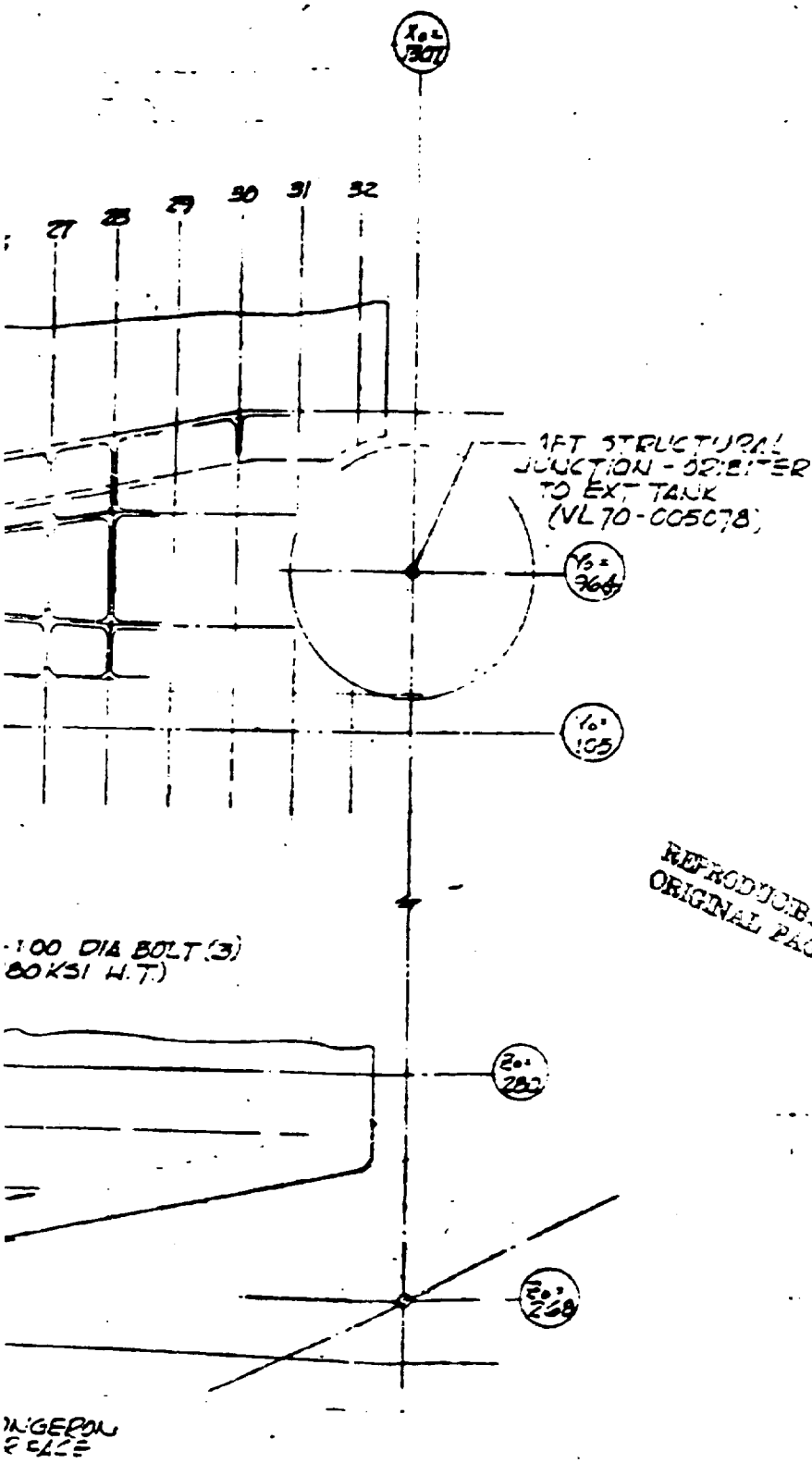
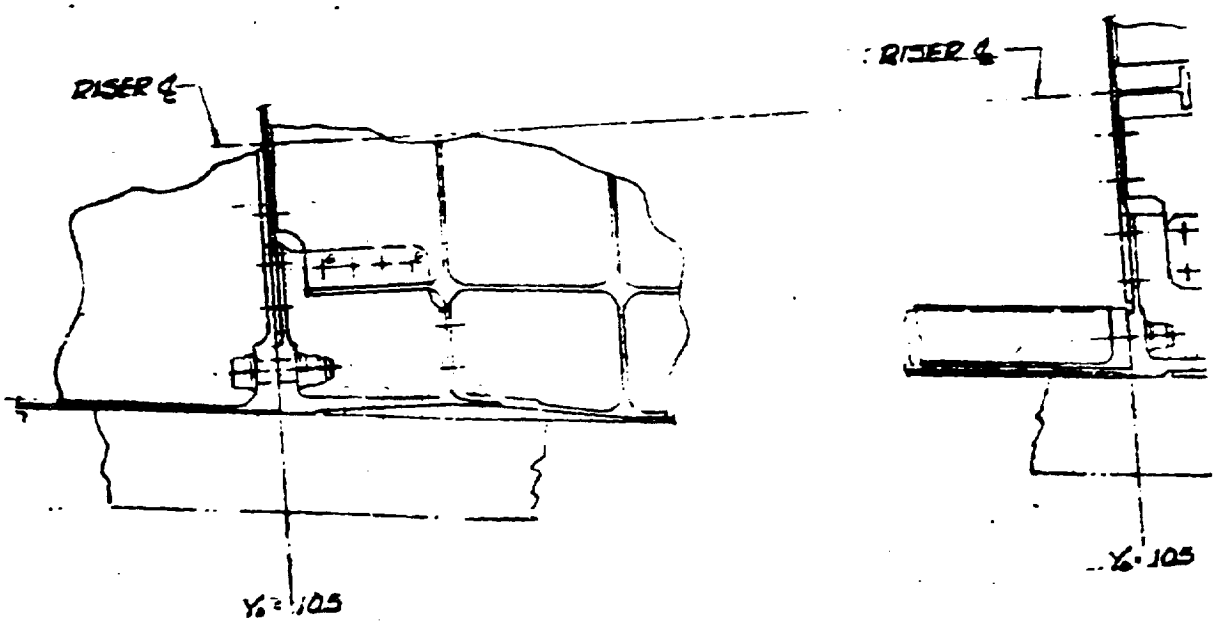
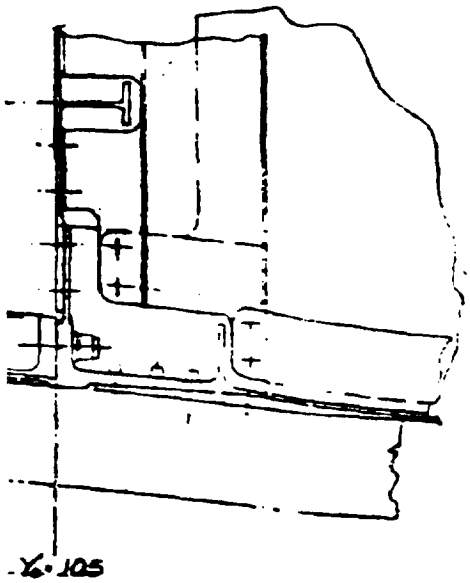


Figure 1.4.4. Mid Fuselage Lower Aft Longeron

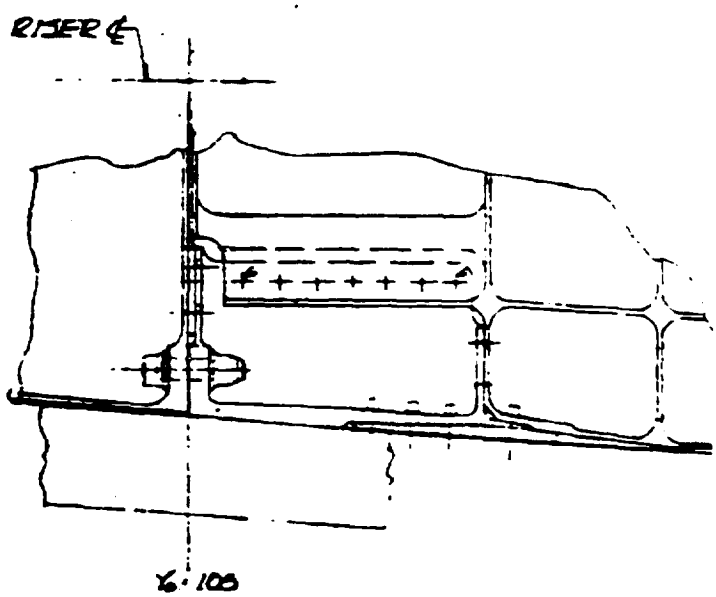


SECTION D-D
SCALE
(R₀ = 112.)

BOUT FRAME



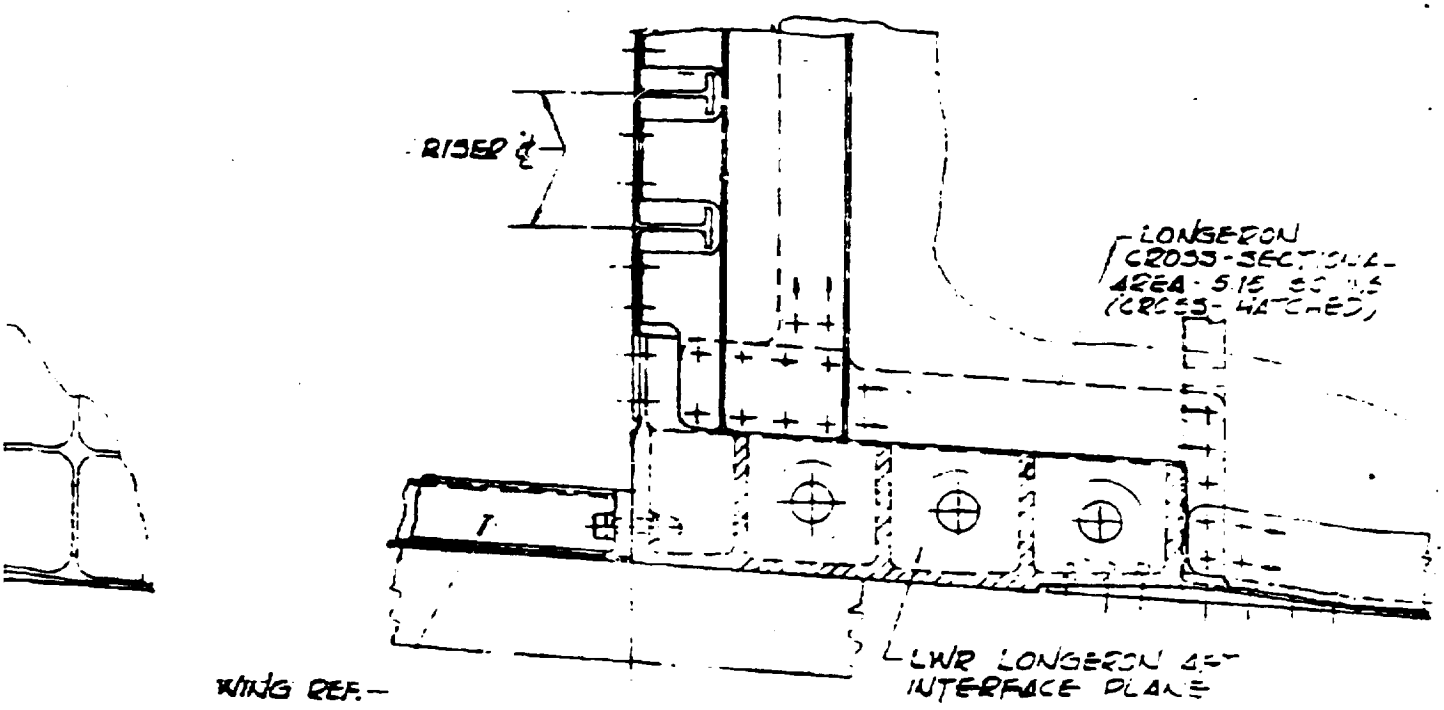
SECTION C - C
SCALE 1/2
(X₀ · 1220)



SECTION B - B
SCALE 1/2
(X₀ · 1249)

OUT FRAME

2



Y₀ = 105

SECTION A - A
SCALE 1/2
Y₀ = (187.9)

OUT FRAME

3

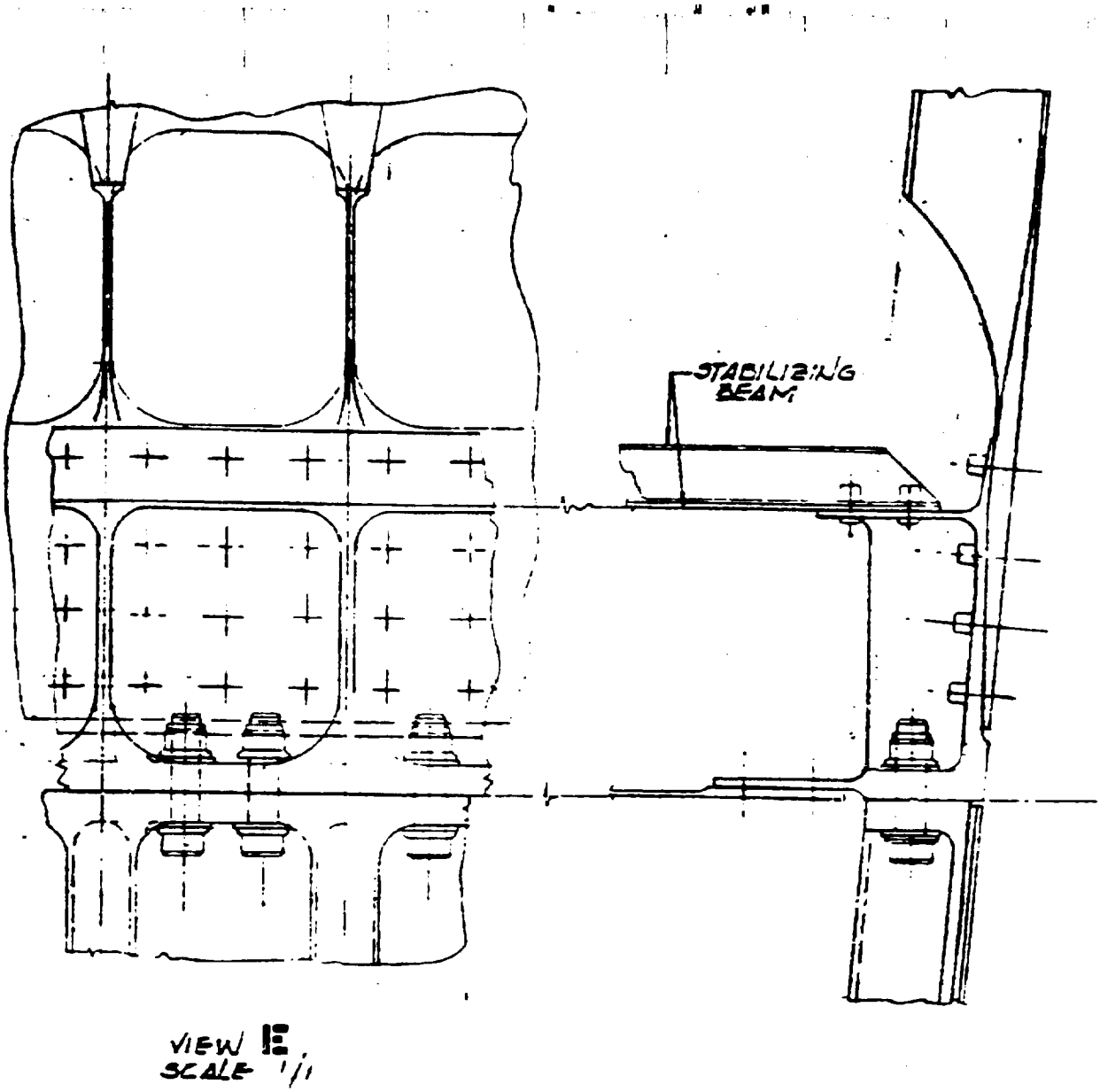
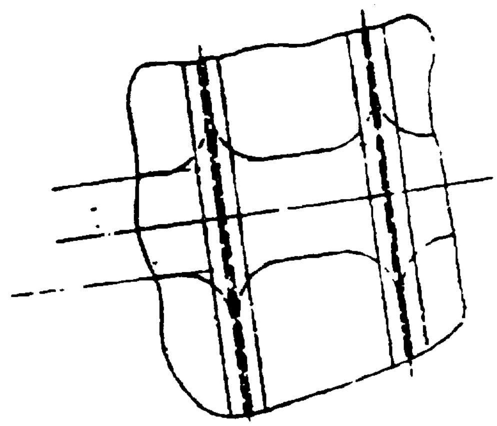
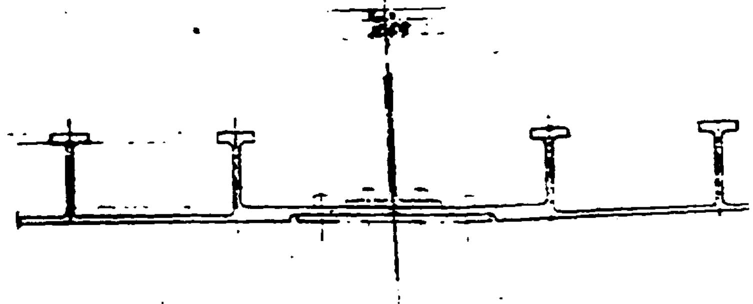


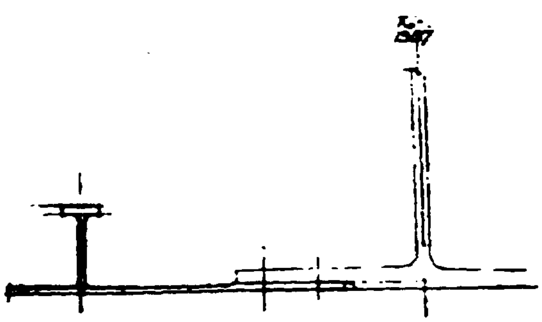
Figure 1.4.5. Mid Fuselage Lower Aft Longeron



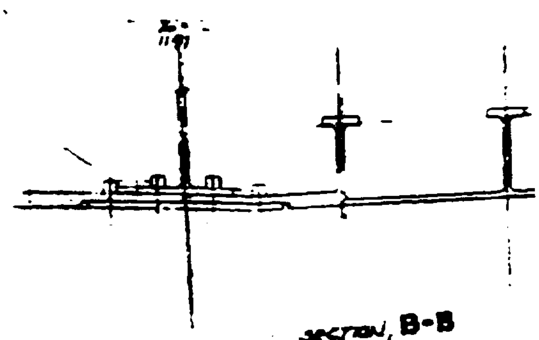
SECTION C-C
SCALE 1/1



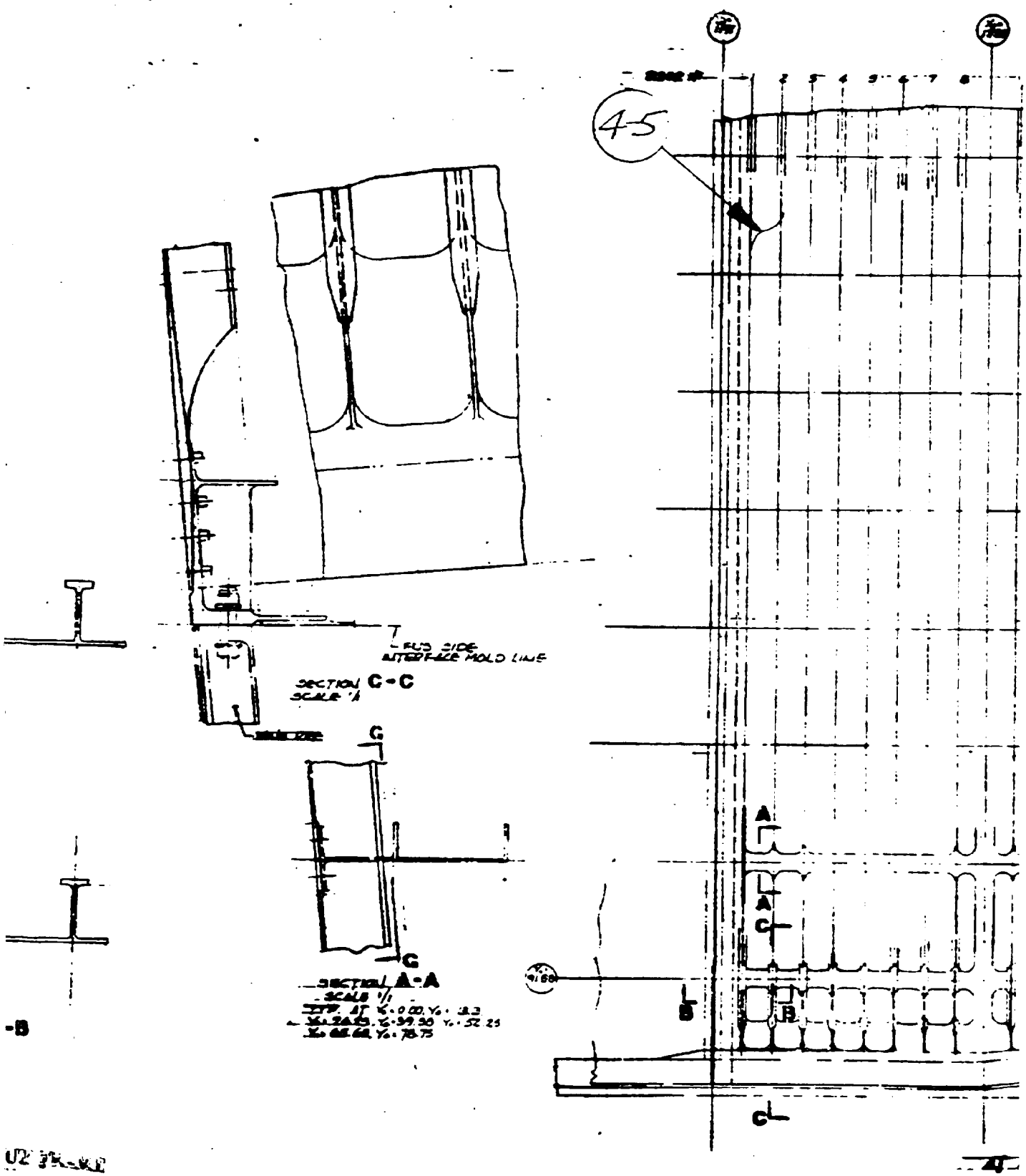
SECTION D-D
SCALE 1/1



SECTION F-F
SCALE 1/2



SECTION B-B
SCALE 1/1


45
A
A
C
B
B
C
SECTION C-C
SCALE 1"
SECTION A-A
SCALE 1"

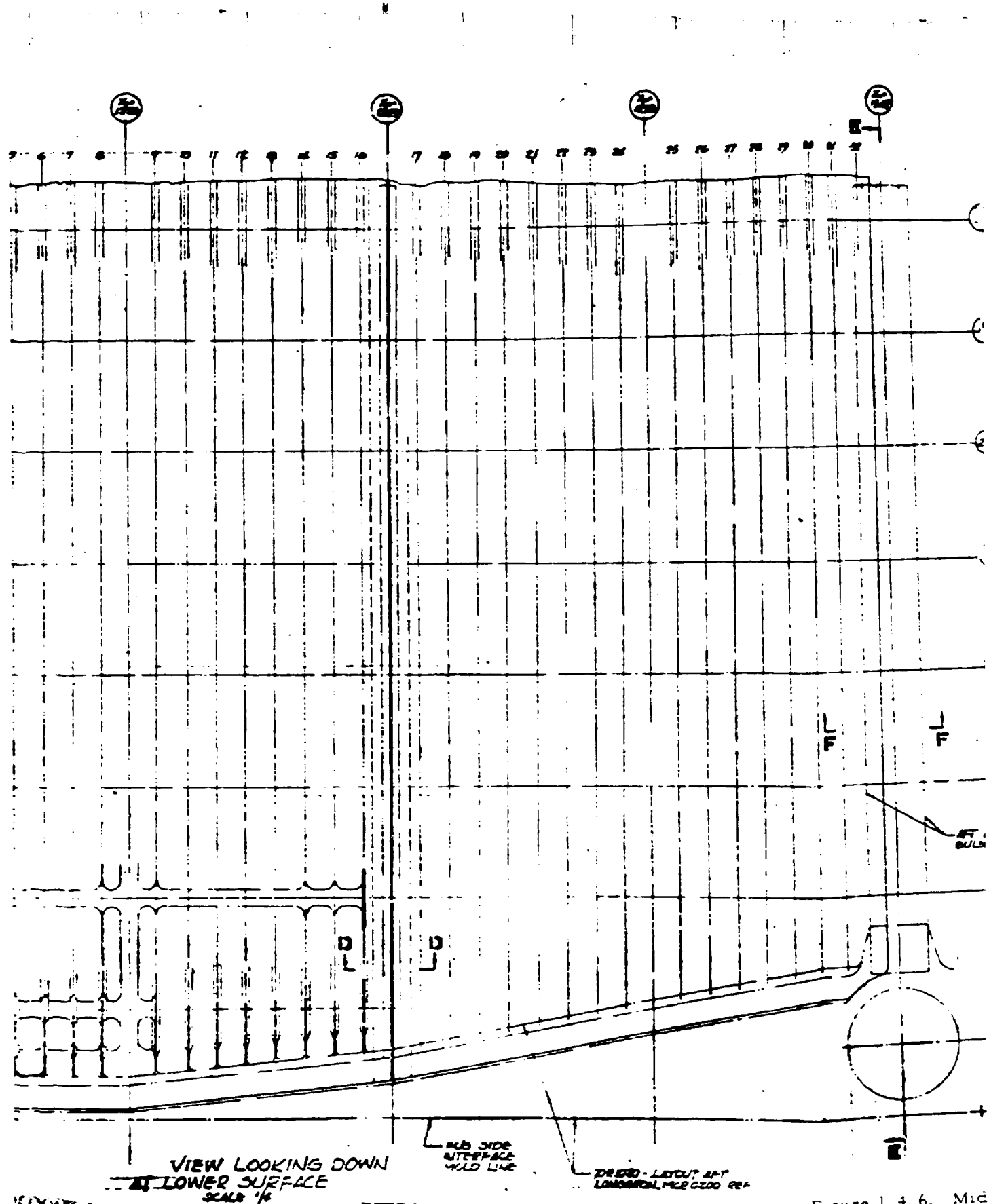
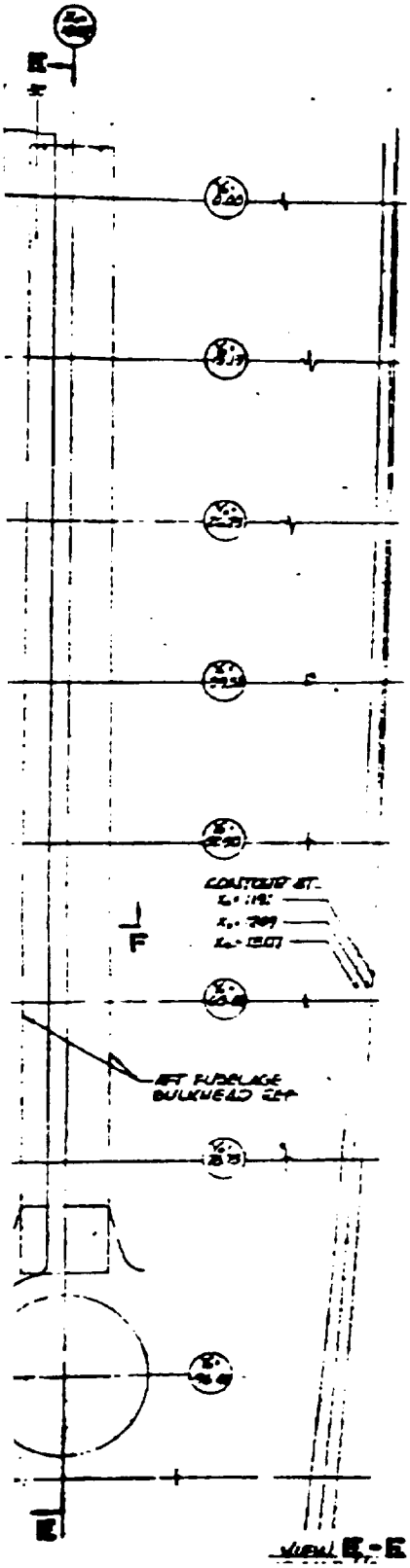


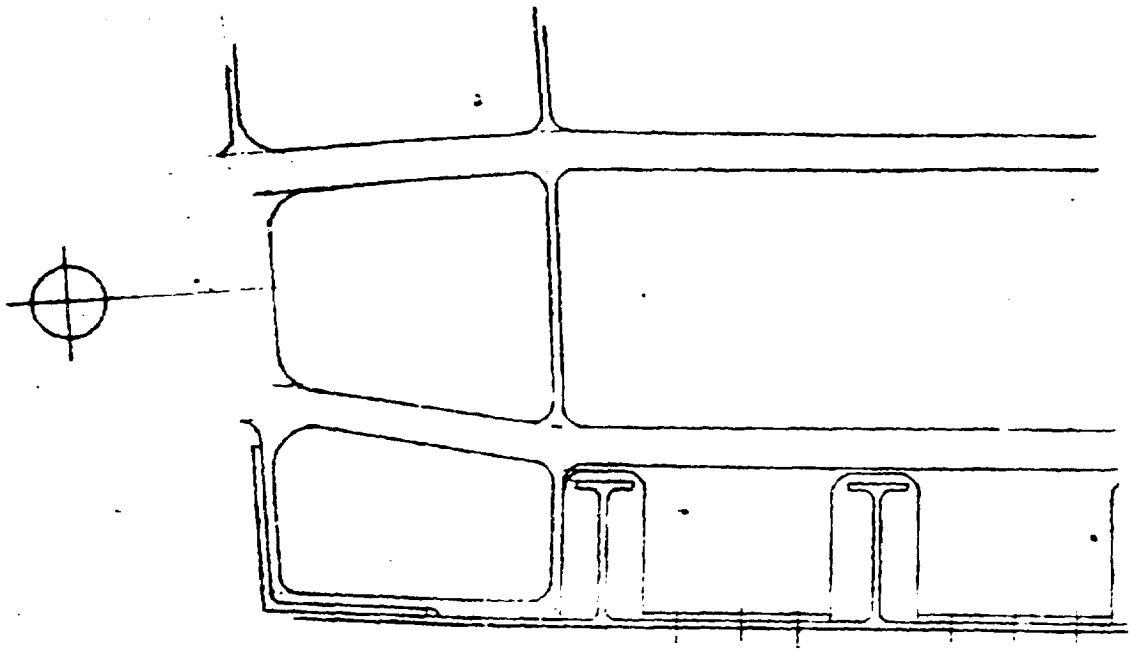
Figure 1.4.6. Mid



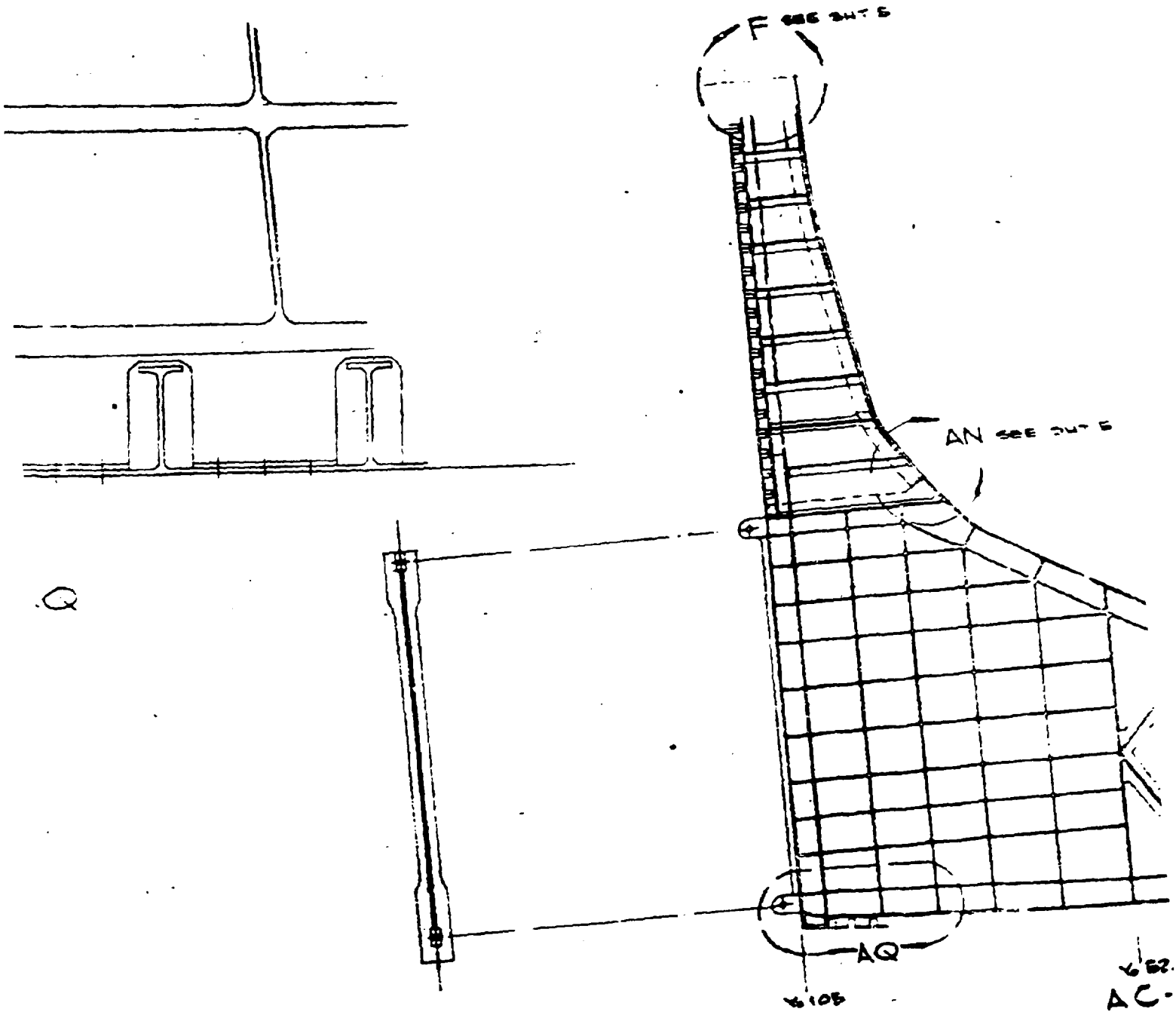
NOTES:—

1. MACHINED LANDS ALL EXIST ST EACH FRAME, SKIN STIFFENER AND BULKHEAD.
2. SKIN THICKNESSES VARY ON EACH INDIVIDUAL SKIN PANEL.
3. ALL SKINS ARE CONTOURED
4. ALL RIVETS ARE TEST AND ARE SPACED 9 TO INCHES APART

1.4.6. Mid Fuselage Lower Aft Skin Panels

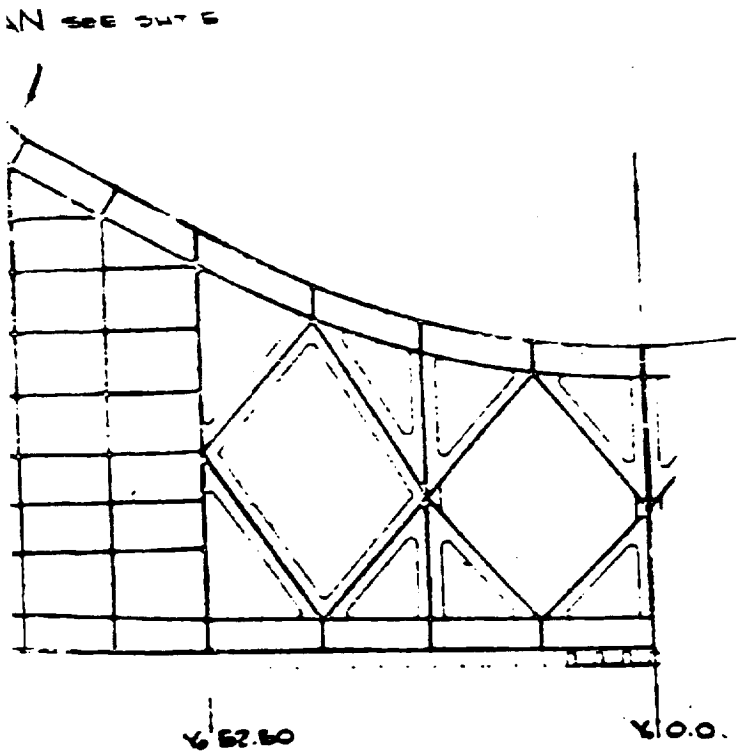


DETAIL AQ



OLDOUT FRAME

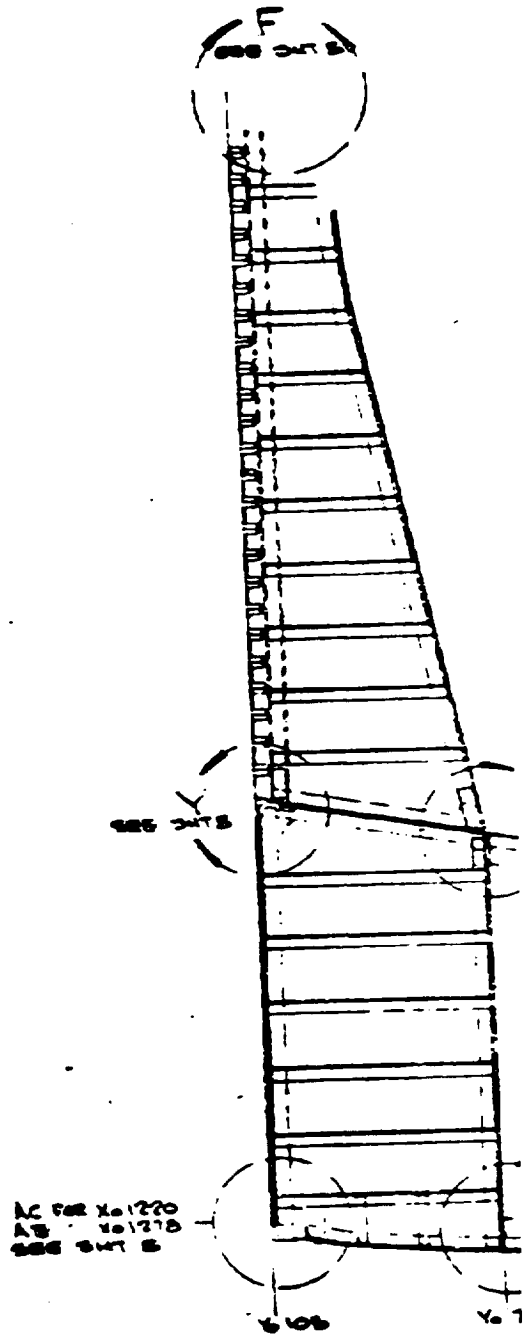
2

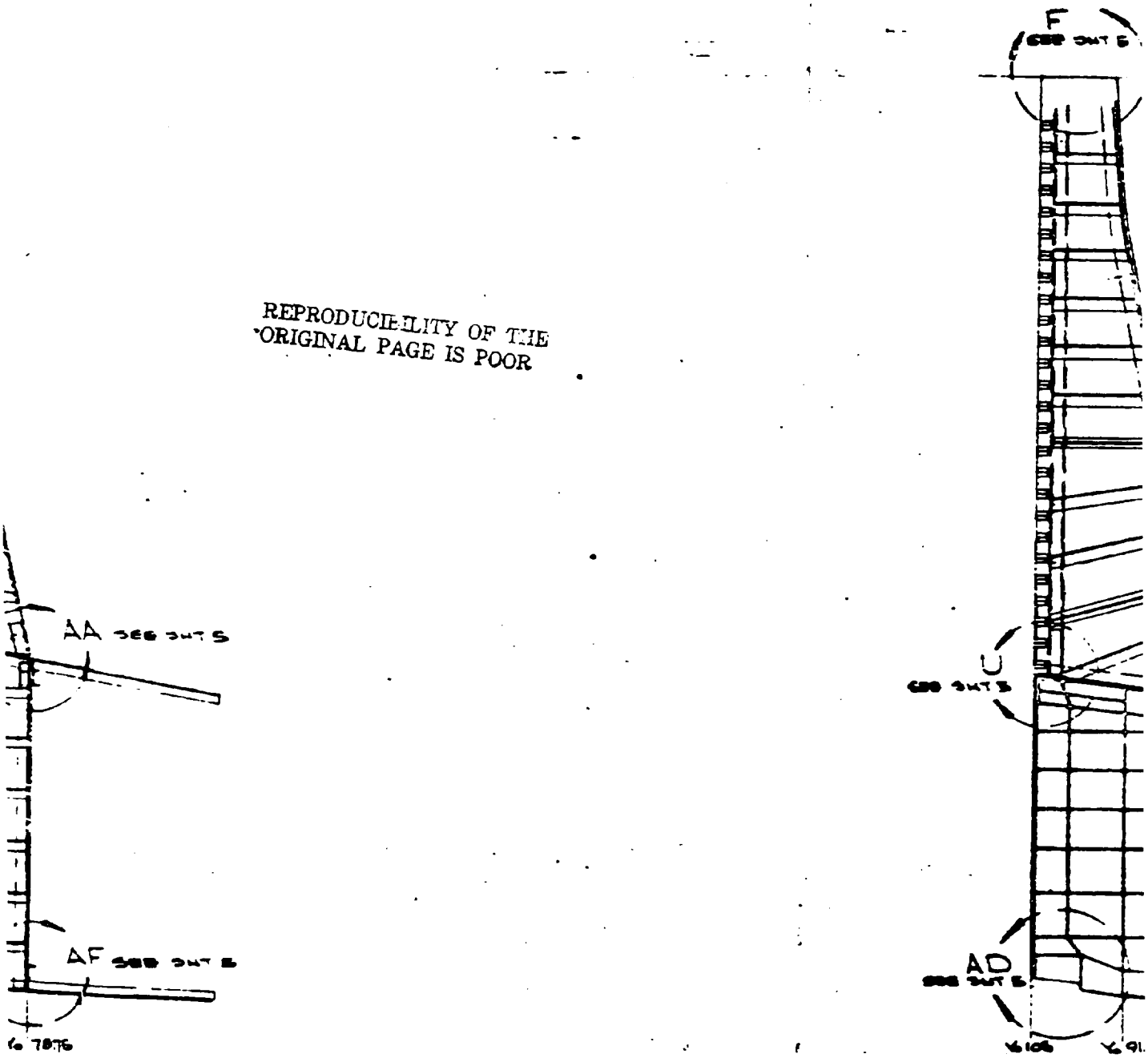


AC-AC

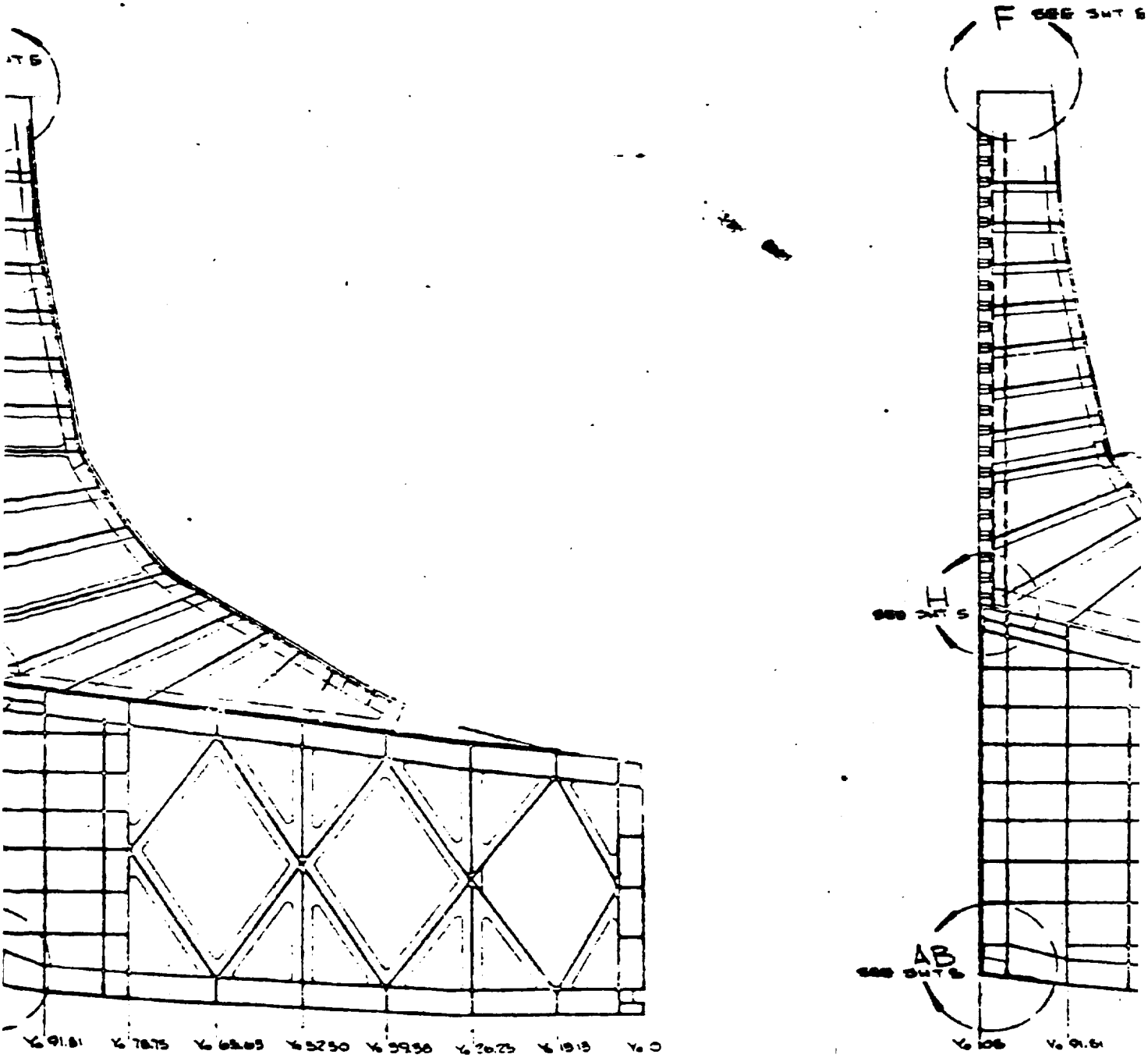
OLDOUT FRAME

3



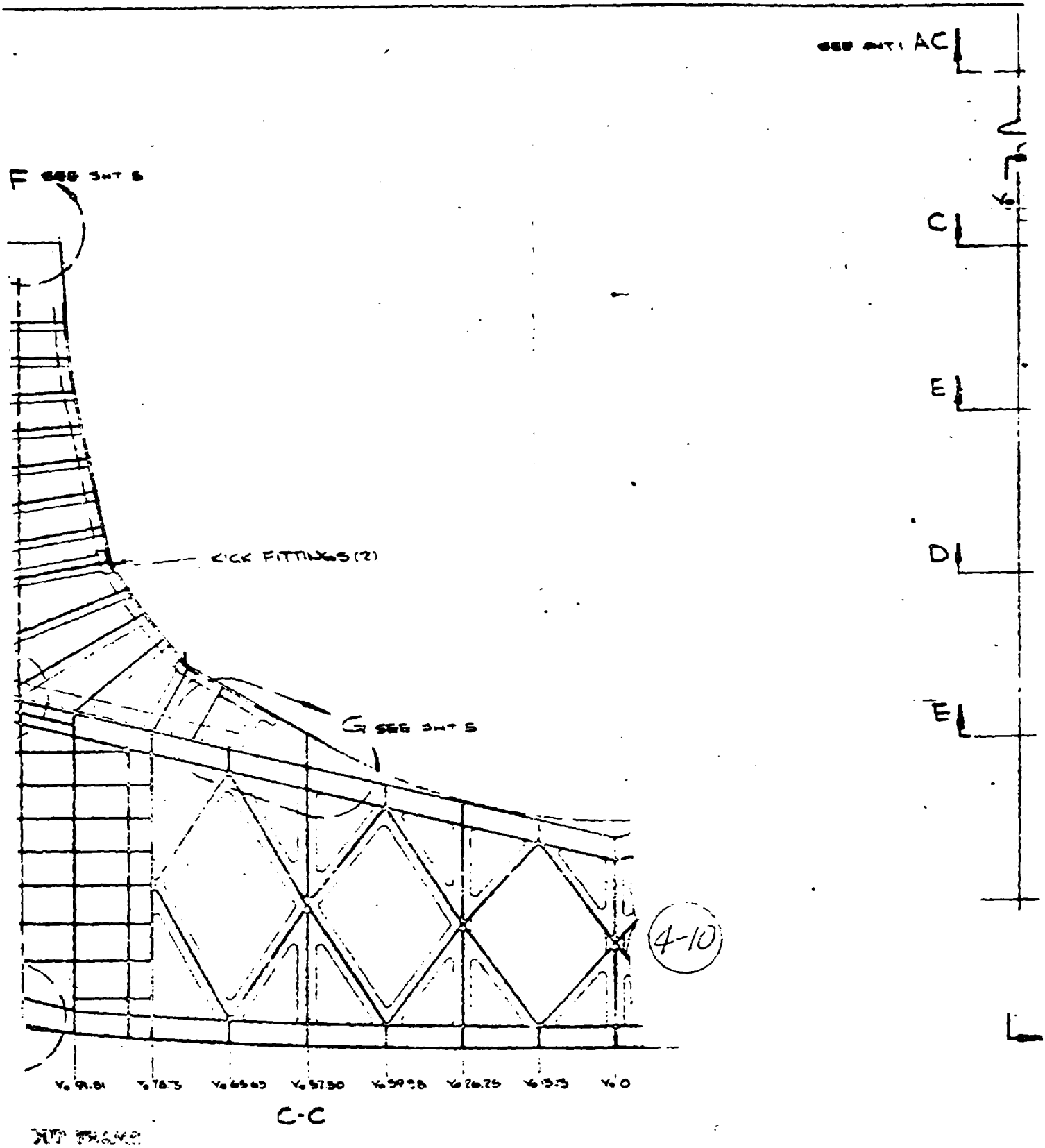


FRAME


F SEE SHT 6
H
SEE SHT 5
AB
SEE SHT 6
Y= 91.81
Y= 78.75
Y= 65.63
Y= 52.50
Y= 39.38
Y= 26.25
Y= 13.13
Y= 0
Y= 108
Y= 91.61

D-D

OUT FRAME


SEE SHT AC
F SEE SHT 6
C
E
D
E
KICK FITTINGS (2)
G SEE SHT 5
4-10
Y₀ 91.81
Y₀ 78.75
Y₀ 65.63
Y₀ 52.50
Y₀ 39.38
Y₀ 26.25
Y₀ 13.13
Y₀ 0
C-C

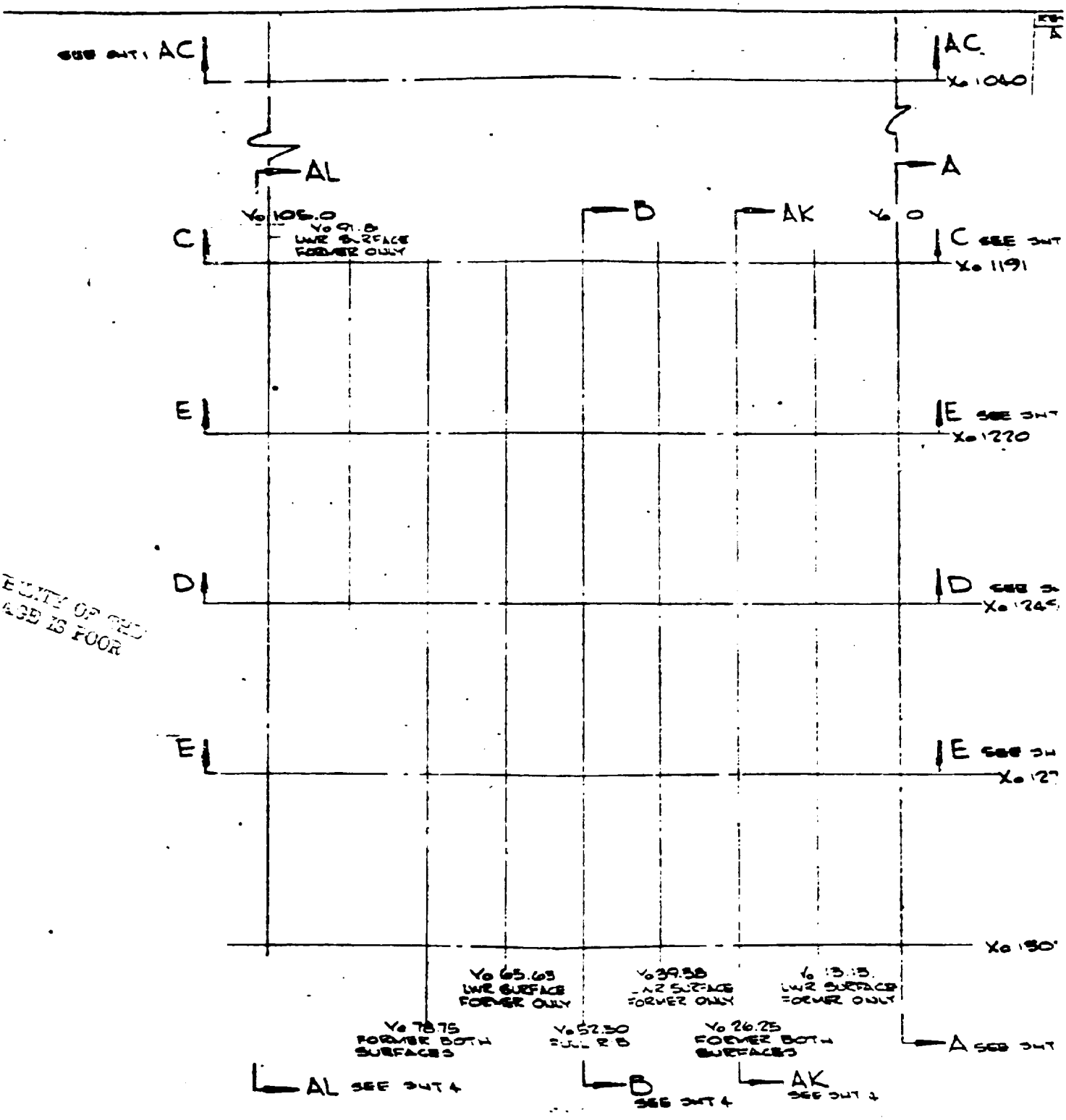
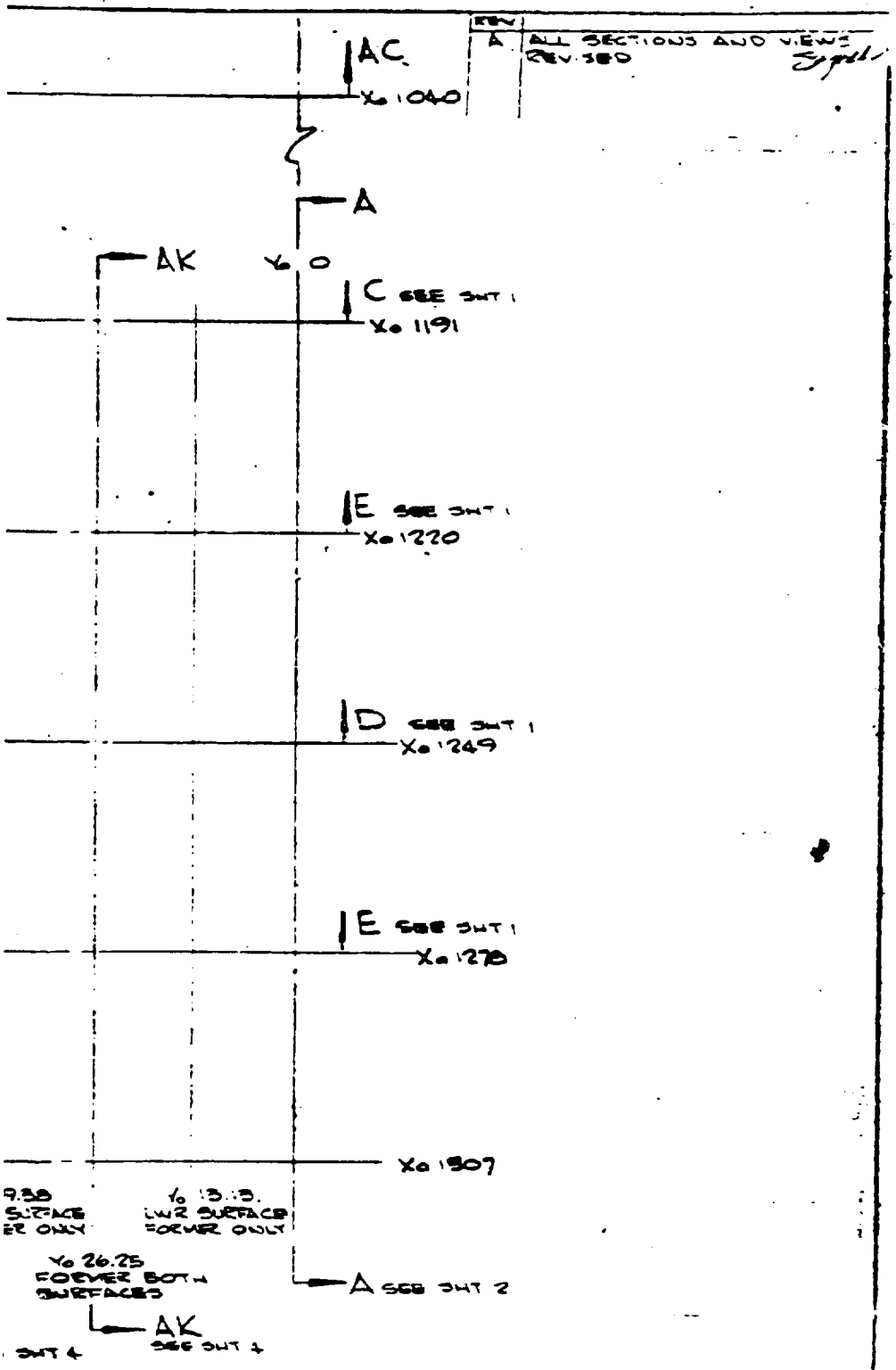
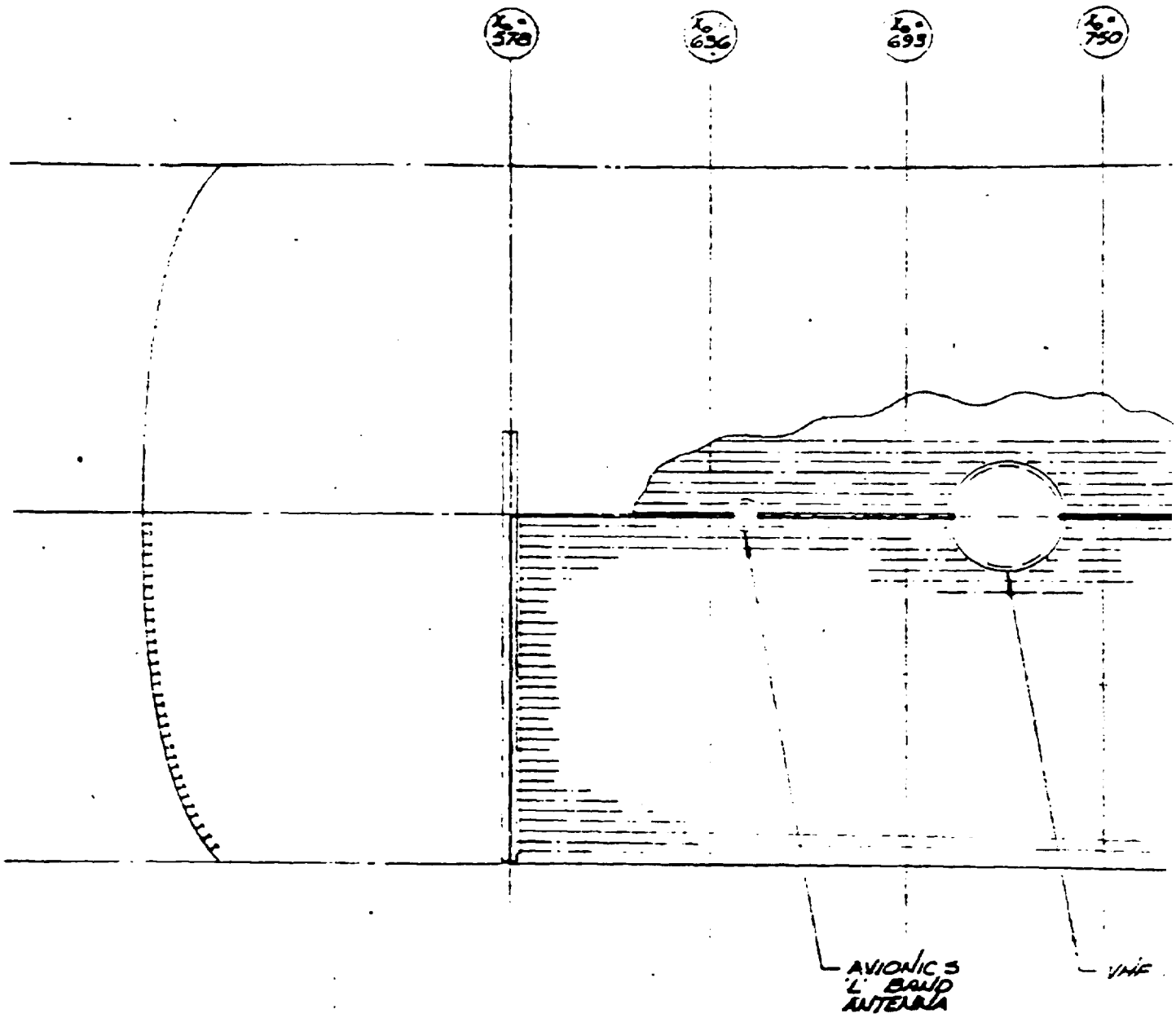


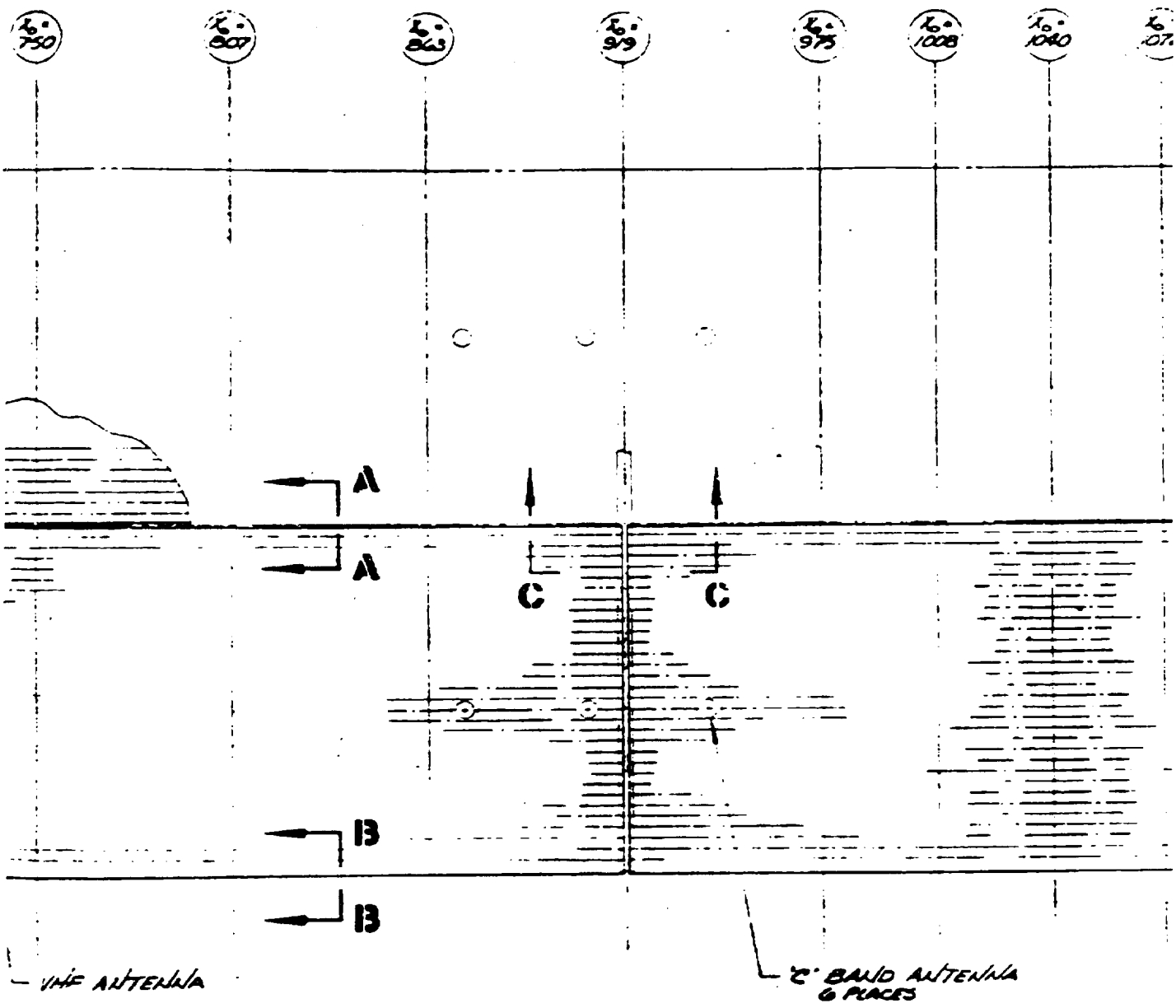
Figure 1.4.7. Mid Fuselage Wing Carry-Through



Mid Fuselage Wing Carry-Through Torque Box



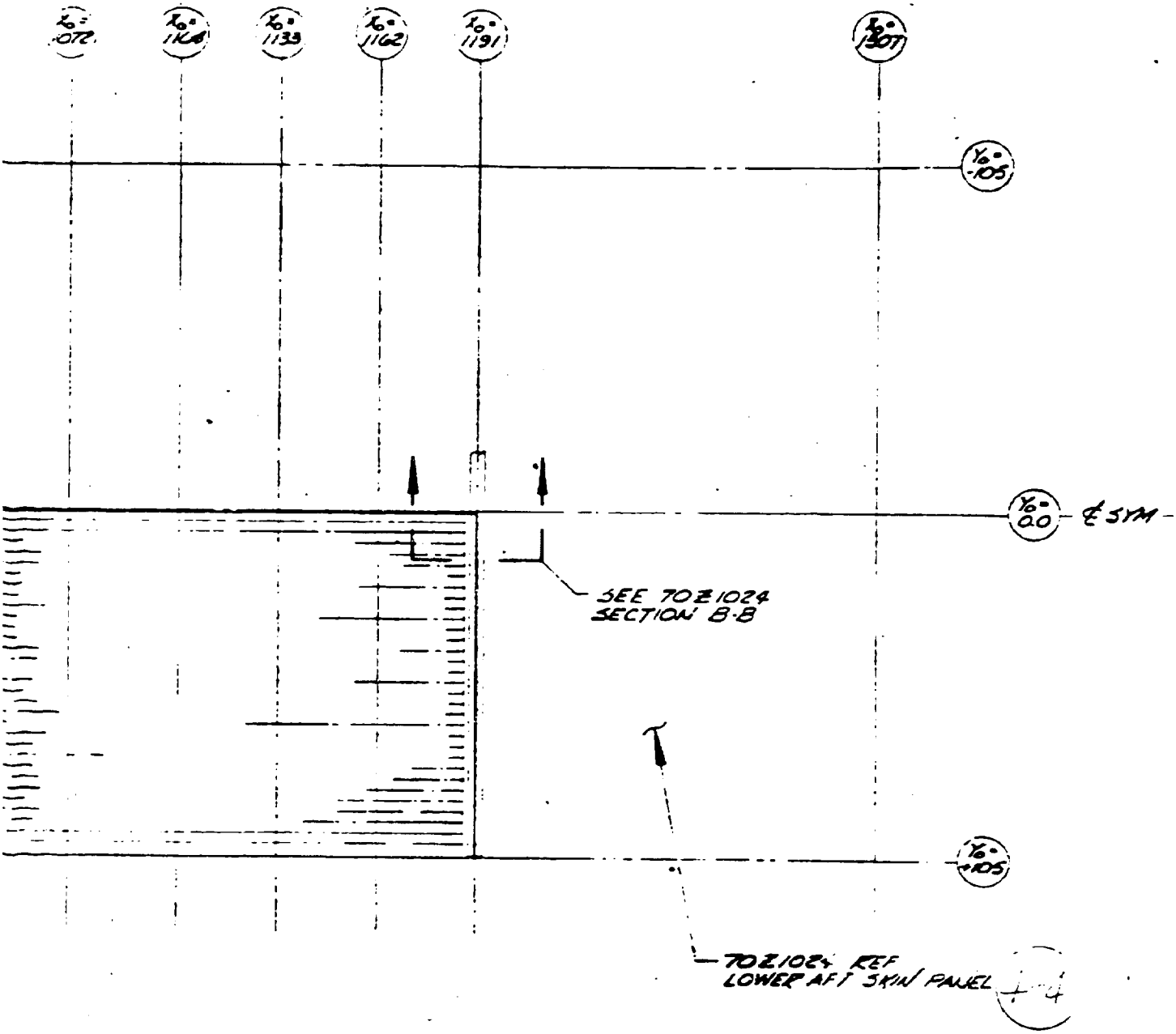
OUT FRAME



PLAN VIEW

SCALE 1/20

OUT FRAME


Xo 1072
Xo 1108
Xo 1139
Xo 1162
Xo 1191
Xo 1307
Yo -105
Yo 00
℄ SYM
SEE 70Z1024
SECTION B-B
Yo -105
70Z1024 REF
LOWER AFT SKIN PANEL
4

OUT FRAME

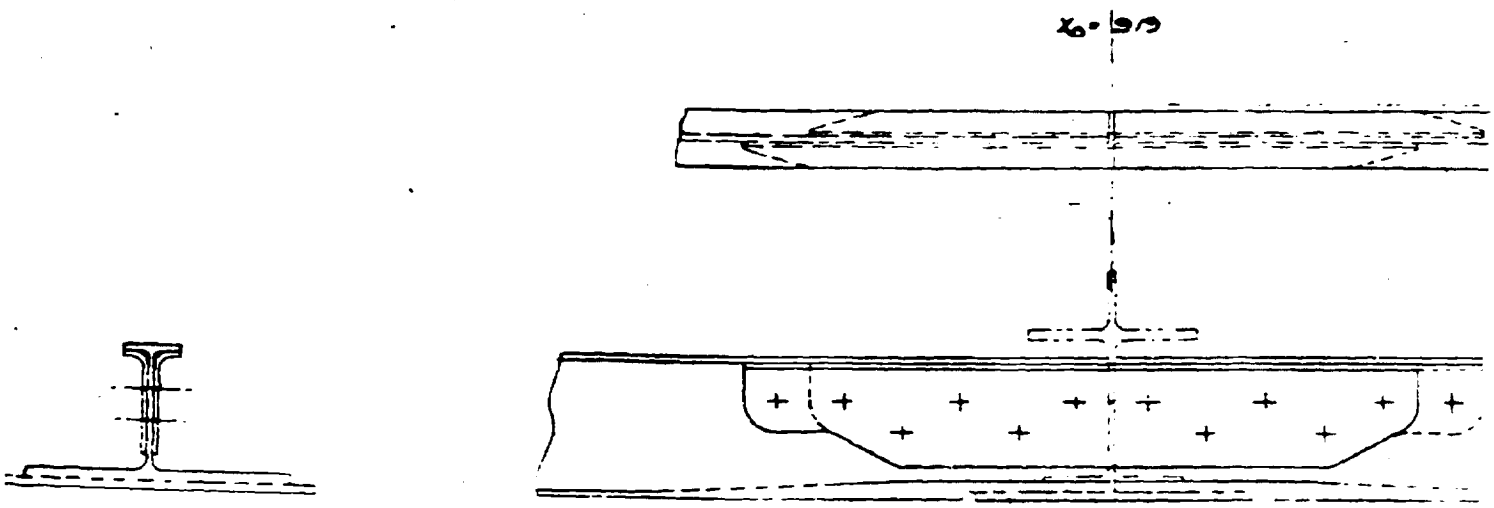
2

NOTES-

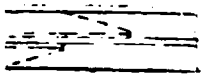
1. MACHINED LANDS WILL EXIST AT EACH FRAME, SKIN STIFFENER AND BULKHEAD
2. SKIN THICKNESSES TAPY ON EACH INDIVIDUAL SKIN PANEL
3. ALL SKINS ARE COMPOUND CONTOURED
4. ALL STIFFENERS ARE TEE AND ARE SPACED 3.25 INCHES APART

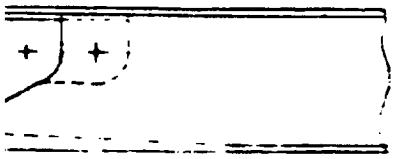
FOLDOUT FRAME

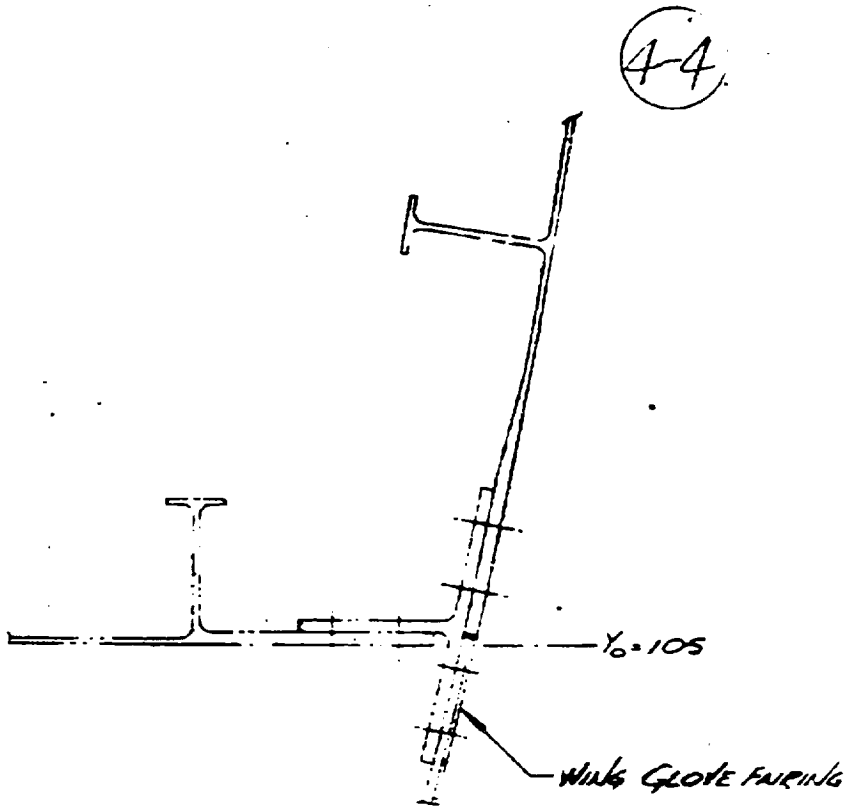
Figure 1.4.8. Mid Fuselage Lower Skin Panels



SECTION C - C
SCALE 1/1







SECTION B - B
SCALE 1/1

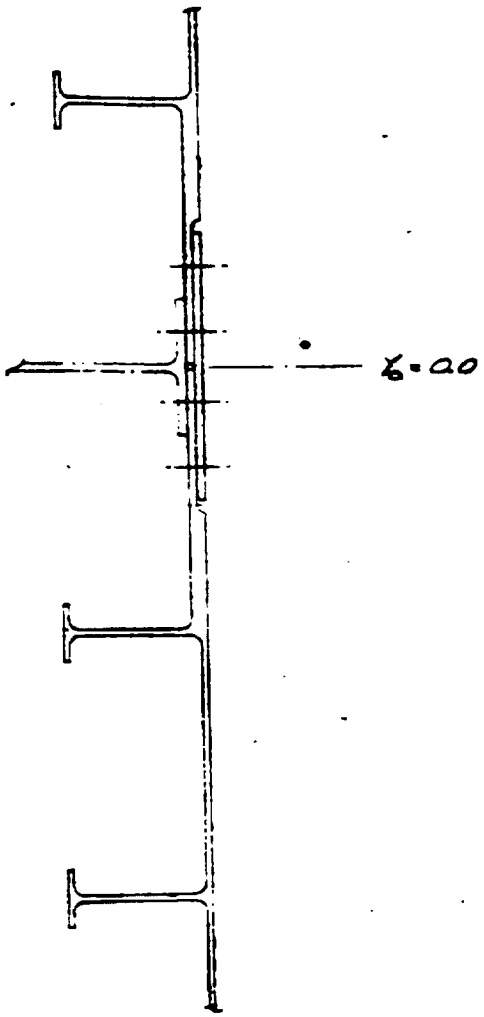


Figure 1.4.9. Mid Fuselage Lower Skin Panels

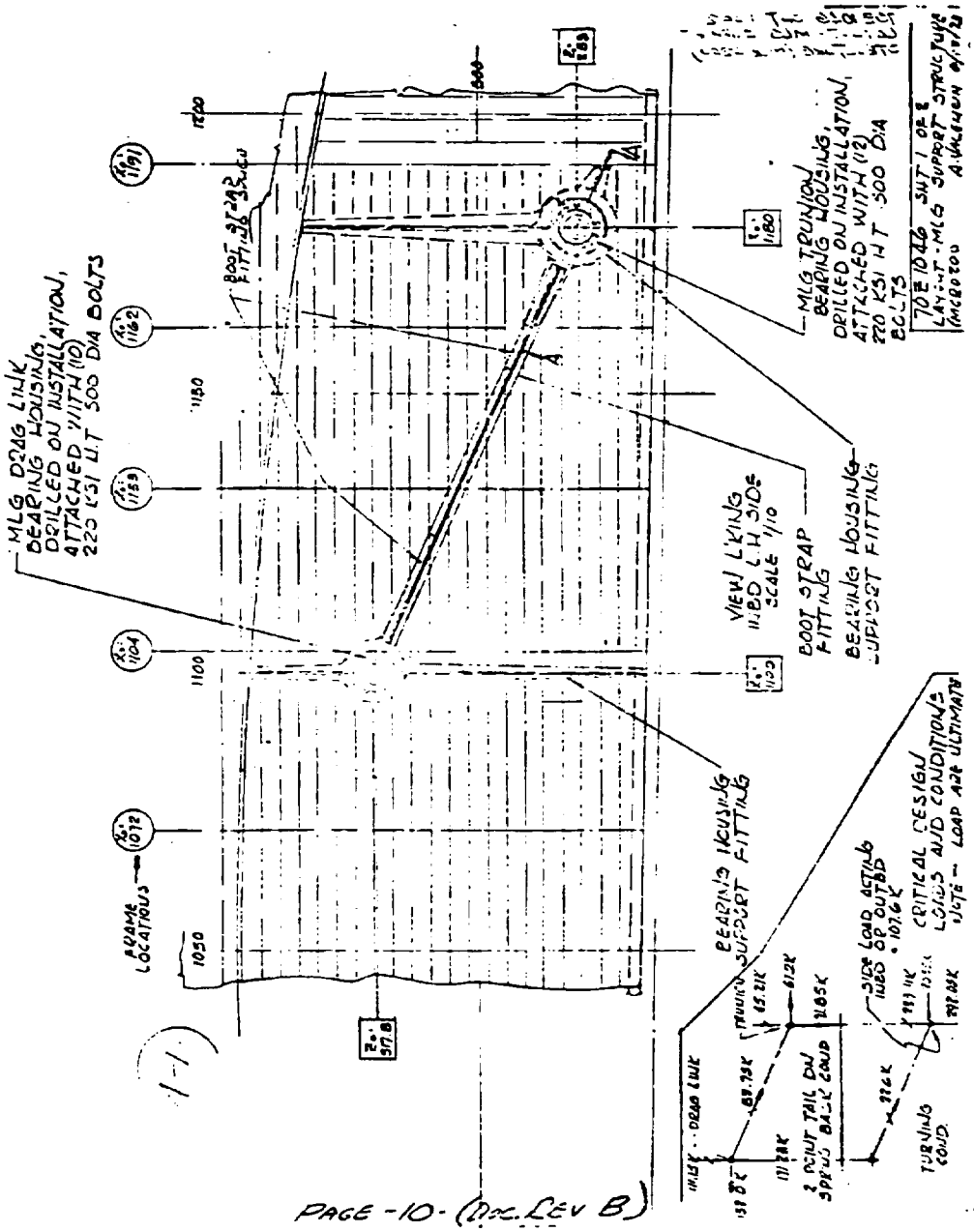


Figure 1.4.10. Mid Fuselage Main Landing Gear Support Structure

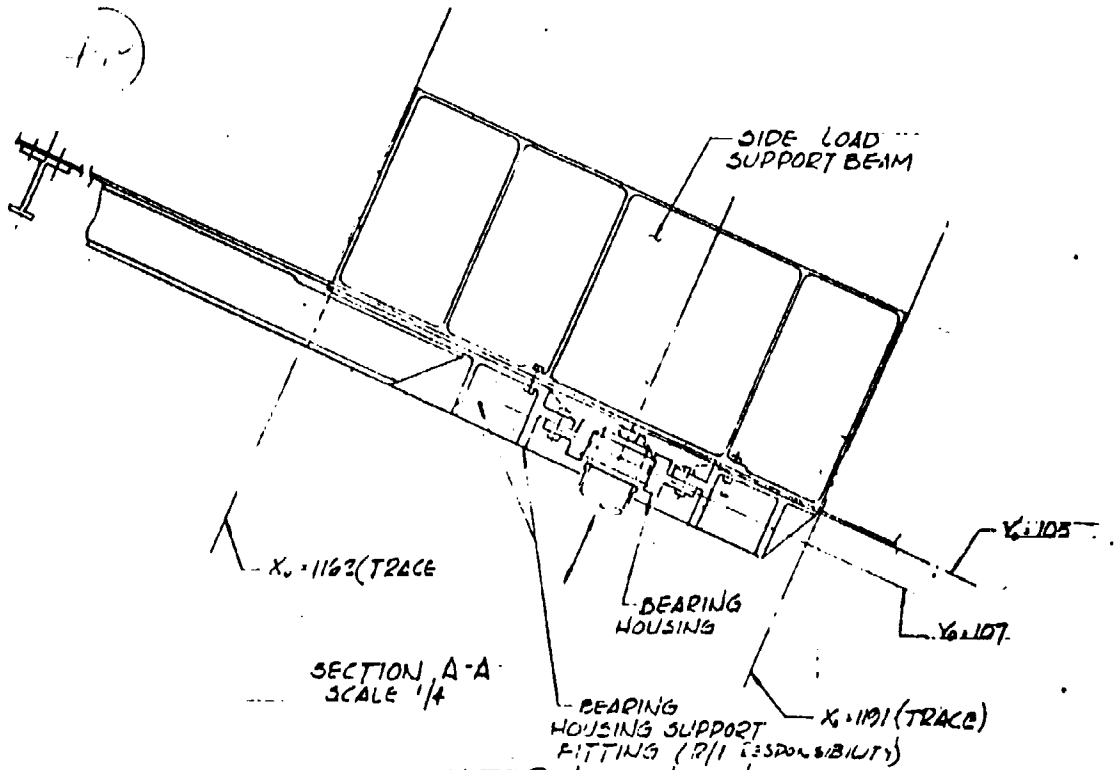
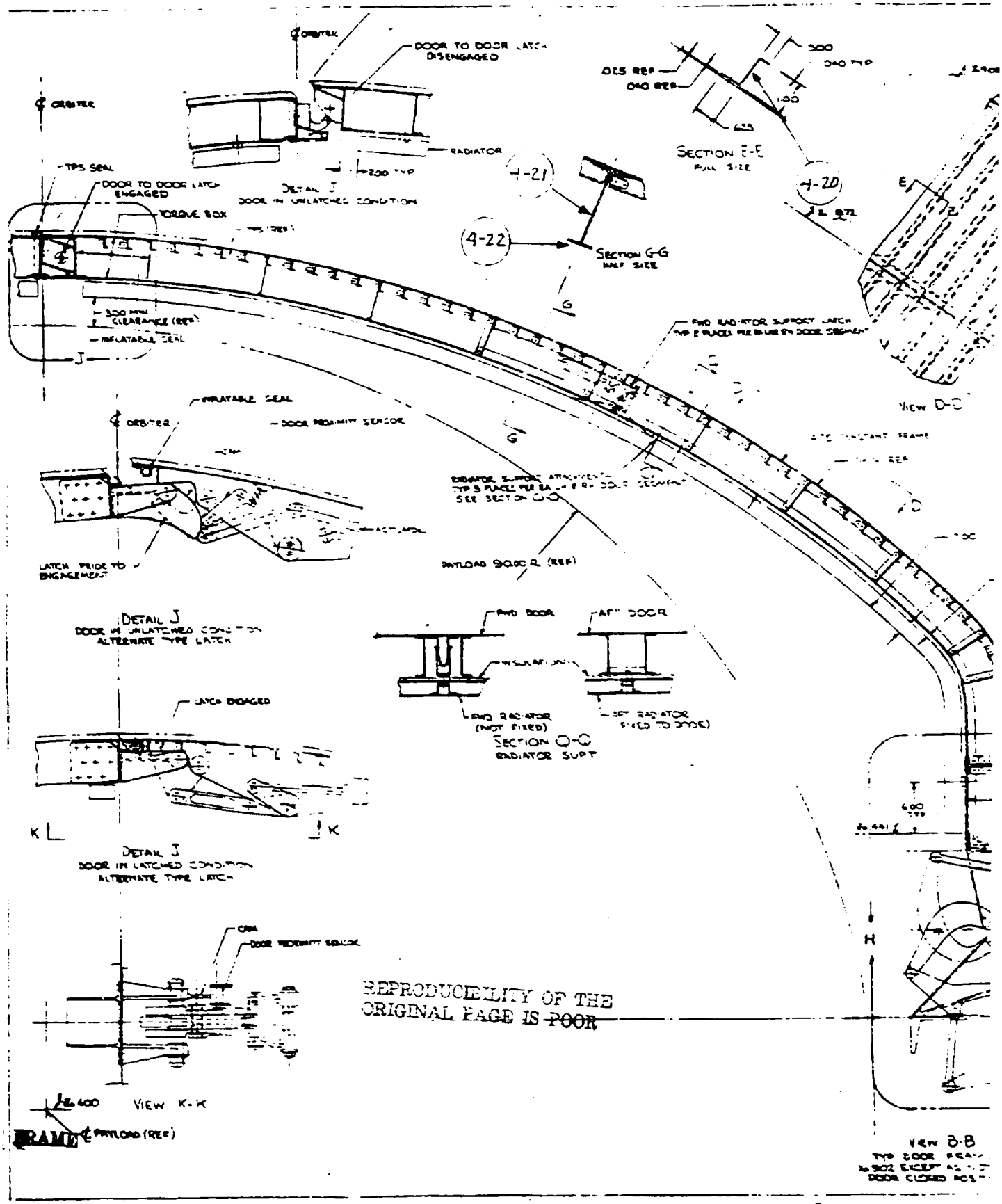
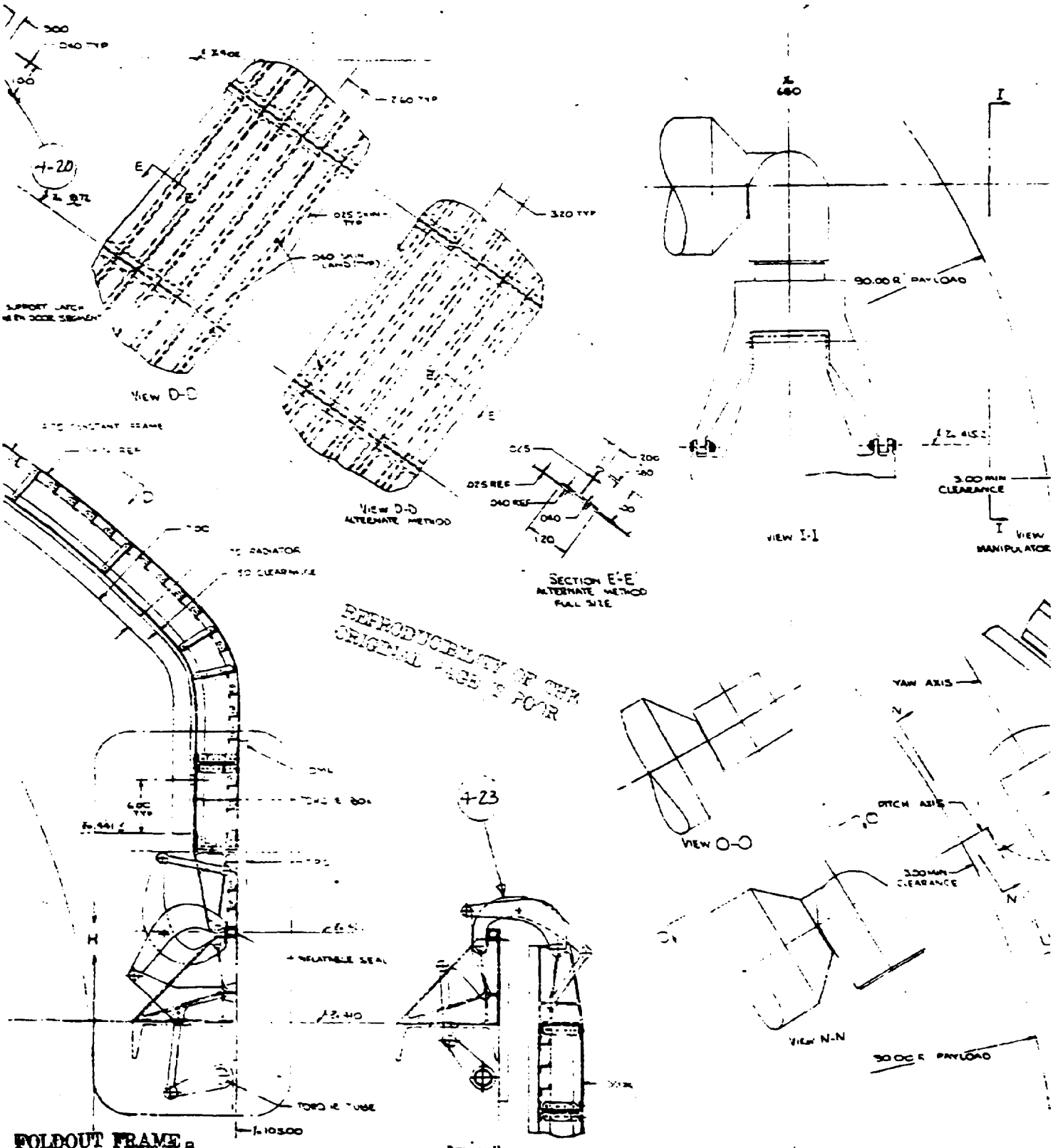
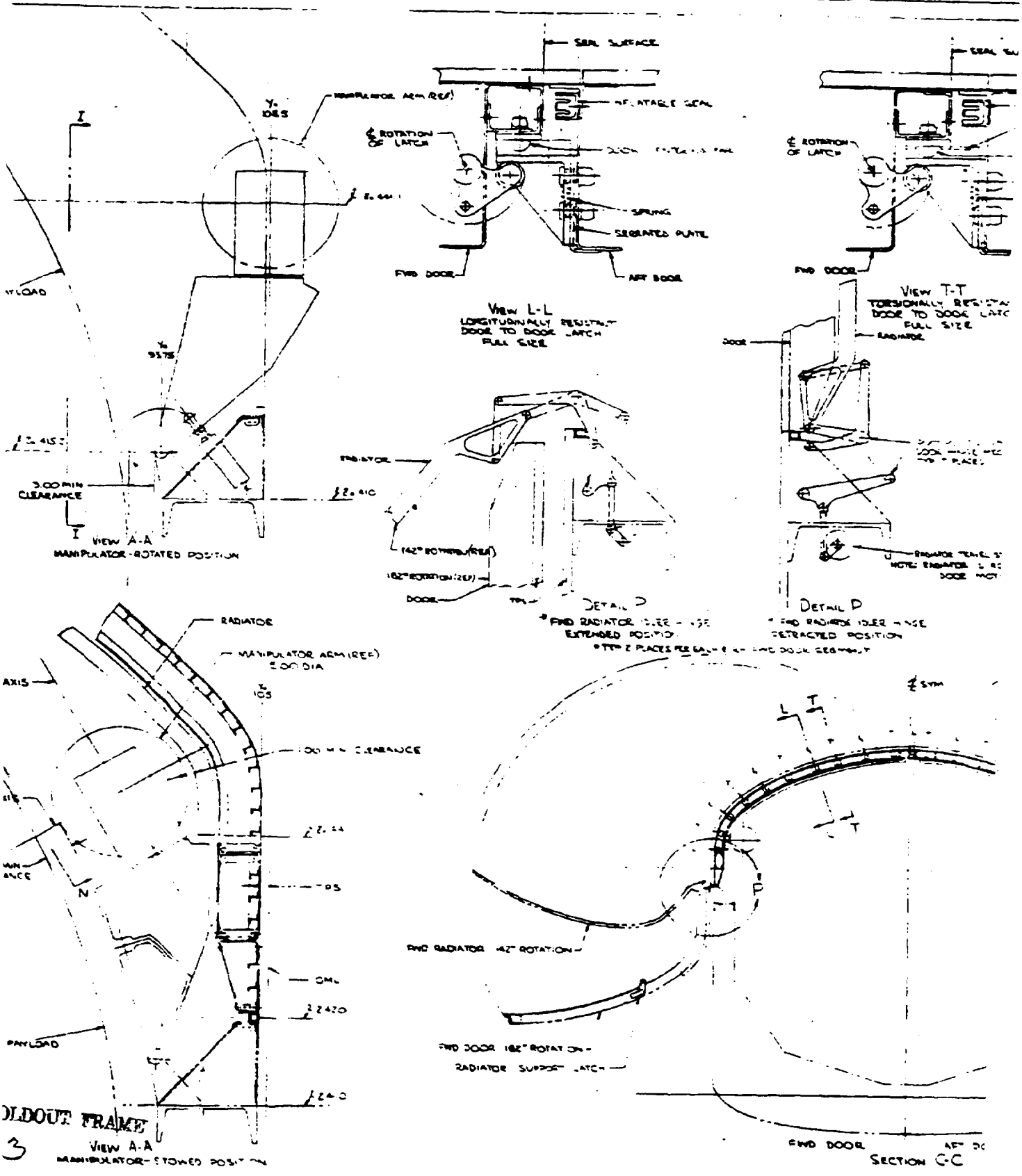


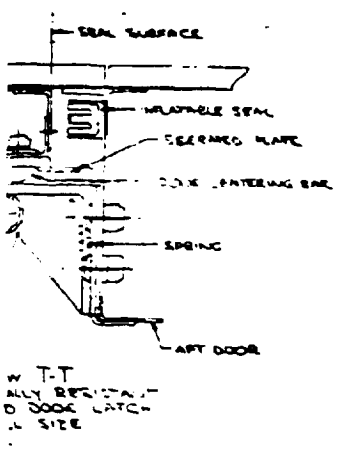
Figure 1.4.11. Mid Fuselage Main Landing Gear Support Structure

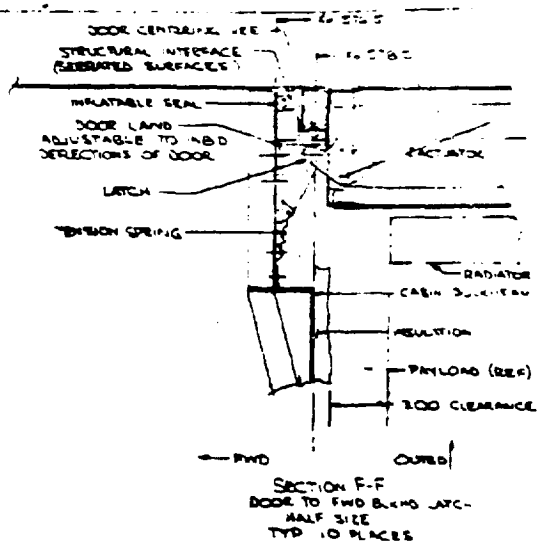




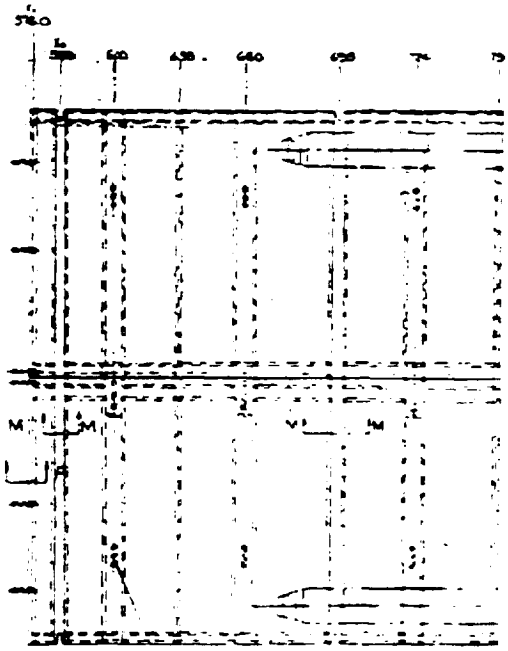


OLDOUT FRAME 3



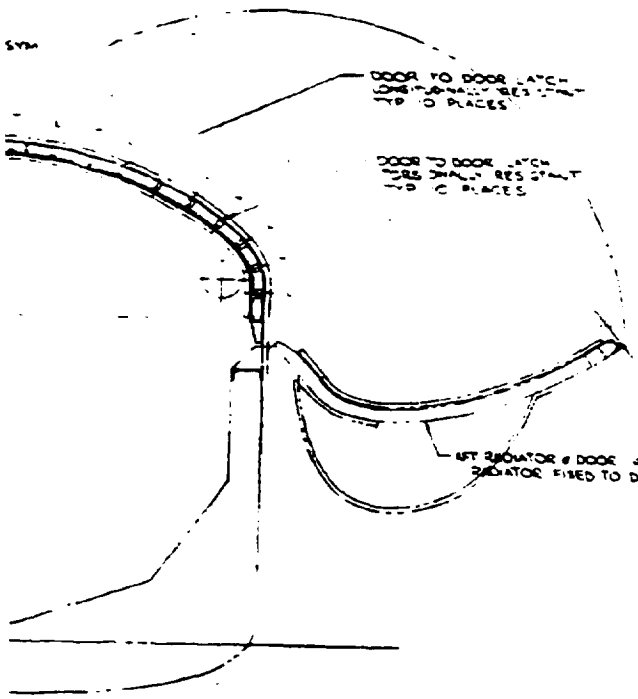


SECTION F-F
DOOR TO FWD BLKHD LATCH
HALF SIZE
TYP 10 PLACES

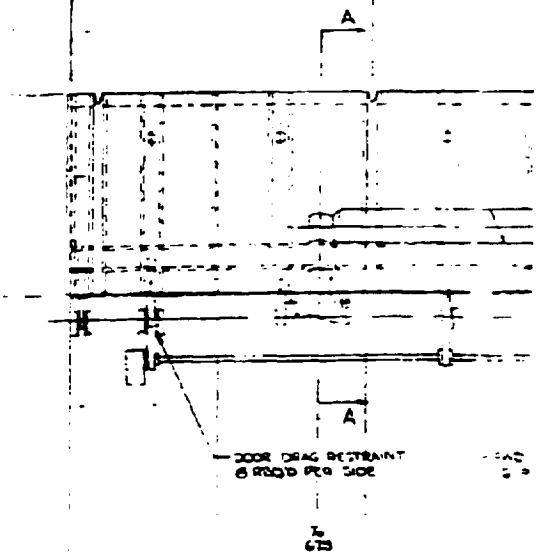


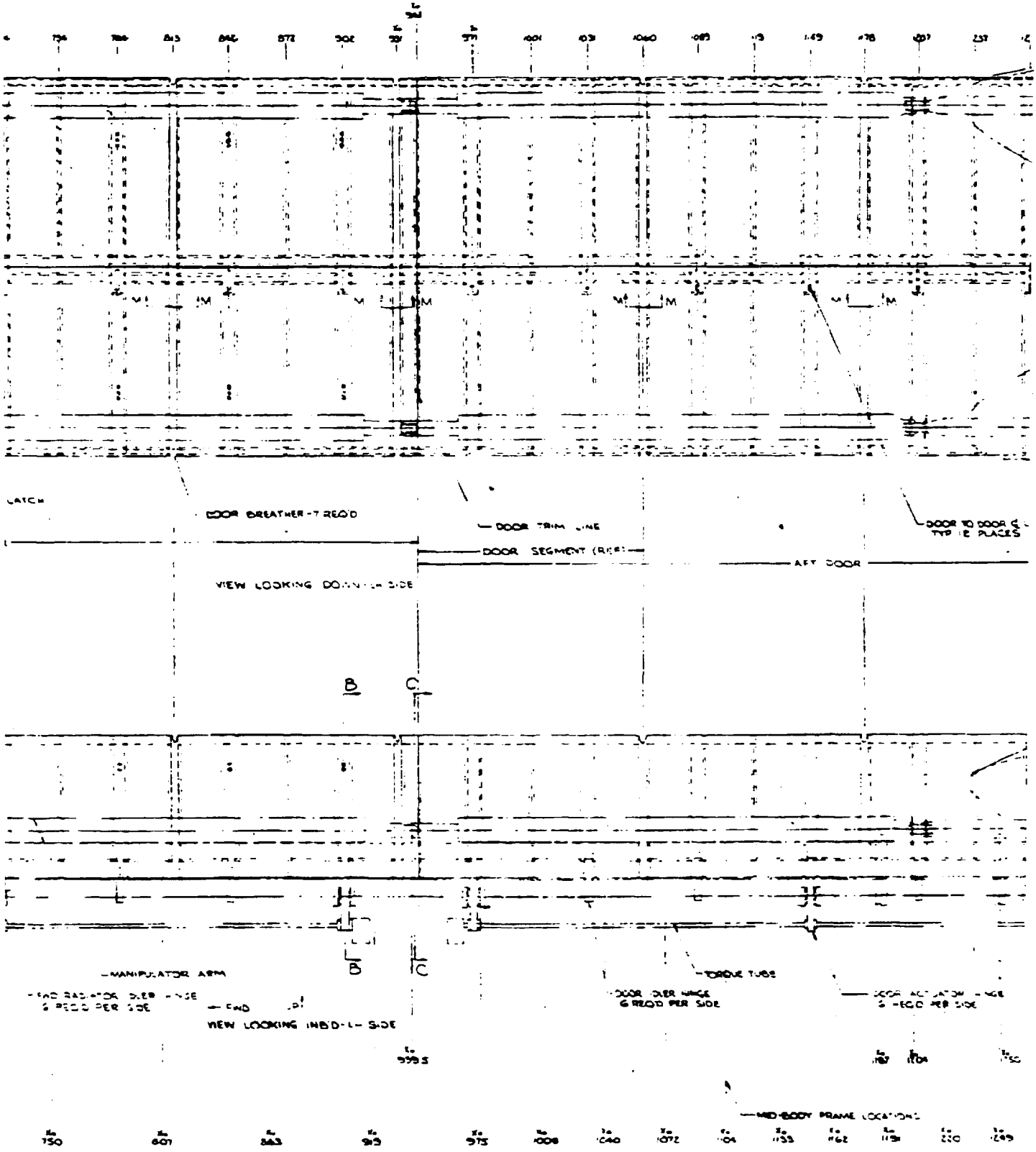
RADIATOR SUPPORT LATCH
TYP 12 PLACES

FWD DOOR



C-C




DOOR BREATHER - 7 REQ'D
DOOR TRIM LINE
DOOR SEGMENT (REF)
AFT DOOR
DOOR TO DOOR Ø - TYP 12 PLACES
VIEW LOOKING DOWN
B
C
MANIPULATOR ARM
END RADIATOR DEPLOYMENT ACTUATOR - 6 REQ'D PER SIDE
END
VIEW LOOKING INBOARD
TORQUE TUBE
DOOR DEPLOYMENT HINGE - 6 REQ'D PER SIDE
DOOR ACTUATOR HINGE - 6 REQ'D PER SIDE
MID-BODY FRAME LOCATIONS

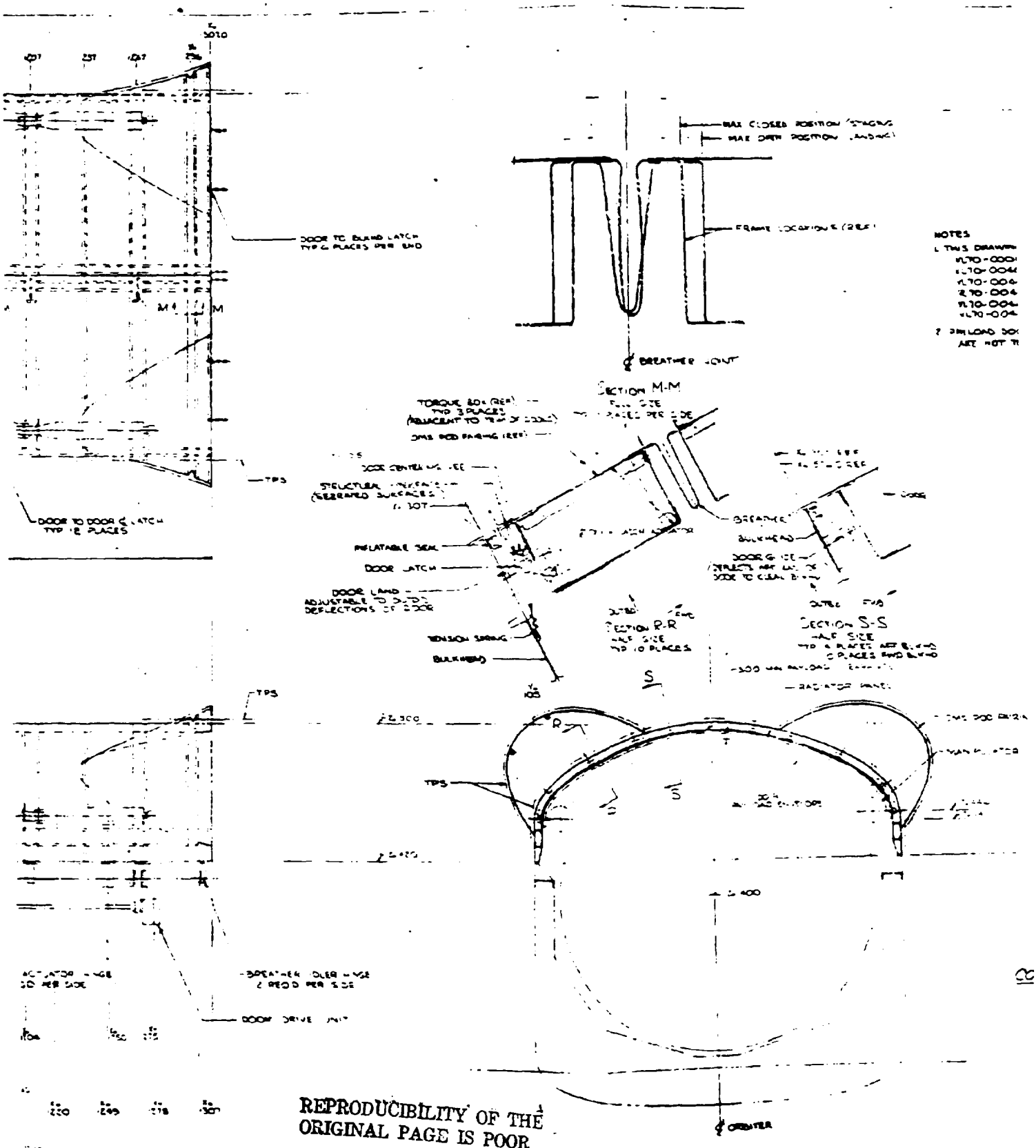


Figure 1.4.12. Mid Fuselage Payload

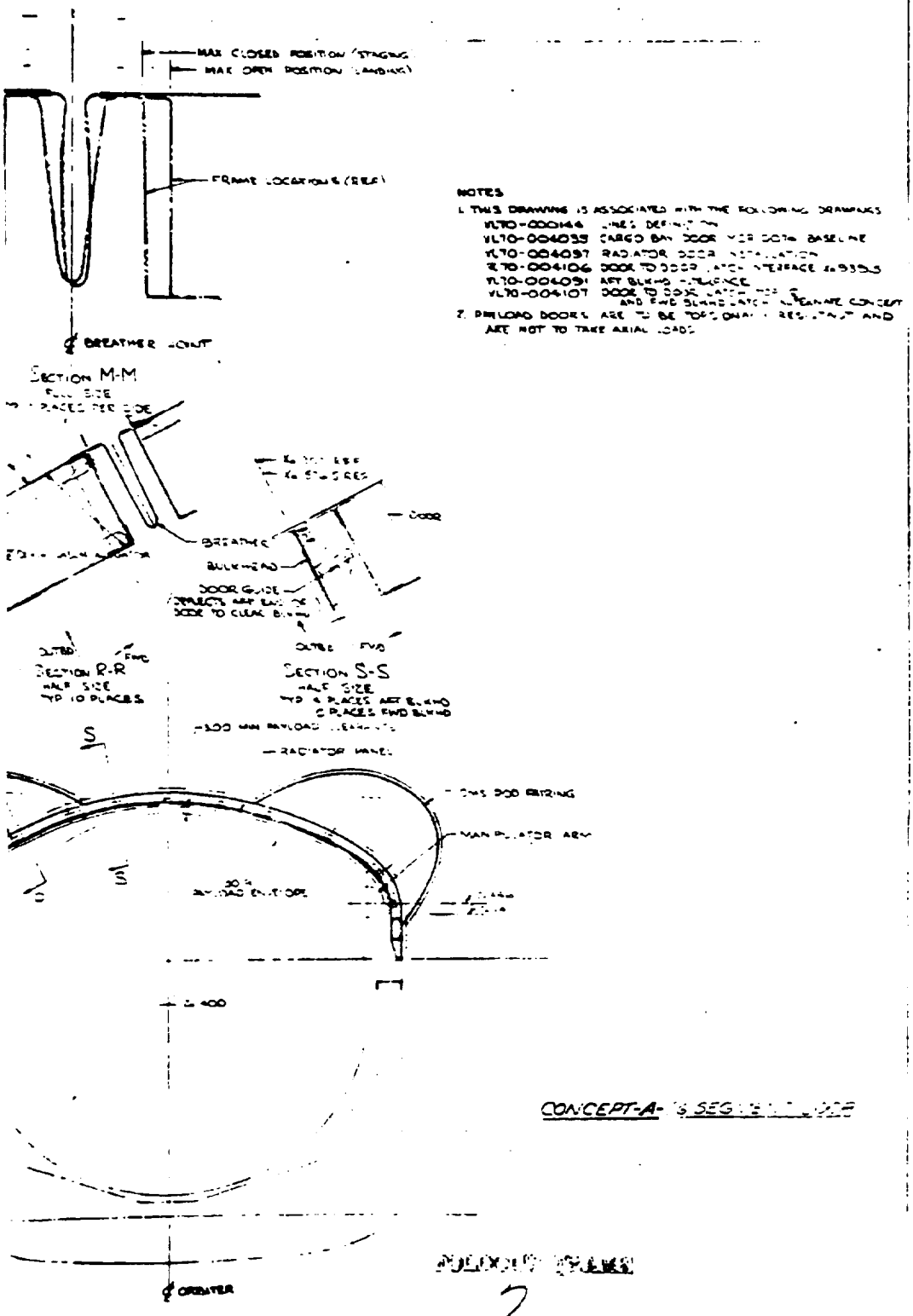
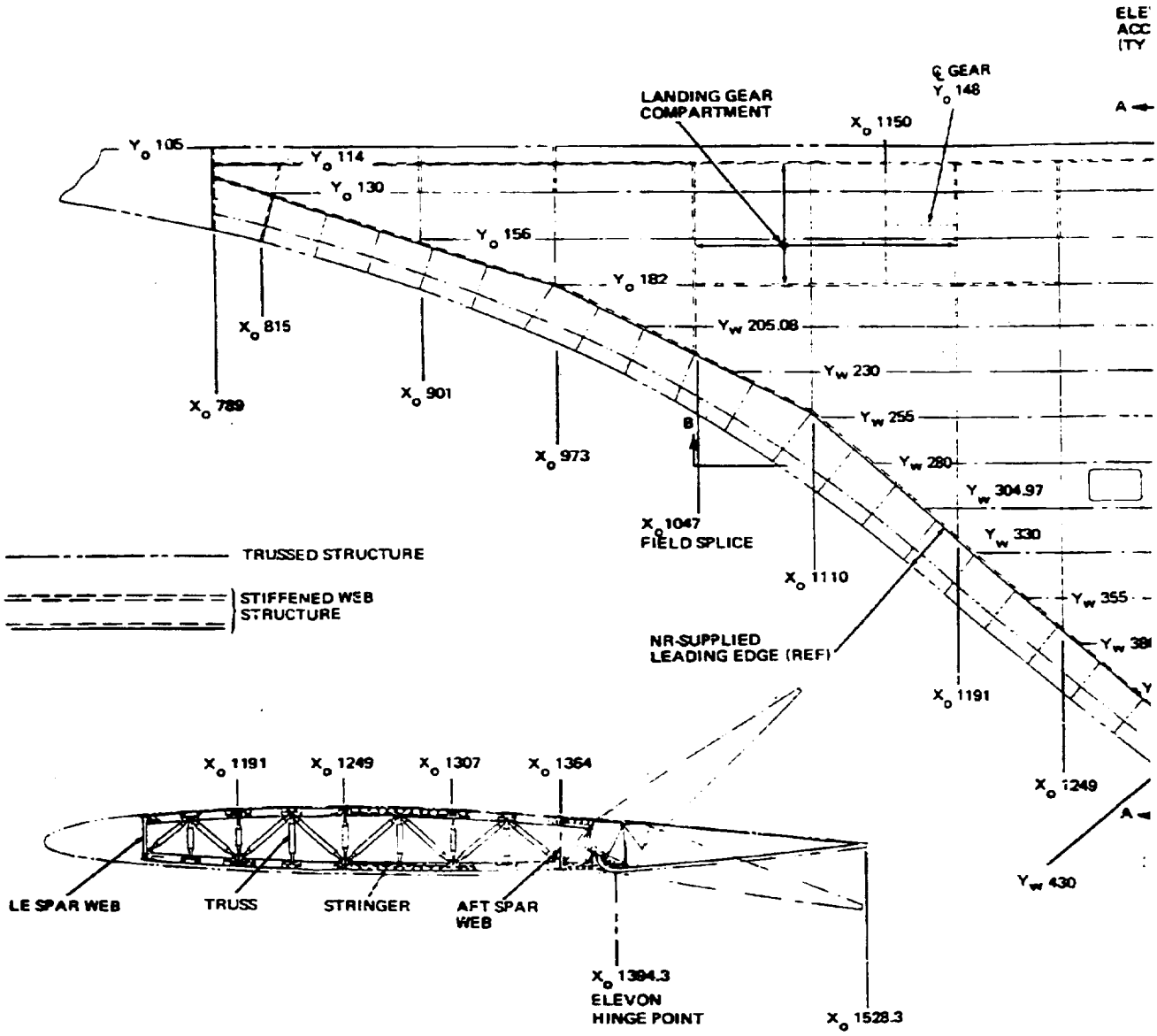


Figure 1.4.12. Mid Fuselage Payload Bay Doors



SECTION B-B
TYPICAL RIB

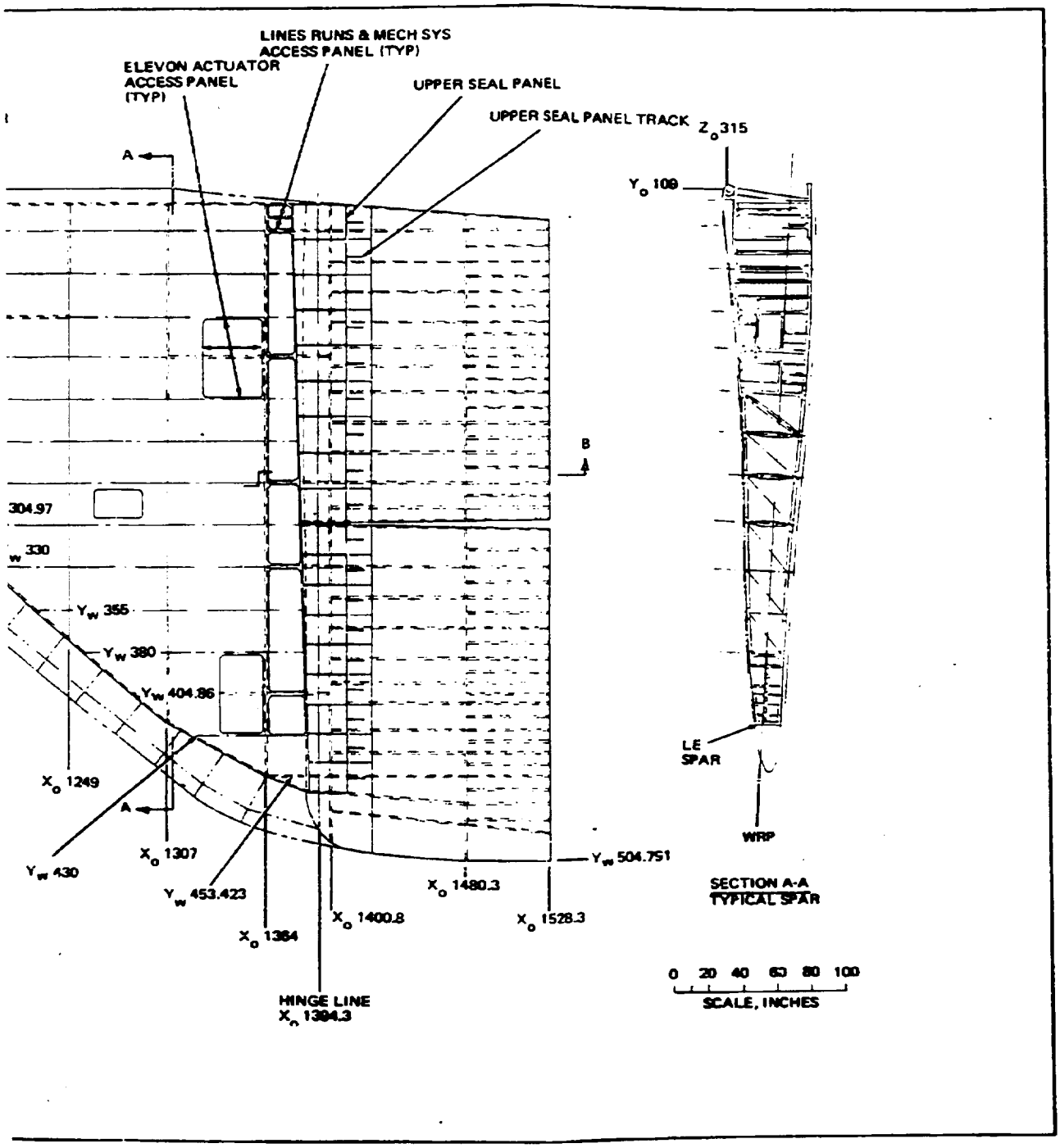
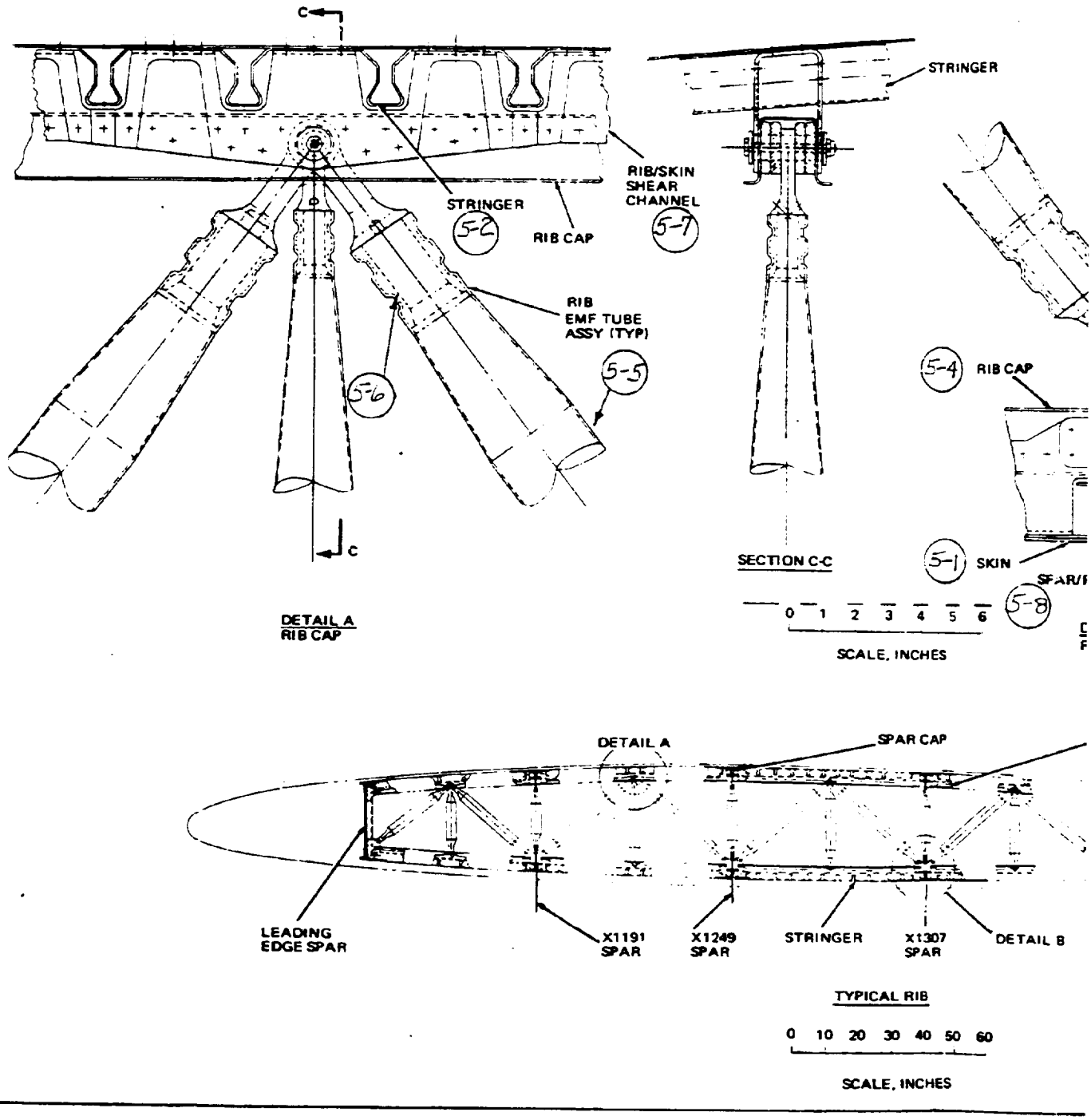


Figure 1.5.1. Wing Structure Subsystem Structural Arrangement

W/2/1



2-1-117

FOLDOUT FRAME

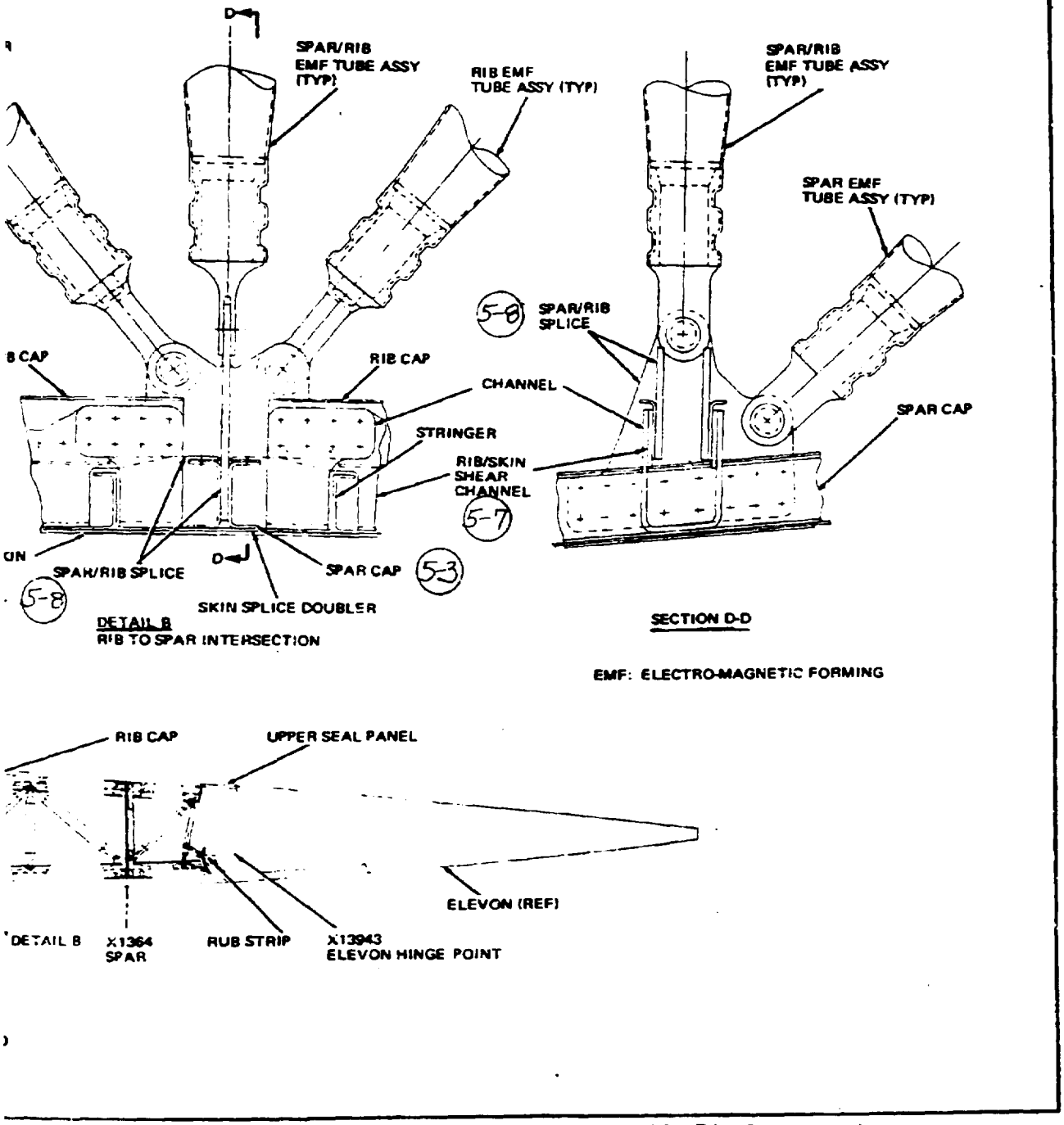
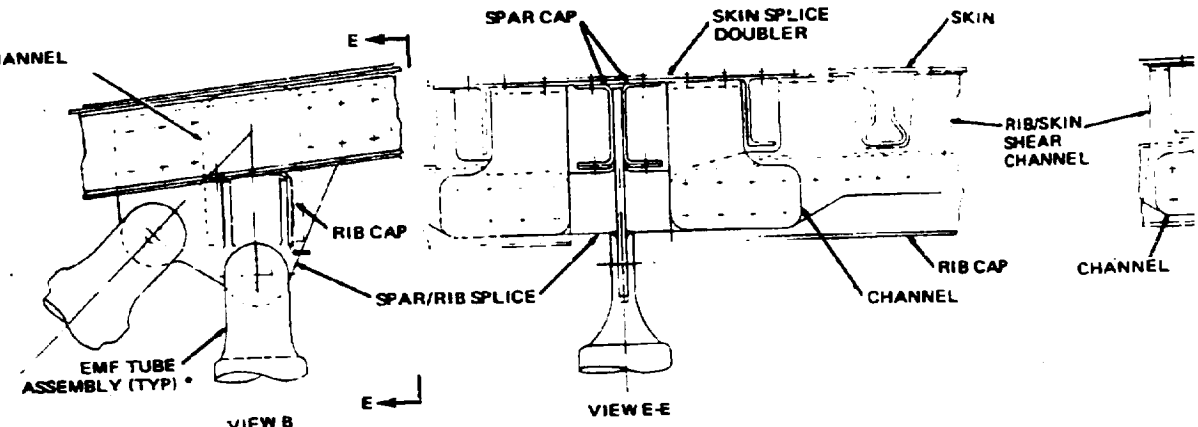
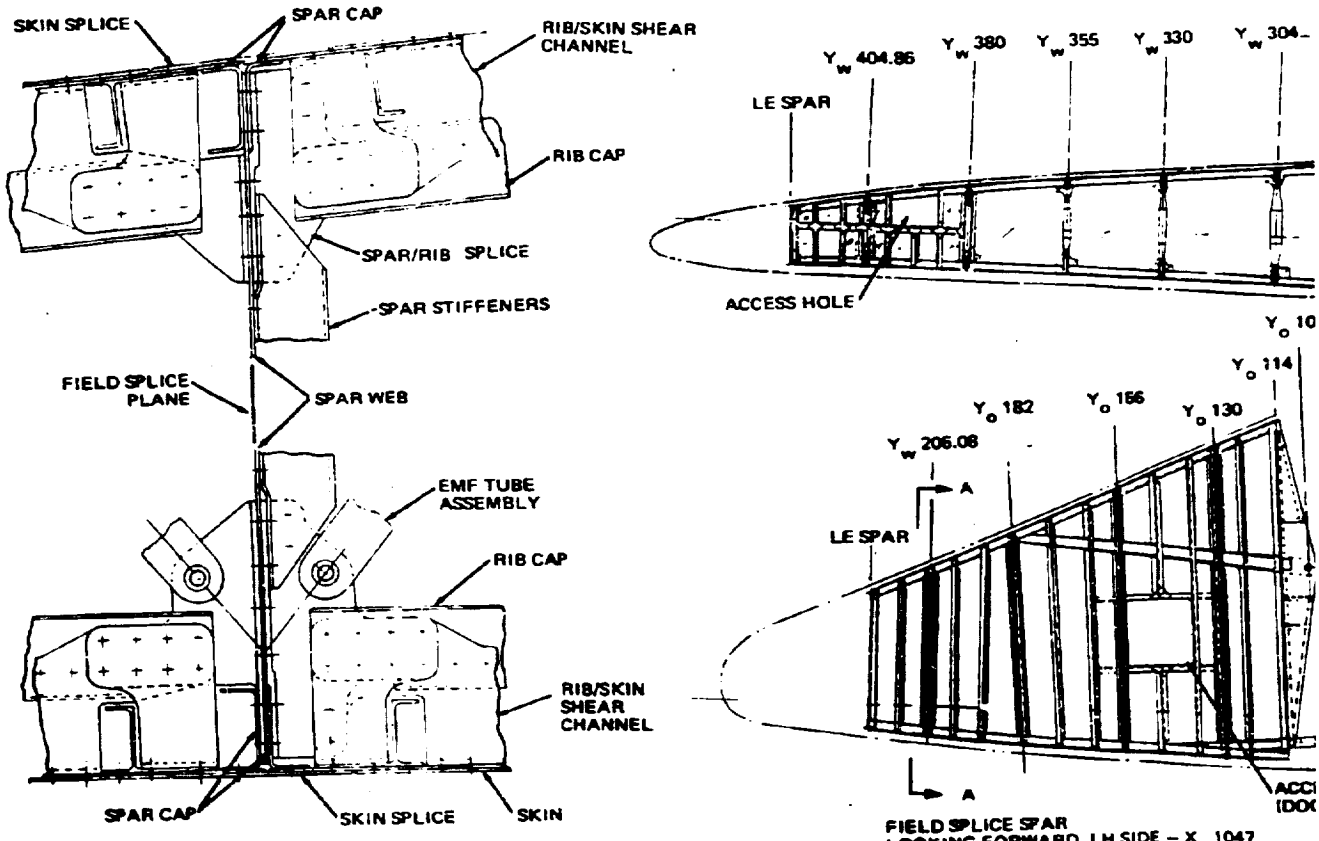


Figure 1.5.2. Wing Assembly Rib Construction





2-1-109

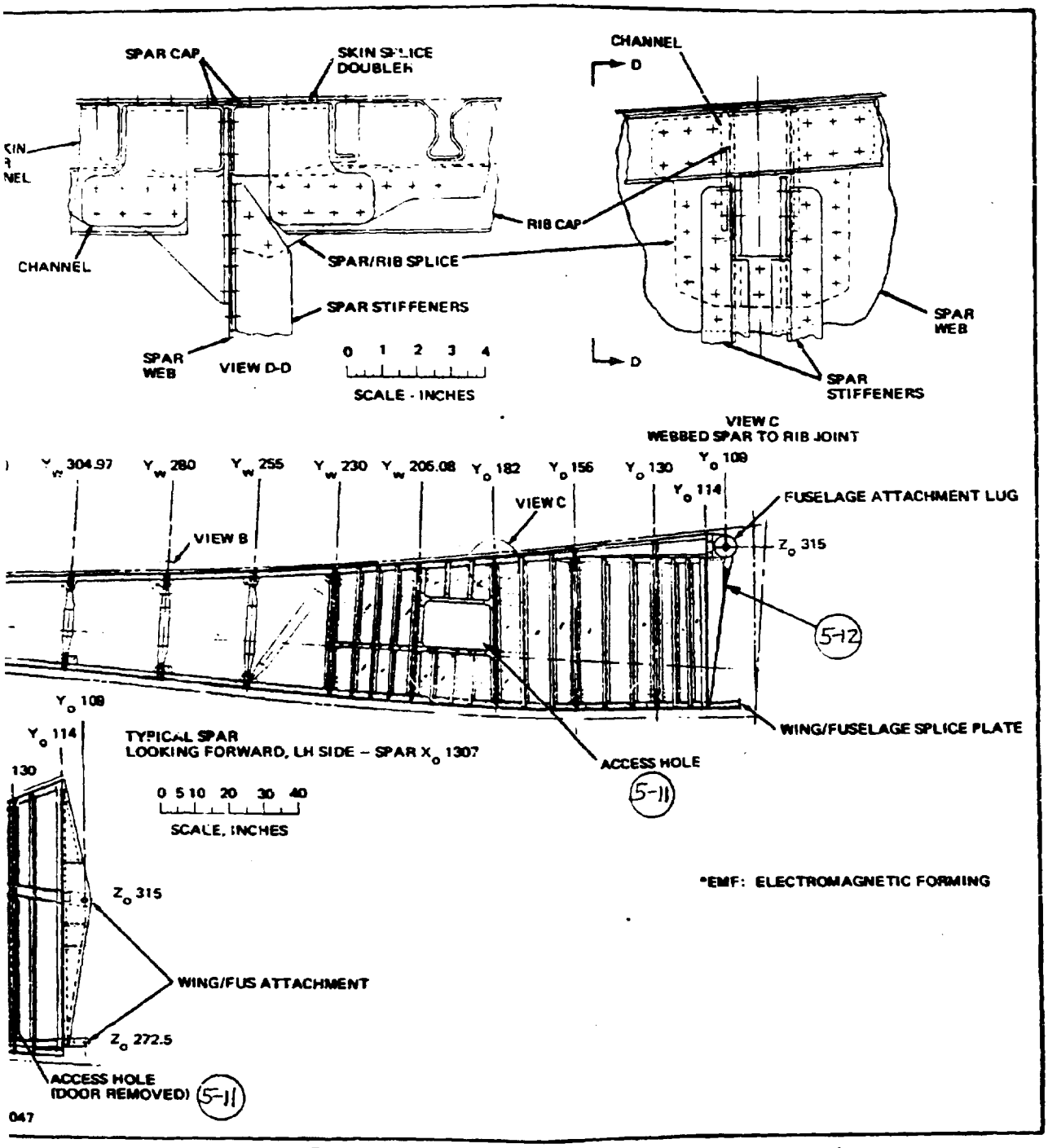
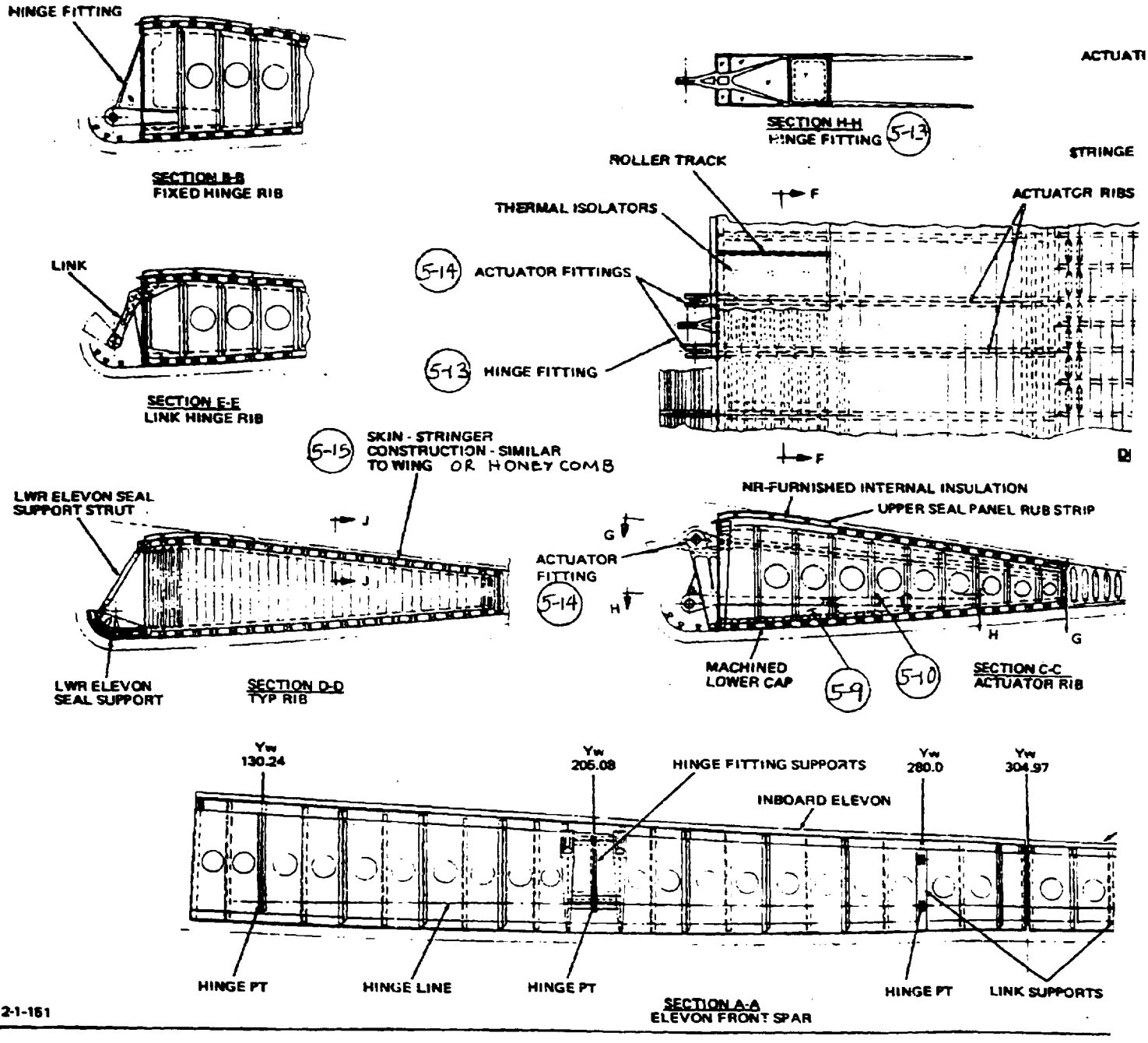


Figure 1.5.3. Wing Assembly Spar Construction


HINGE FITTING
SECTION B-B
FIXED HINGE RIB
LINK
SECTION E-E
LINK HINGE RIB
SECTION H-H
HINGE FITTING
5-13
ACTUATI
STRINGE
ROLLER TRACK
THERMAL ISOLATORS
ACTUATOR RIBS
5-14
ACTUATOR FITTINGS
5-13
HINGE FITTING
F
F
5-15
SKIN - STRINGER
CONSTRUCTION - SIMILAR
TO WING OR HONEY COMB
LWR ELEVON SEAL
SUPPORT STRUT
J
J
LWR ELEVON
SEAL SUPPORT
SECTION D-D
TYP RIB
NR-FURNISHED INTERNAL INSULATION
UPPER SEAL PANEL RUB STRIP
G
ACTUATOR
FITTING
5-14
H
H
G
MACHINED
LOWER CAP
5-9
5-10
SECTION C-C
ACTUATOR RIB
Yw
130.24
Yw
205.08
HINGE FITTING SUPPORTS
Yw
280.0
Yw
304.97
INBOARD ELEVON
HINGE PT
HINGE LINE
HINGE PT
HINGE PT
LINK SUPPORTS
SECTION A-A
ELEVON FRONT SPAR

2-1-151

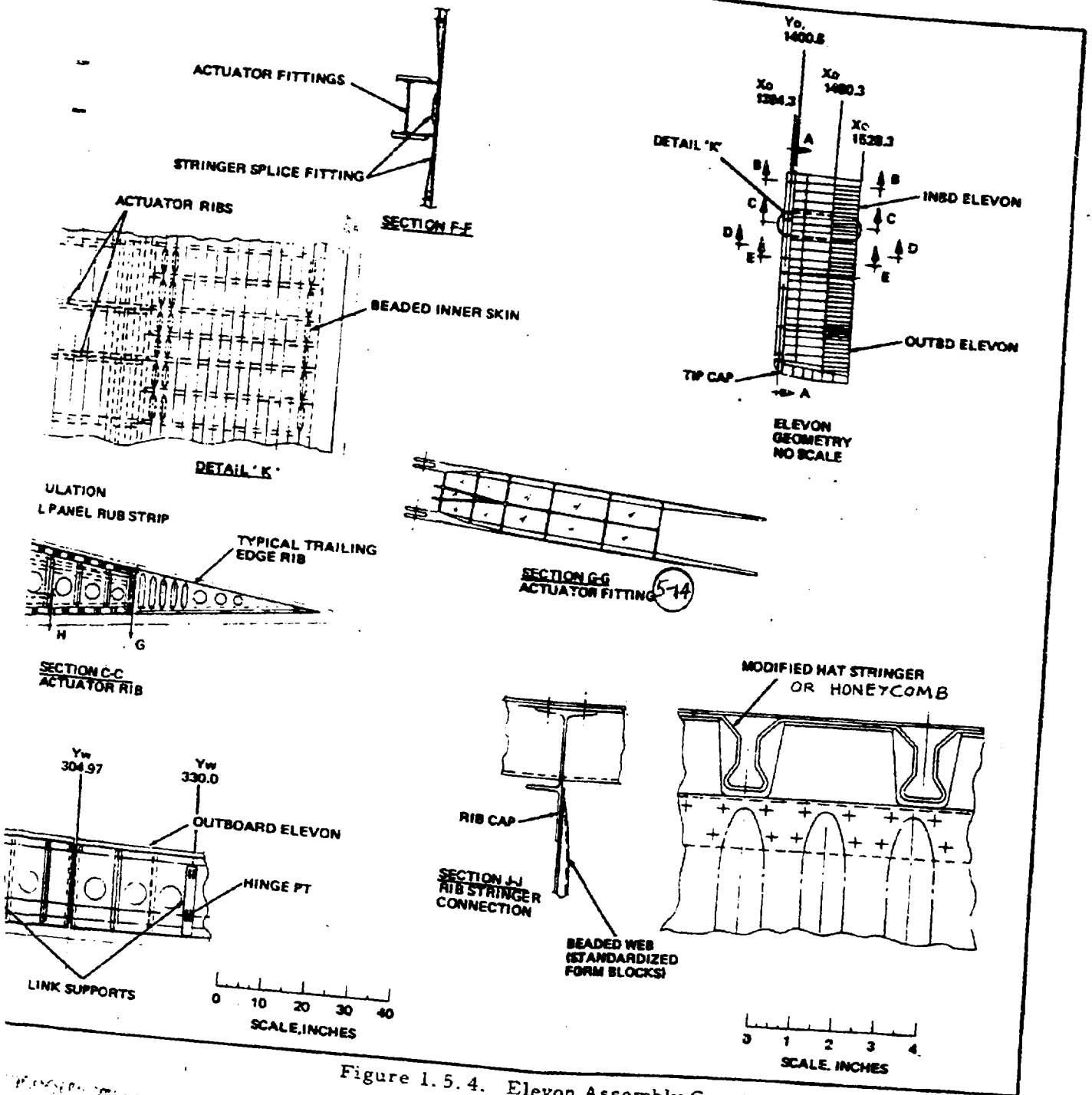
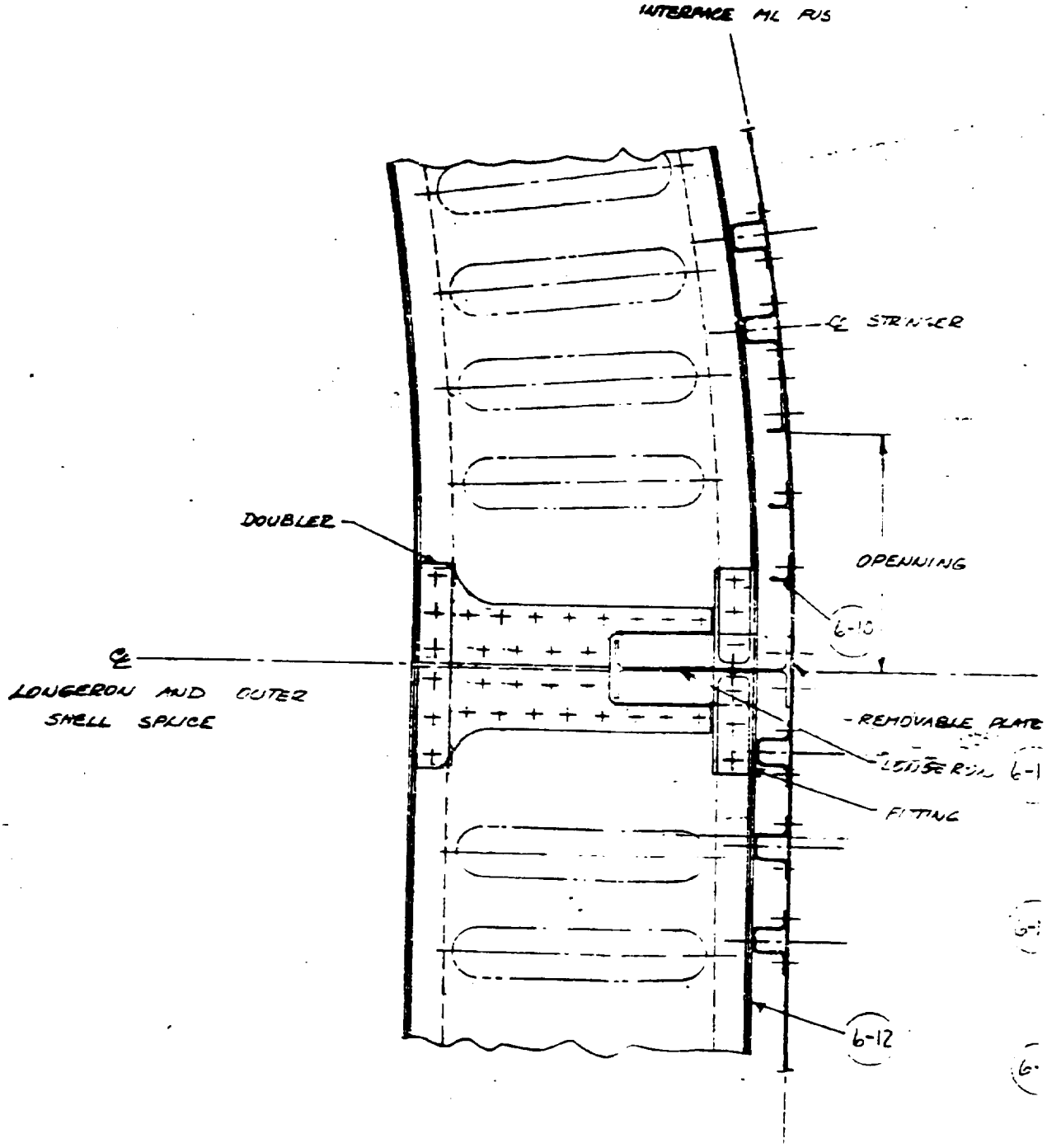


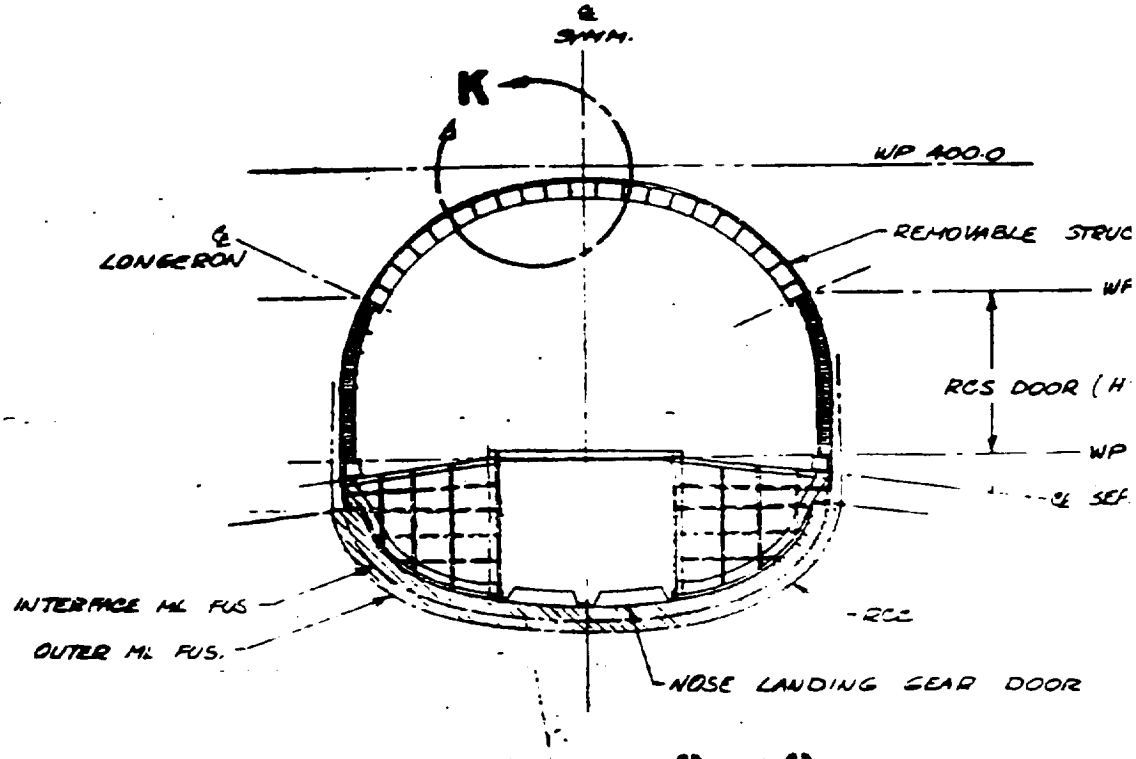
Figure 1.5.4. Elevon Assembly Construction



SECTION N - N

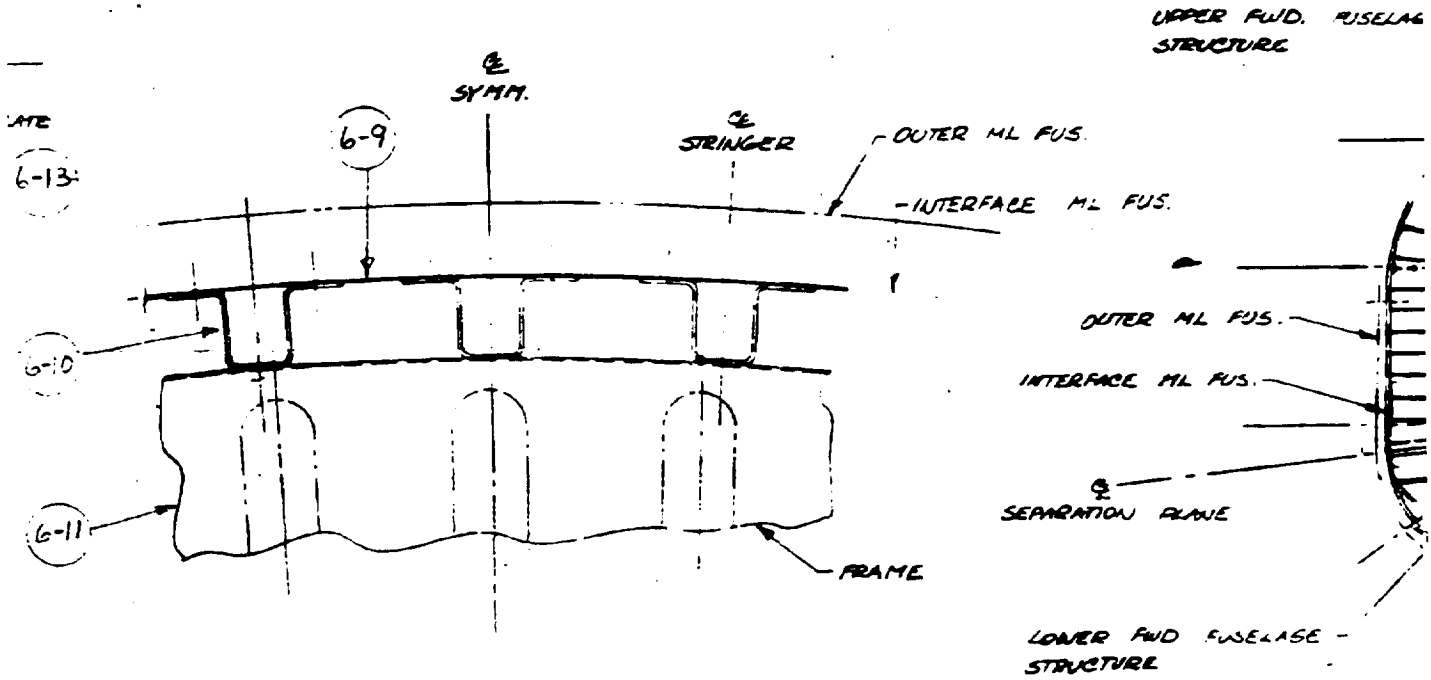
SCALE 1/2

CUTOUT FRAME



SECTION G - G

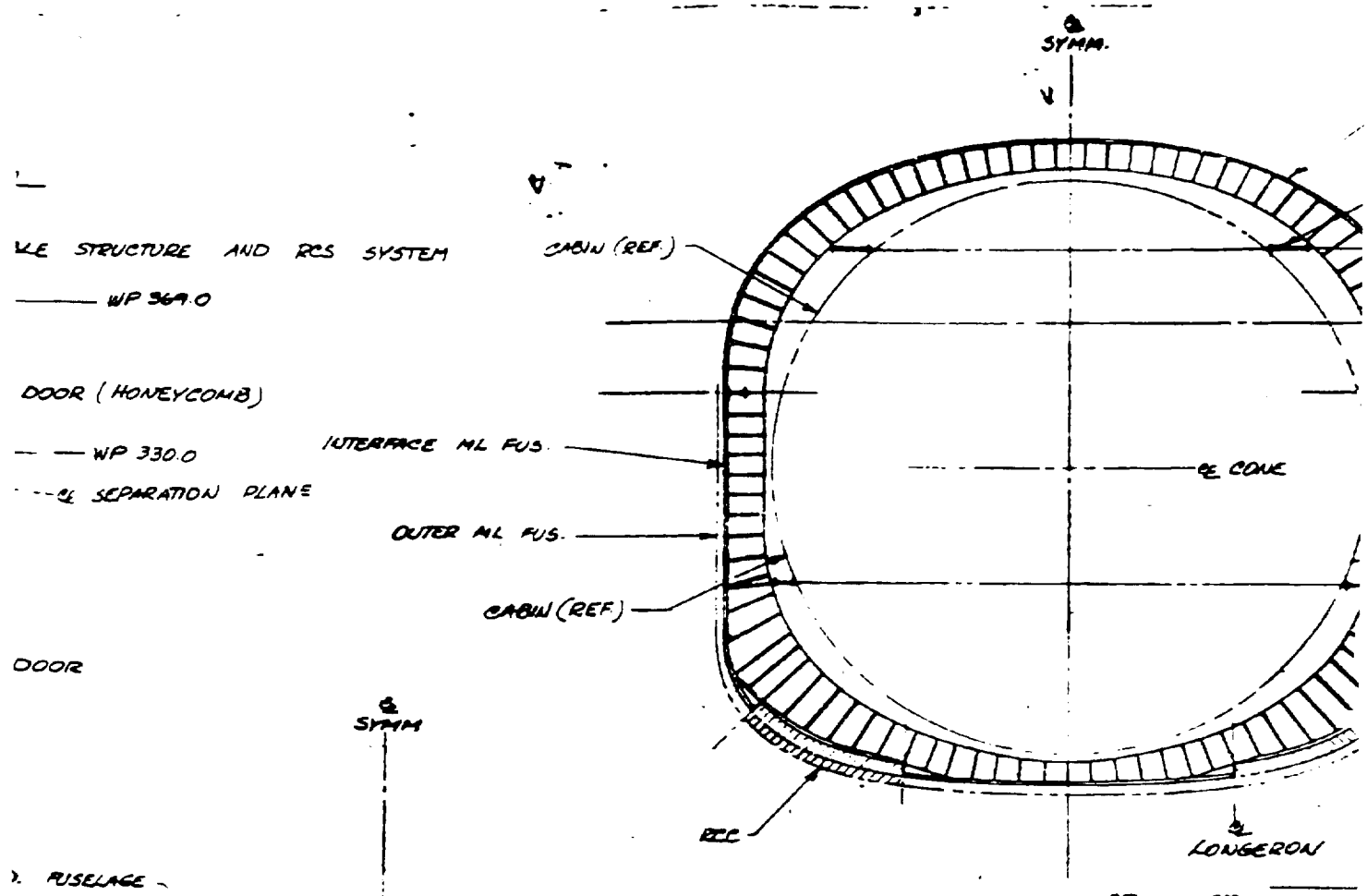
STA. 2200



VIEW K

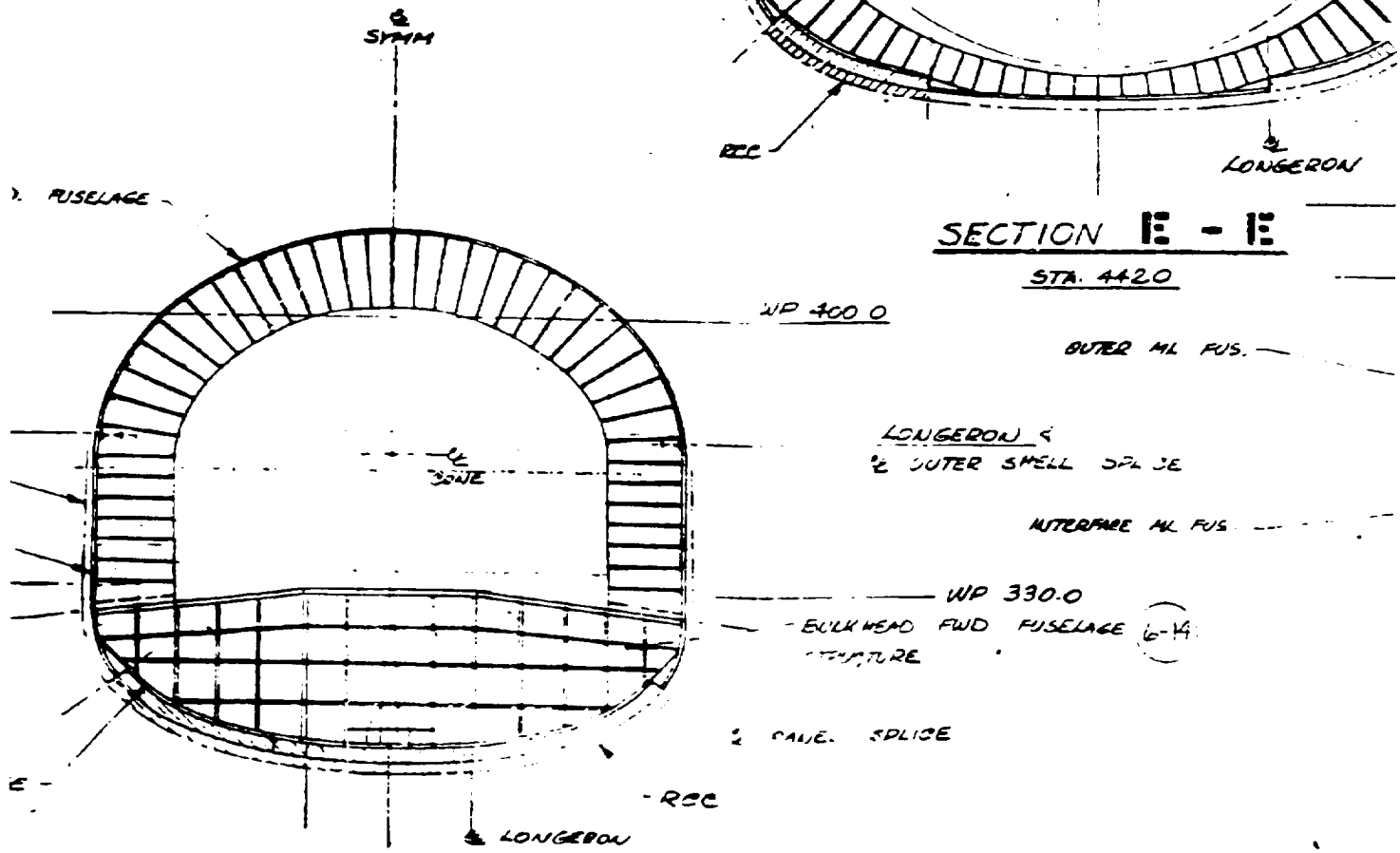
SCALE . 1/1

TYP FOR ALL FRAMES EXCEPT BULKHDS



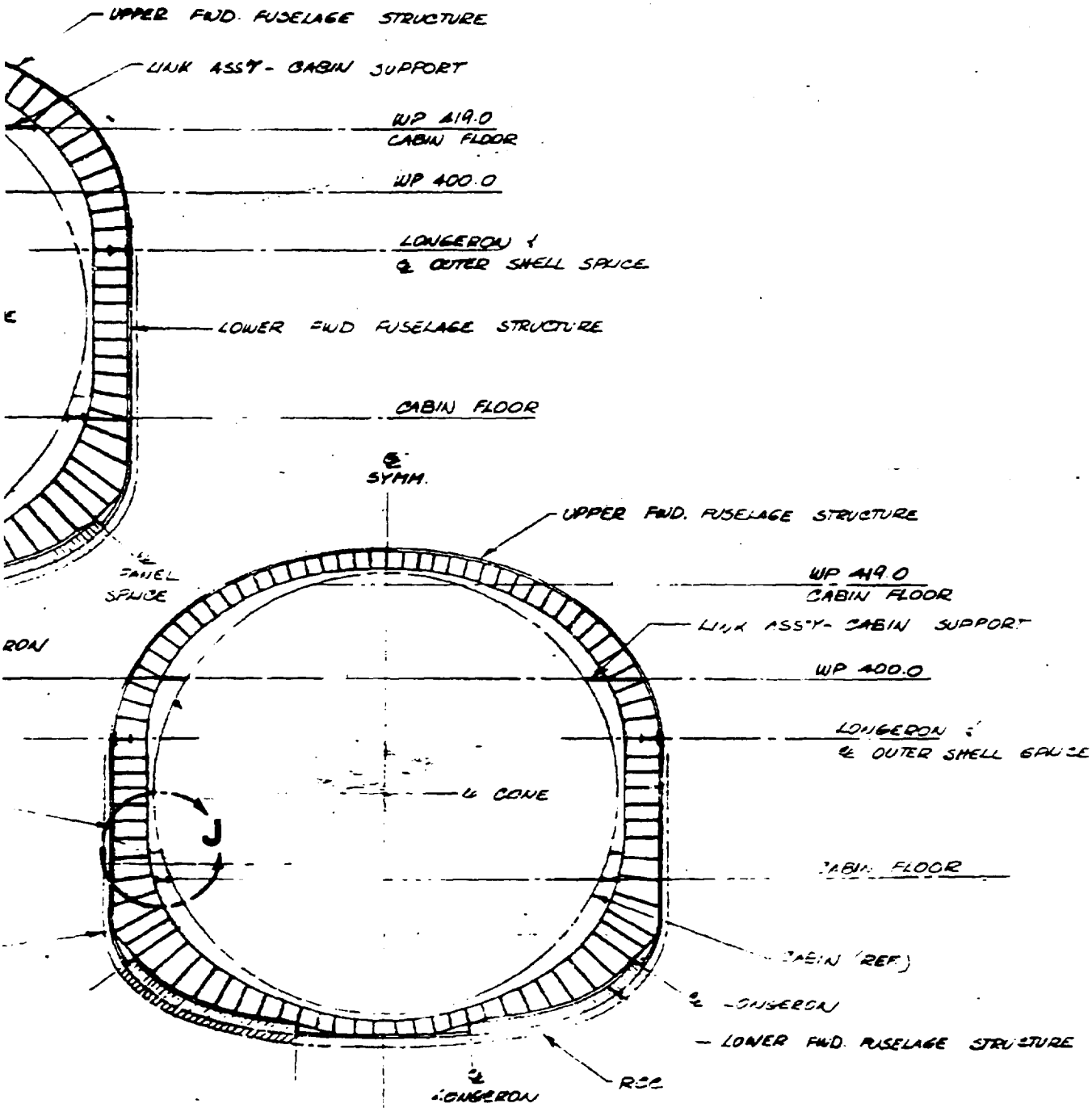
SECTION E - E

STA. 4420



SECTION C - C

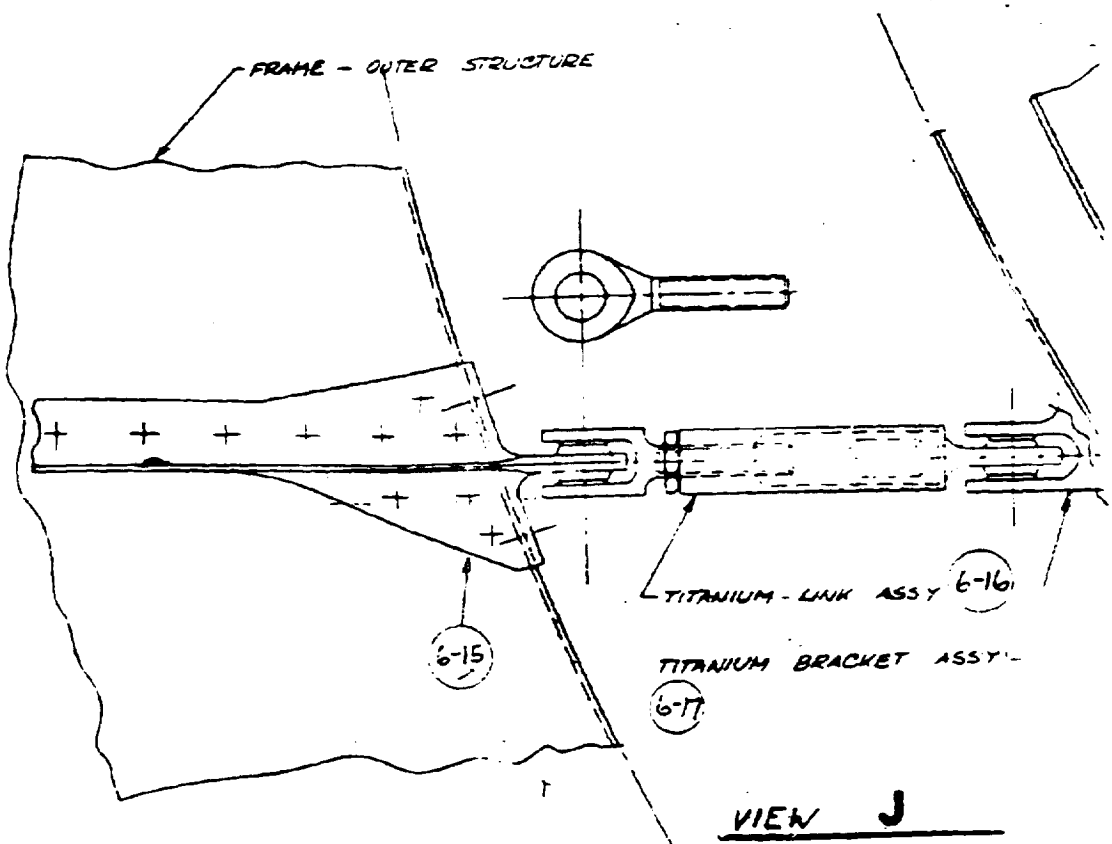
STA 372.0



SECTION D - D

STA. 407.2

FRAME

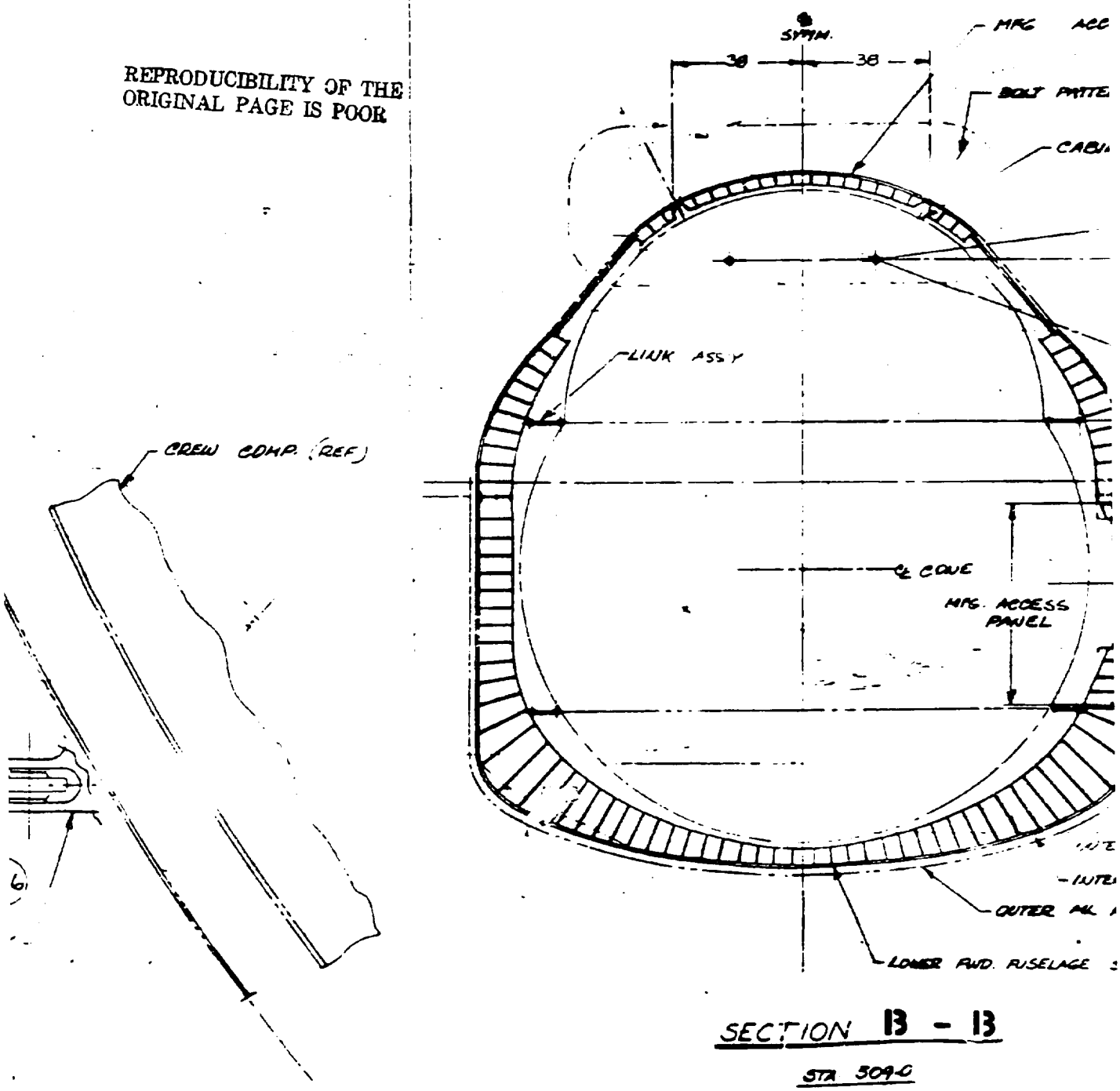


VIEW J

SCALE 1/1

DETAIL OF LINK ASSY

FOLDOUT FRAME



SECTION 13 - 13

STA 509.0

EN MAIN SUPPORT

DOUBLE FRAME

6

ACCESS PANEL

T PATTERN

CABIN (REF.)

WP 469.0

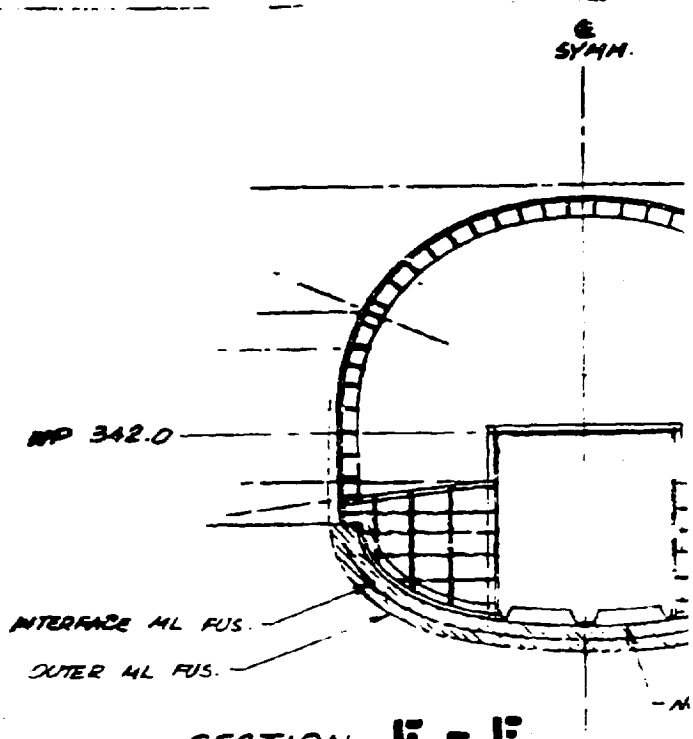
UPPER FWD. FUSELAGE STRUCTURE

WP 419.0
CABIN FLOOR

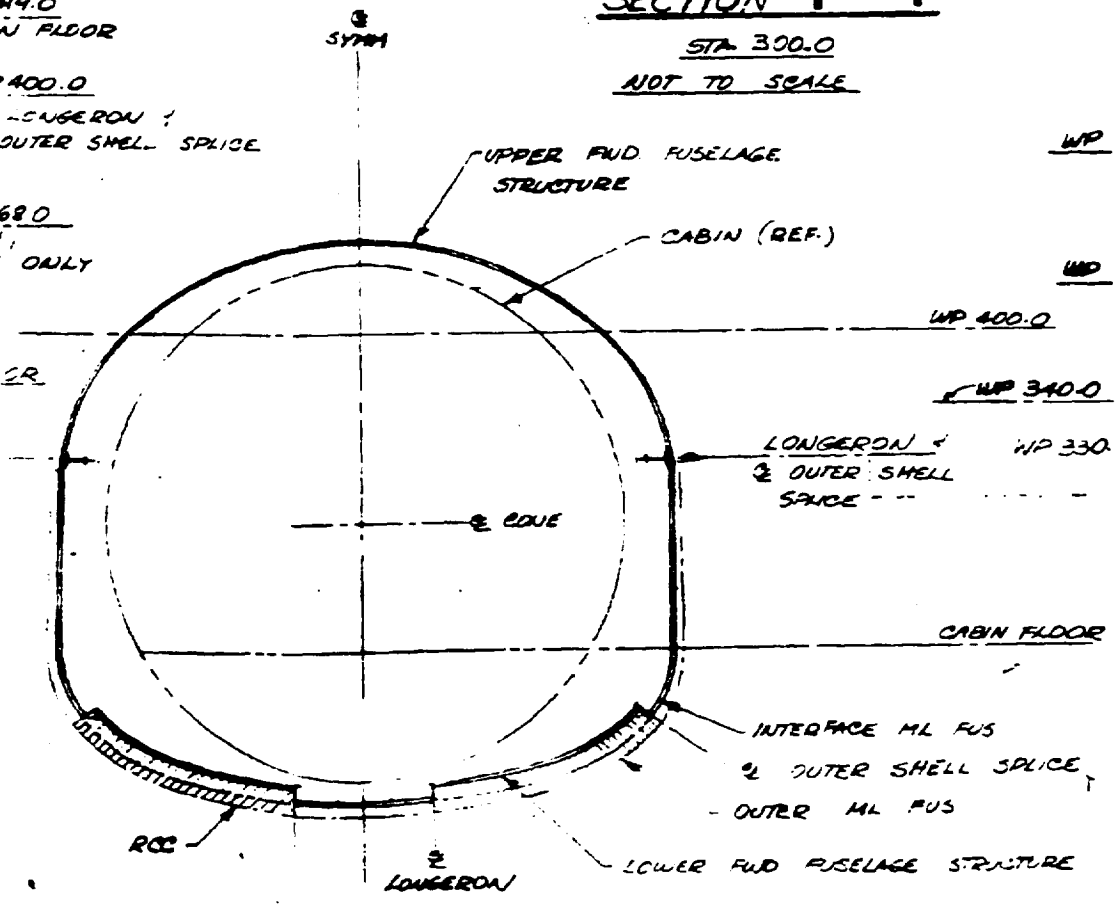
WP 400.0
LONGERON 1
½ OUTER SHELL SPLICE

HATCH WP 368.0
½ HATCH;
RH SIDE ONLY

OUTER SHELL SPLICE
INTERFACE ML FUS.
OR ML FUS.
ELAGE STRUCTURE

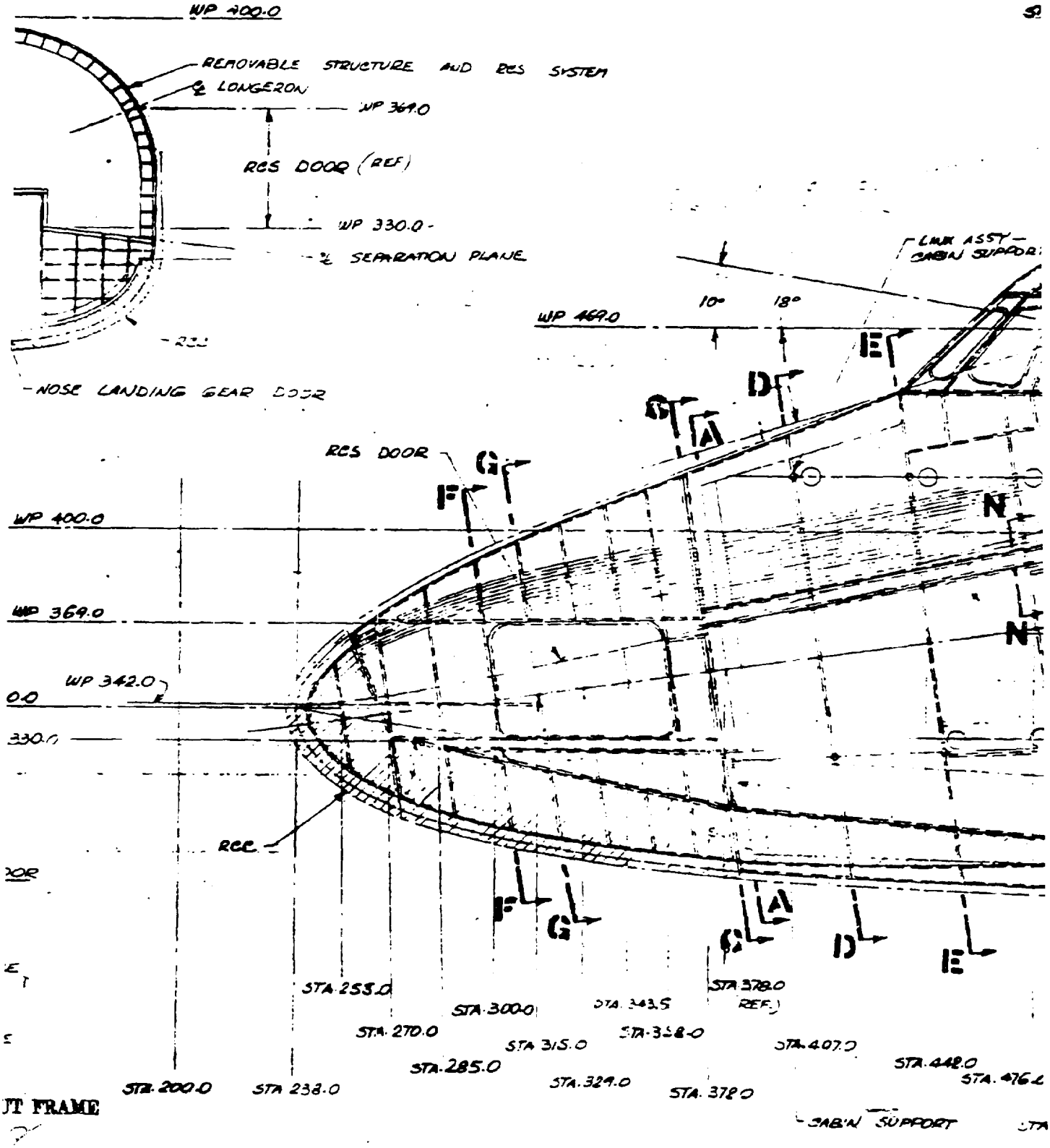


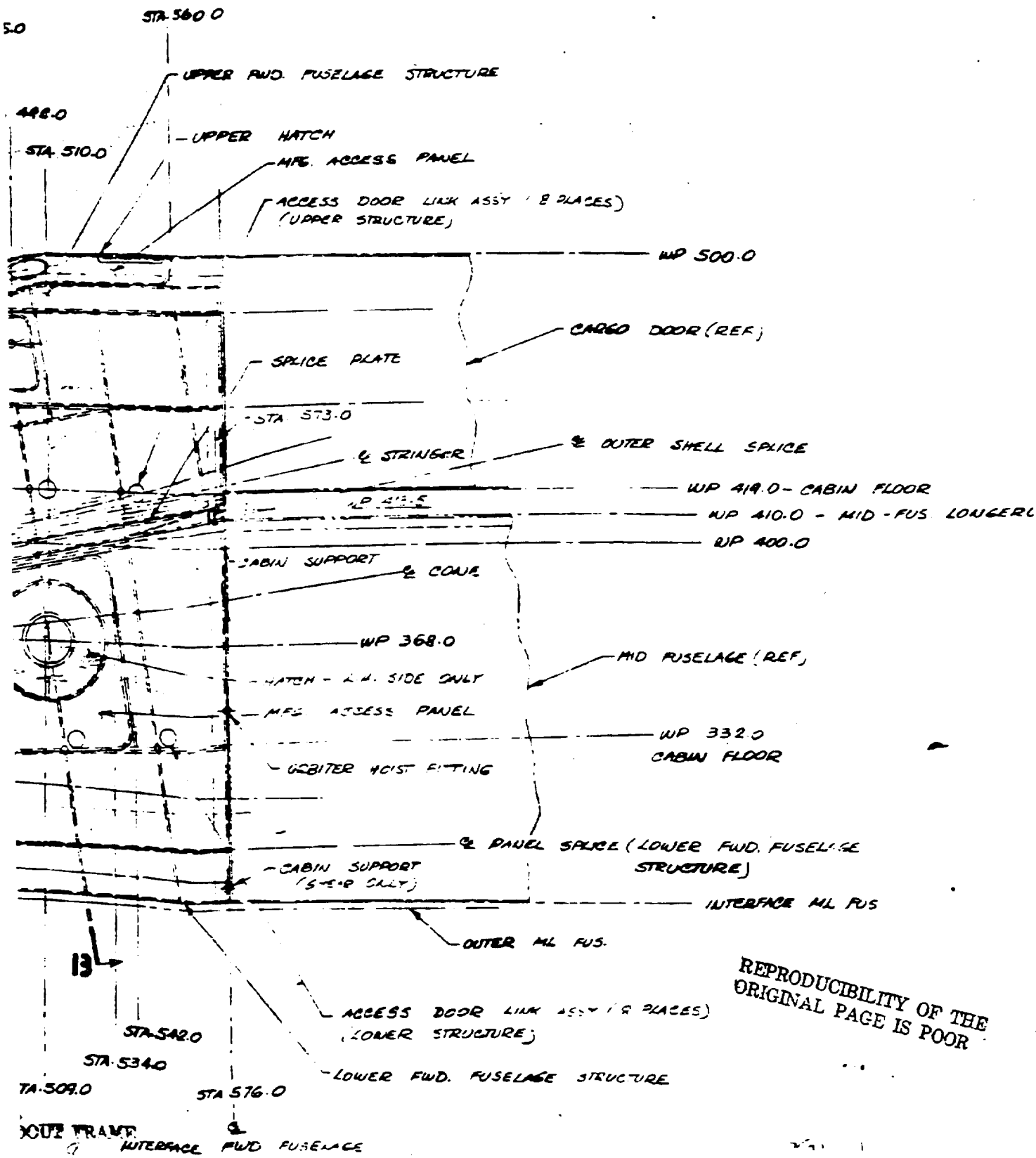
SECTION F - F
STA 300.0
NOT TO SCALE

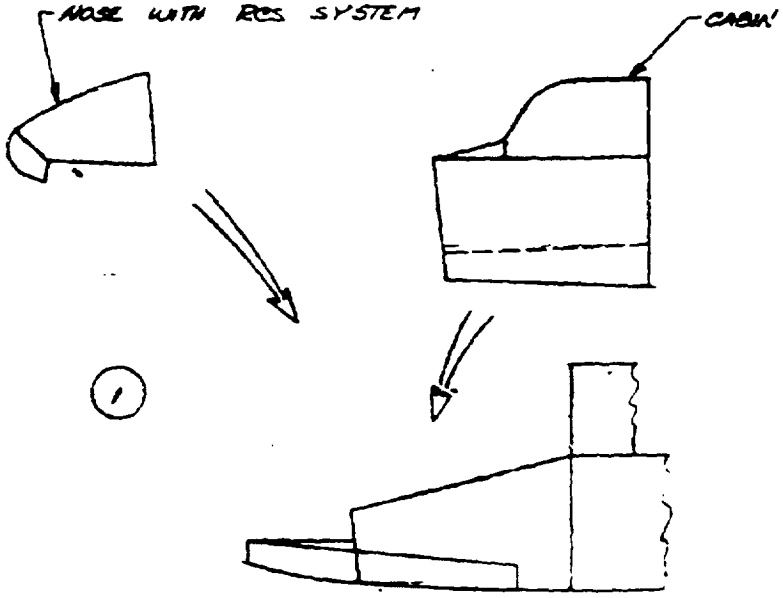


SECTION A - A
STA 378.0

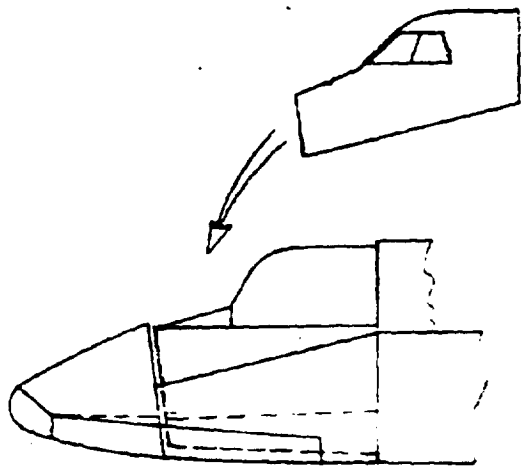
JT FRAME


WP 400.0
REMOVABLE STRUCTURE AND RCS SYSTEM
℄ LONGERON
WP 369.0
RCS DOOR (REF)
WP 330.0
℄ SEPARATION PLANE
NOSE LANDING GEAR DOOR
WP 469.0
10°
18°
RCS DOOR
WP 400.0
WP 369.0
WP 342.0
330.0
RCS
STA 200.0
STA 238.0
STA 255.0
STA 270.0
STA 285.0
STA 300.0
STA 315.0
STA 324.0
STA 343.5
STA 358.0
STA 378.0
STA 378.0 REF.
STA 407.0
STA 448.0
STA 476.4
JT FRAME
CABIN SUPPORT





AL ALLOY STRINGERS



LONGERON

NC
• CR
AI
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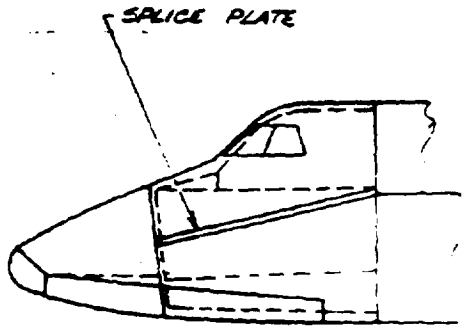
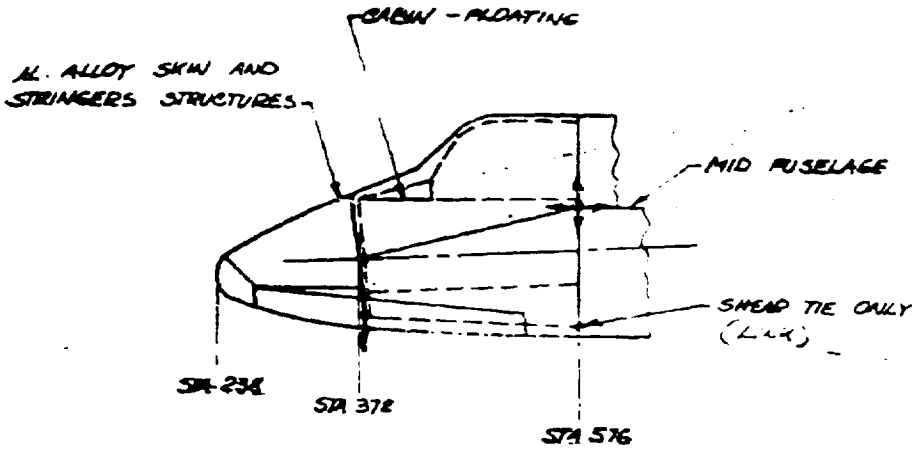
A
IF
L
• RL
4C
• AL
ON
JO
PU



THE
OR

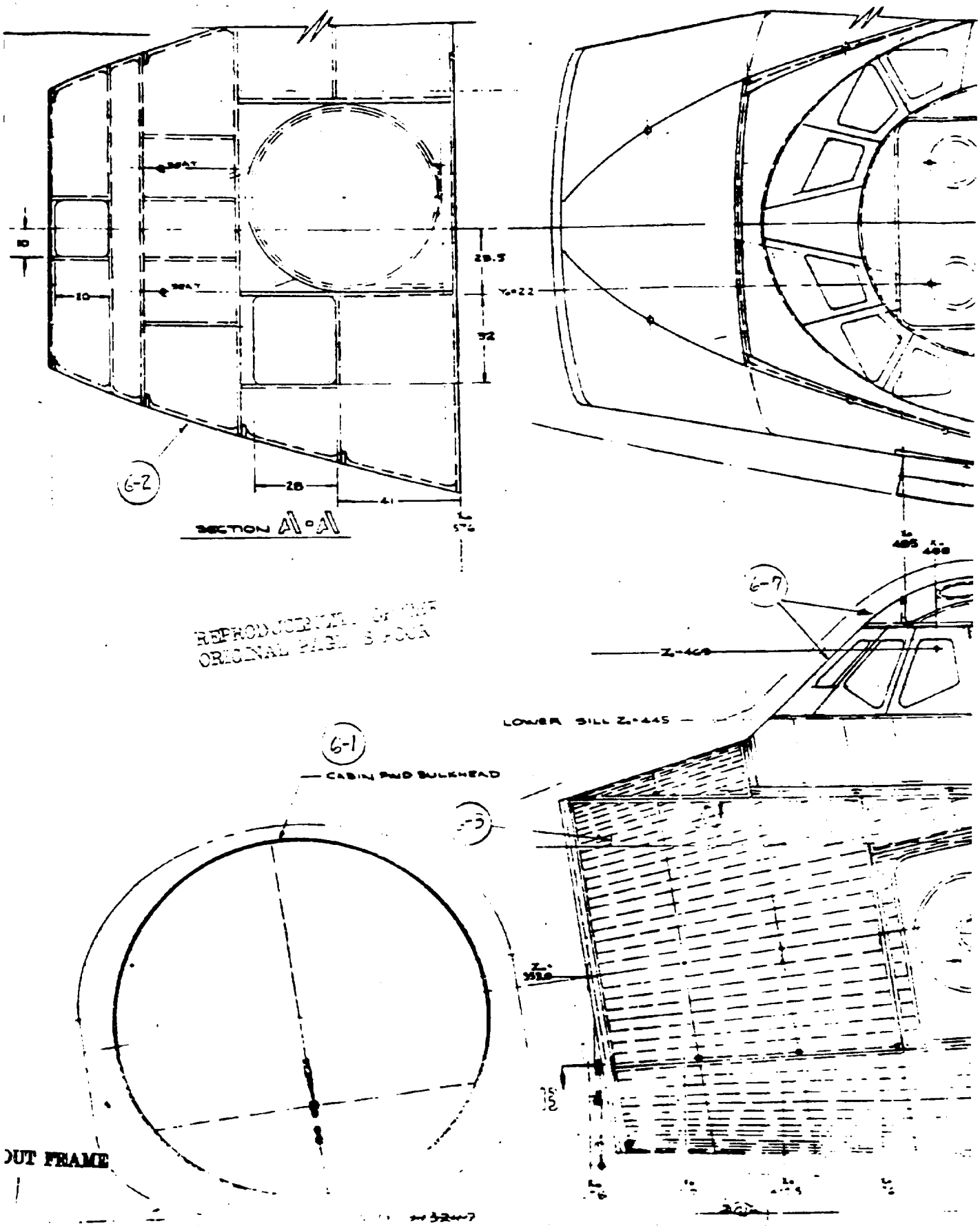
OUT FROM



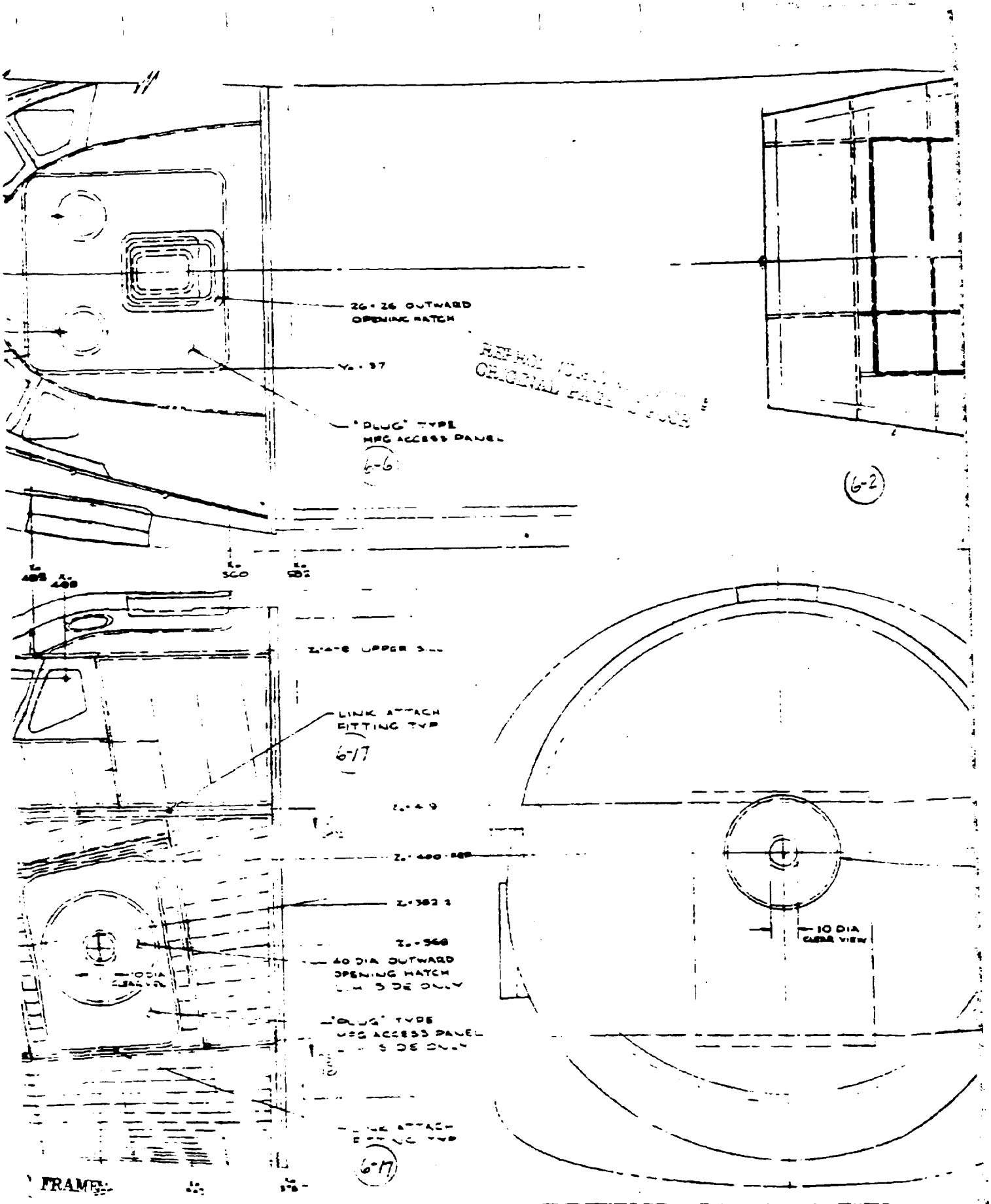
NOTES:

- CREW COMPARTMENT IS FLOATING AND IS SUPPORTED AT STA 372 AND LOADS ARE CARRIED ON 'Z' AXIS ONLY. LOADS AT STA 576 ARE CARRIED ON 'X' AND 'Z' AXIS ONLY. LOADS AT SHEAR TIE LUG ARE CARRIED ON 'Y' AXIS ONLY.
- OUTER SHELL IS SUPPORTED BY LUGS AT STA'S 407.0, 442.0, 476.0, 509.0 AND 542.0
- ALL FLIGHT LOADS ARE CARRIED THRU OUTER SHELL ONLY, EXCEPT LOADS IN 'Y' AXIS ARE CARRIED JOINTLY BY BOTH STRUCTURES (CABIN AND FWD. FUSELAGE STRUCTURE - OUTER SHELL)

Figure 1. 6. 1. Forward Fuselage Structure



OUT FRAME


26 · 26 OUTWARD
OPENING HATCH
'PLUG' TYPE
MPG ACCESS PANEL
6-6
(6-2)
LINK ATTACH
FITTING TYP
6-17
40 DIA OUTWARD
OPENING HATCH
'PLUG' TYPE
MPG ACCESS PANEL
10 DIA
CLEAR VIEW
6-17
FRAME

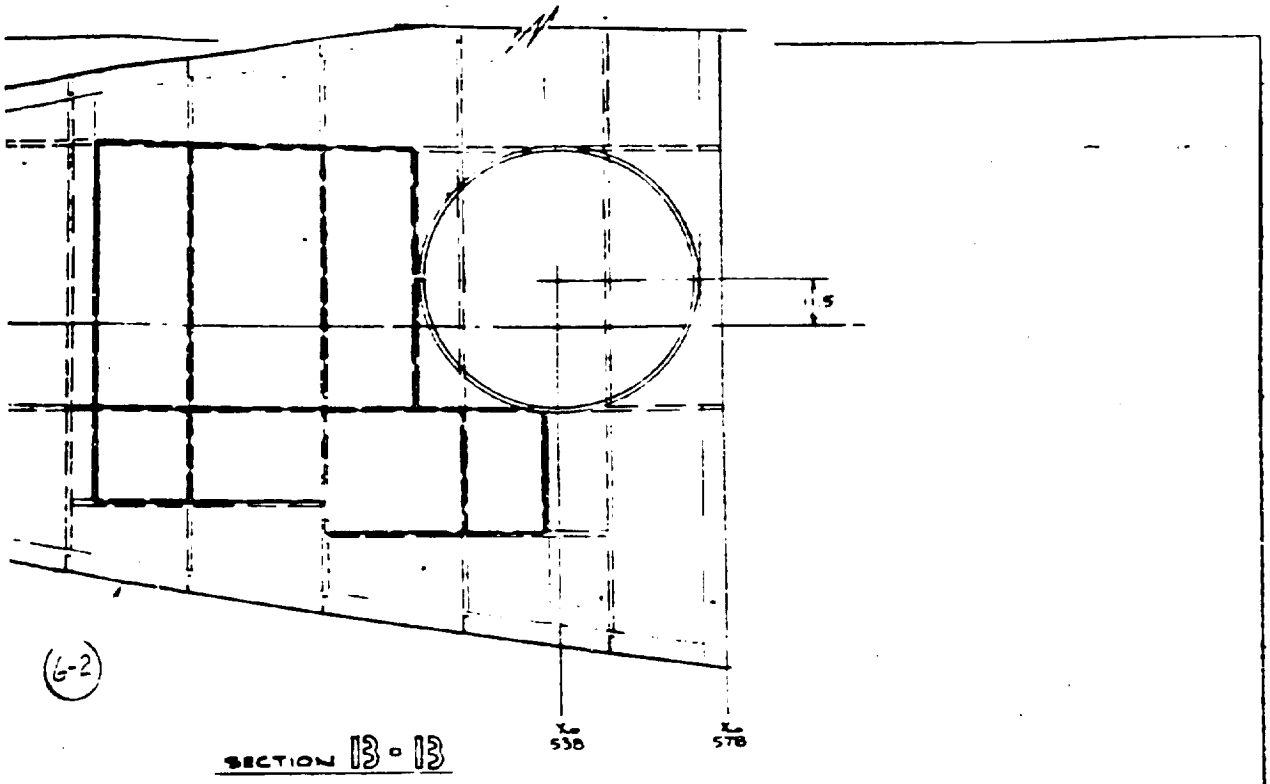
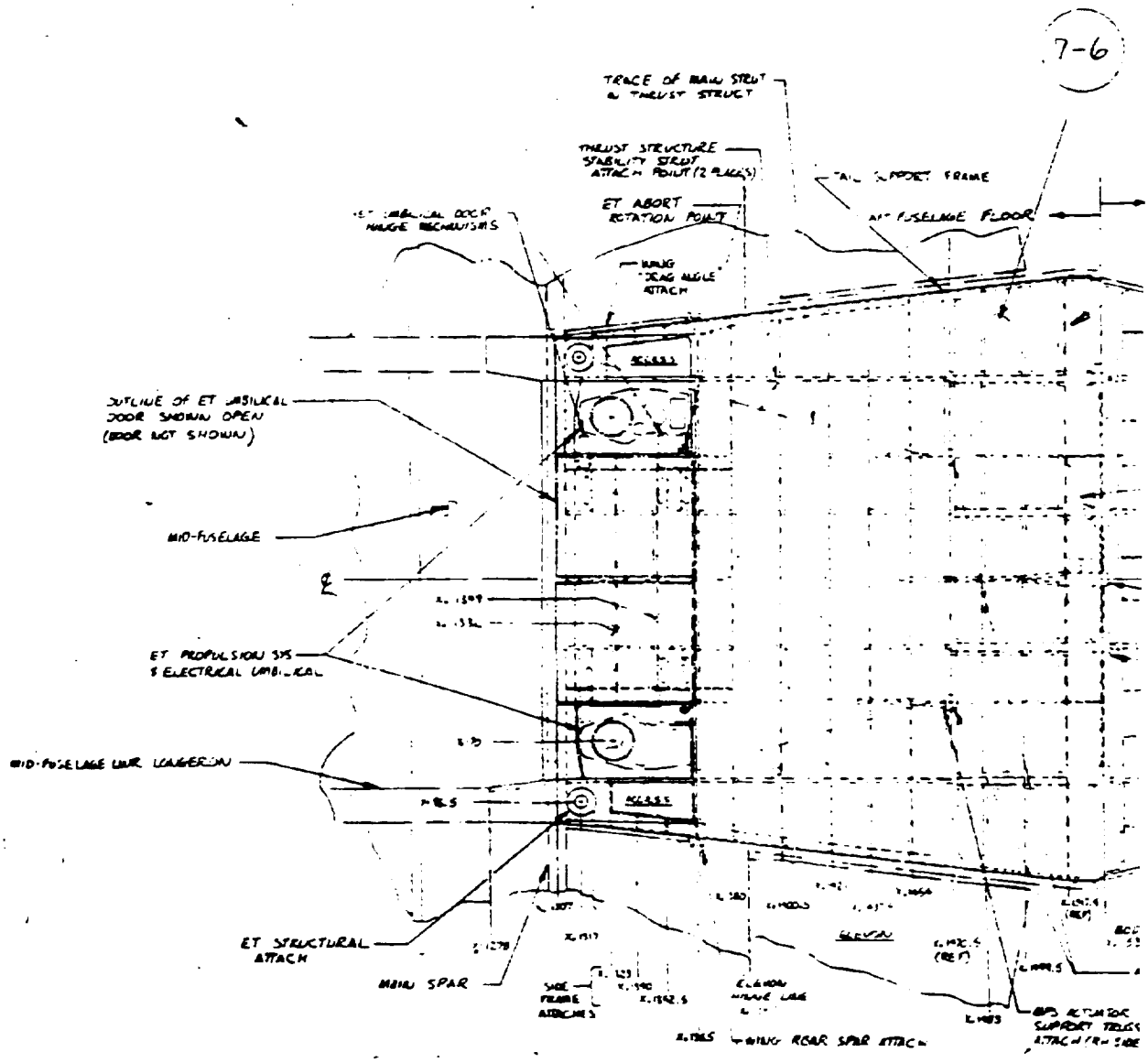
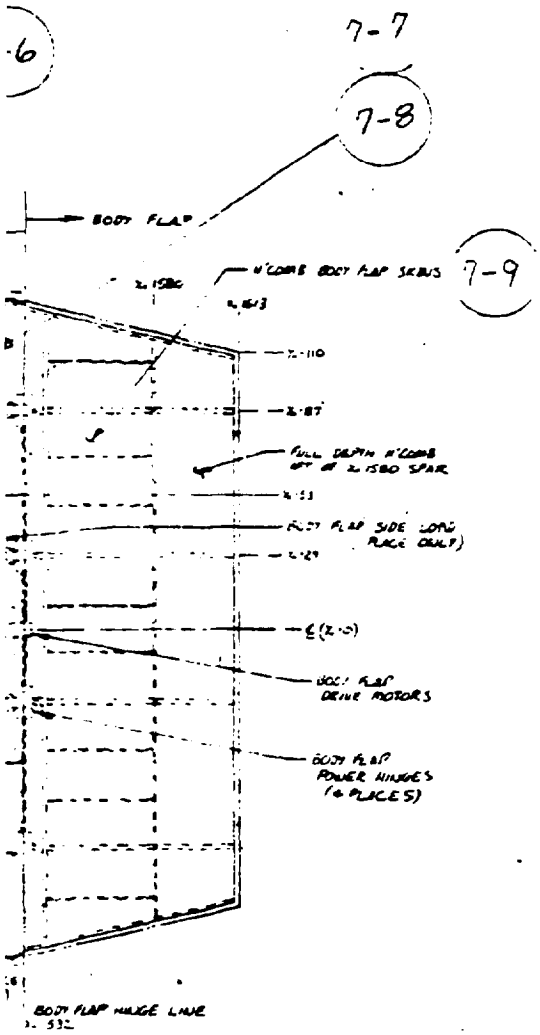


Figure 1. b. 2. Cabin Structure

7-6


TRACE OF MAIN STRUT & THRUST STRUCT
THRUST STRUCTURE STABILITY STRUT ATTACH POINT (2 PLACES)
TAIL SUPPORT FRAME
ET ABORT ROTATION POINT
MT FUSELAGE FLOOR
ET UMBILICAL DOOR HINGE MECHANISMS
WING DRAG ANGLE ATTACH
OUTLINE OF ET UMBILICAL DOOR SHOWN OPEN (DOOR NOT SHOWN)
MID-FUSELAGE
ET PROPULSION SYS & ELECTRICAL UMBILICAL
MID-FUSELAGE LOWER LONGERON
ET STRUCTURAL ATTACH
MAIN SPAR
SIDE FRAME ATTACHES
ELEVON
ELEVON HINGE LINE
WING REAR SPAR ATTACH
RCS ACTUATOR SUPPORT TRUSS ATTACH FRM SIDE

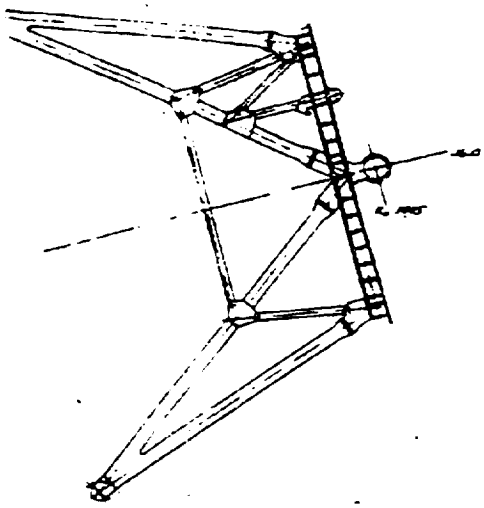
T FRAME



VIEW C-C
SCALE 1/20
VIEW LOOKING UP

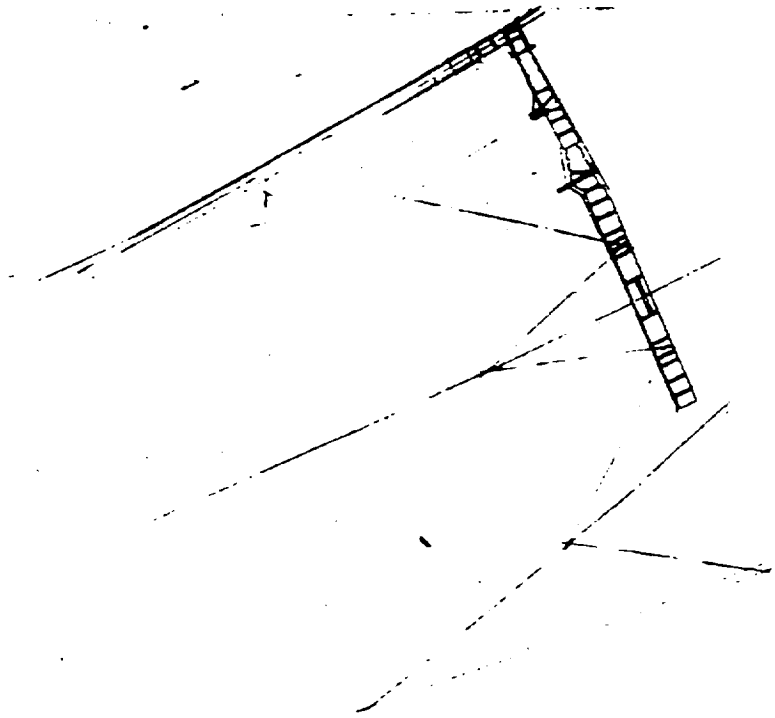
E-E

FRAME



E-E

THRUST SUPT STRUCT TRUSS WORK
4.70-003083

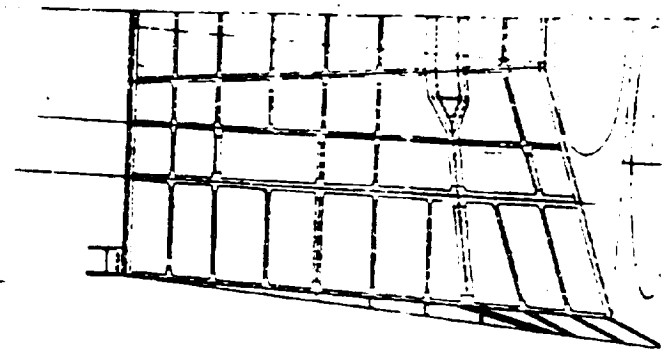


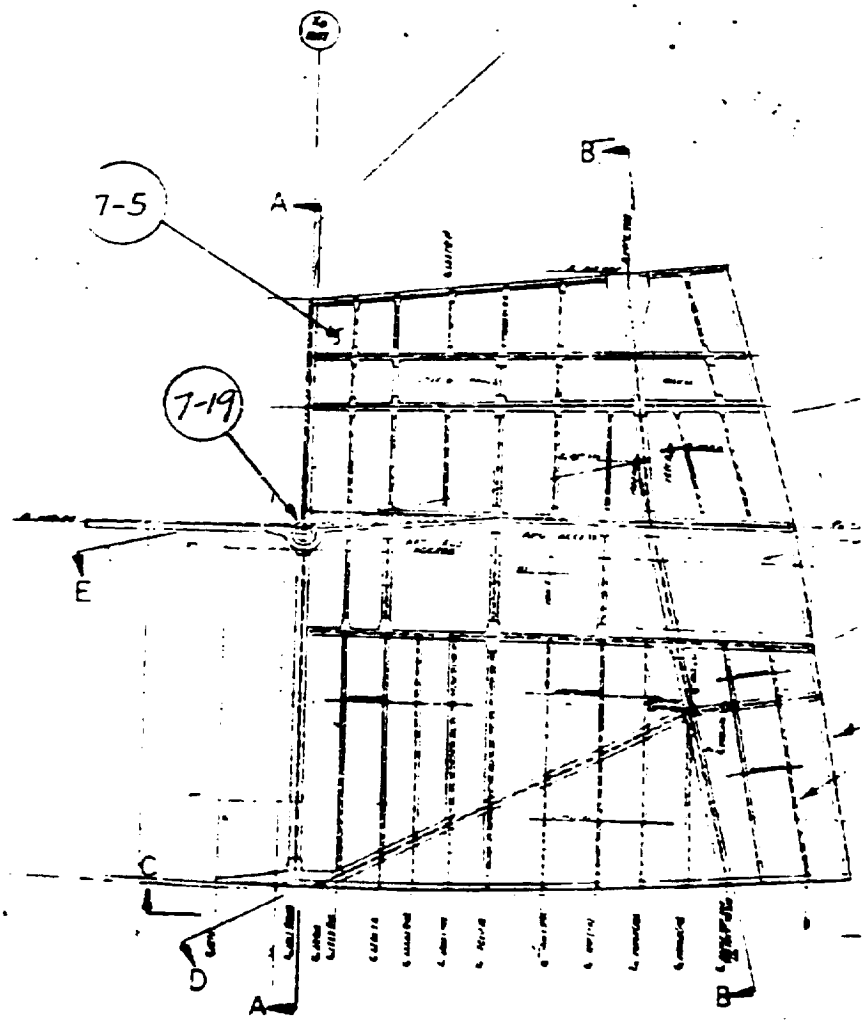
D-D

VIEW LOOK THRUST SUPT STRUCT TRUSS WORK
SEE 4.70-003099

OUP FRAME

3




7-5
7-19
A
B
E
C
D
A
B

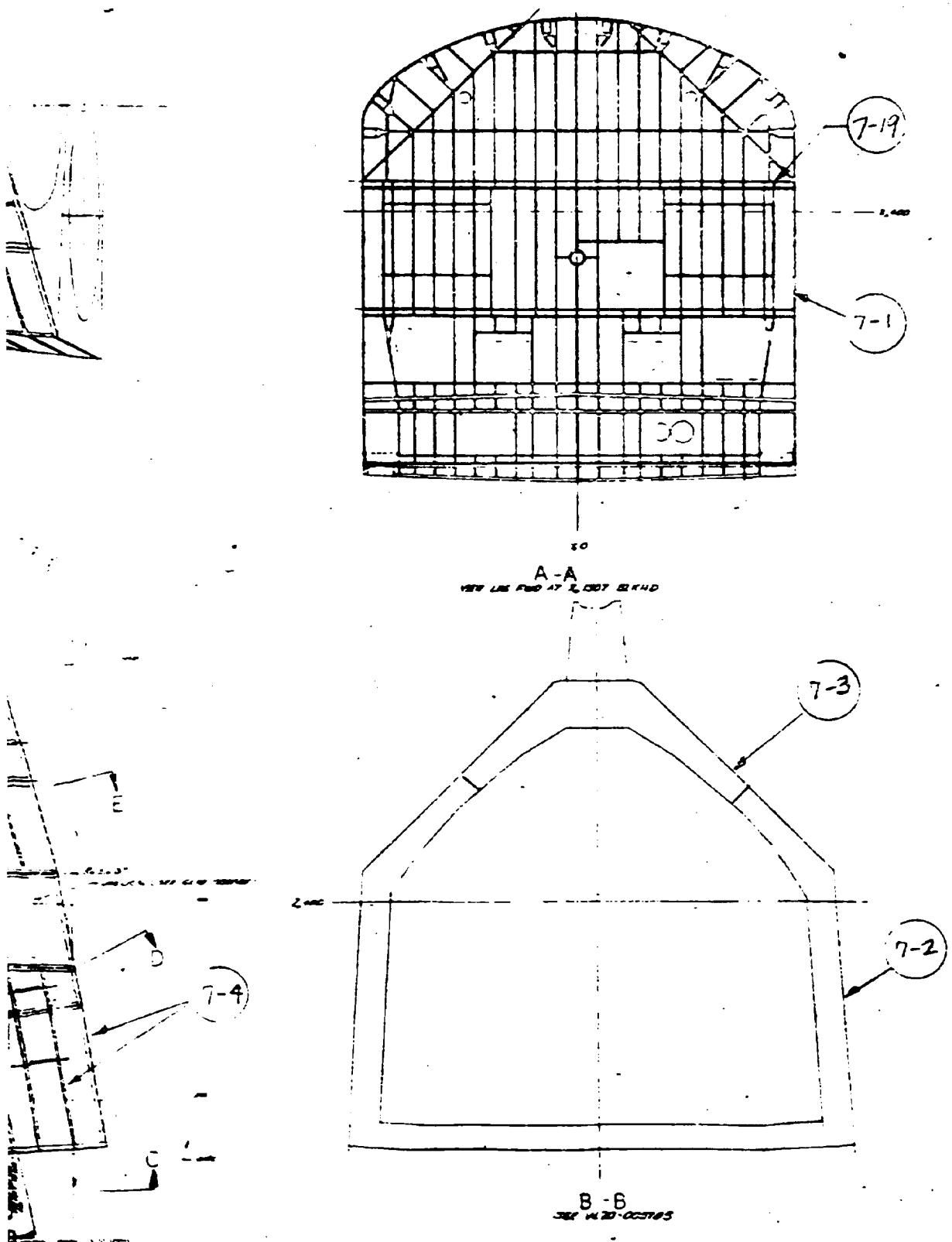
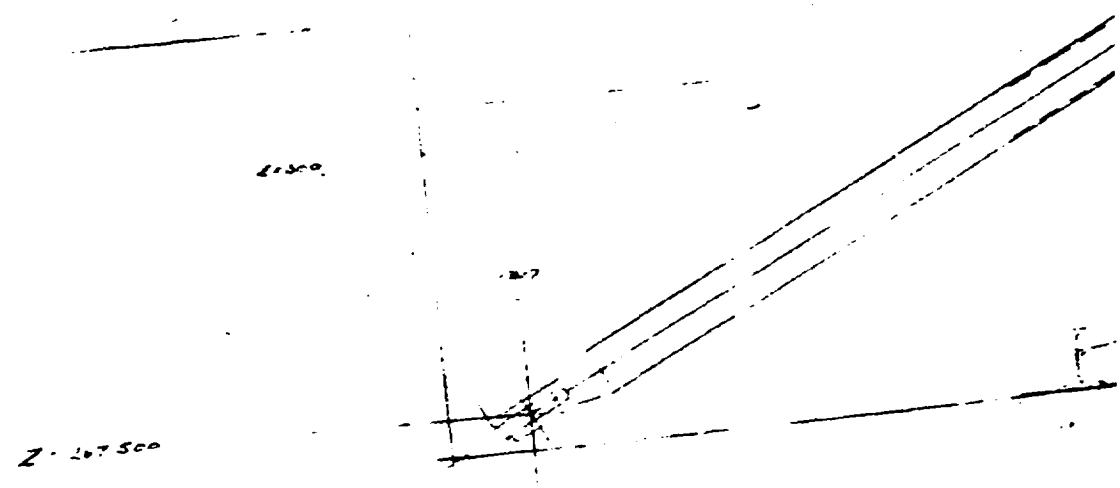
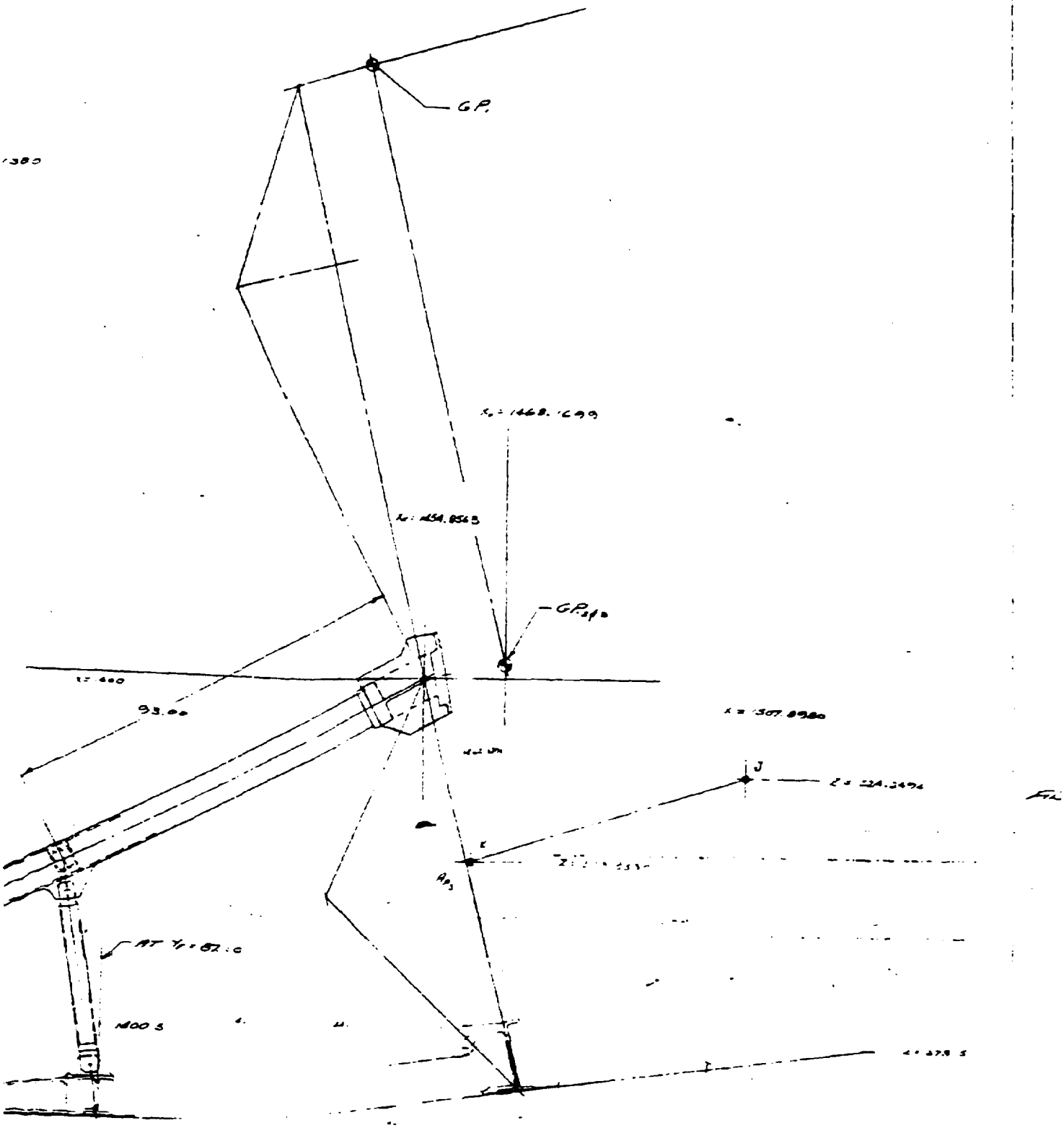
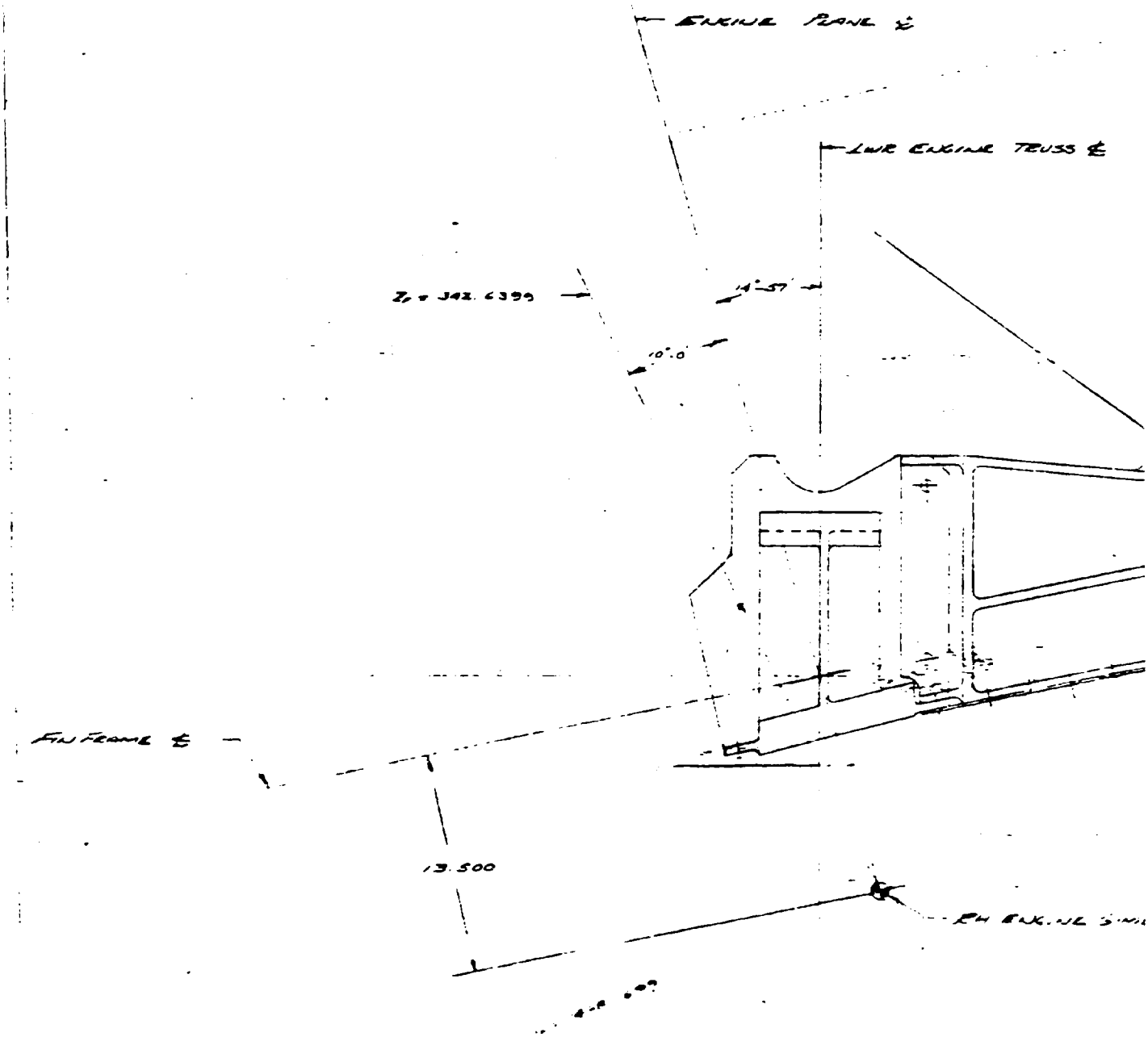


Figure 1.7.1. Aft Fuselage Structural Arrangement

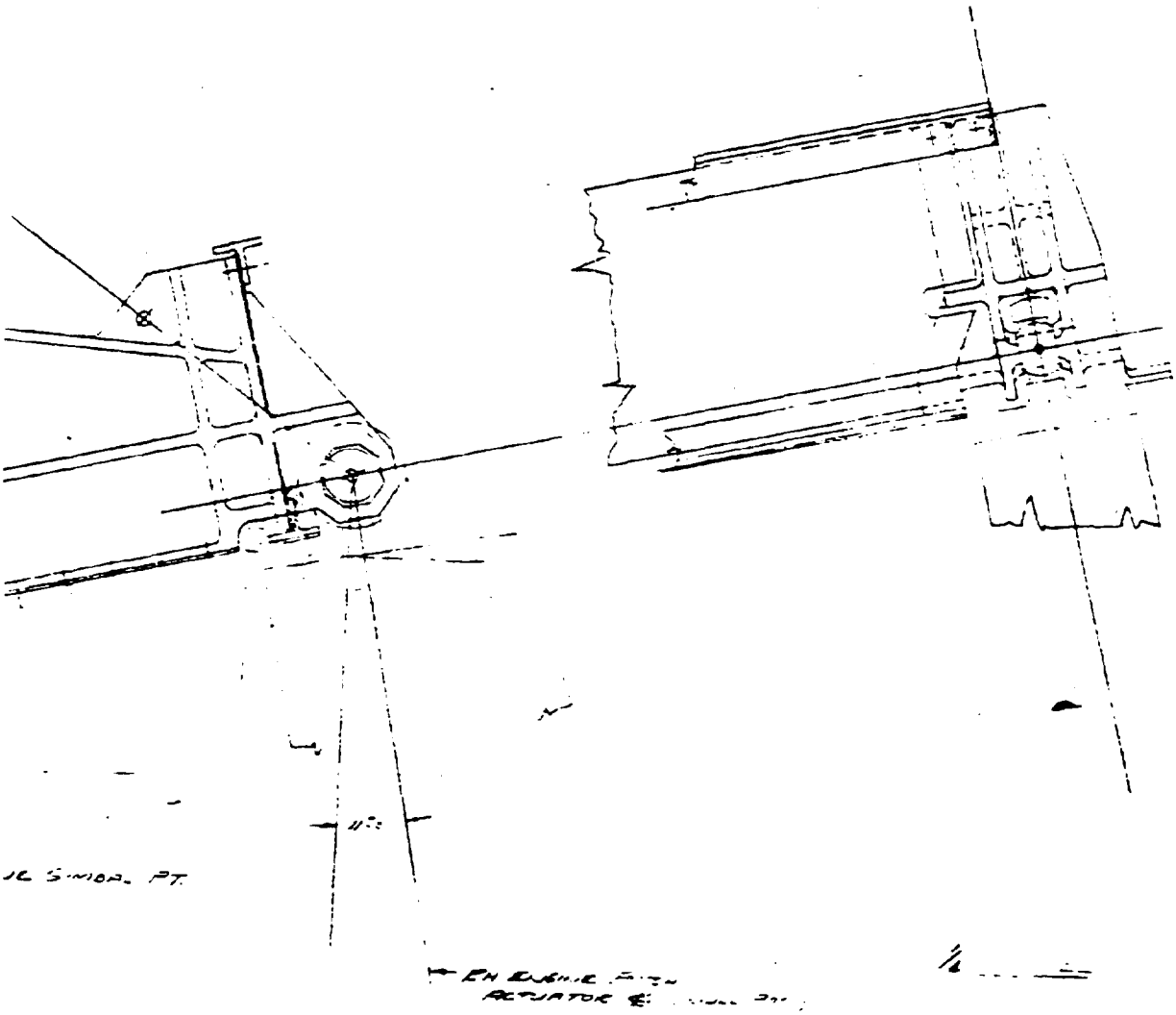




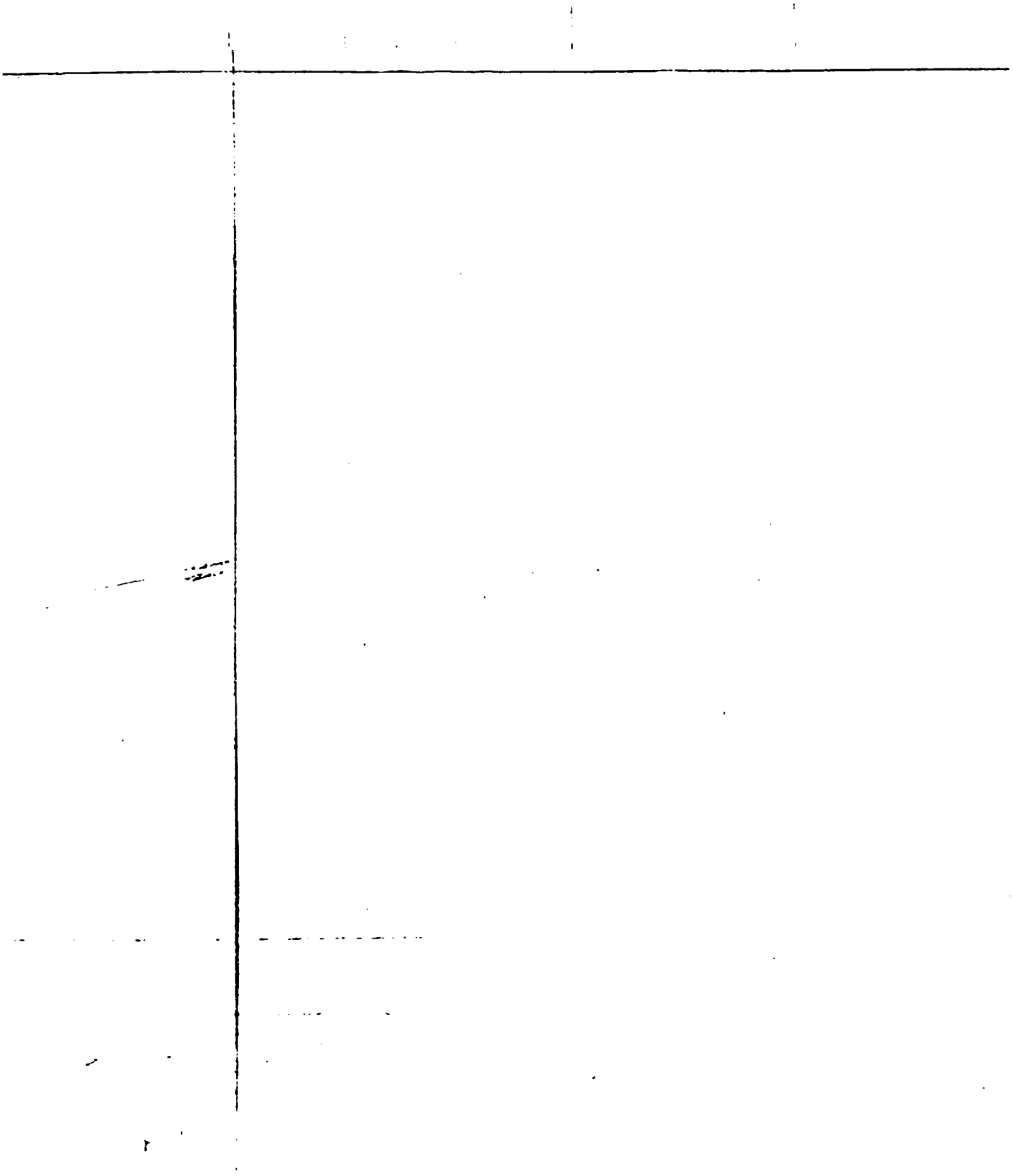
OUT FRAME

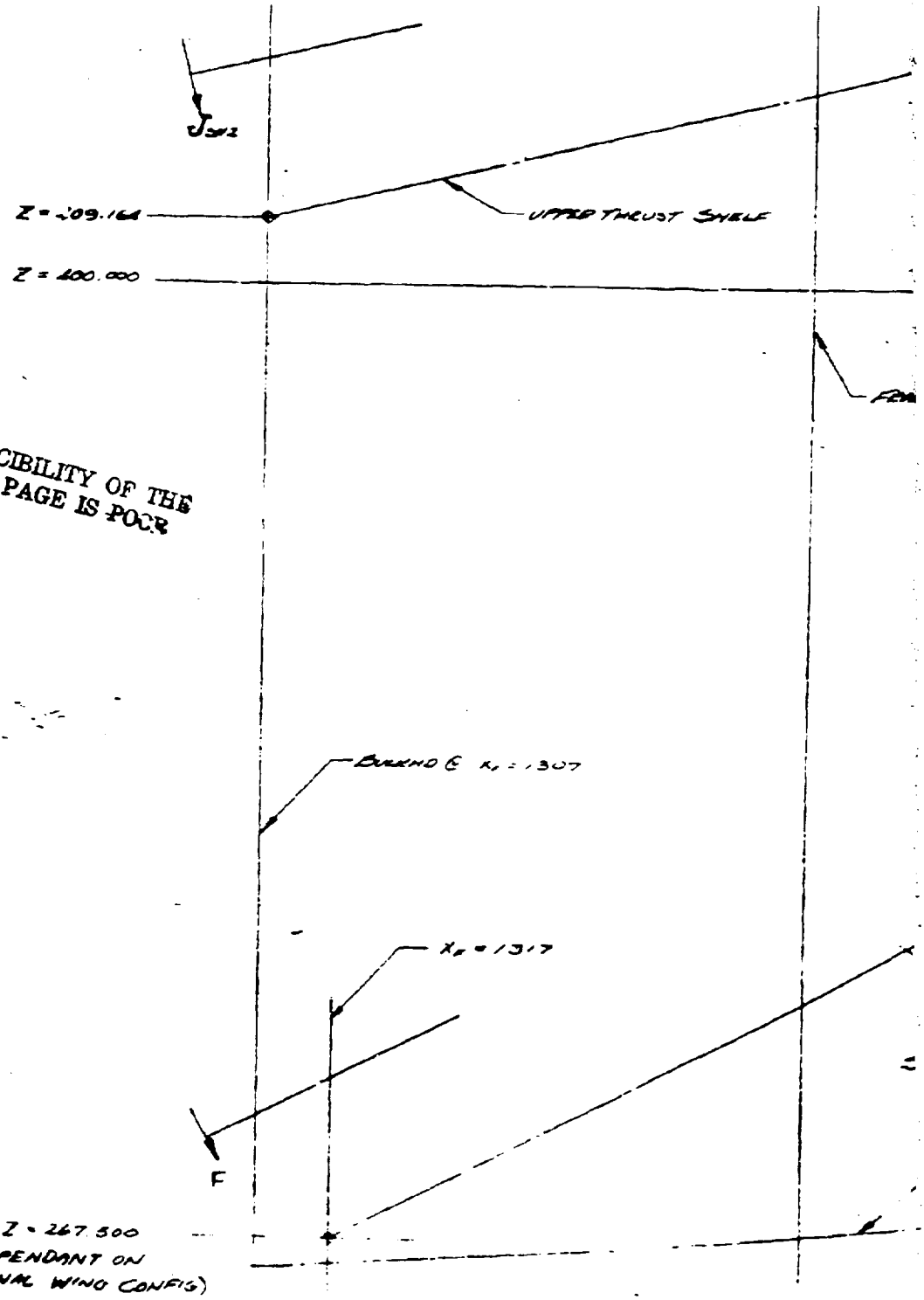

ENGINE PLANE ℄
LWR ENGINE TRUSS ℄
Z = 342.6399
14°-57'
10°.0
FIN FRAME ℄
13.500
RH ENGINE SIMI

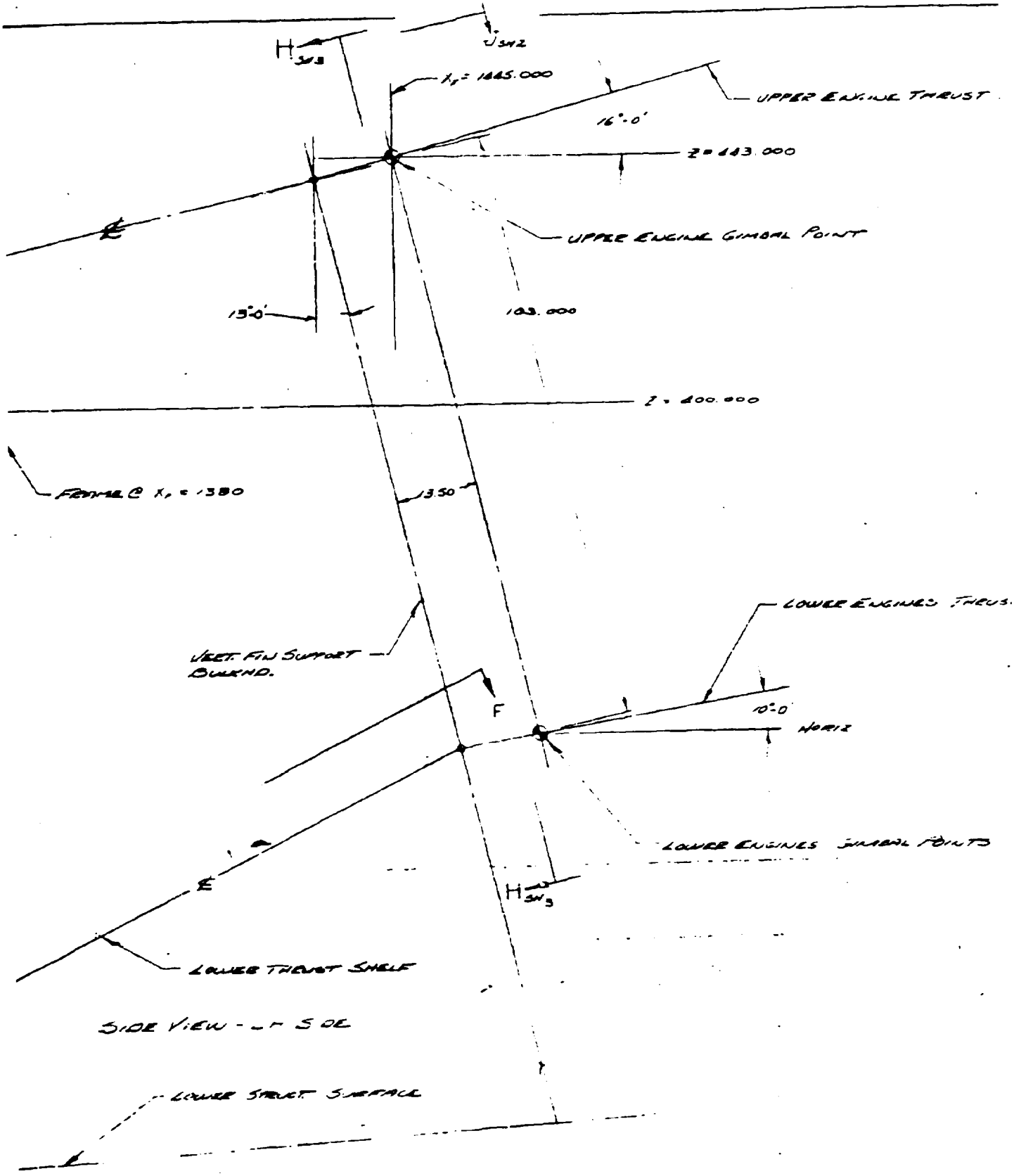
FRAME

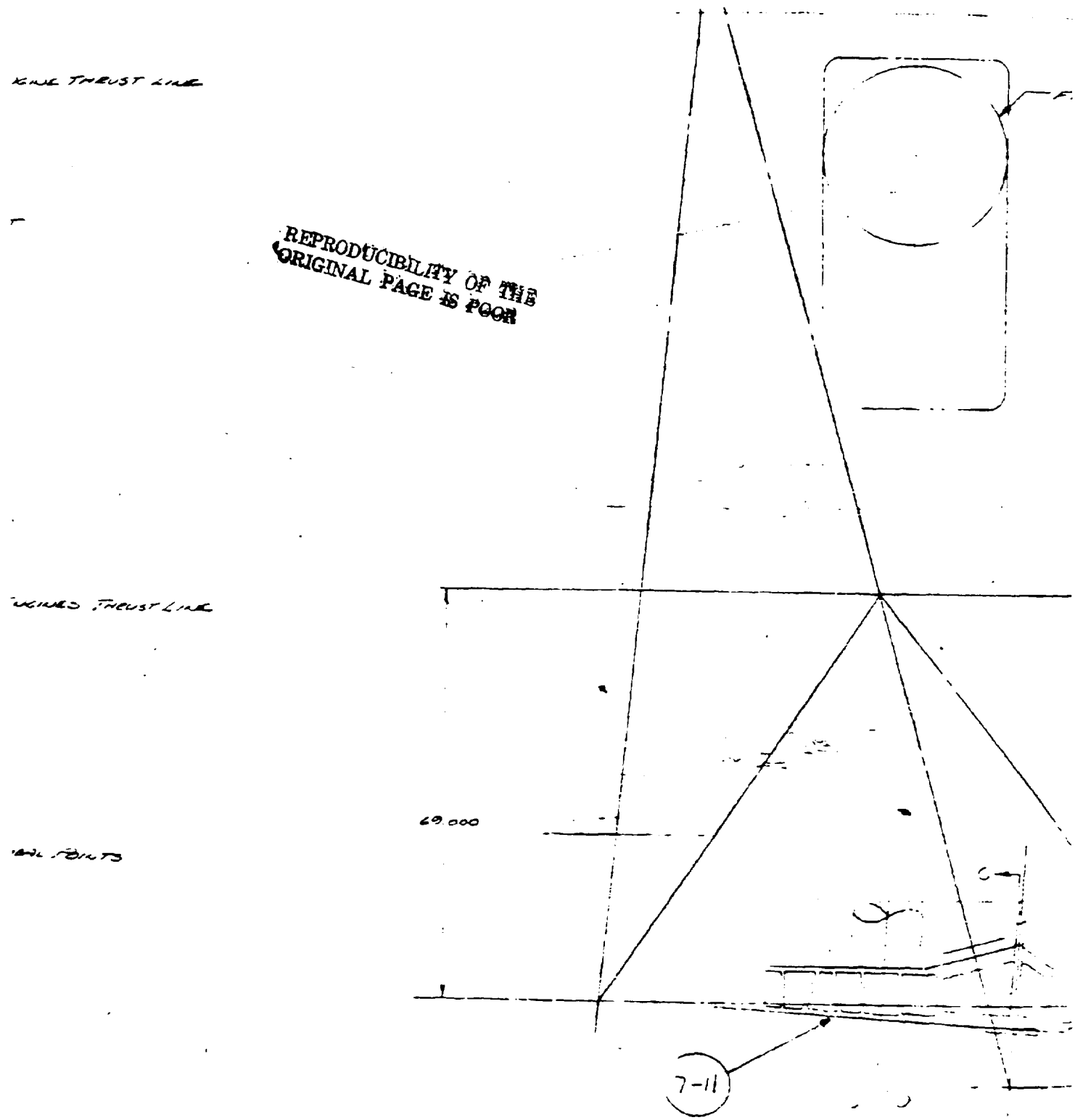


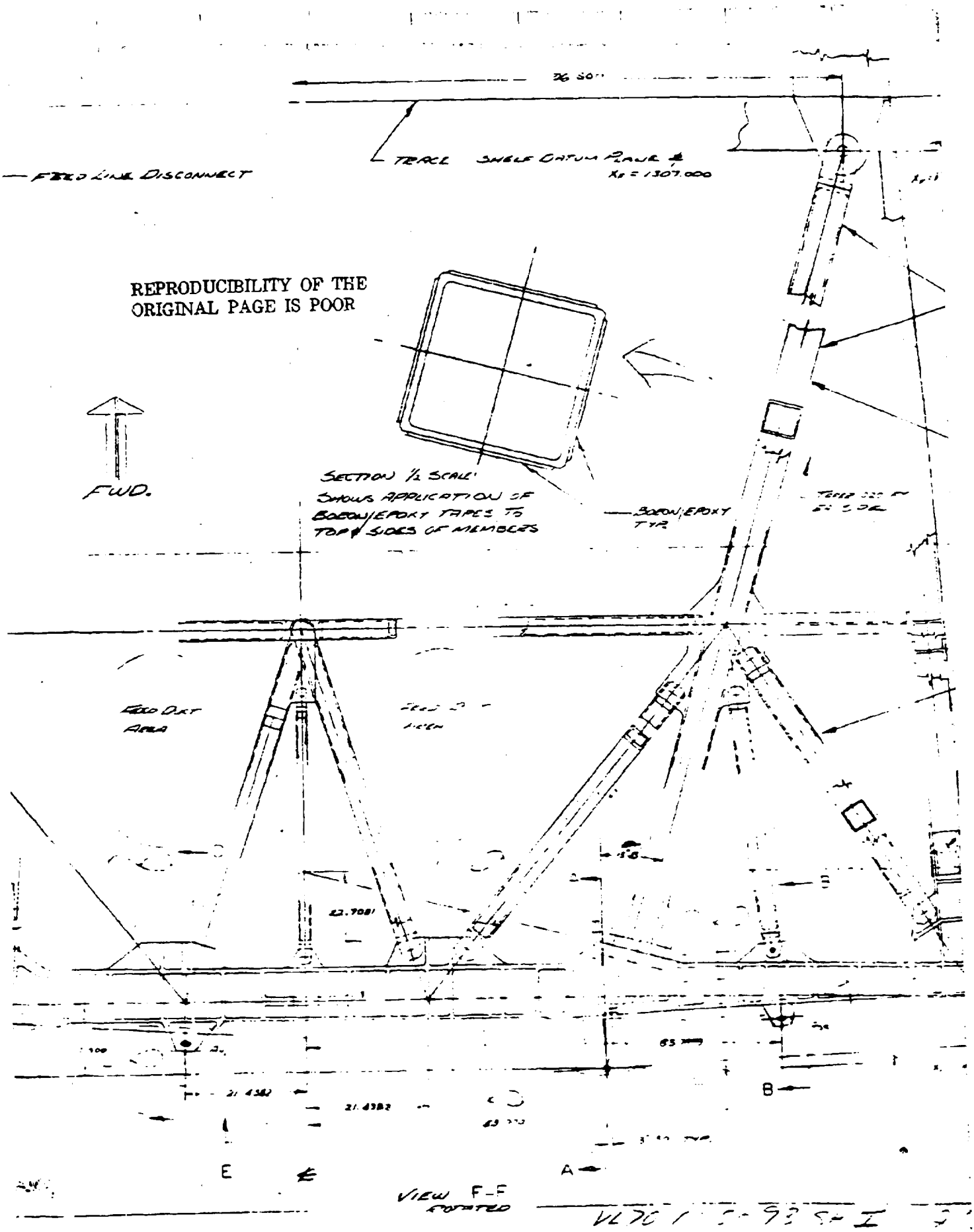
REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

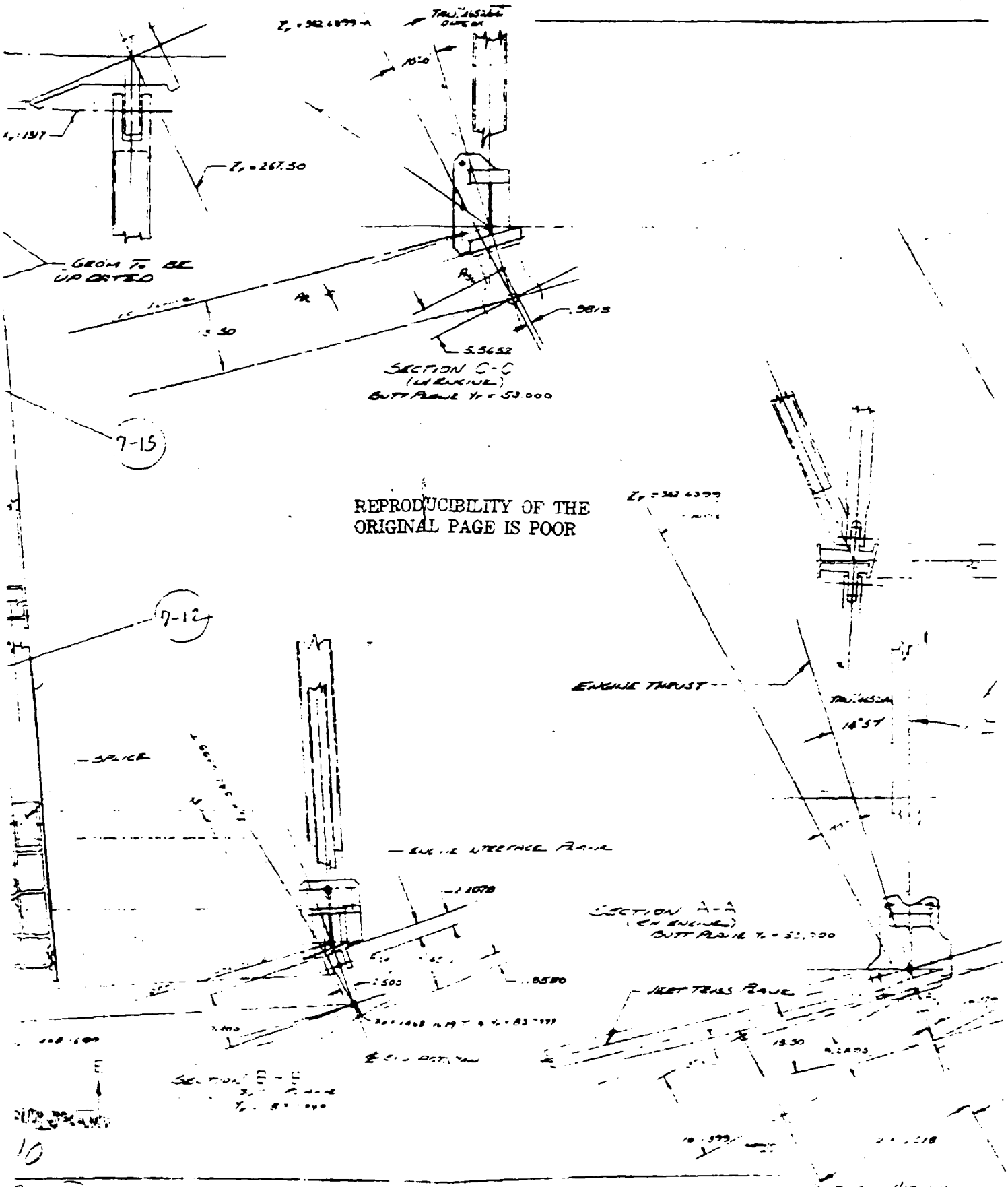


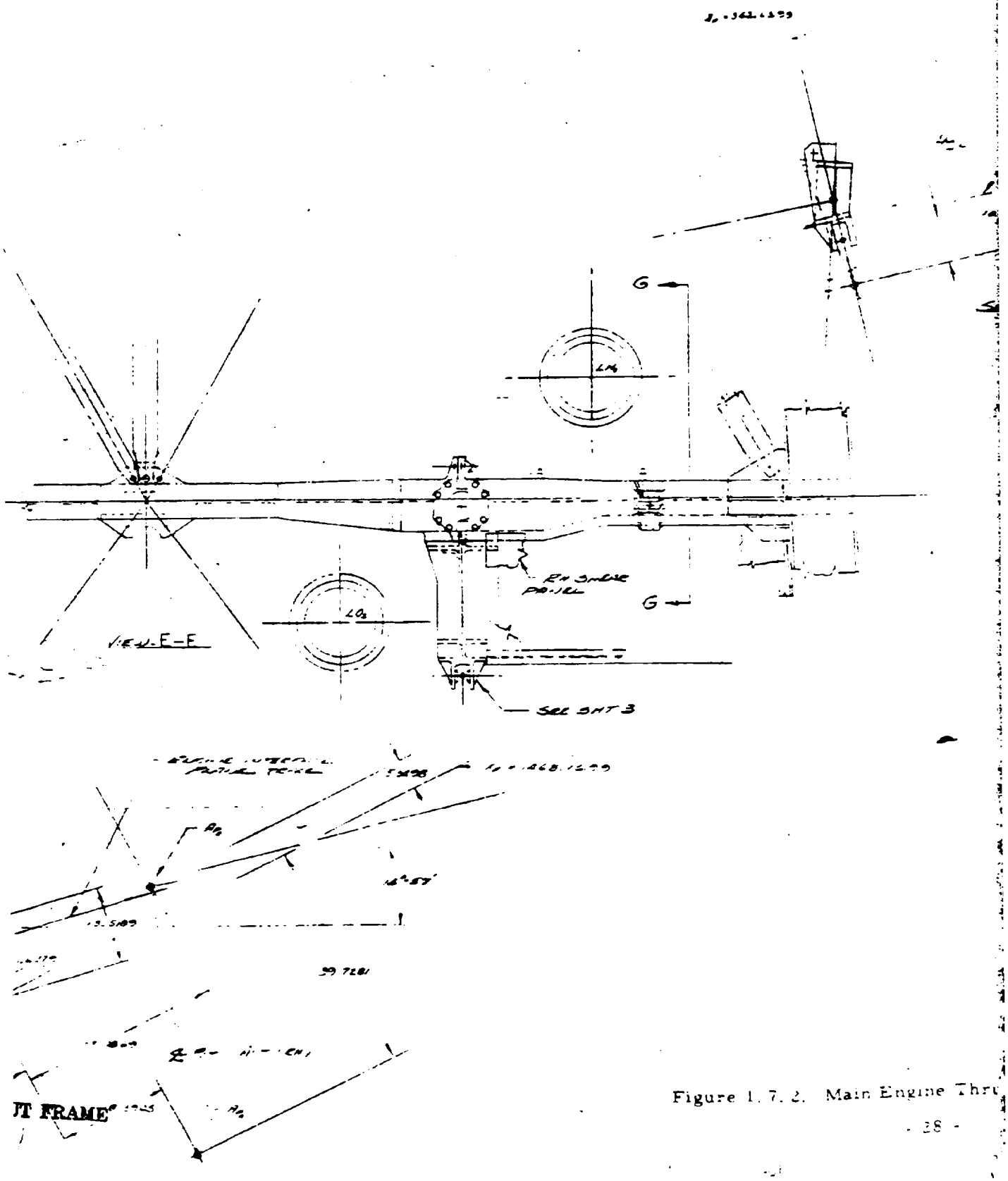



H_{SW3}
J_{SH2}
$X_1 = 1445.000$
UPPER ENGINE THRUST
16°-0'
Z = 443.000
UPPER ENGINE GIMBAL POINT
15°-0'
103.000
Z = 400.000
FRAME @ X_1 = 1380
13.50
LOWER ENGINES THRUS.
VERT. FIN SUPPORT BULKHD.
F
10°-0
HORIZ
LOWER ENGINES GIMBAL POINTS
H_{SW3}
LOWER THRUST SHELF
SIDE VIEW - LH SIDE
LOWER STRUCT. SURFACE



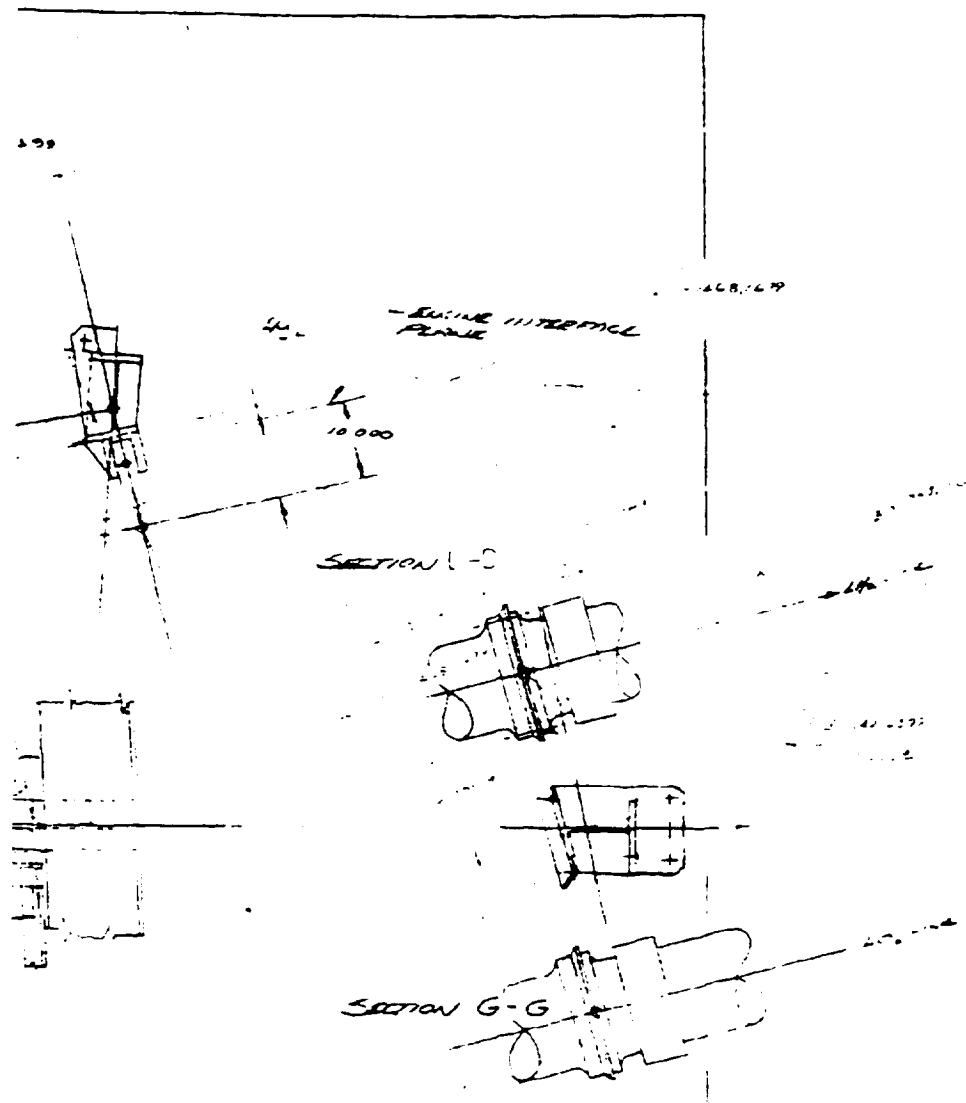



GROM TO BE UPDATED
SECTION C-C
(LH ENGINE)
BUTT PLANE Y_T = 53.000
7-15
REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR
7-12
ENGINE THRUST
SPLICE
ENGINE INTERFACE PLANE
SECTION A-A
(RH ENGINE)
BUTT PLANE Y_T = 53.000
KEEL TRUSS PLANE



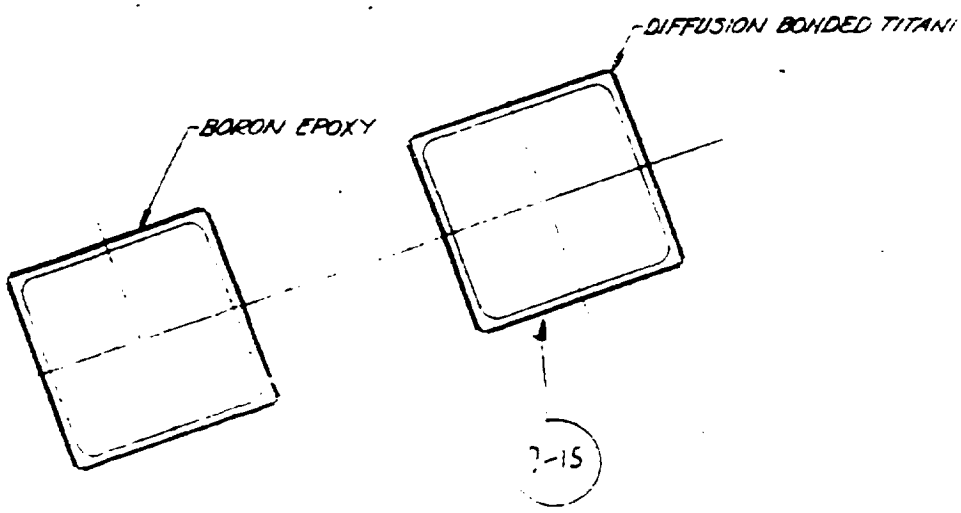
JT FRAME

Figure 1.7.2. Main Engine Thru

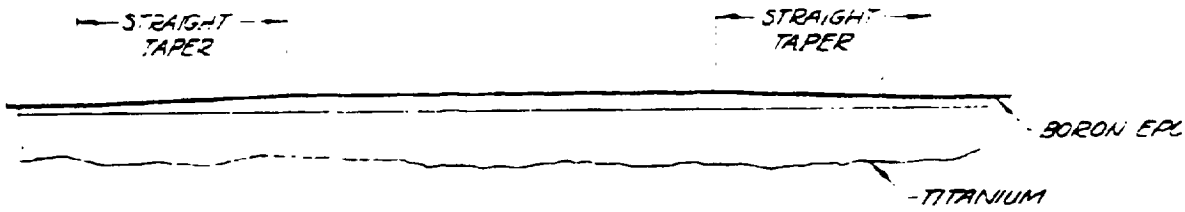


FOLDOUT FRAME

. 2. Main Engine Thrust Support Structure



SECT B - B
SCALE 1/2

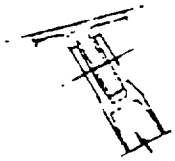


SECT C-C (ROTATED 5)
SCALE 1/2

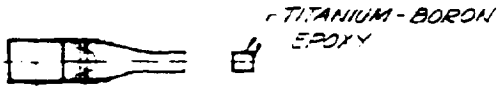
REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

AME

TANIUM

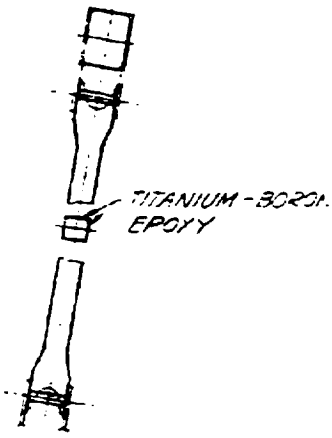


VIEW A-A

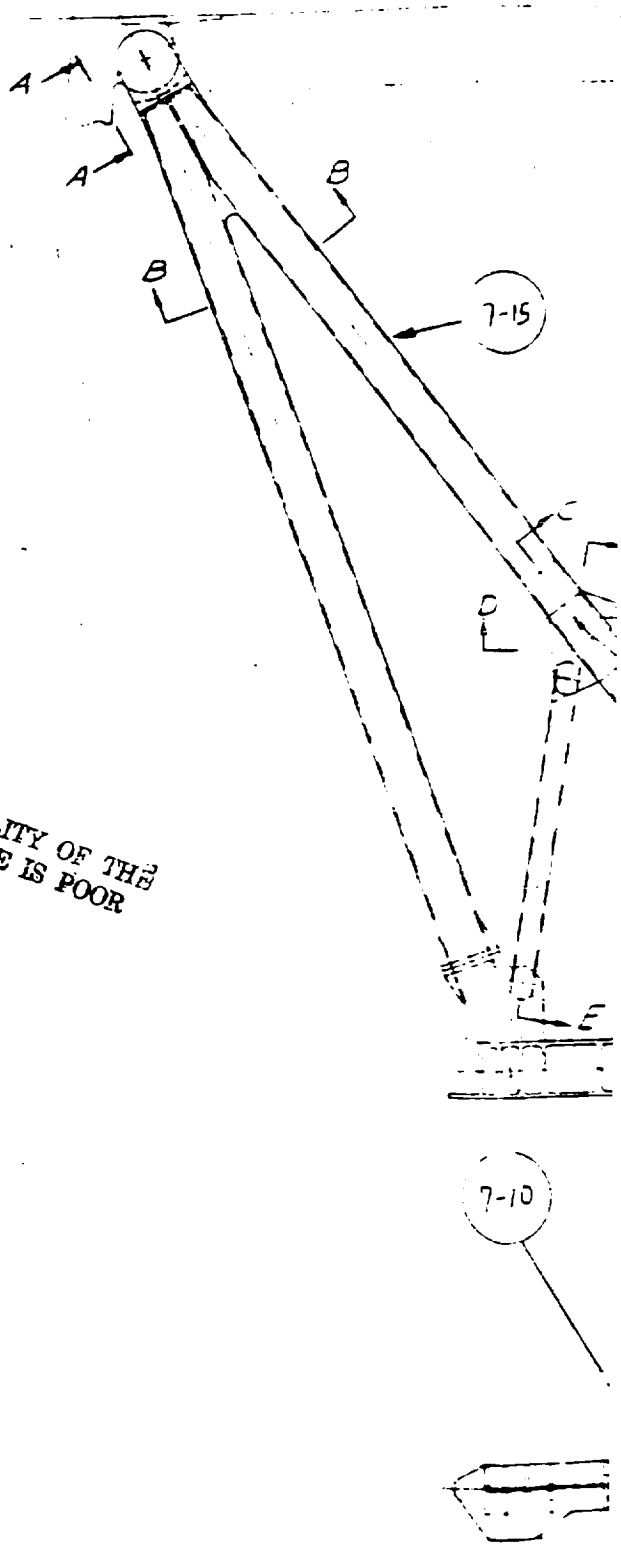


SECT D-D

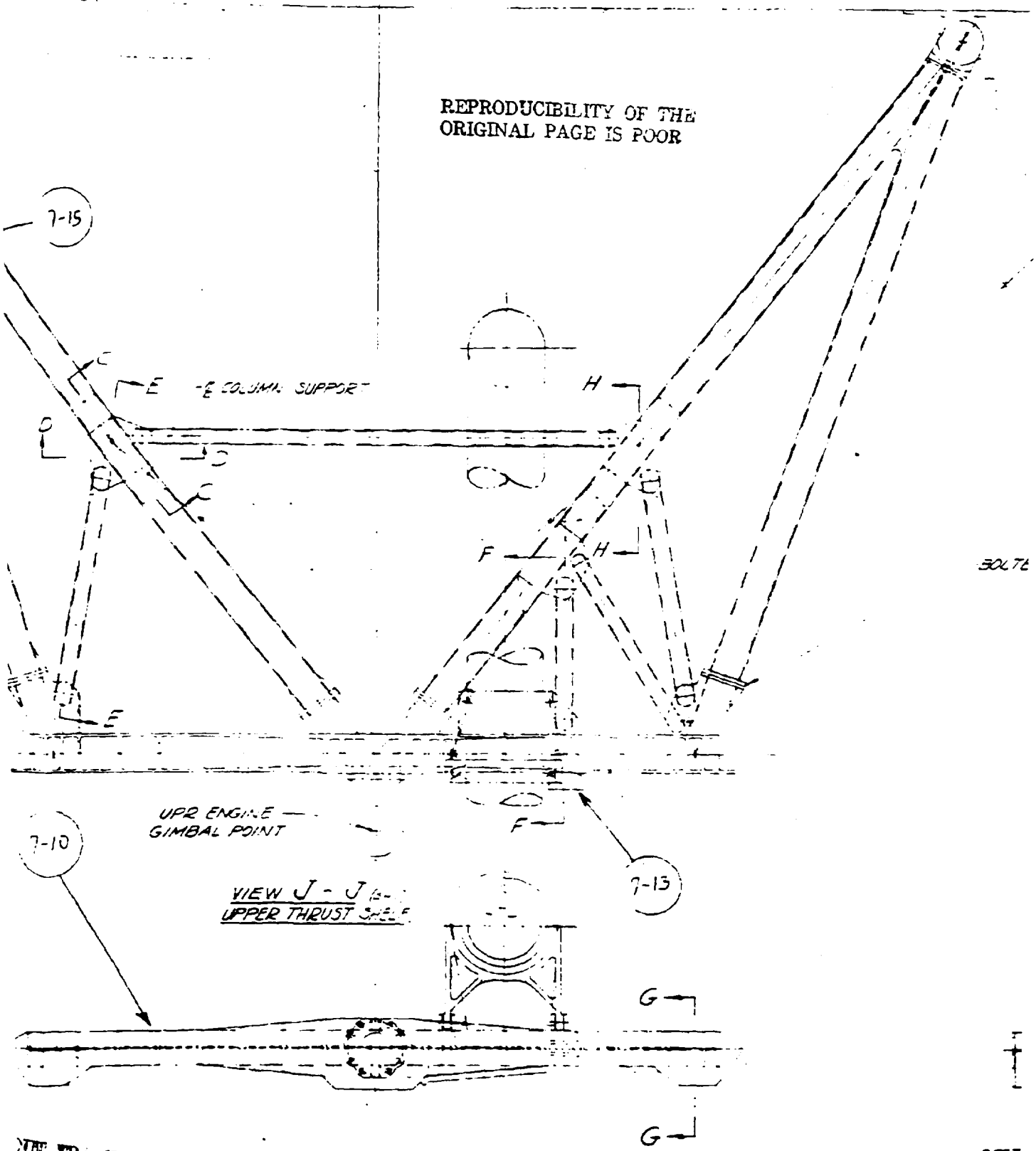
EPOXY

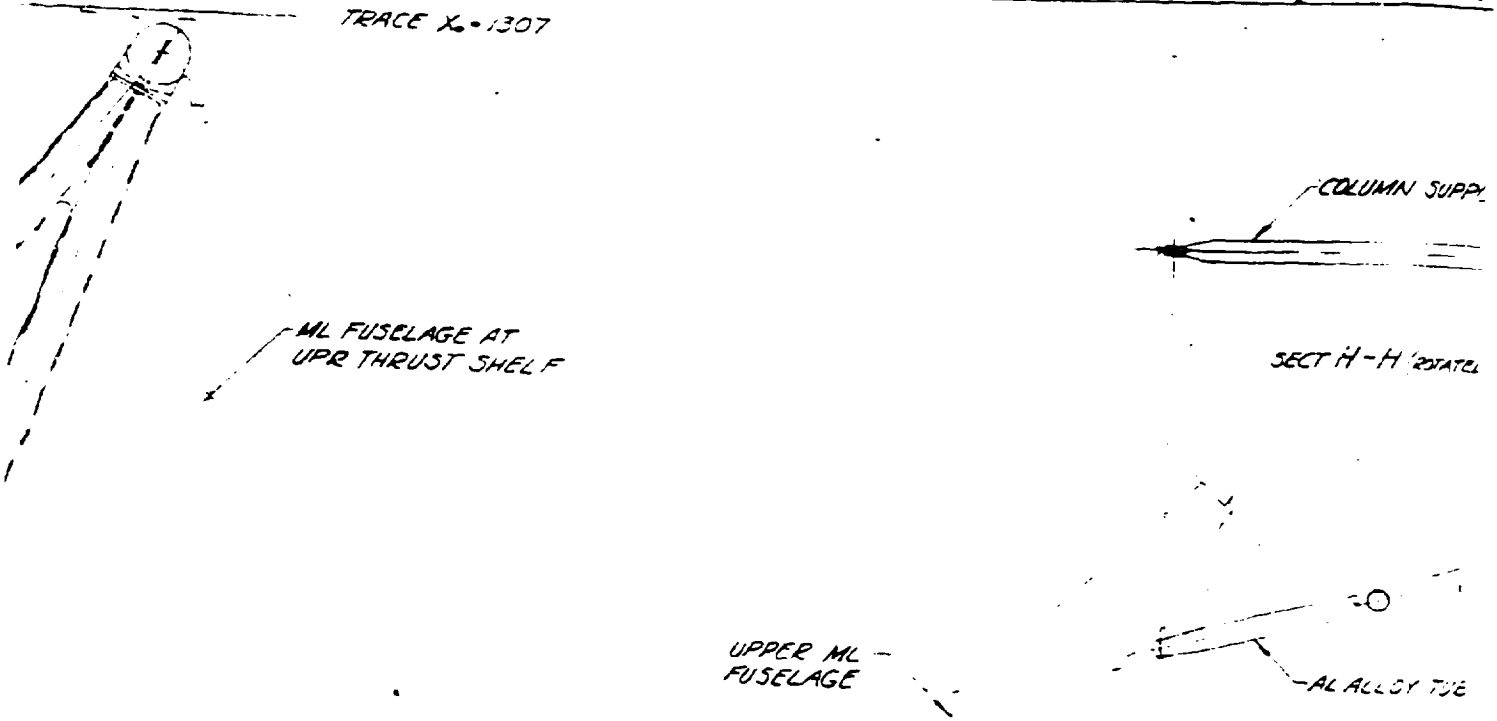


SECT E-E



T FRAME




TRACE X₀ = 1307
F
COLUMN SUPP
ML FUSELAGE AT
UPR THRUST SHELF
SECT H-H (ROTATED
UPPER ML
FUSELAGE
AL ALLOY TUBE
BOLTED FLANGES
BORON EPOXY
TUBES
SECT F-F
SECT G-G

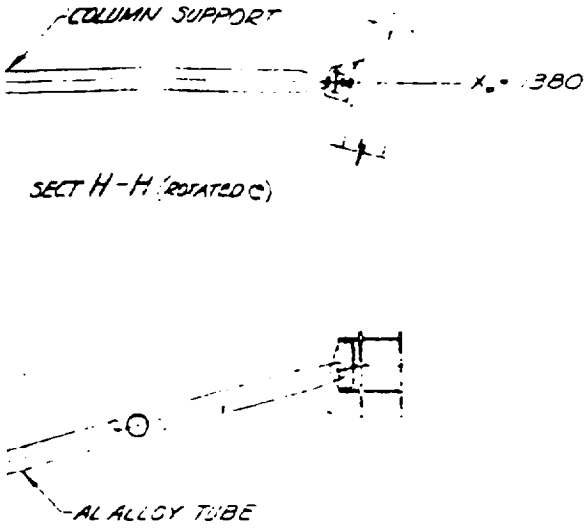
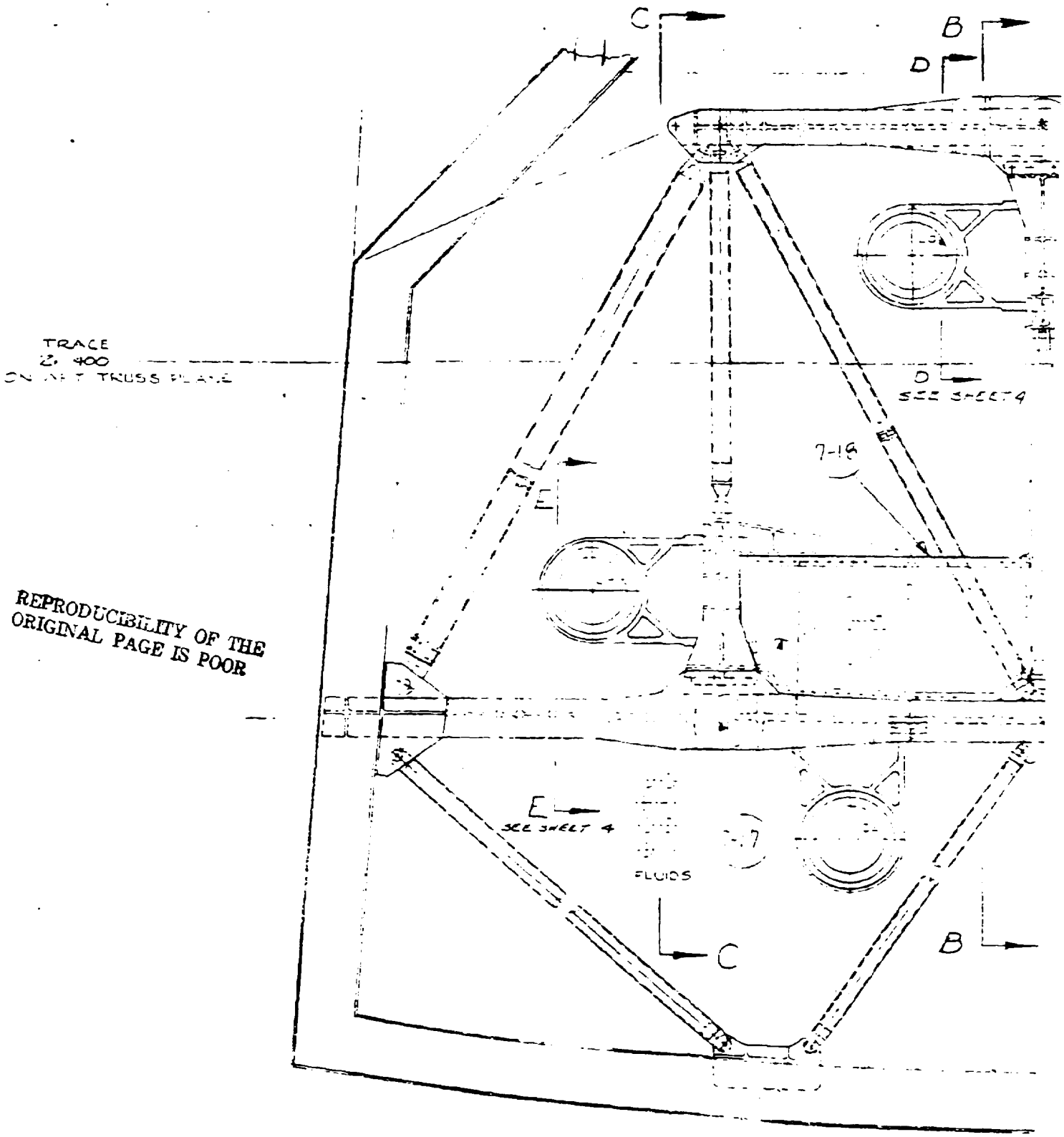
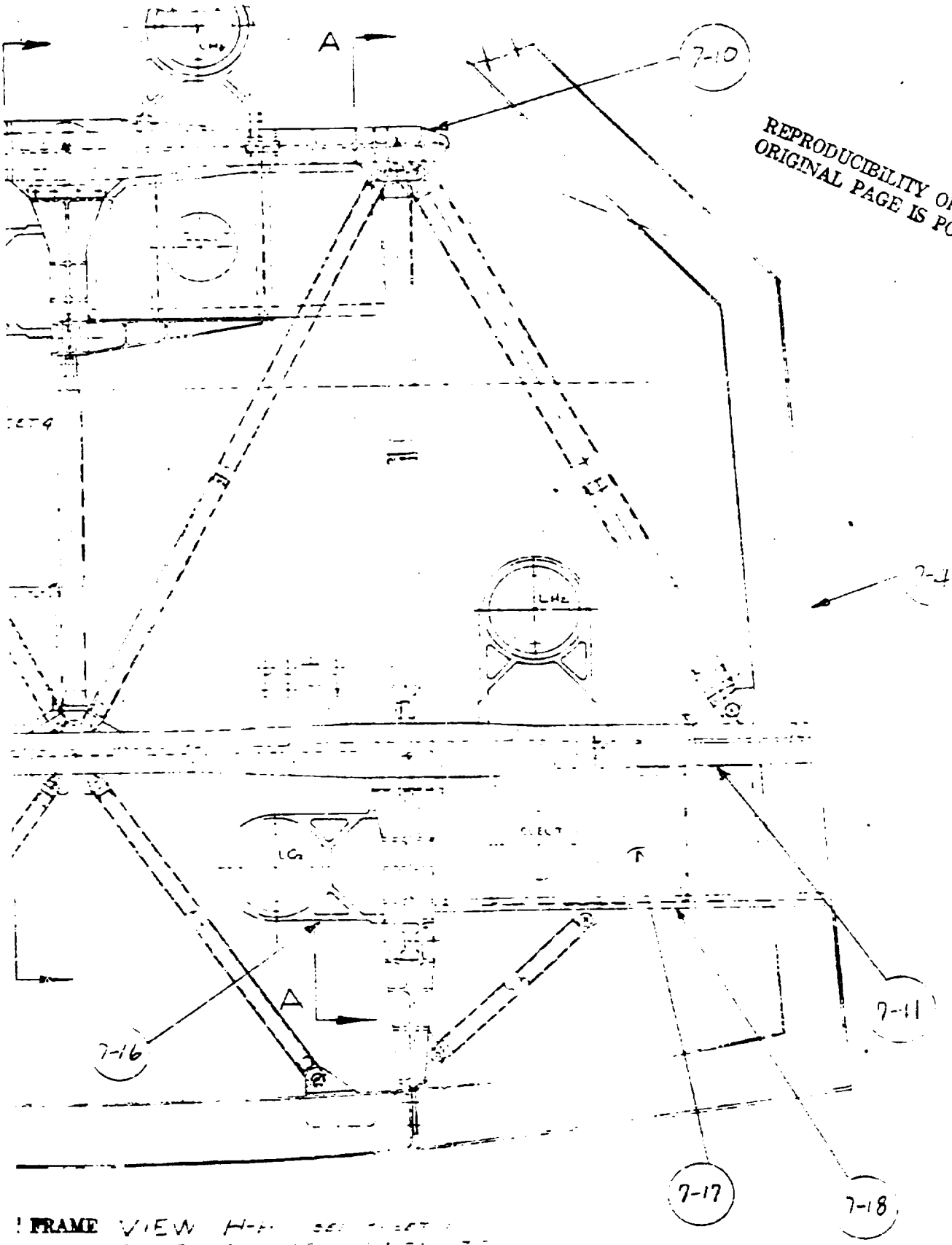


Figure 1. 7. 3. Main Engine Thrust Support Structure



VL 70-005093 SH. 3 3 of 3



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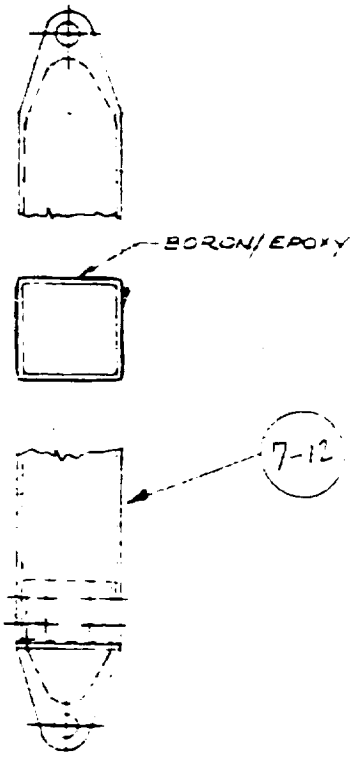
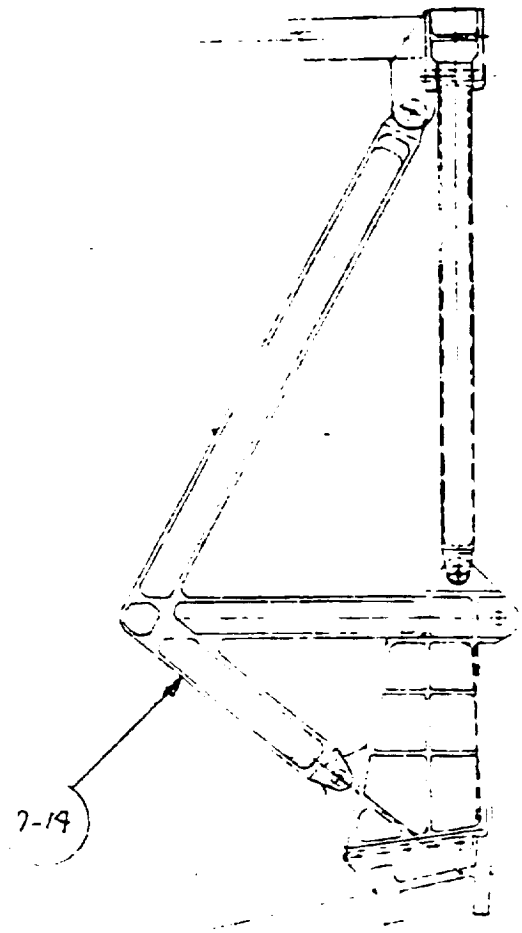


7-4

TYPICAL TRUSS MEMBER
GALVANIC DIFFUSION BONDED
TITANIUM BORON/EPOXY
TAPES APPLIED TO 2 TER
SURFACES. ONE END FITT
MECHANICALLY FASTENED
SCALE 1/4



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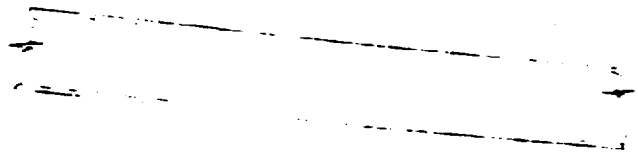

SECTION C-C

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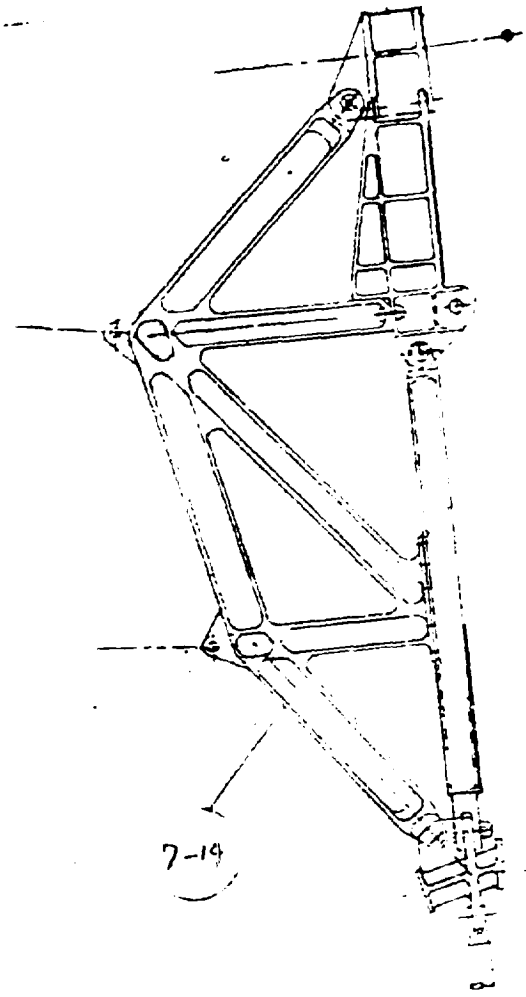
3

VL70-C-5593 SH. 3

2 (A)



7-14

SECTION B-E

BOLT OUT FRAME

C-C 4

2 @ 3

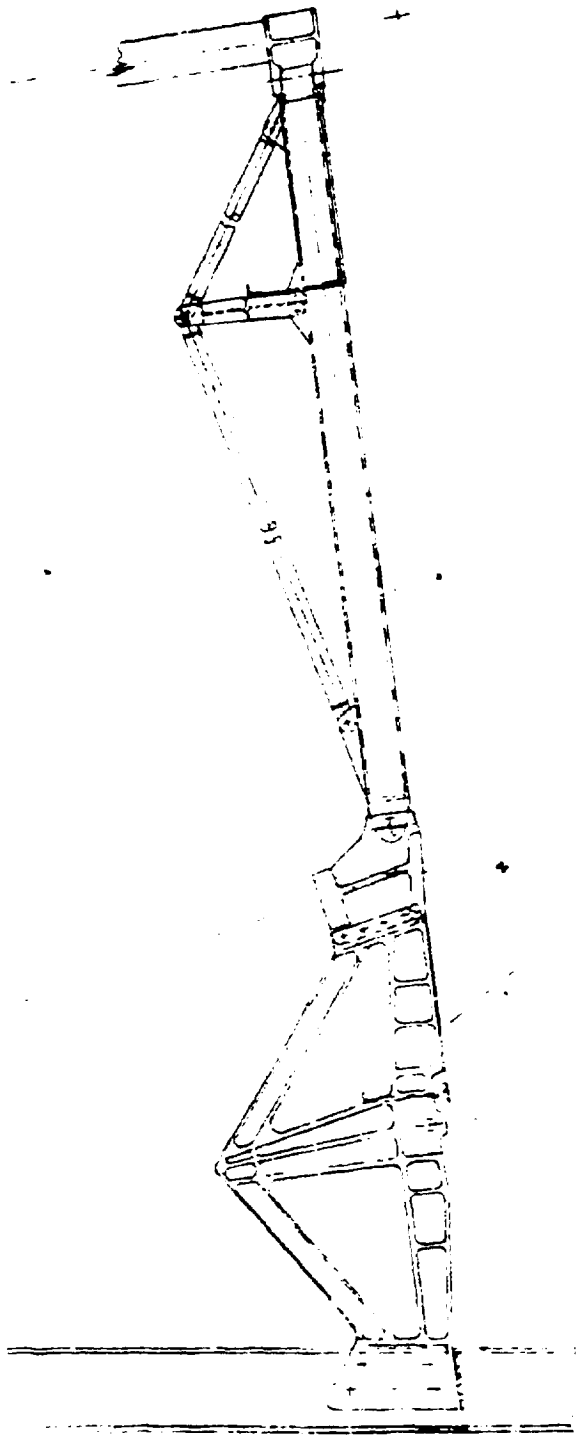
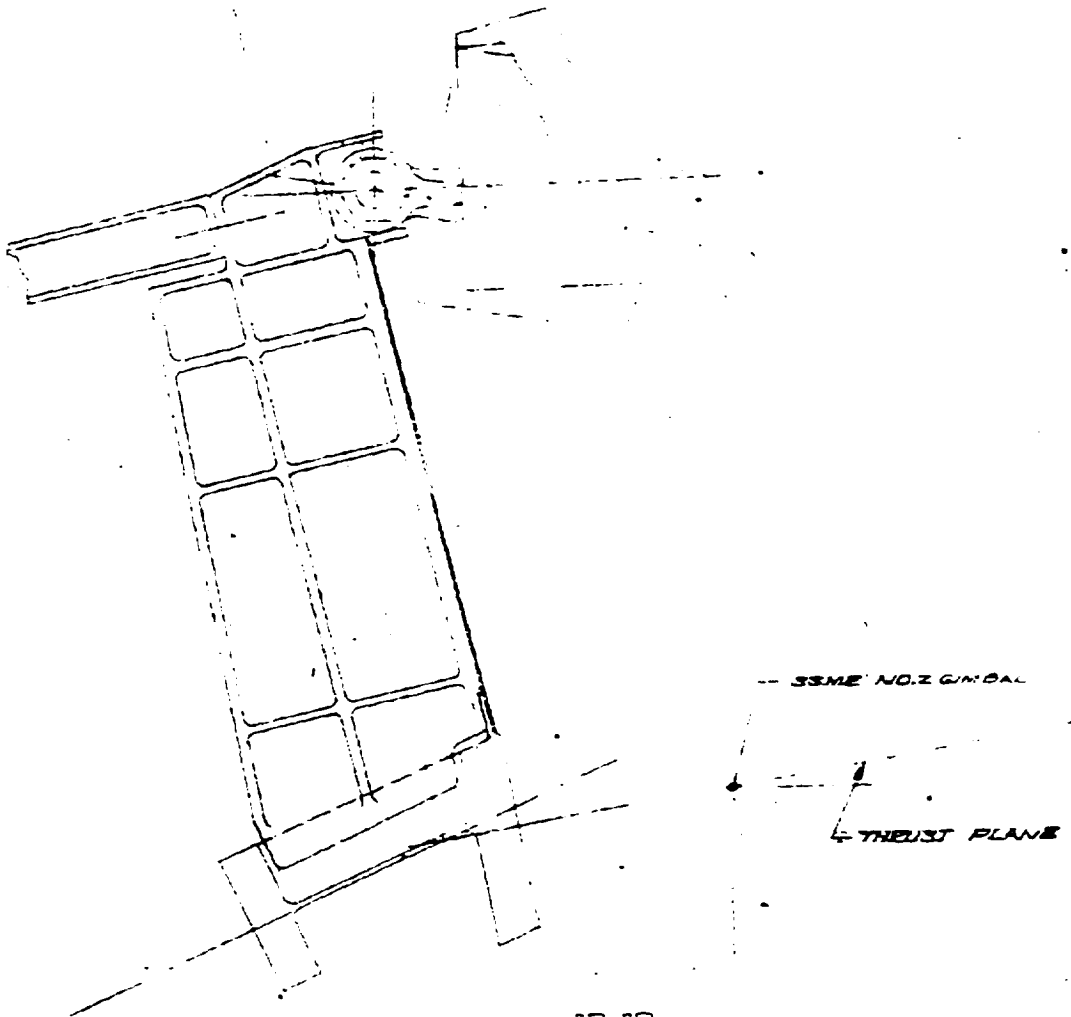
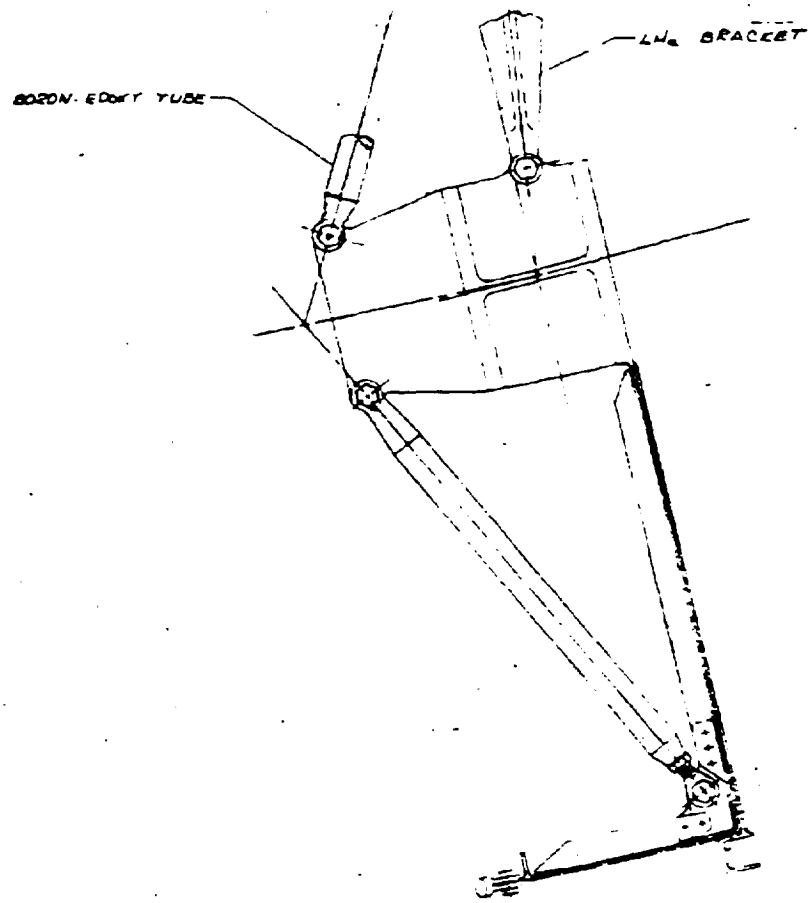


Figure 1.7.4. Main Engine Thrust Support S



SECTION LOOKING SHT 3 SCALE: 1/4
VIEW LKG INBD AT PITCH ACTUATOR & INLET
STRUCTURE FOR SSME NO 2 (LWR LH)

VL70-005093 SH. 4. 3 M 3



SECTION B-B SCALE: 1/2

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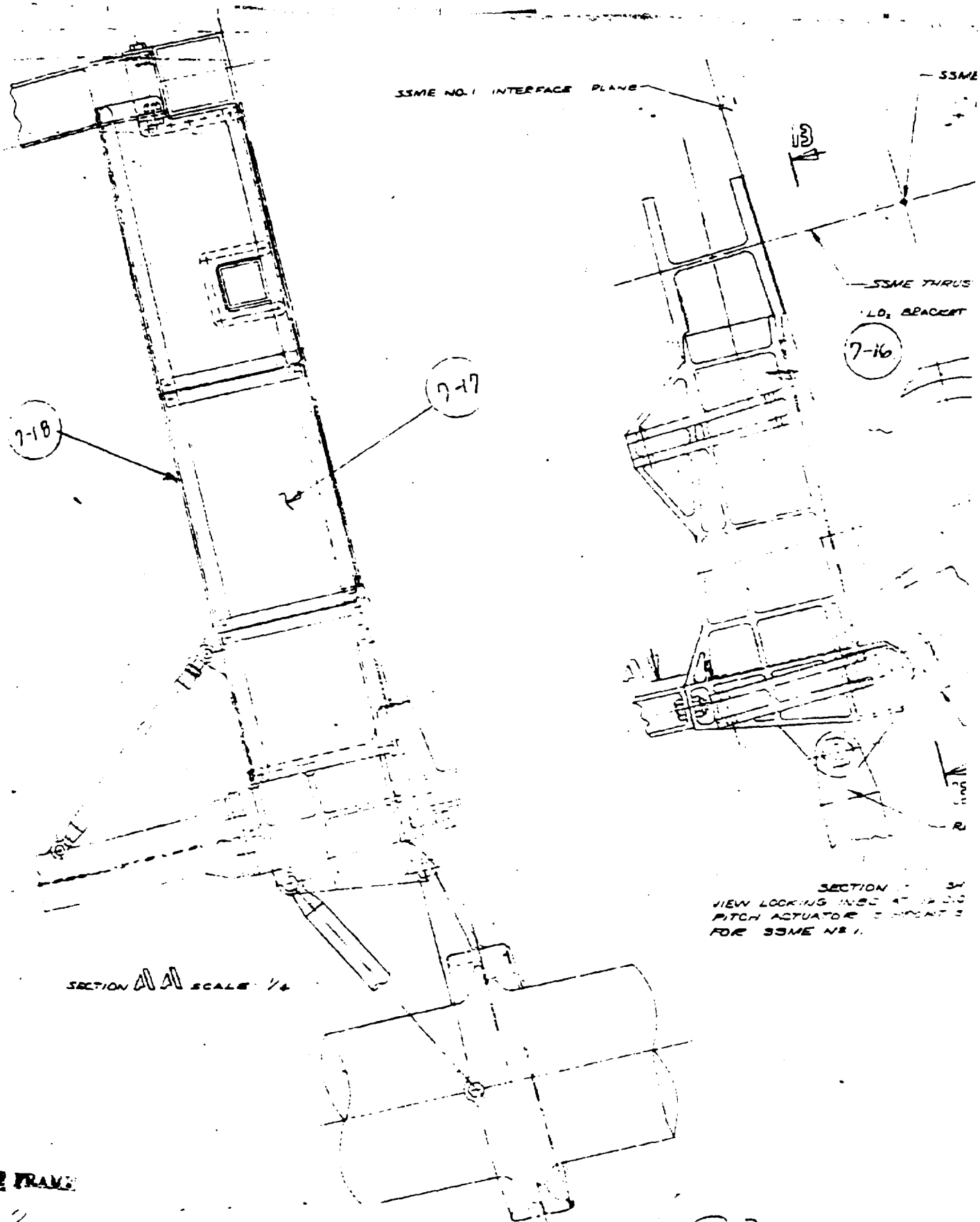
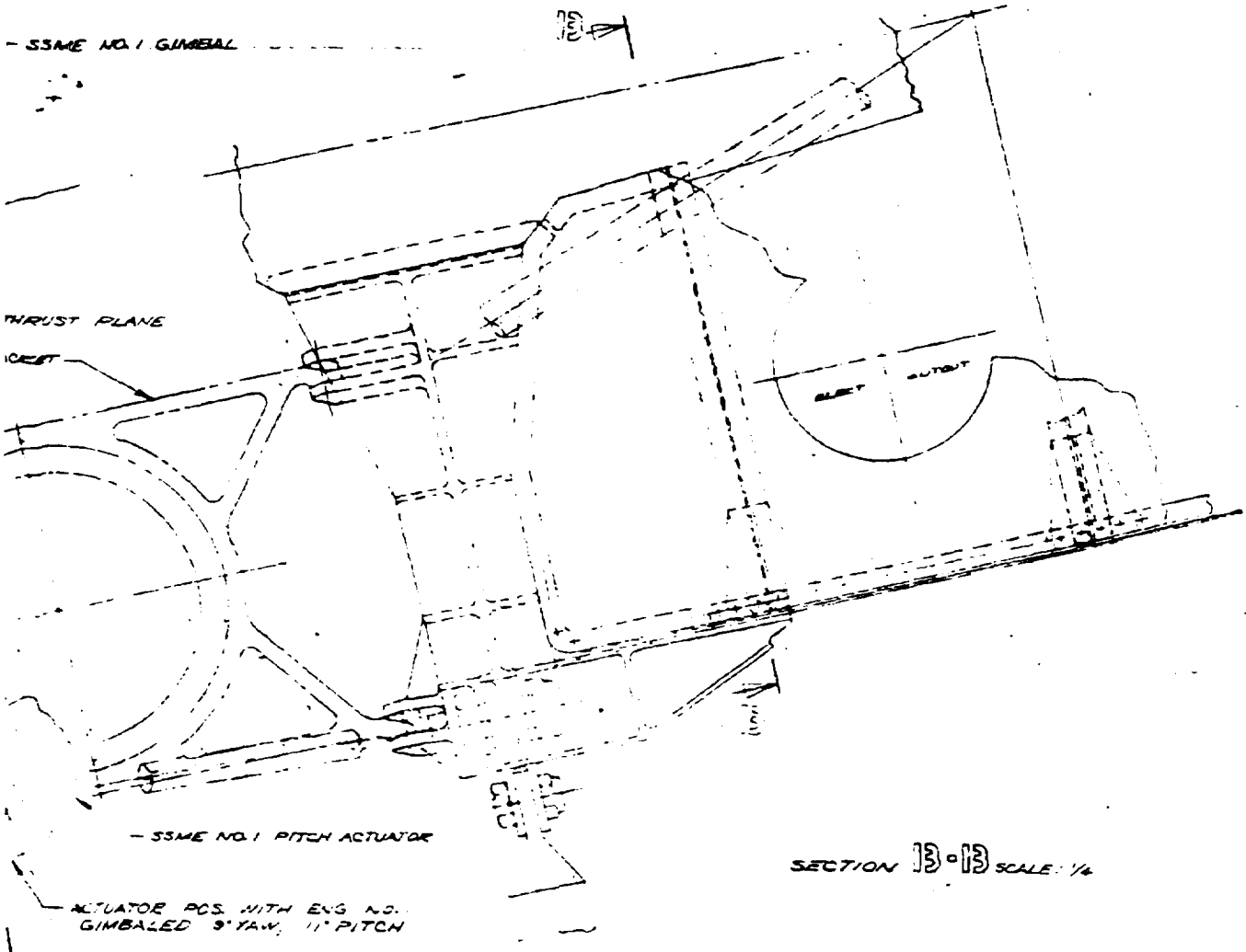


VL70-005093 SH. 4

2 3 1

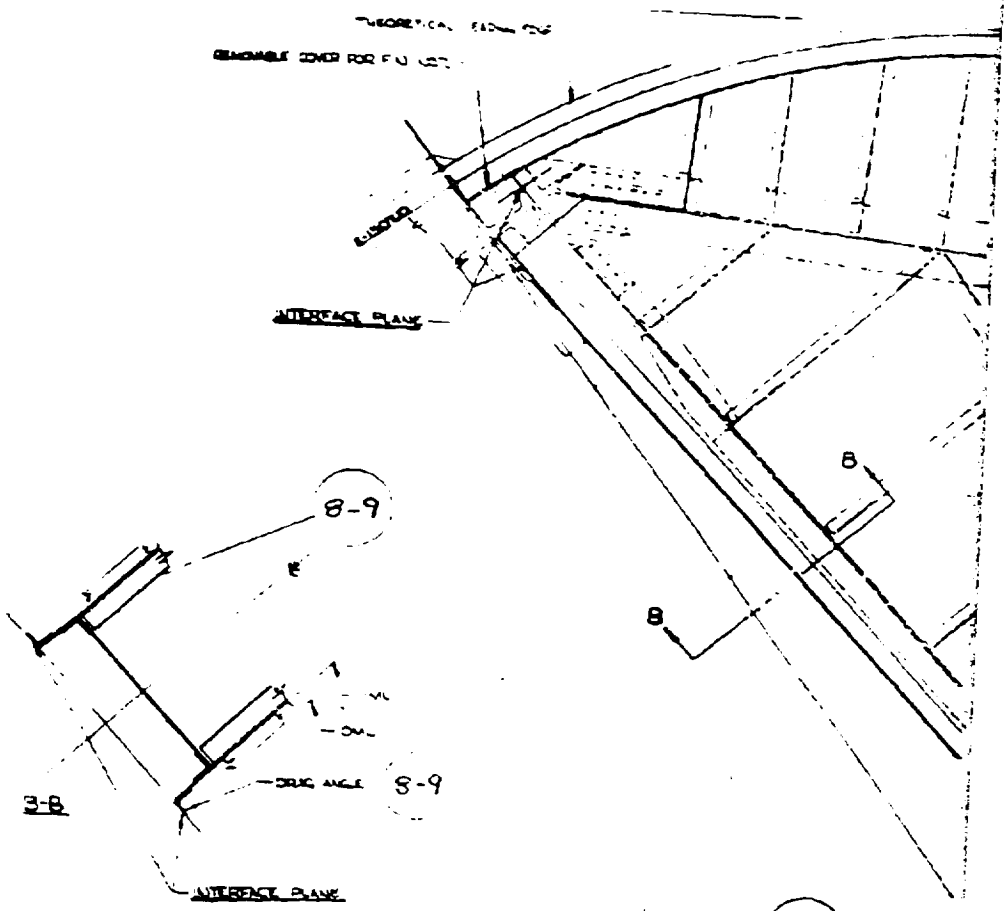


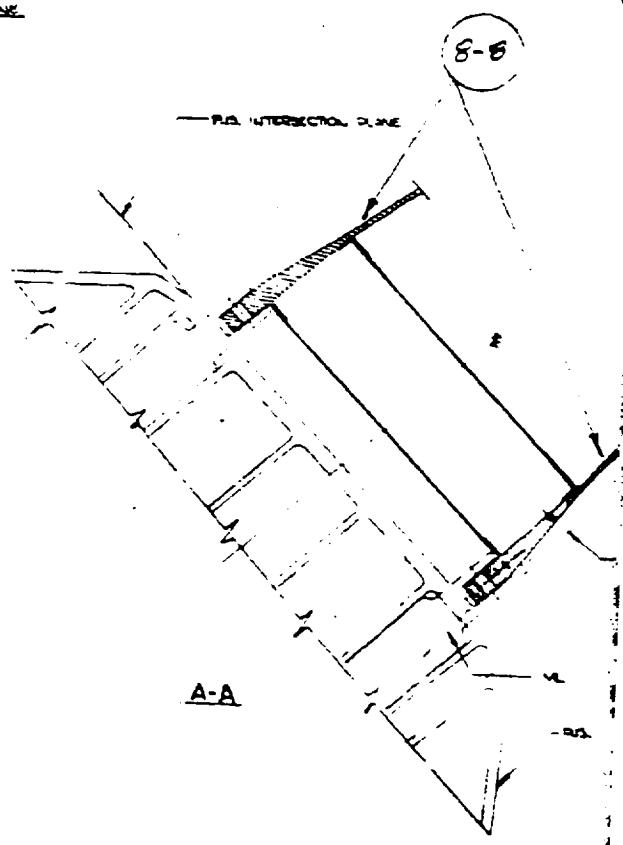
SECTION 13-13 SCALE: 1/4

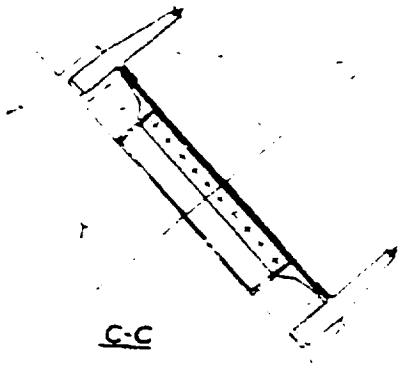
SHT 3 SCALE: 1/4
DO THRUST
T STRUCTURE

FRAME

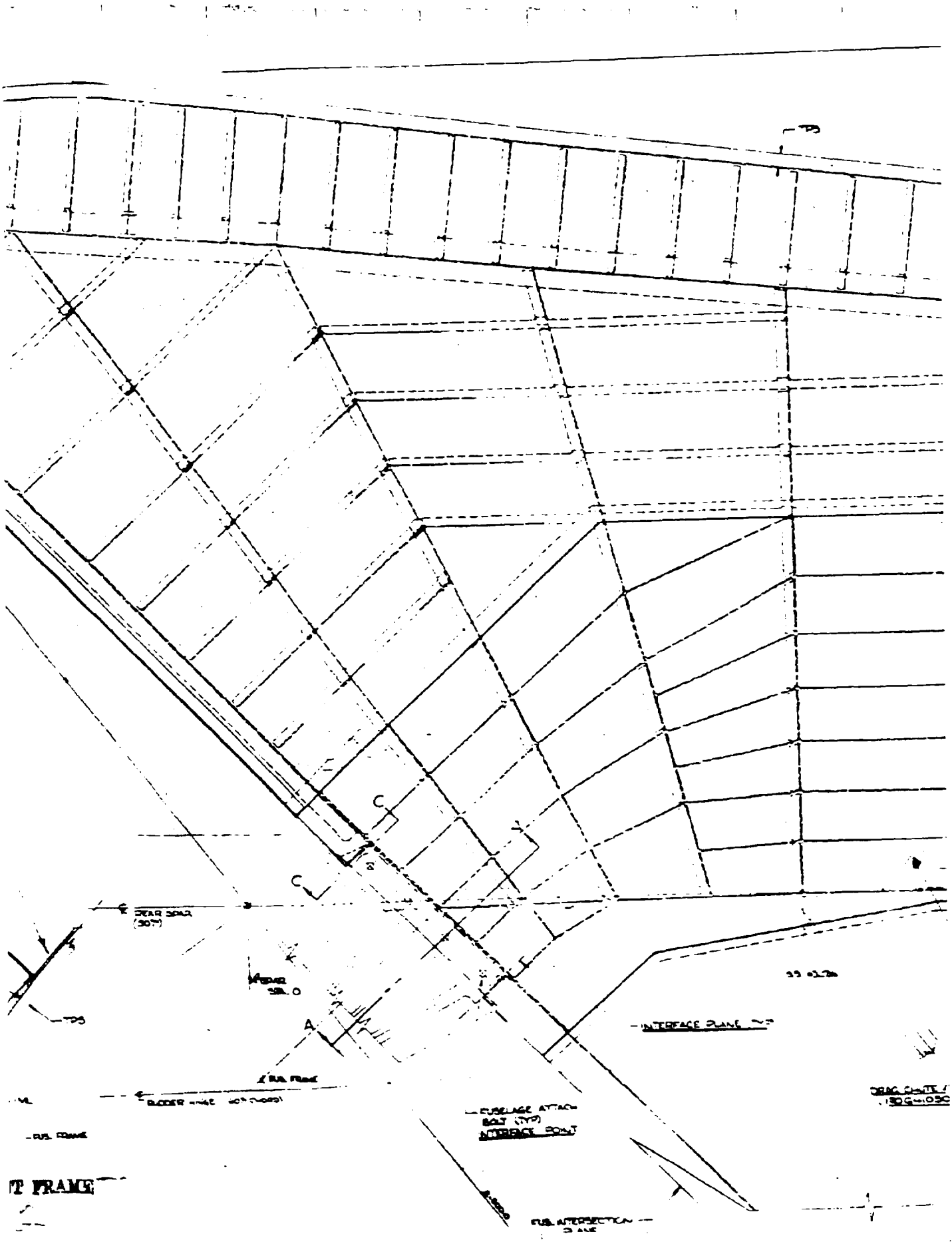
Figure 1.7.5. Main Engine Thrust Support Structure







OUT FRAME



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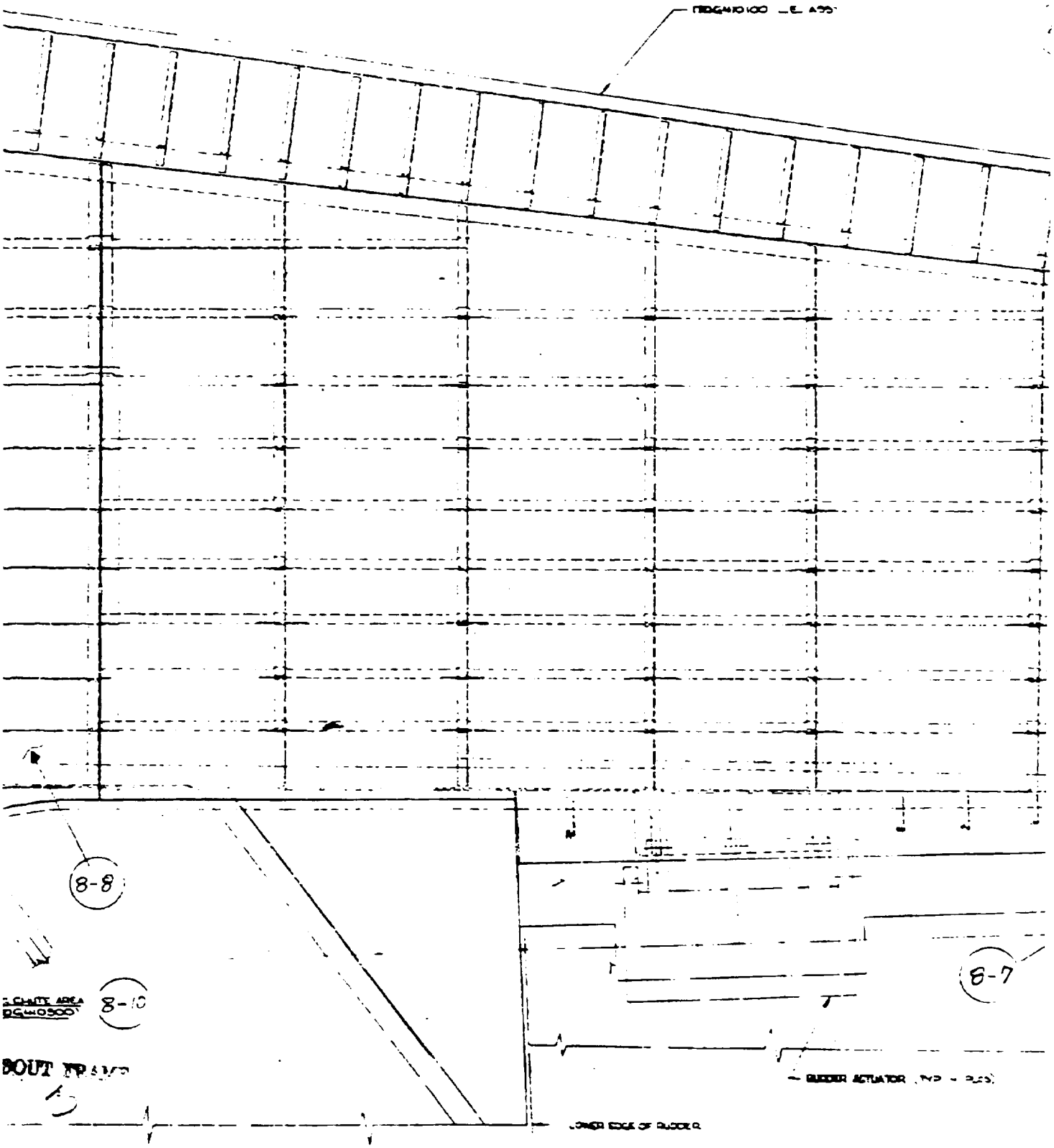
8-8
8-10
8-7
RUDDER ACTUATOR
LOWER EDGE OF RUDDER

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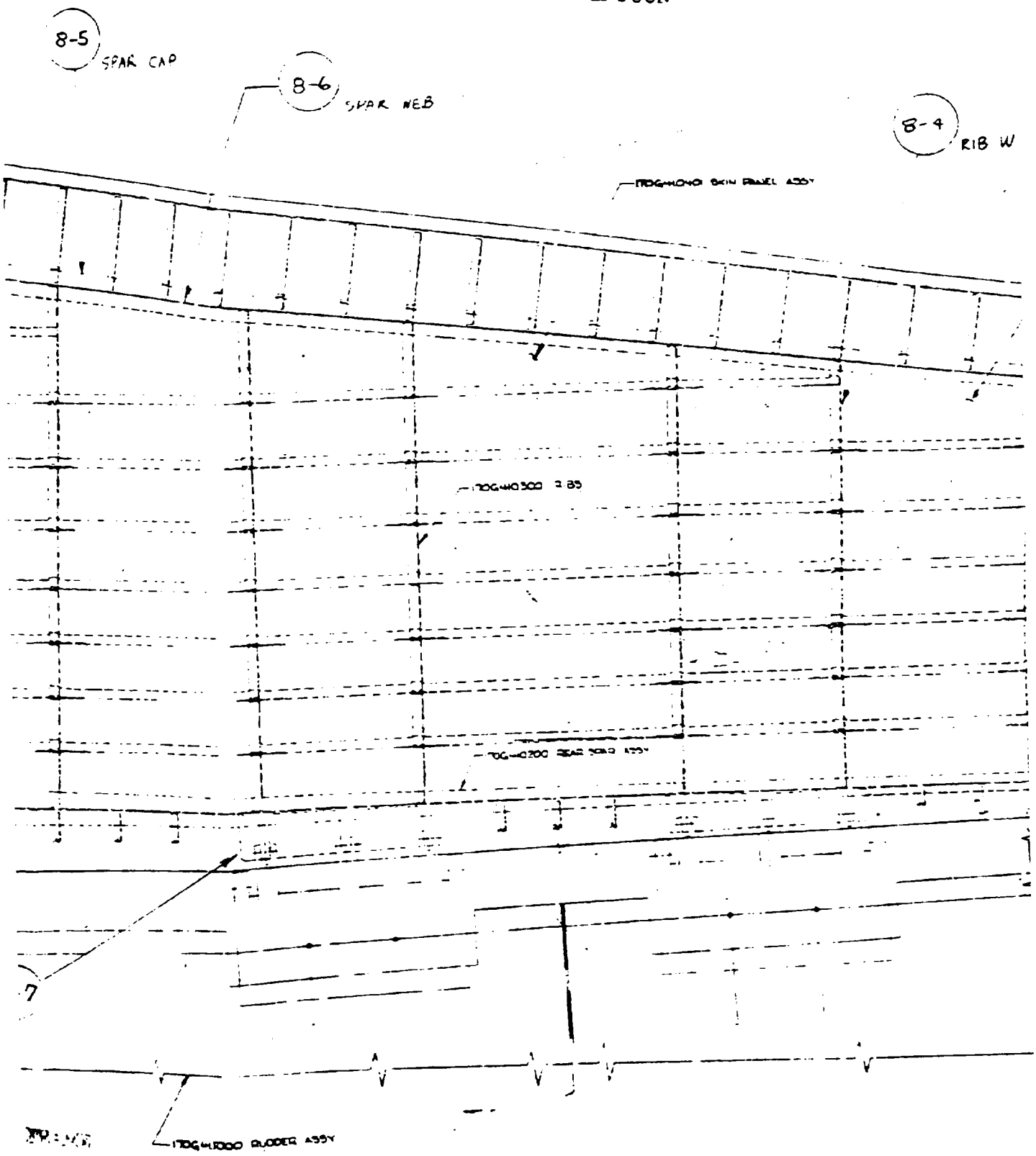
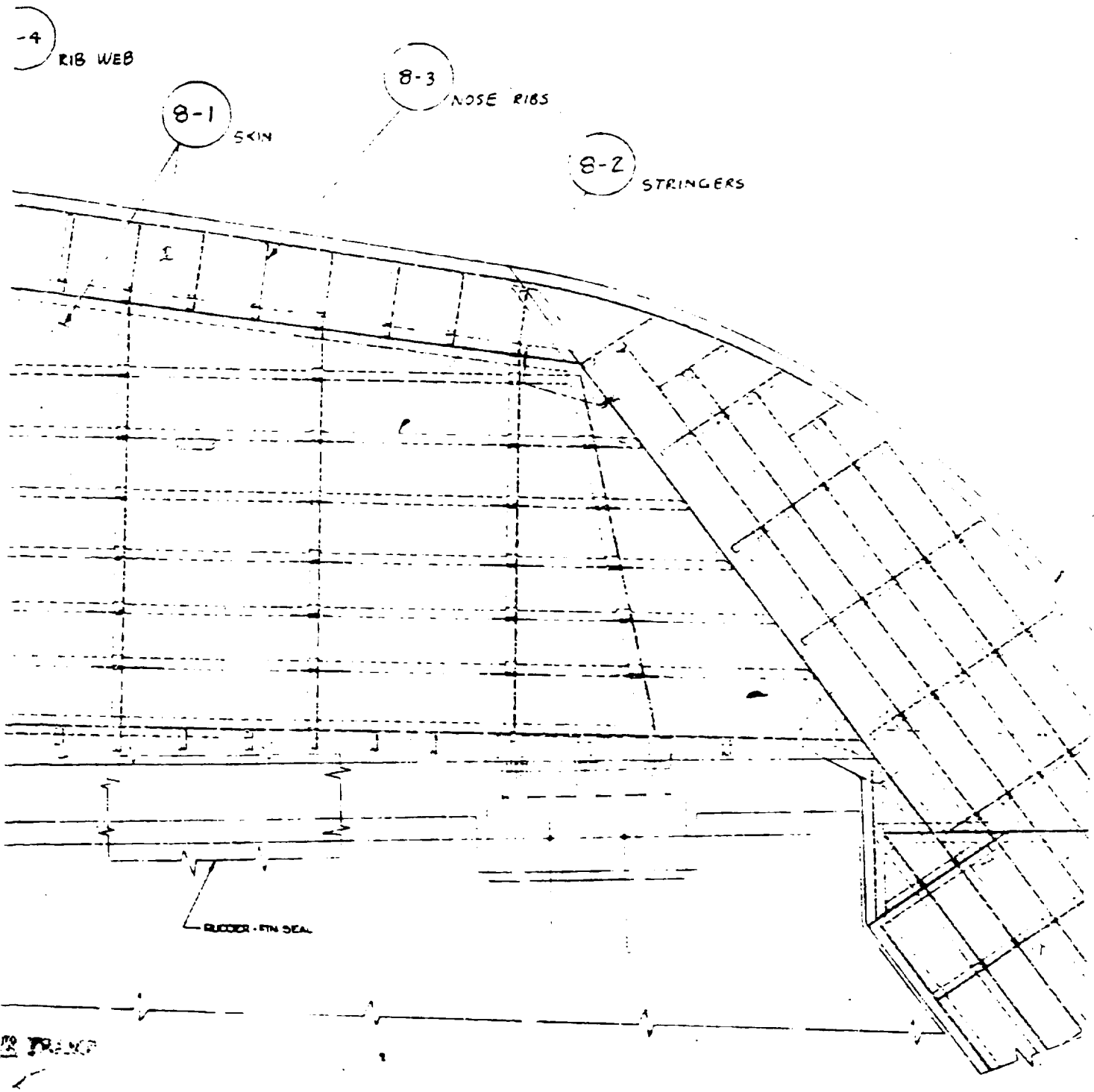



-4
RIB WEB
8-3
NOSE RIBS
8-1
SKIN
8-2
STRINGERS
RUDDER - FIN SEAL

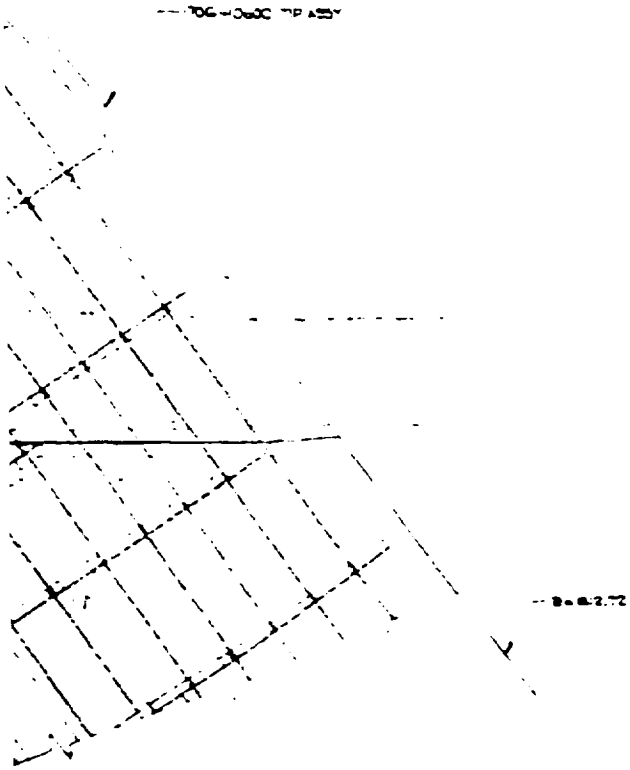
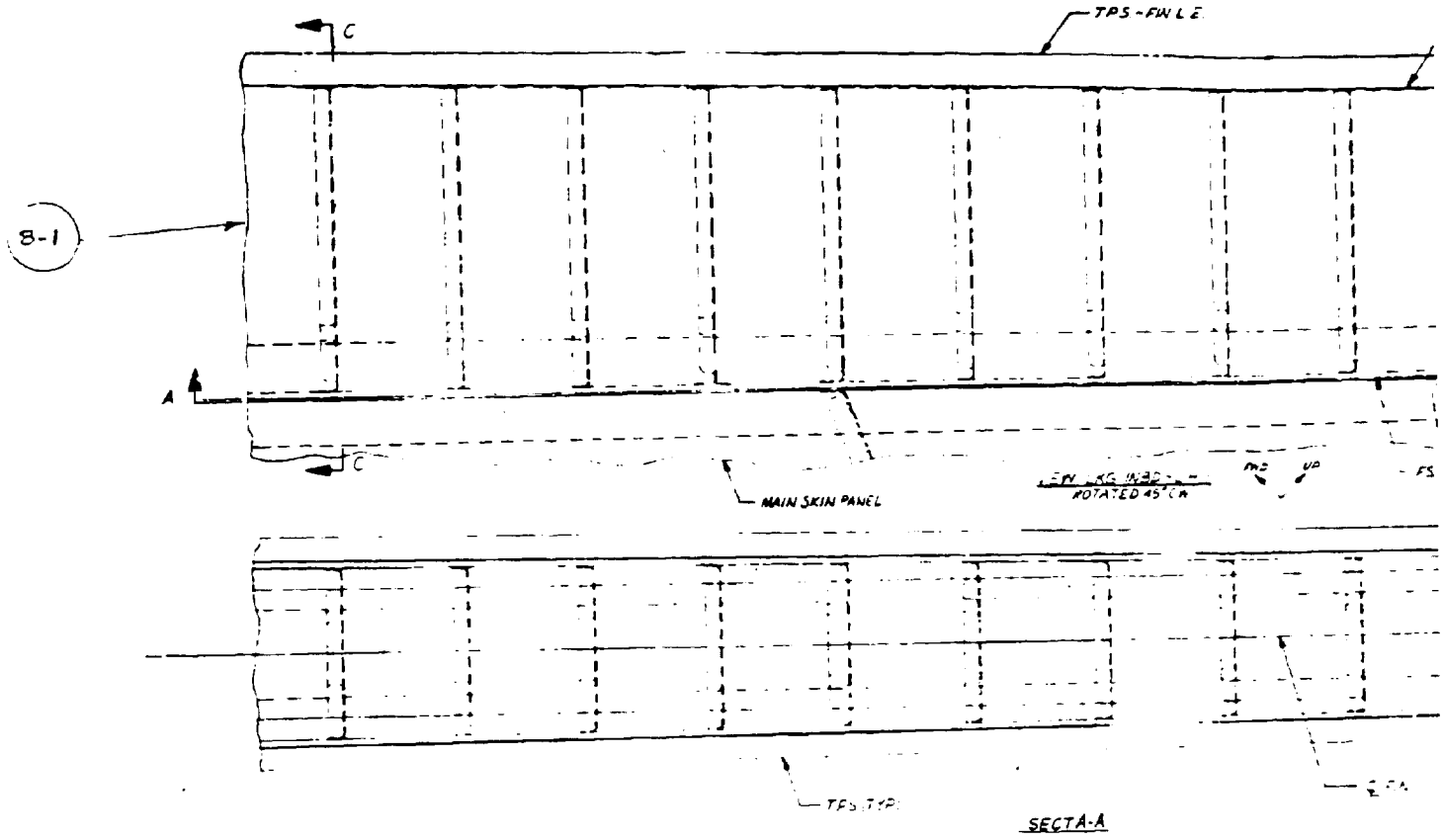
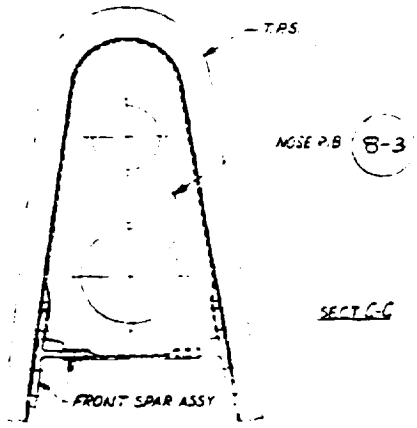


Figure 1.8.1 Vertical Stabilizer Fin Assembly



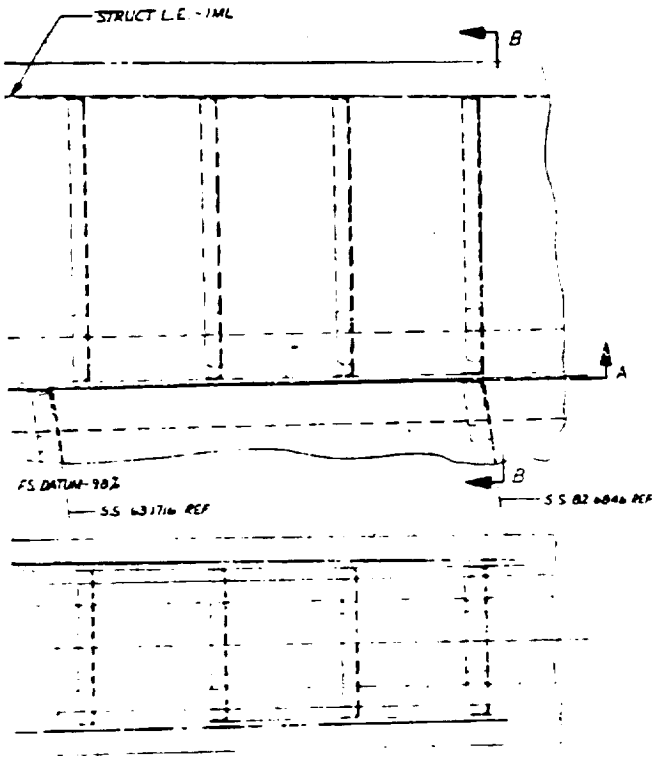
SECT A-A



SECT C-C

SECT

RIB ASSEI



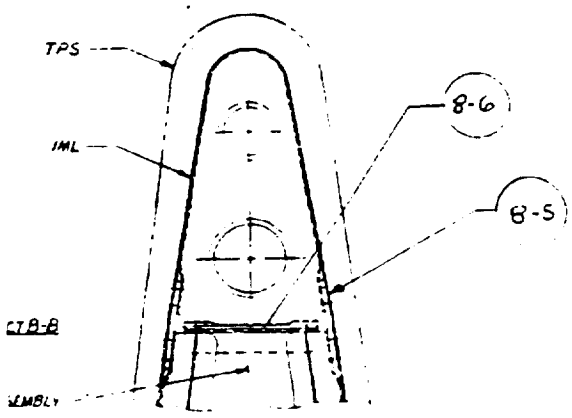
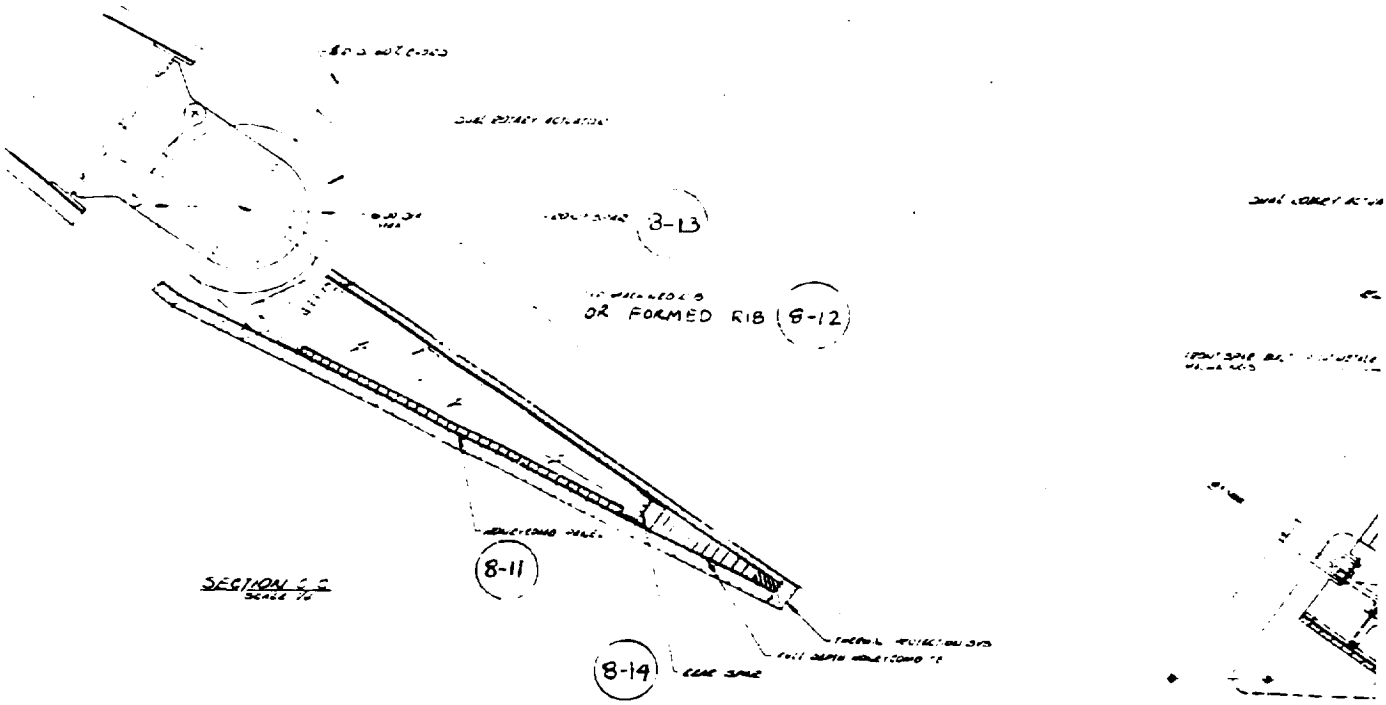


Figure 1.8.2. Vertical Stabilizer Leading Edge Assembly



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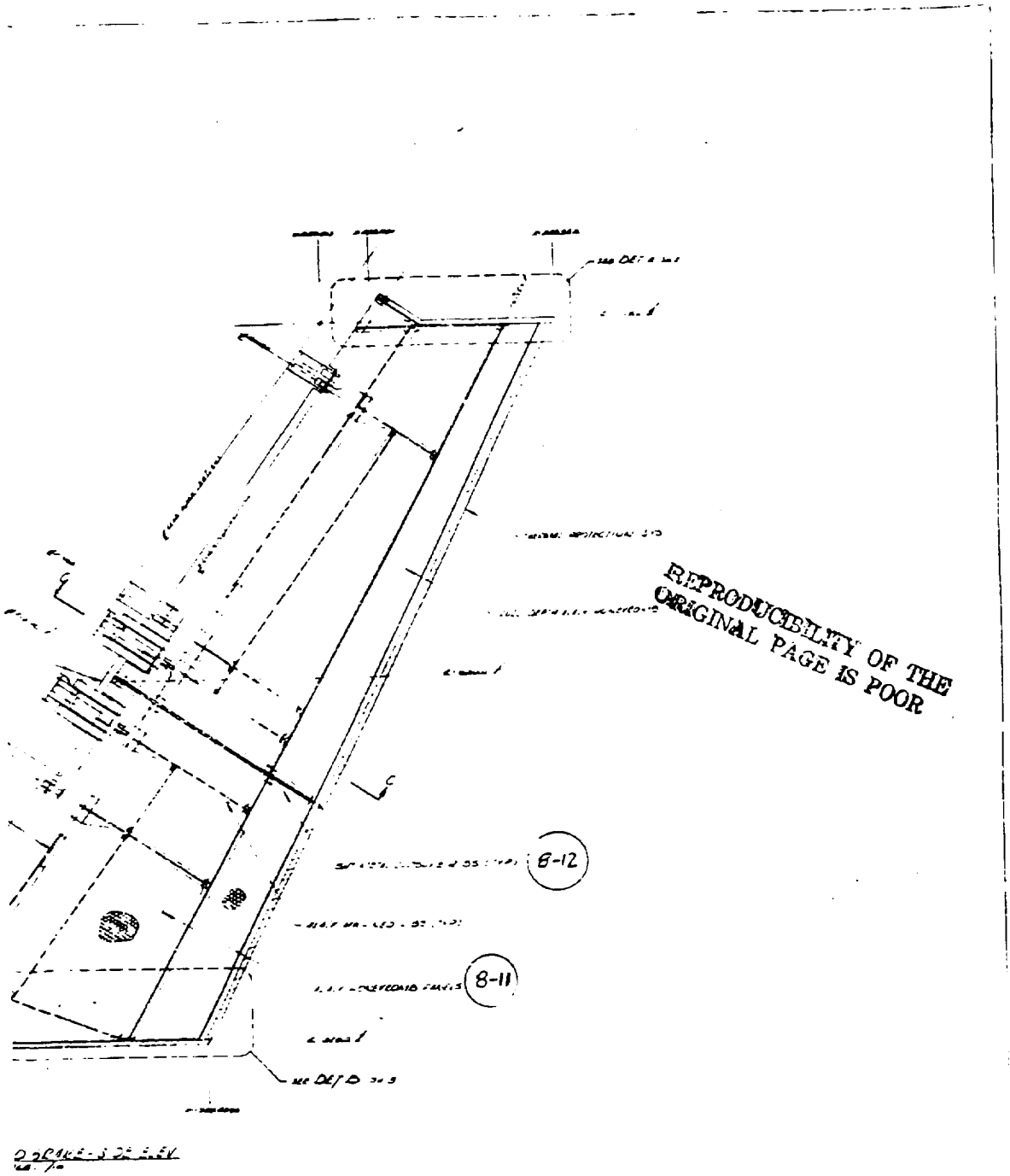
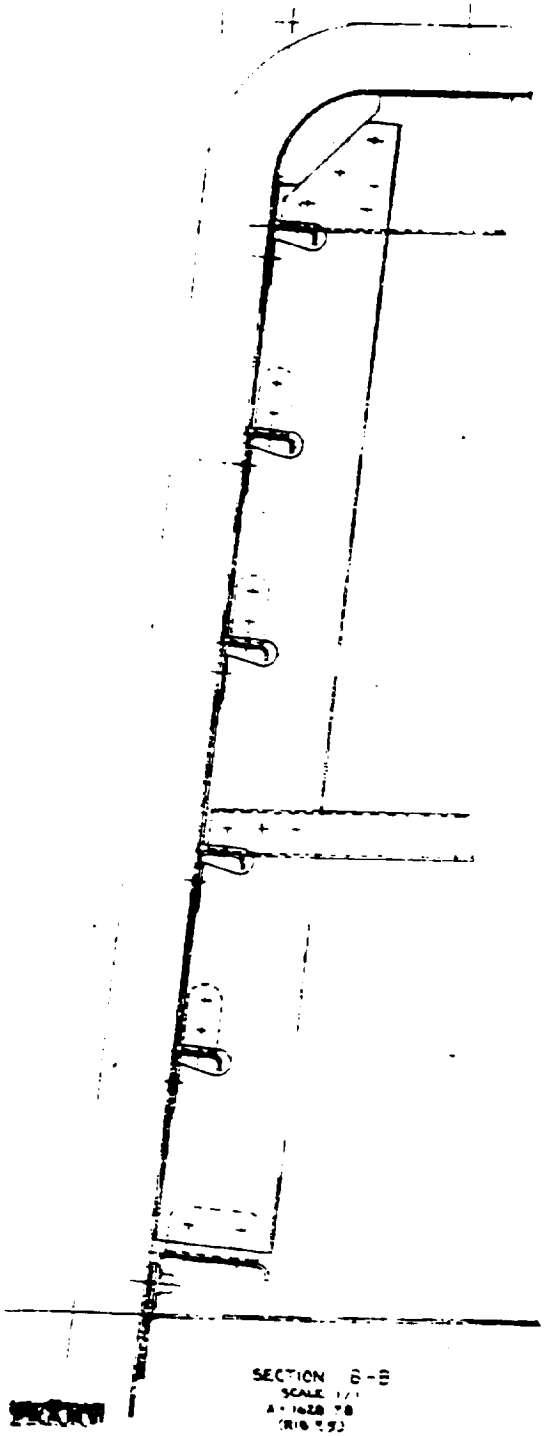
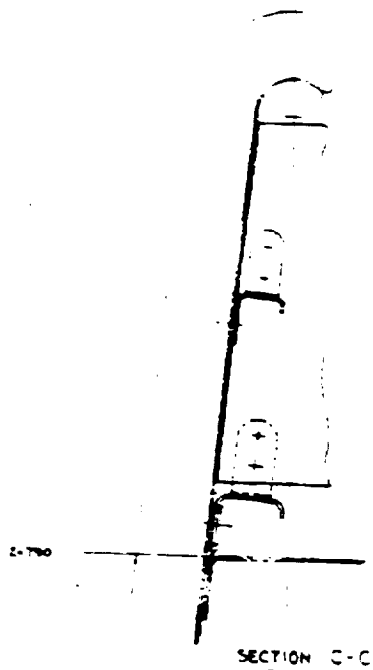


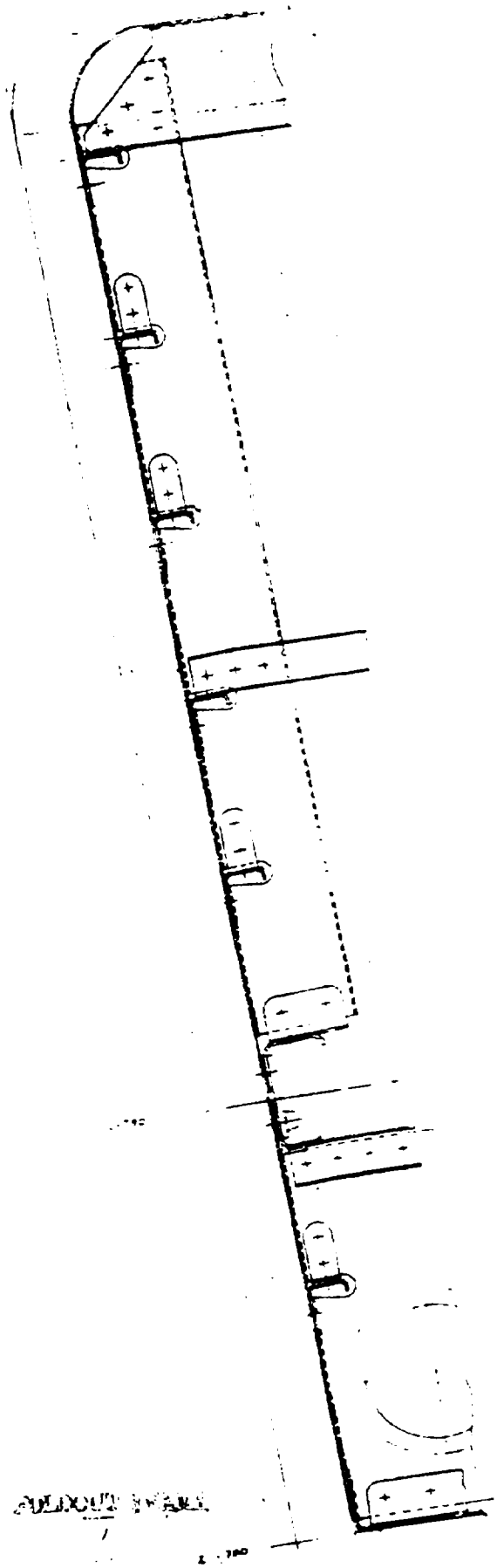
Figure 1.8.3. Vertical Stabilizer Rudder Assembly

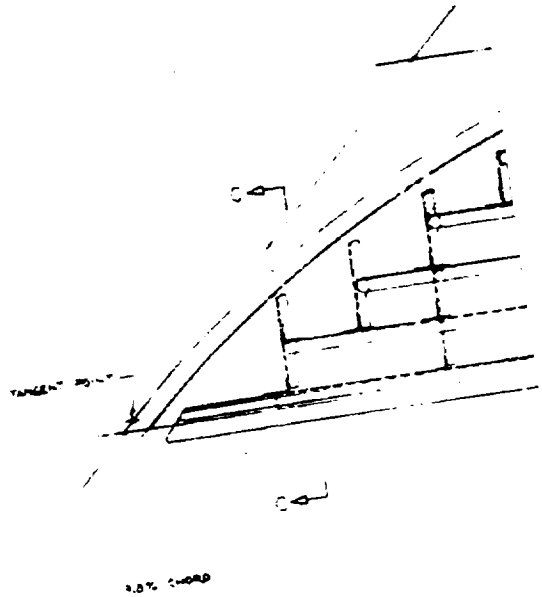


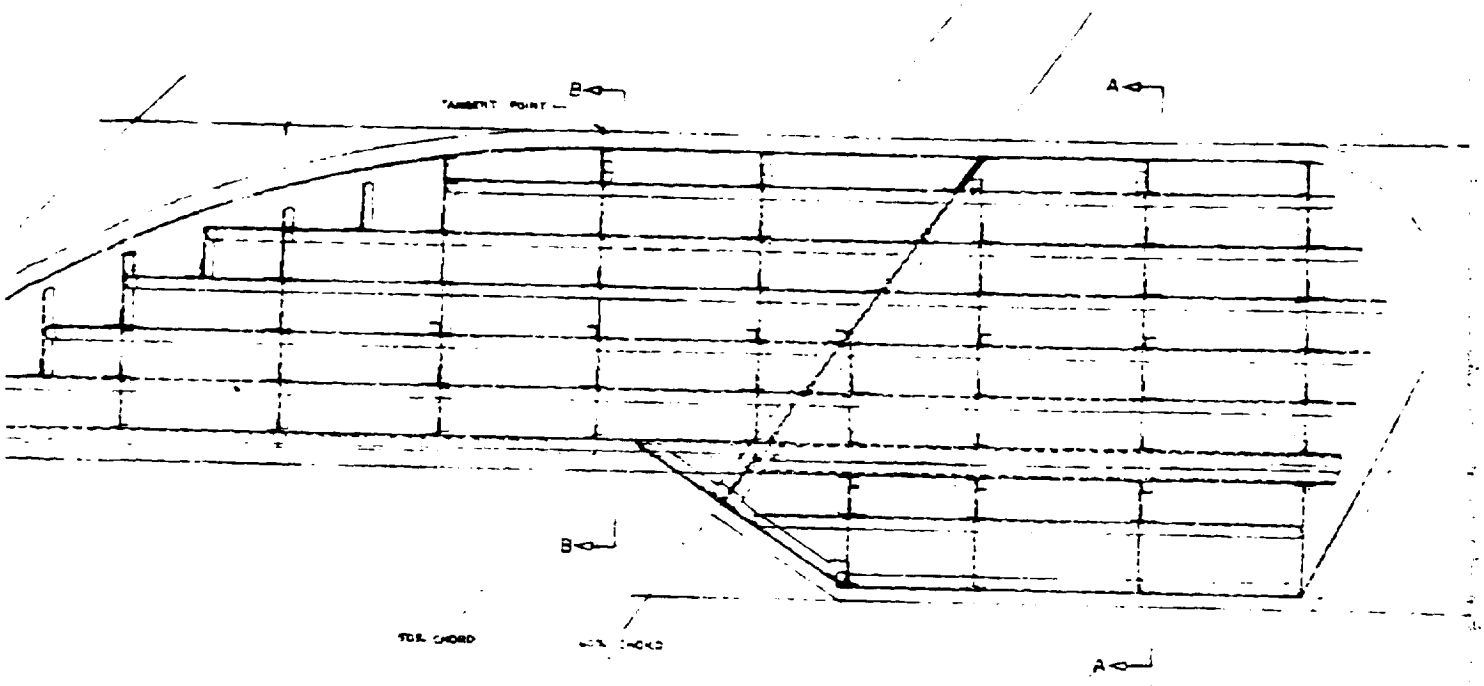
SECTION B-B
SCALE 1/1



SECTION C-C
SCALE 1/1







SCALE 1/4

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SECTION AT Z=700
SCALE 1/4

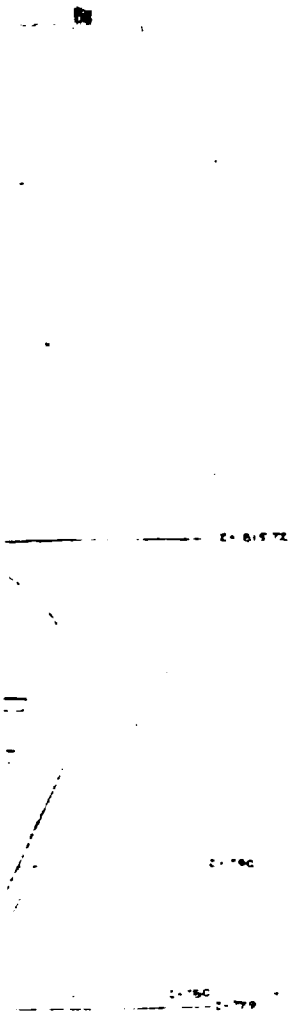
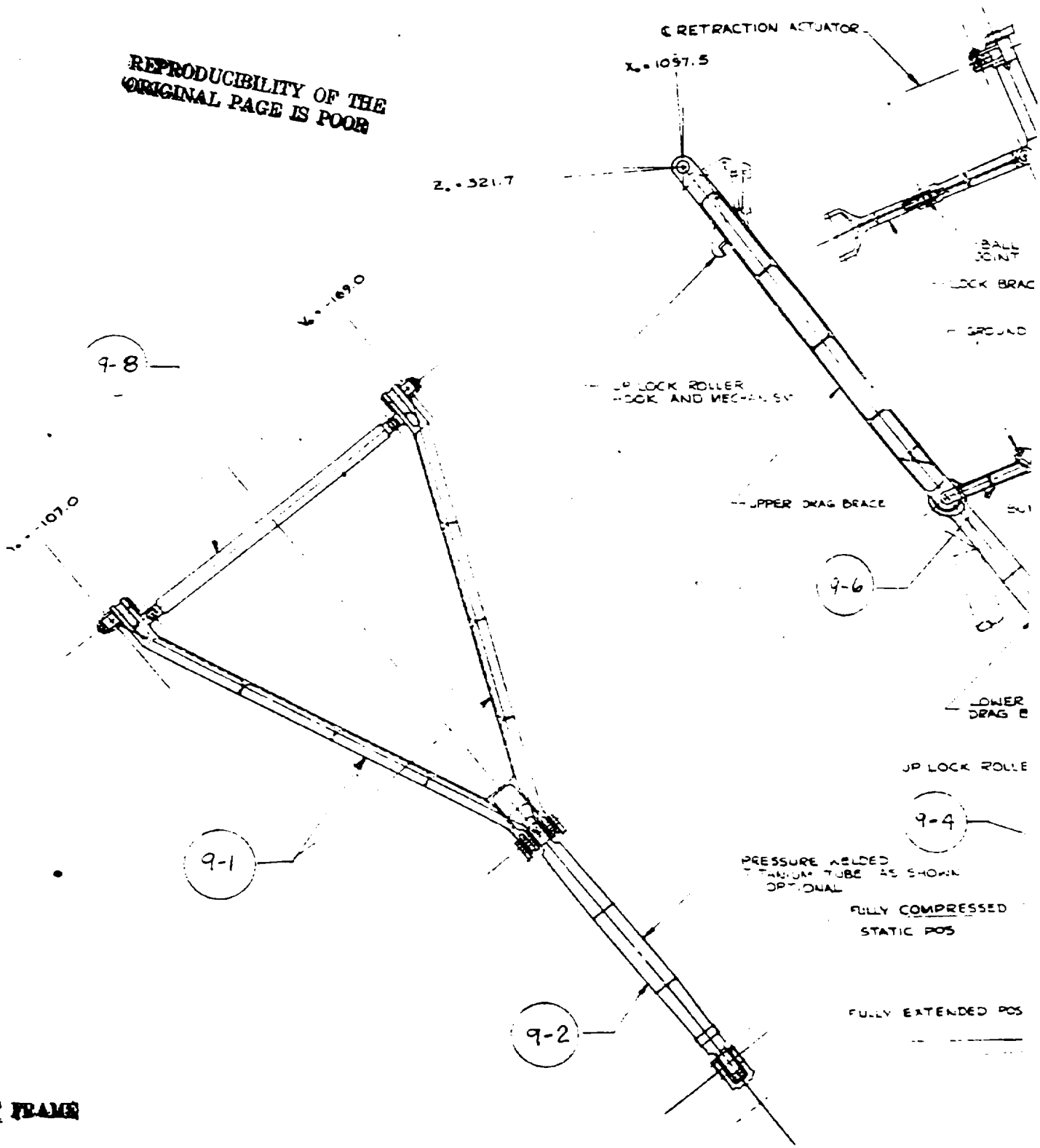


Figure 1.8.4. Vertical Stabilizer Tip Assembly



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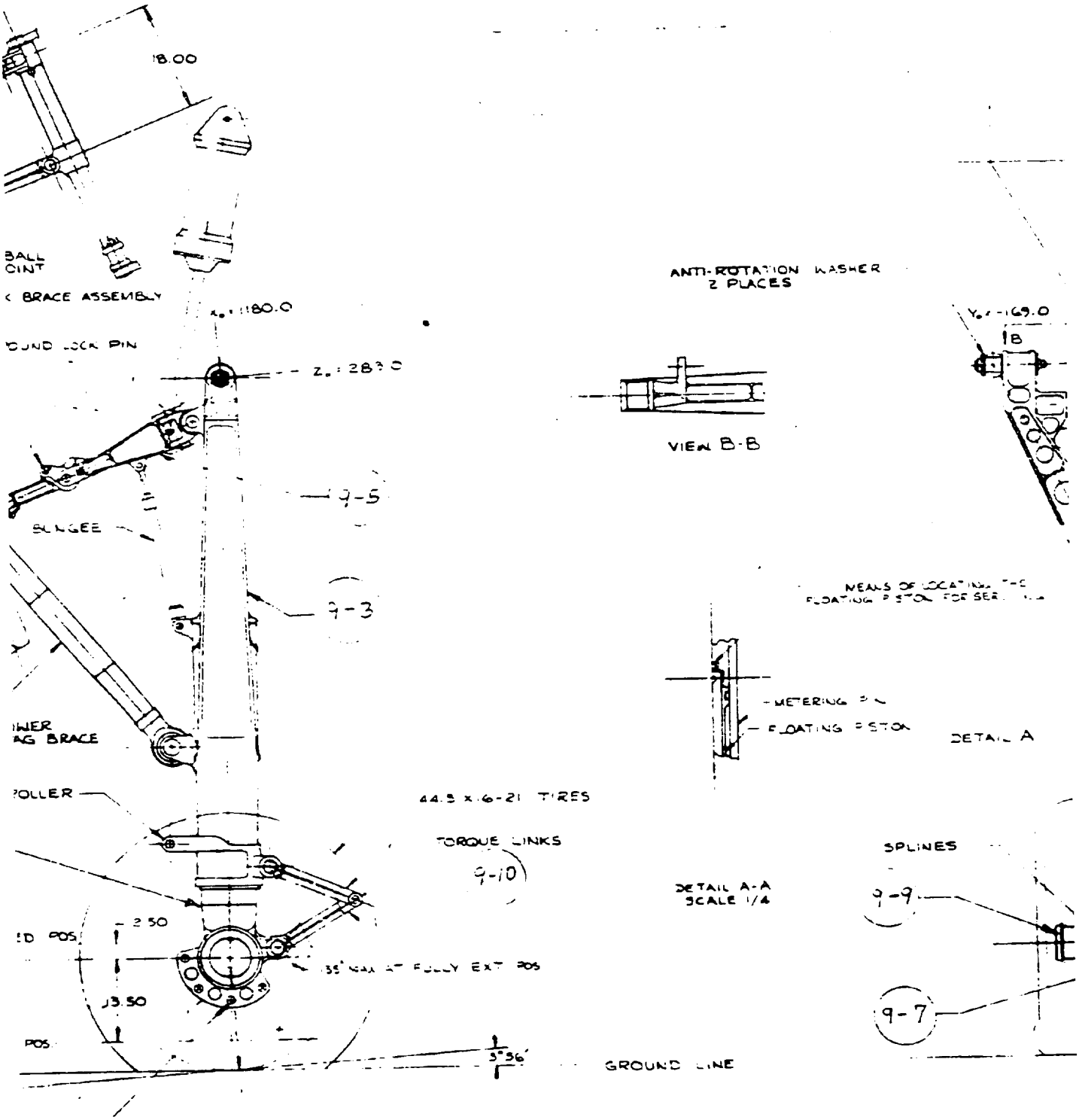
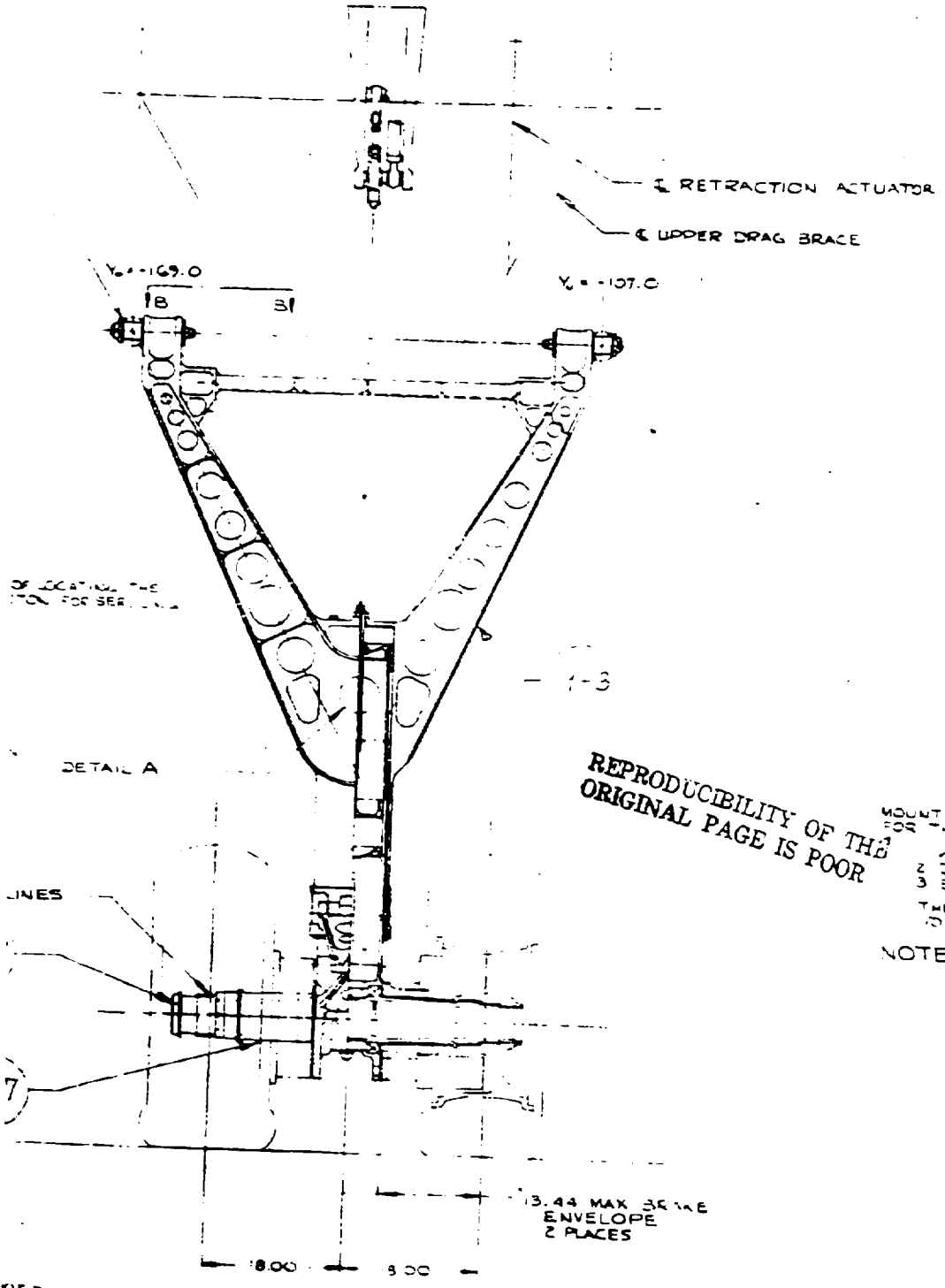

18.00
BALL
OINT
< BRACE ASSEMBLY
OUND LOCK PIN
X₀ = 180.0
Z₀ = 283.0
9-5
BUNGEE
9-3
INER
AG BRACE
ANTI-ROTATION WASHER
2 PLACES
VIEW B-B
Y₀ = 169.0
B
MEANS OF LOCATING THE
FLOATING PISTON FOR SER
METERING PIN
FLOATING PISTON
DETAIL A
ROLLER
44.5 x 16-21 TIRES
TORQUE LINKS
9-10
DETAIL A-A
SCALE 1/4
SPLINES
9-9
9-7
2.50
13.50
POS
35° MAX AT FULLY EXT POS
5°36'
GROUND LINE
18.40 ROLLING RADIUS
BRAKE TORQUE TUBE
ATTACHMENT HOLES
AFT
FRAME



NOTES :

Figure 1.9.1

ING PROVISIONS SHALL BE PROVIDED
HE FOLLOWING ITEMS

NON-WEIGHT ON WHEELS SWITCH
DOWN LOCK SWITCH
BRAKE LINES

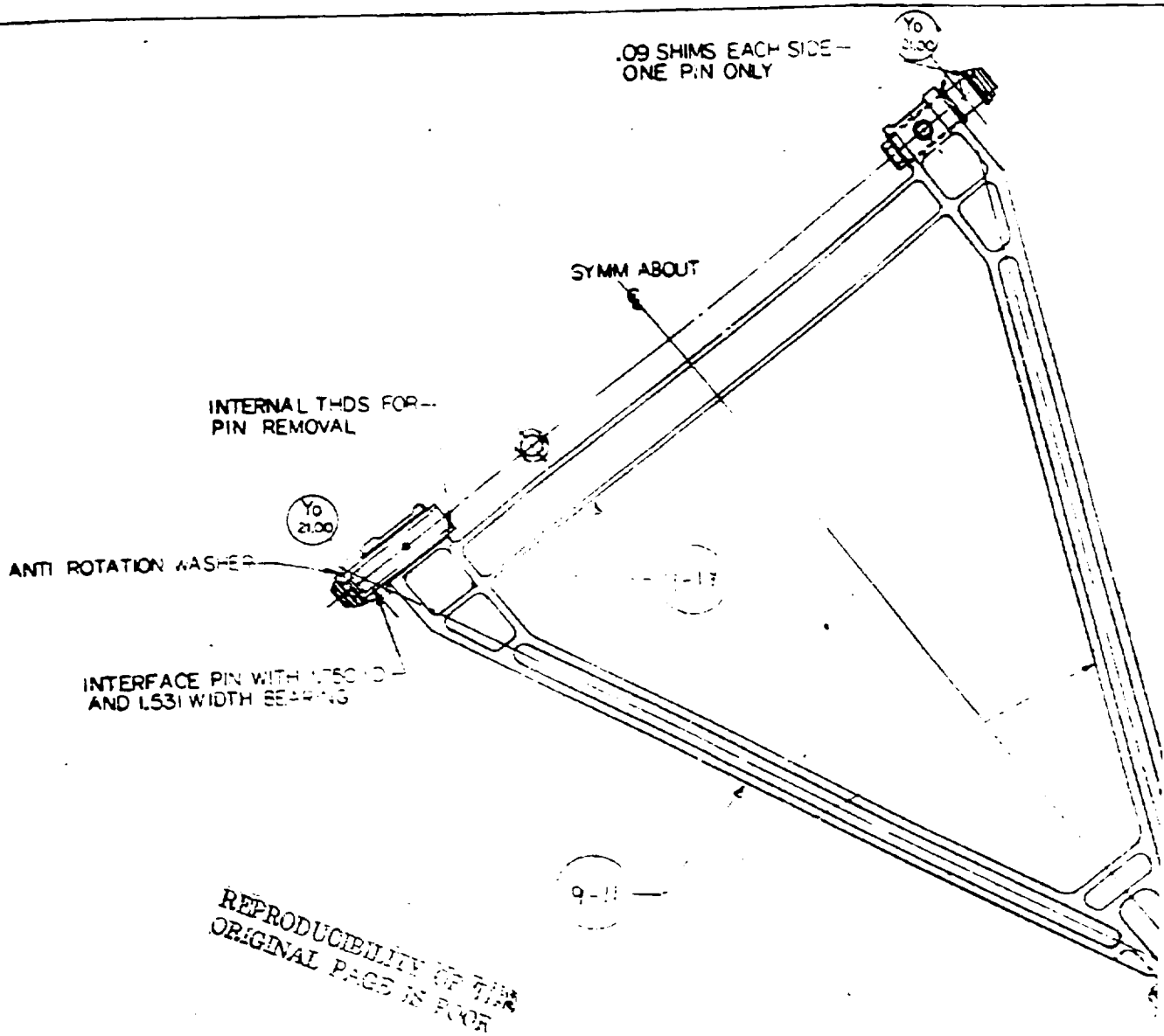
HE EXACT LOCATION AND TYPE FOR THE ABOVE
) BE PROVIDED BY THE BUYER

ES :

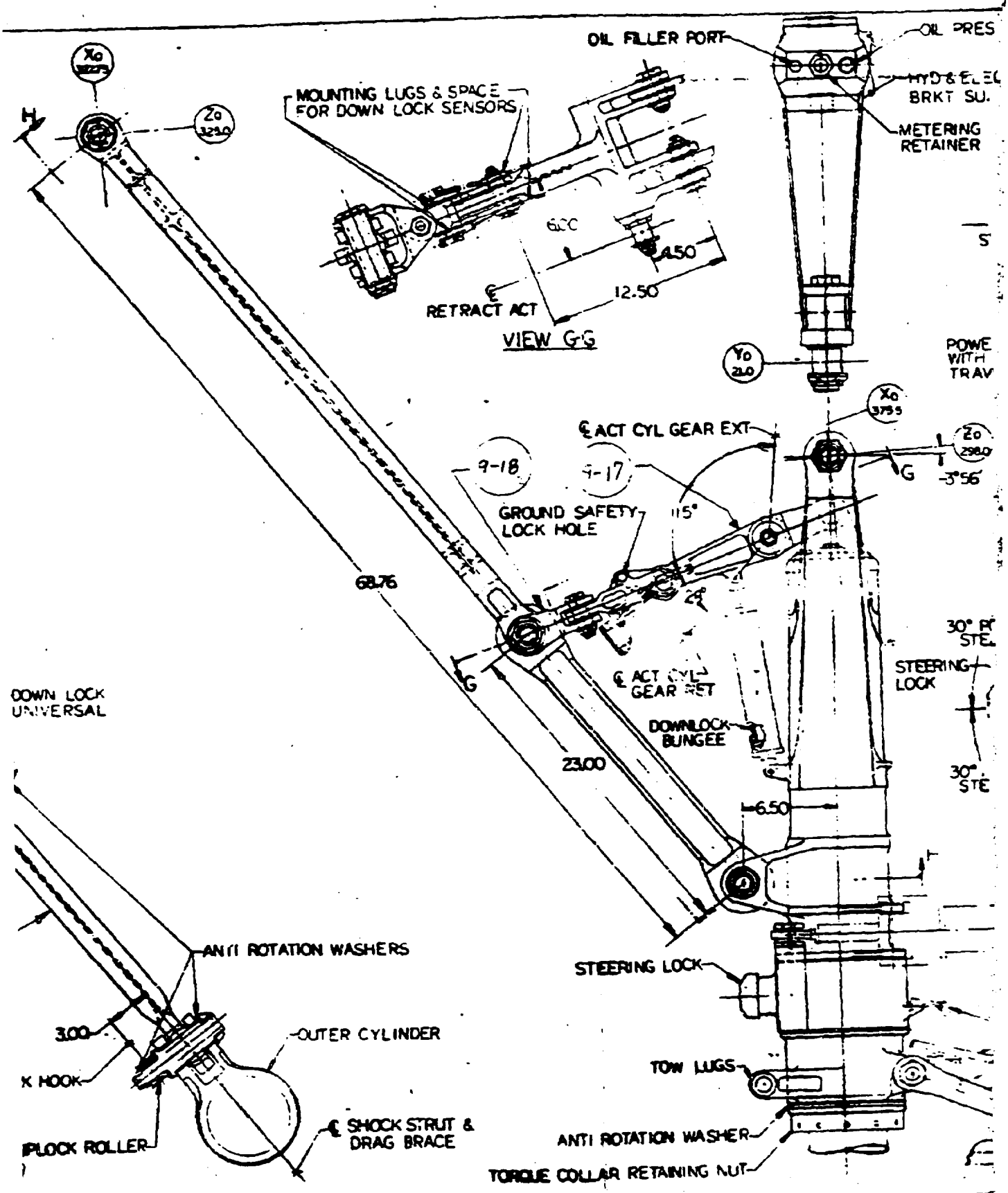
FULCRUM FRAME

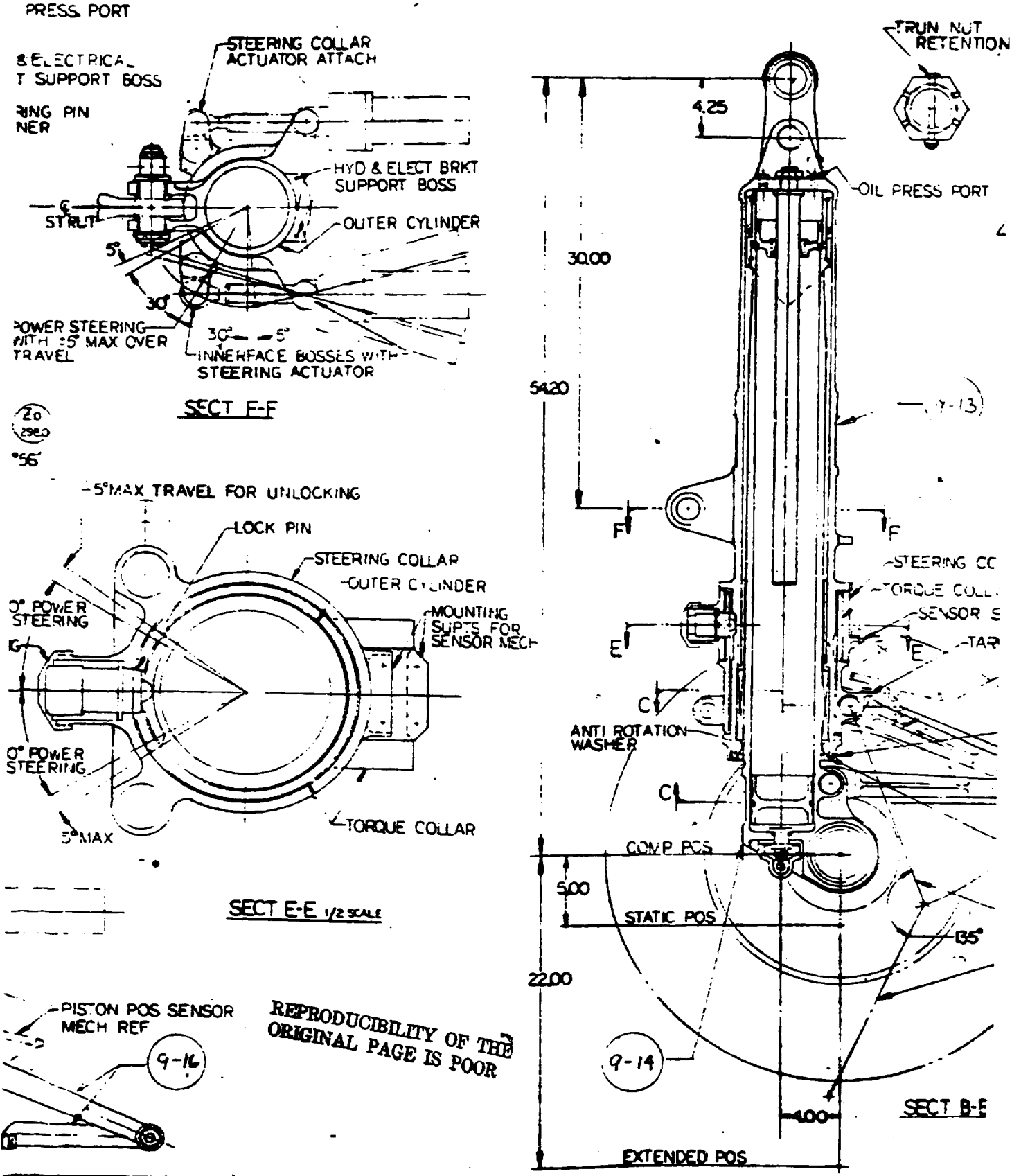
4/

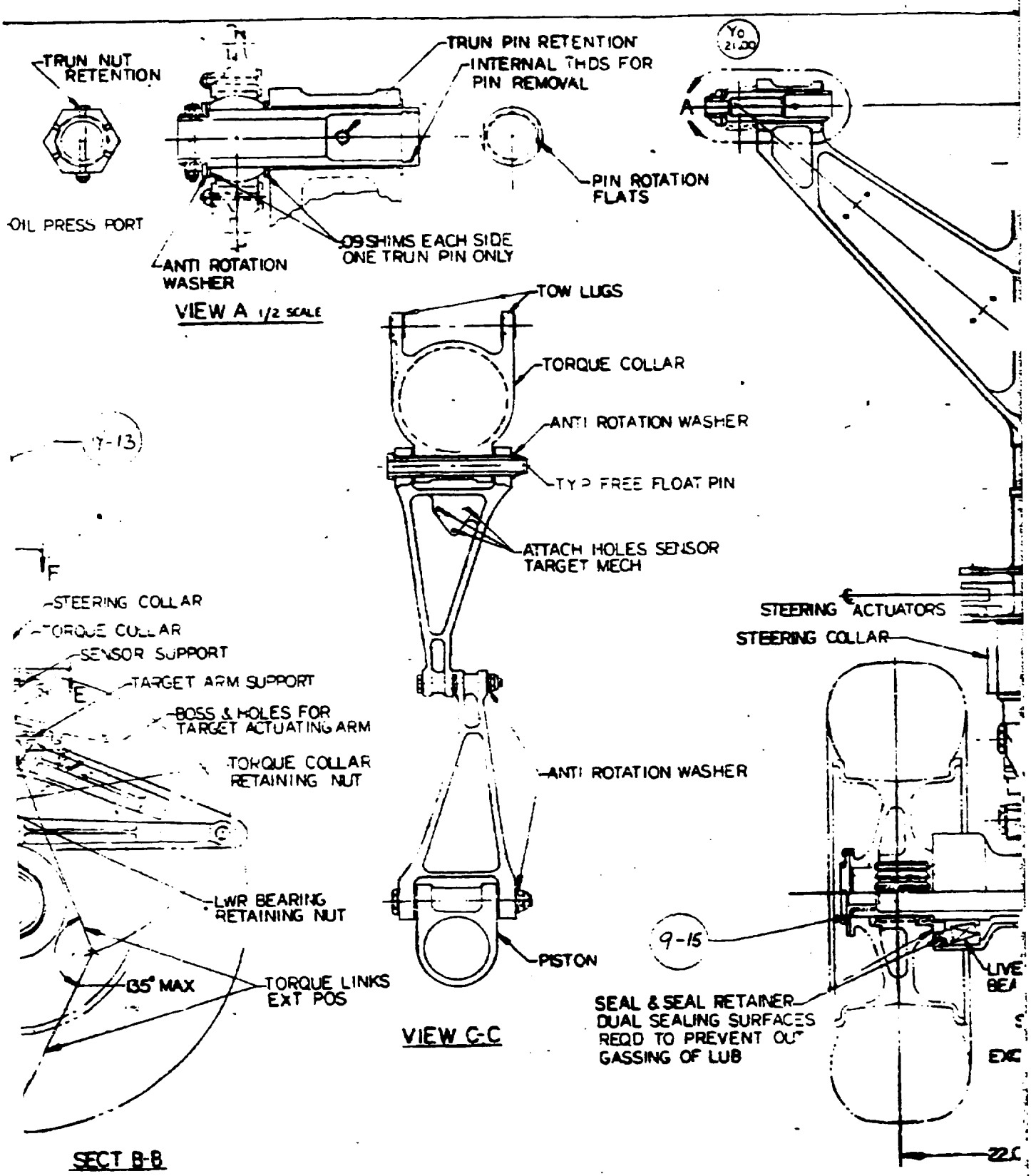
Figure 1.9.1. Main Landing Gear



VIEW HH


OIL FILLER PORT
OIL PRES
HYD & ELEC
BRKT SU.
METERING
RETAINER
MOUNTING LUGS & SPACE
FOR DOWN LOCK SENSORS
6.00
4.50
12.50
RETRACT ACT
VIEW G-G
POWE
WITH
TRAV
ACT CYL GEAR EXT
9-18
9-17
GROUND SAFETY
LOCK HOLE
115°
3°56'
68.76
23.00
DOWN LOCK
UNIVERSAL
ACT CYL
GEAR RET
DOWNLOCK
BUNGEE
30°
STE
STEERING
LOCK
6.50
ANTI ROTATION WASHERS
3.00
OUTER CYLINDER
K HOOK
LOCK ROLLER
SHOCK STRUT &
DRAG BRACE
STEERING LOCK
TOW LUGS
ANTI ROTATION WASHER
TORQUE COLLAR RETAINING NUT





SECT B-B

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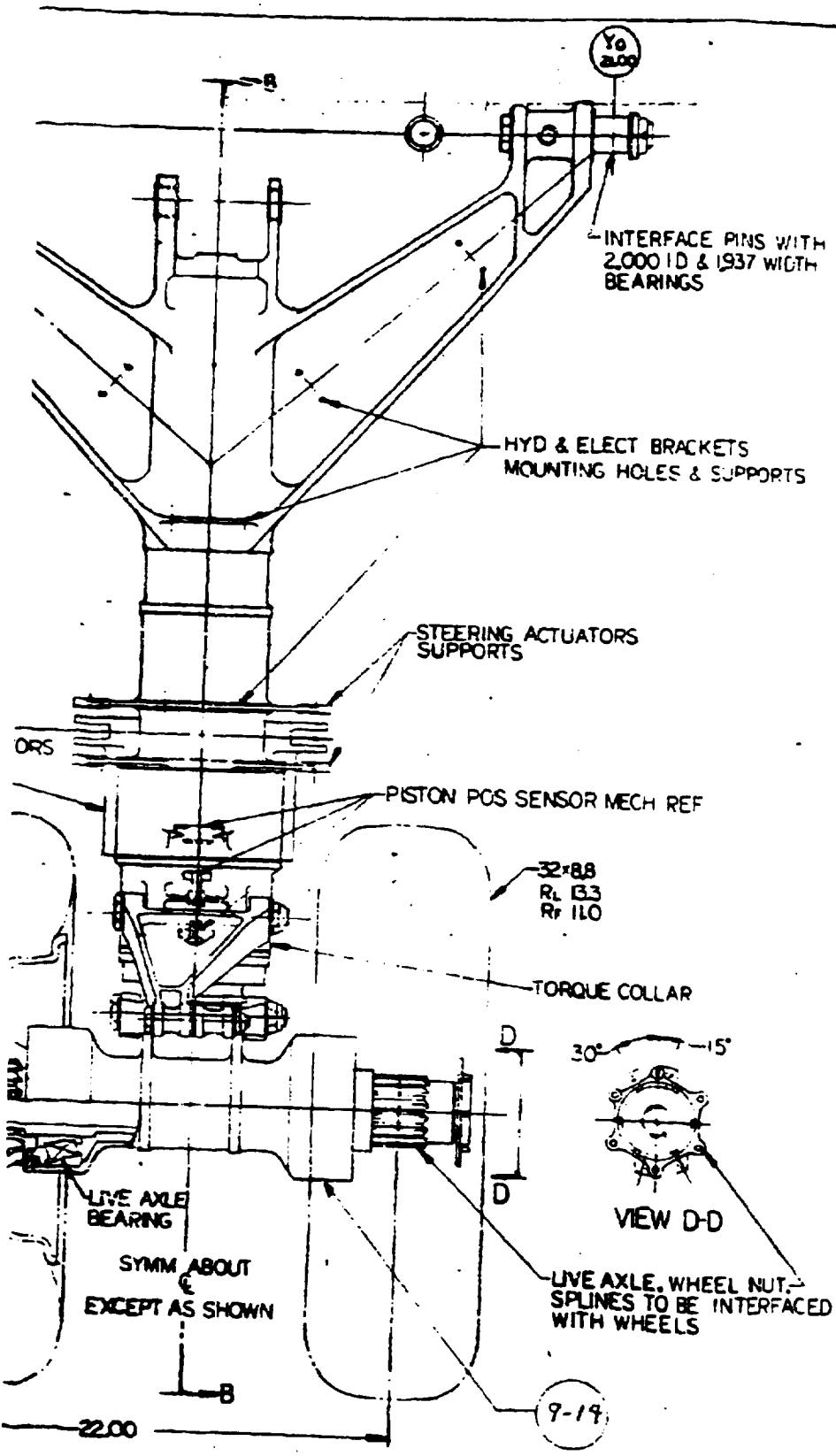
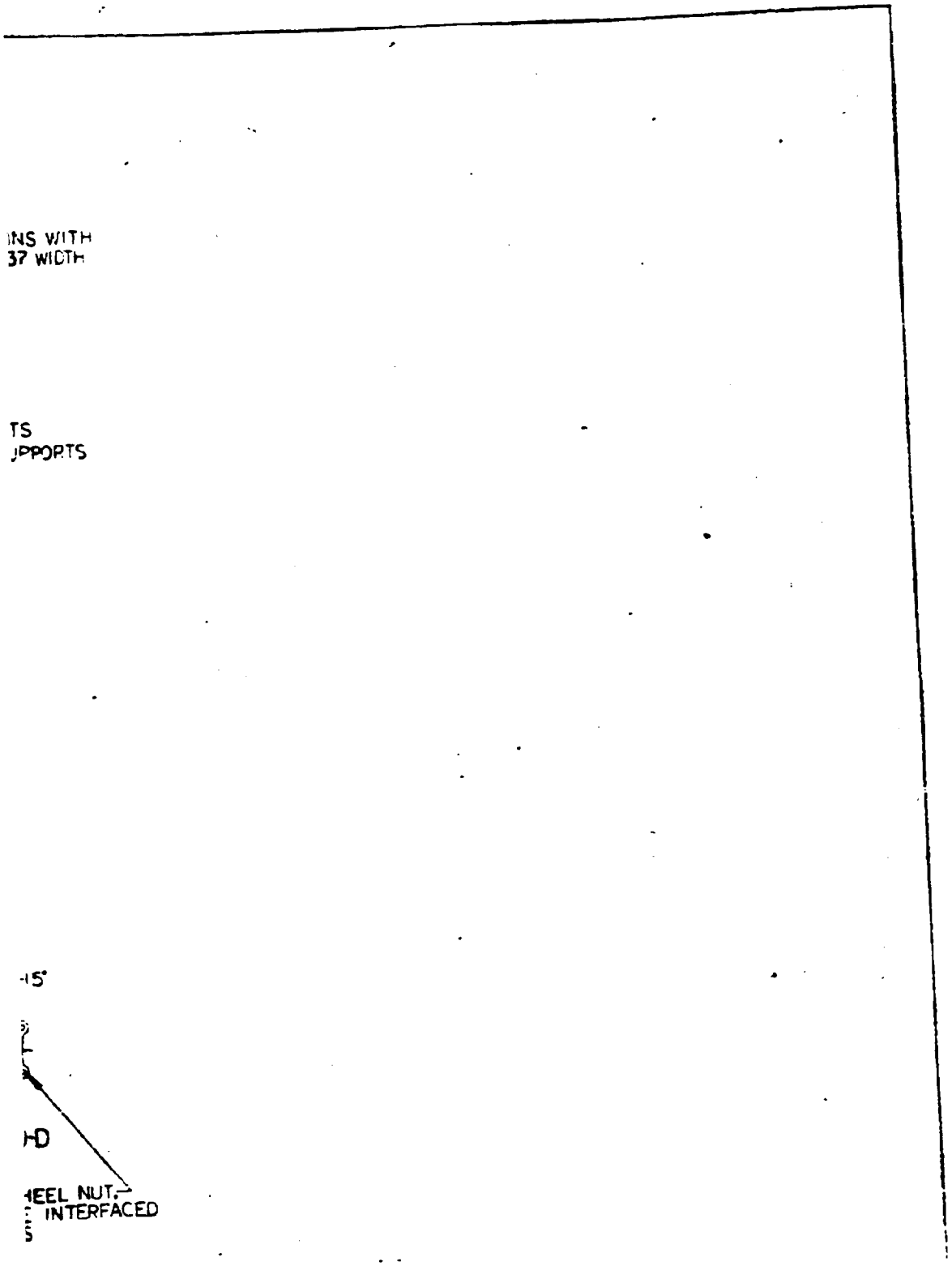


Figure 1.9.2. Nose Landing



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6

Figure 1.9.2. Nose Landing Gear

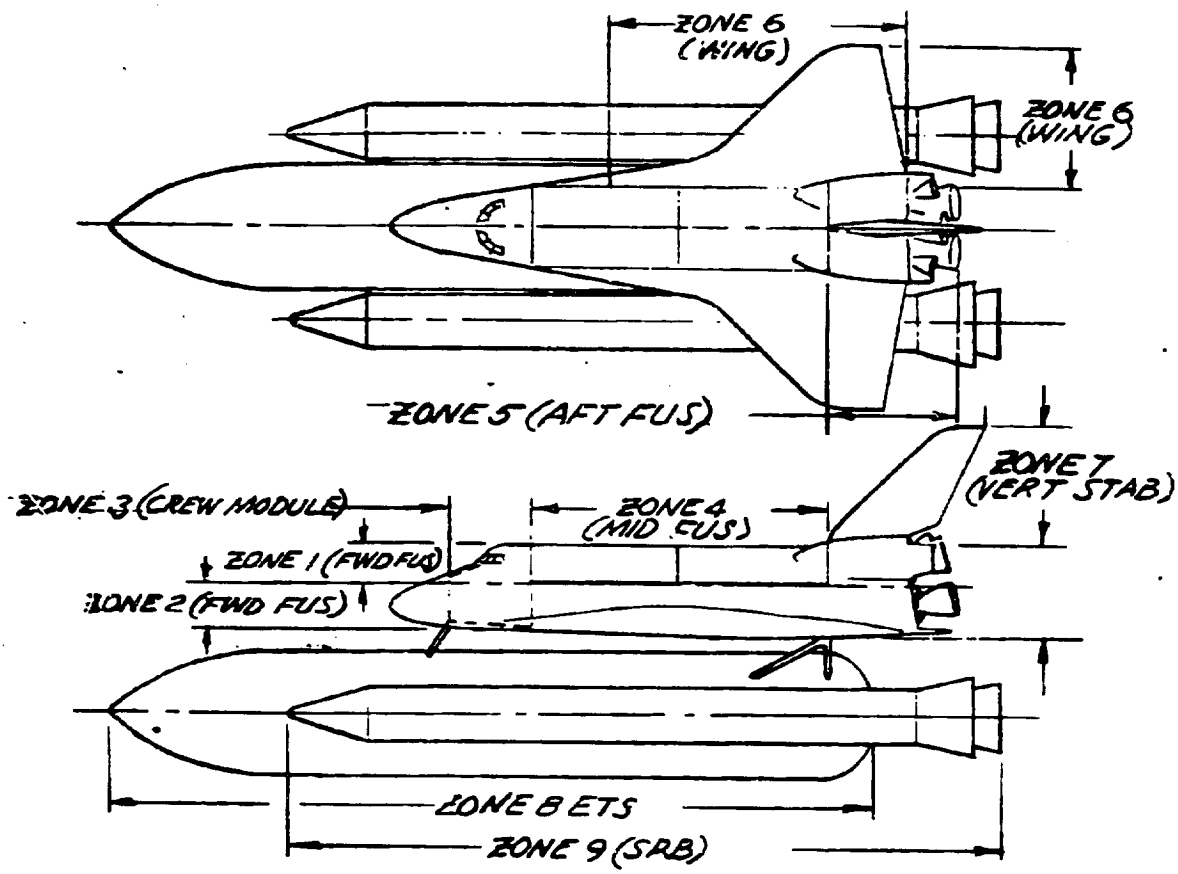
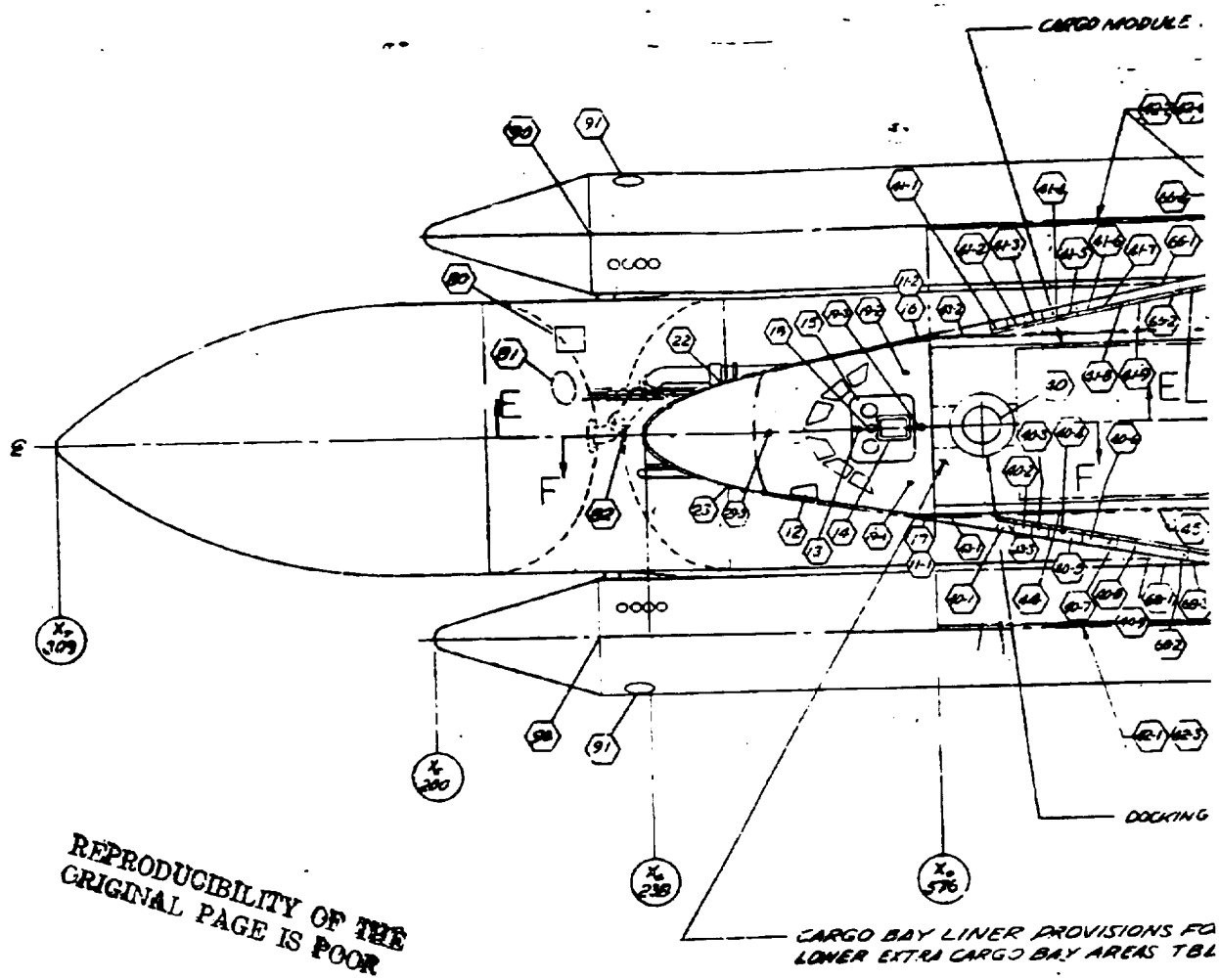
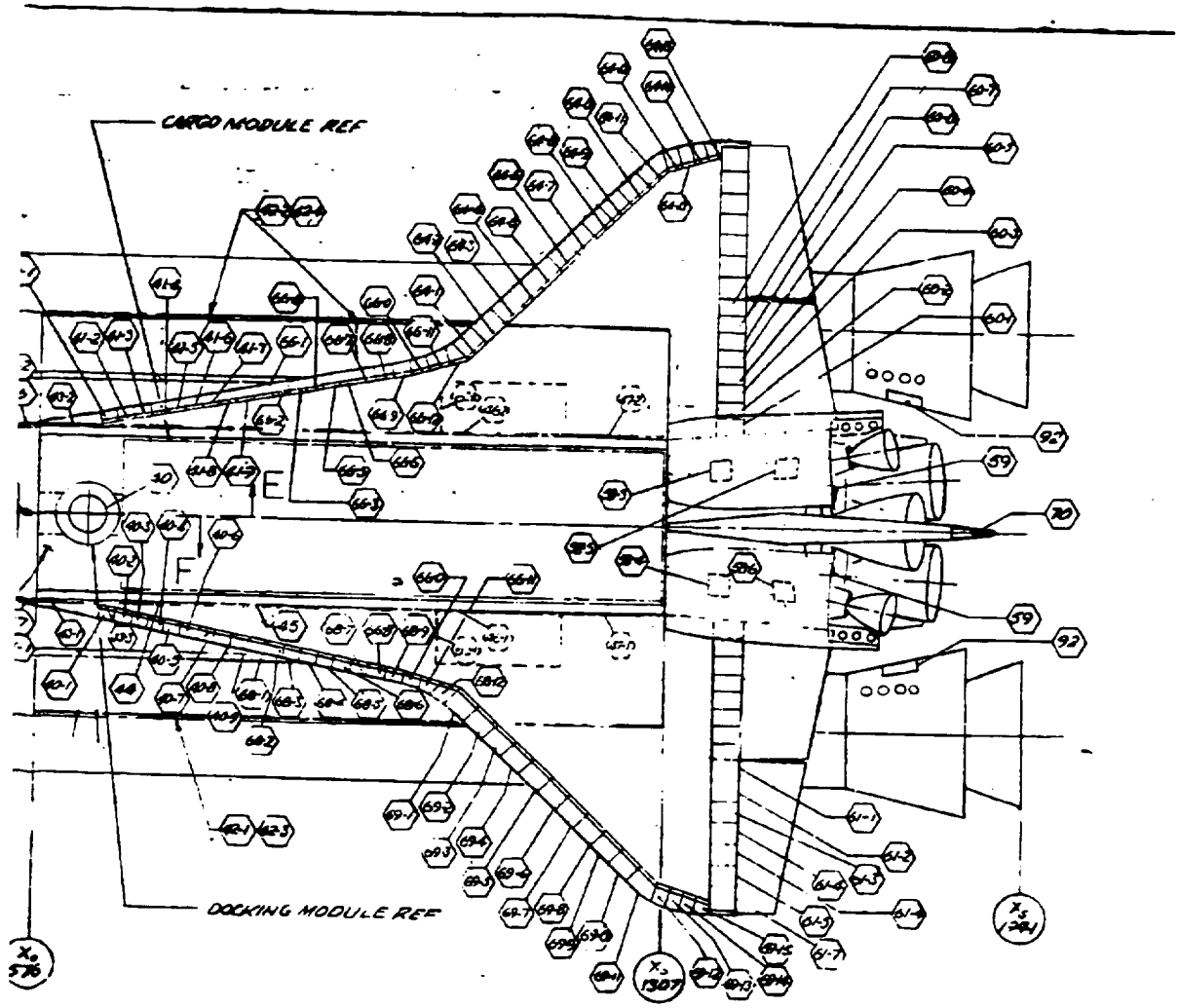


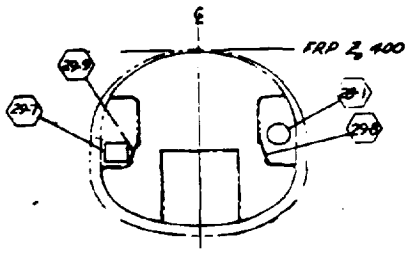
Figure 1.10.1. Shuttle Area Zone Breakdown





LINER PROVISIONS FOR ACCESS TO CARGO BAY AREAS TBD

Figure 1.10.2. Shuttle Maintenance Access



VIEW H-H SCALE 1/40

OUT FRAME

VL72-0000 71A SH 4

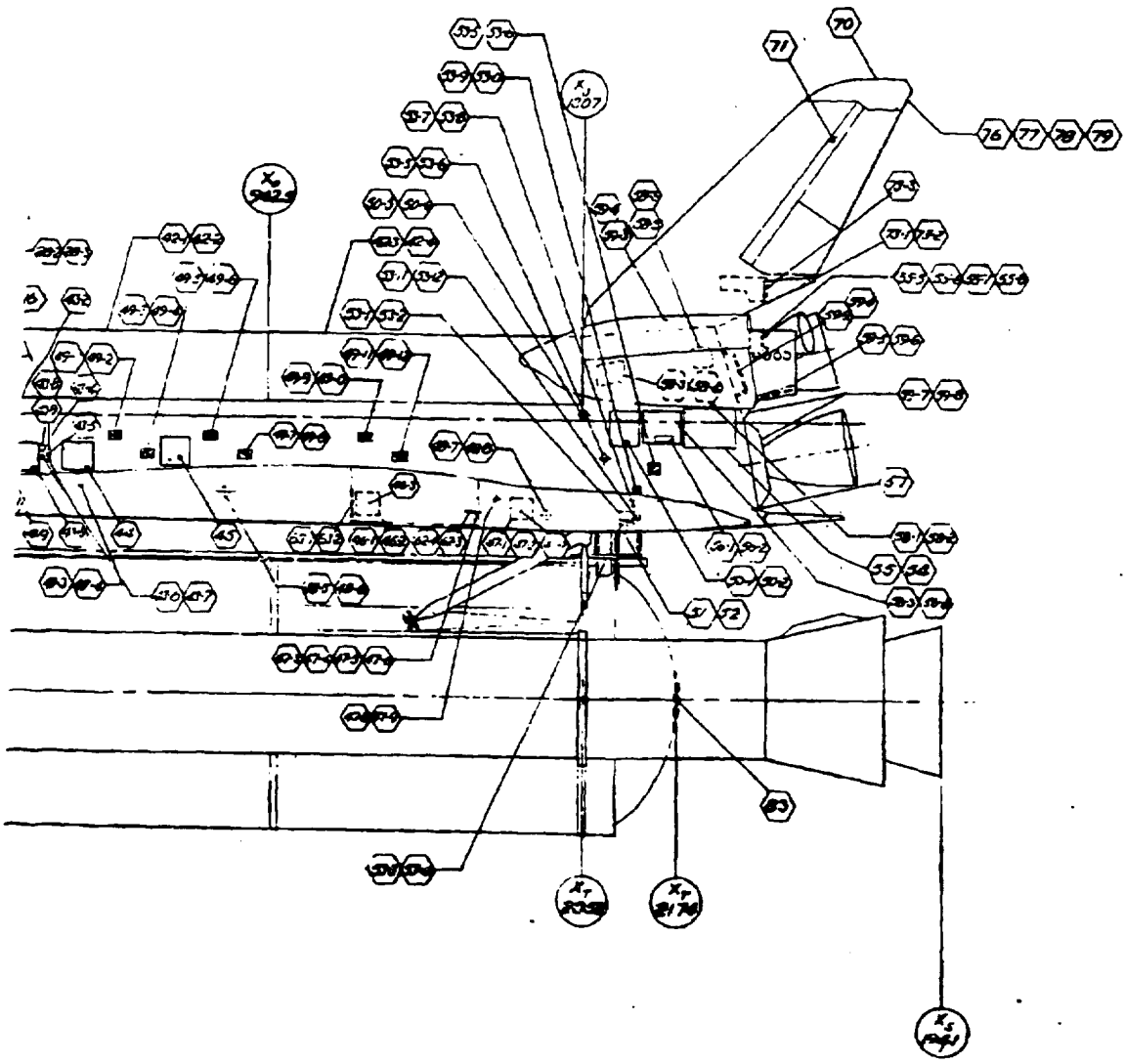


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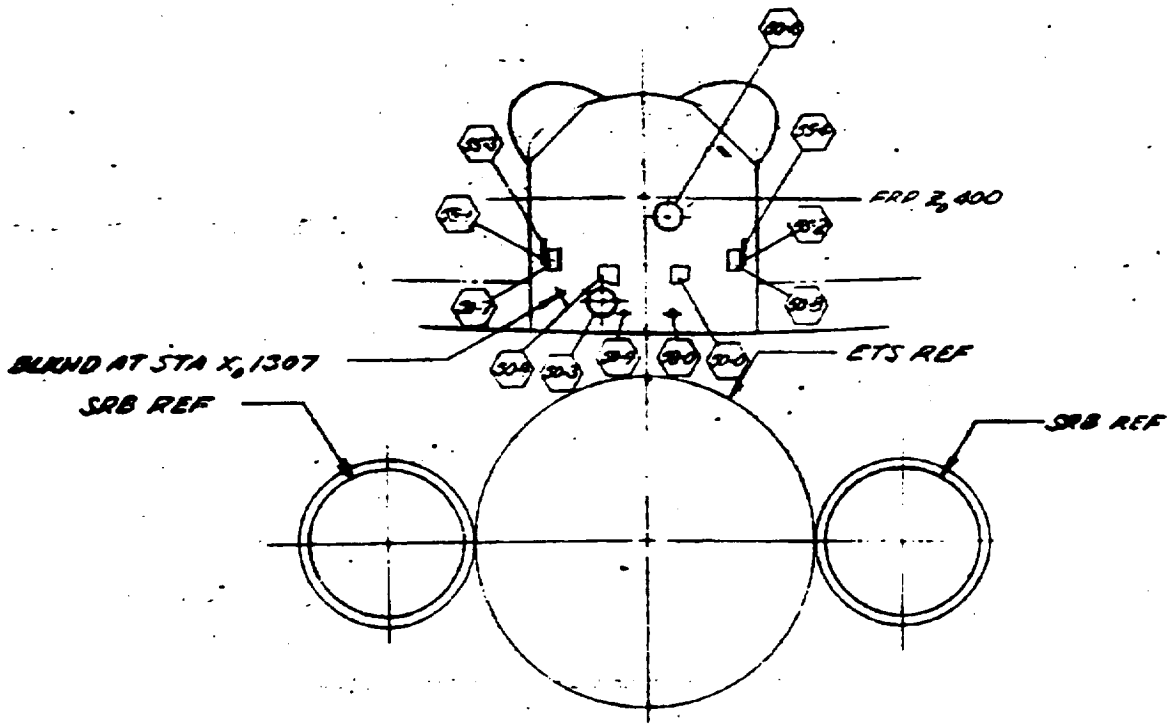
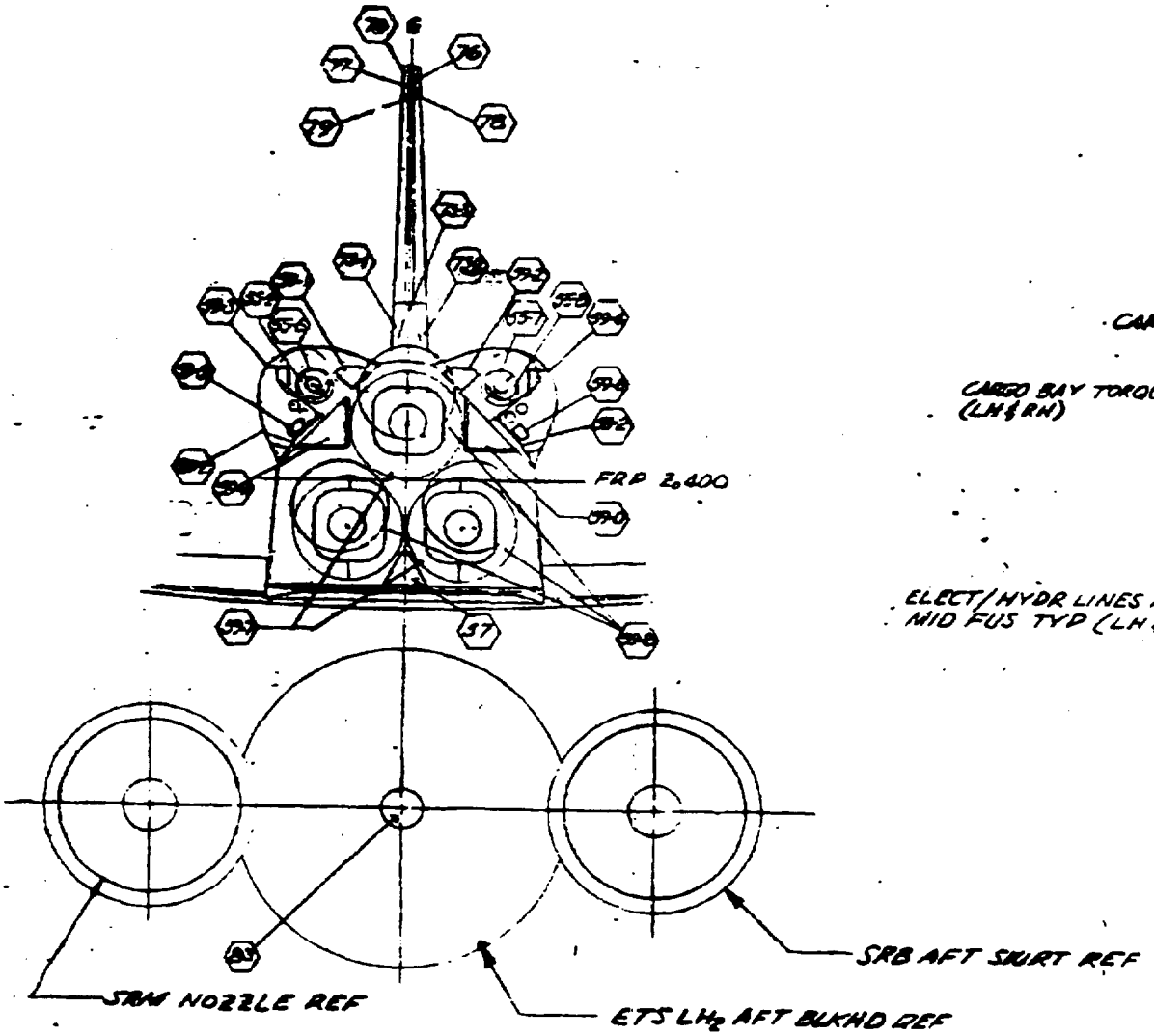
Figure 1.10.3. Shuttle Maintenance Access



VIEW LOOKING FWD AT BLKHD STA X_0 1307

FOLDOUT FRAME



VIEW LOOKING FWD

CARGO MODULE REF -

CARGO BAY TORQUE TUBE TYP (LH & RH)

FRP Z

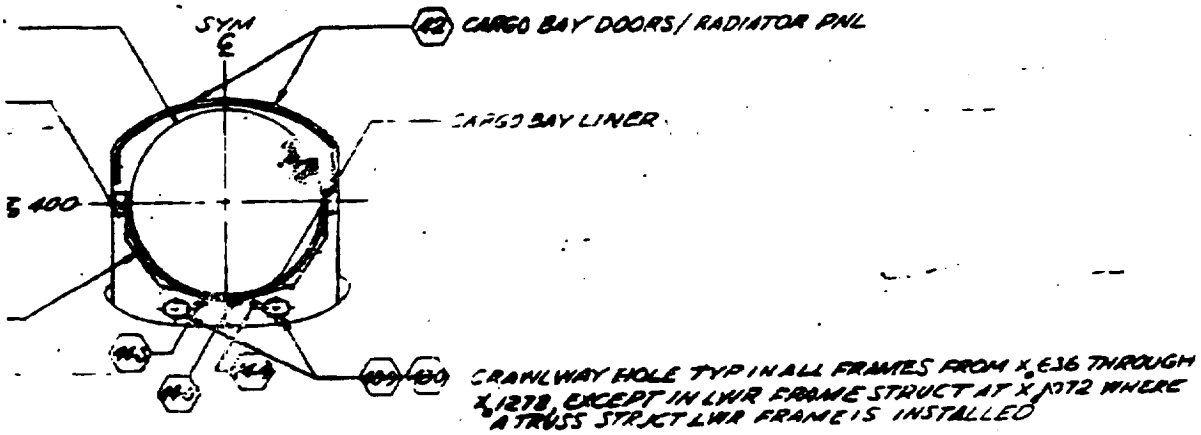
ELECT/HYDR LINES ROUTING T-RU MID FUS TYP (LH & RH)

VIEW L

JT FRAME

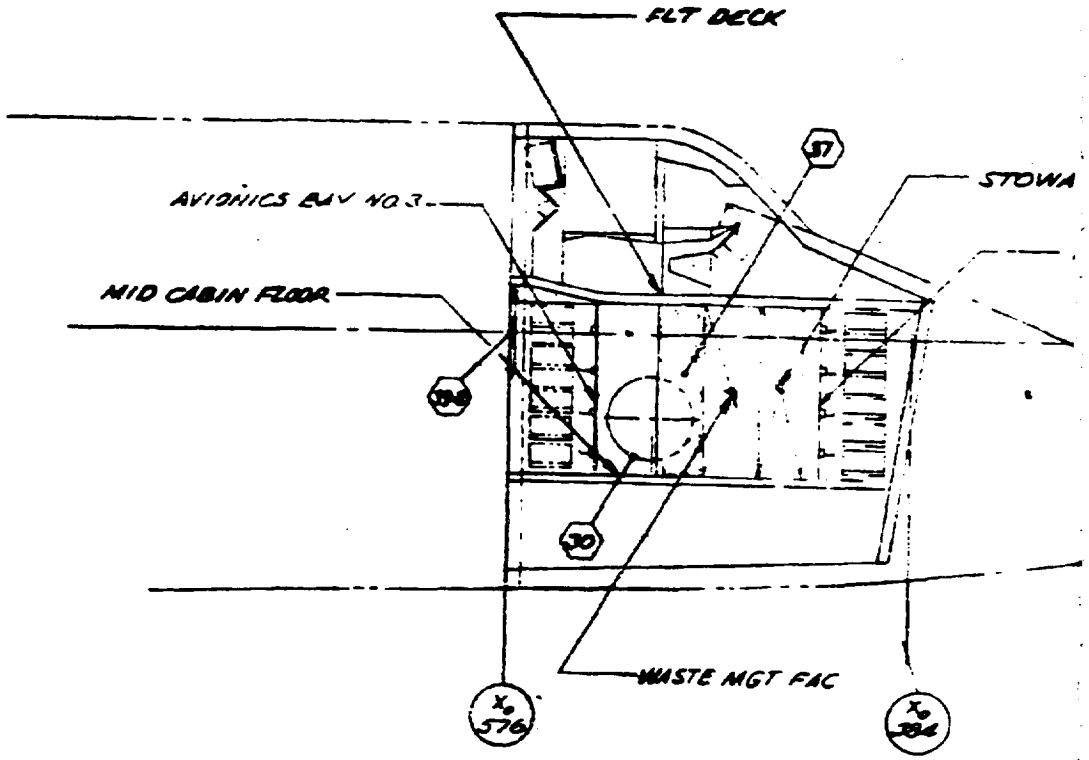
2

2 (M) 4



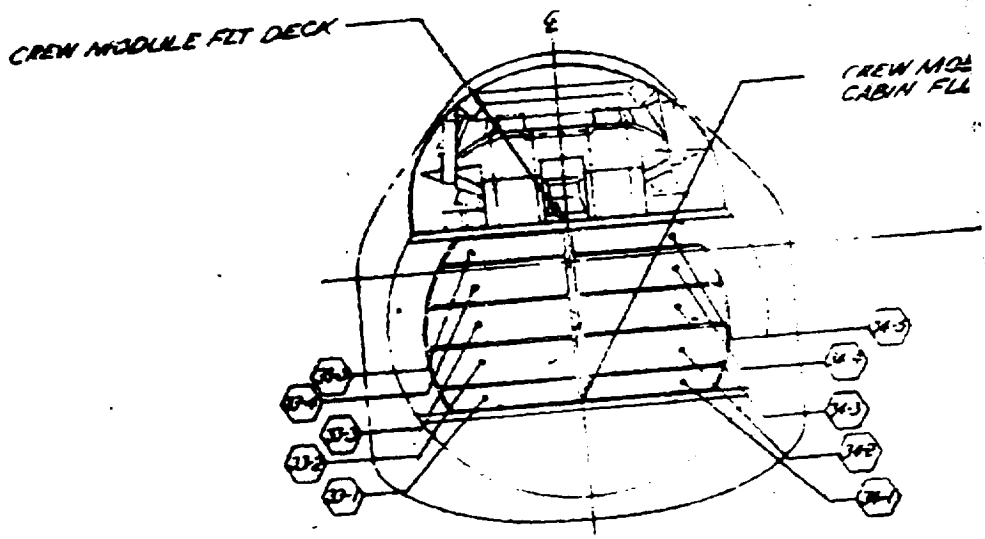
AME

Figure 1.10.4. Shuttle Maintenance Access -



VIEW F-F ROTATED CW 18(
(SCALE 1/40)

FOLDOUT FRAME



VIEW D-D SCALE 1/40

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AVIONICS BAY NO. 1

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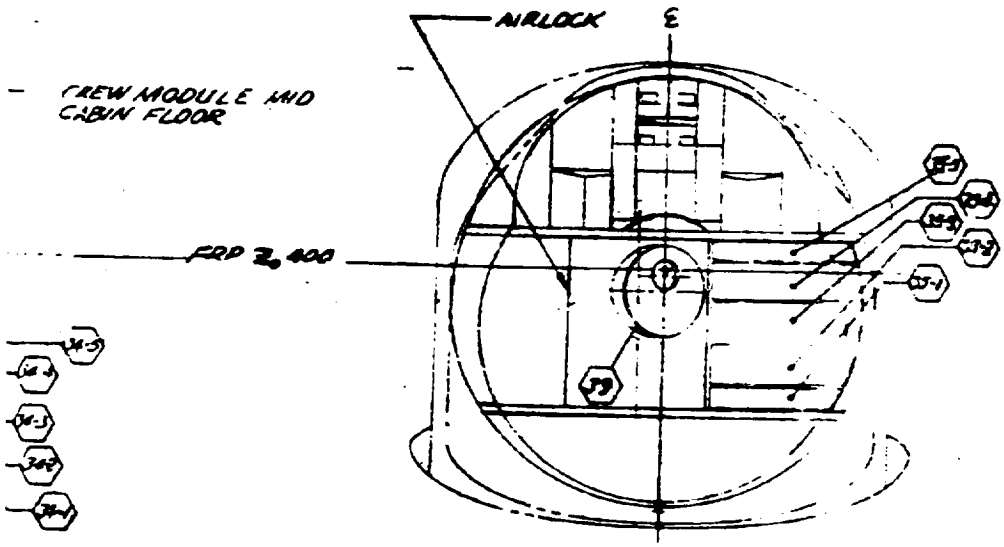
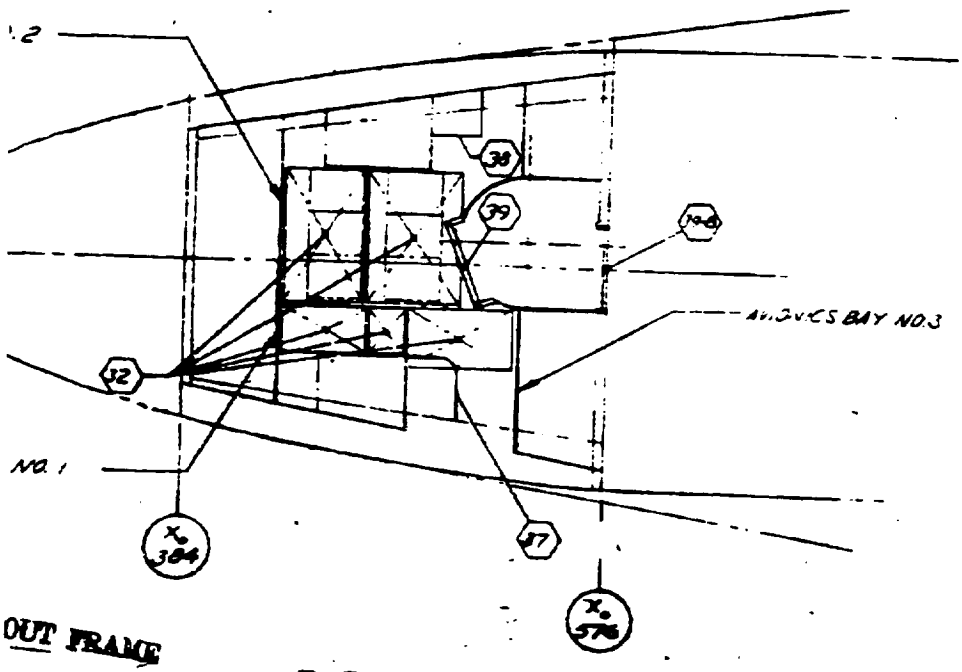
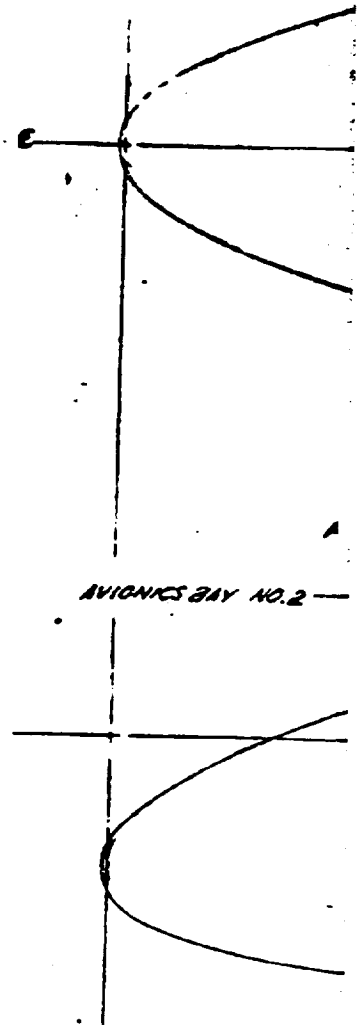


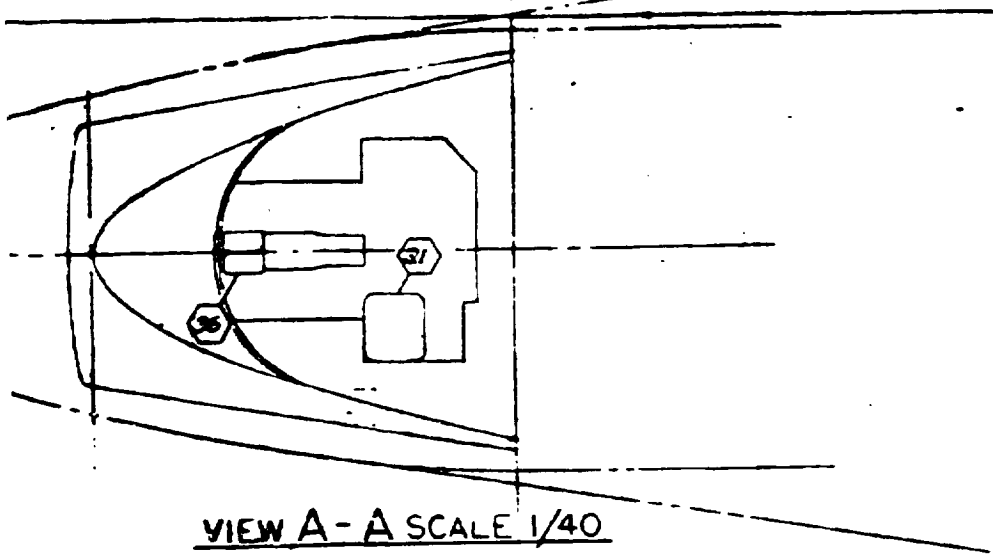
VIEW C–C SCALE 1/40



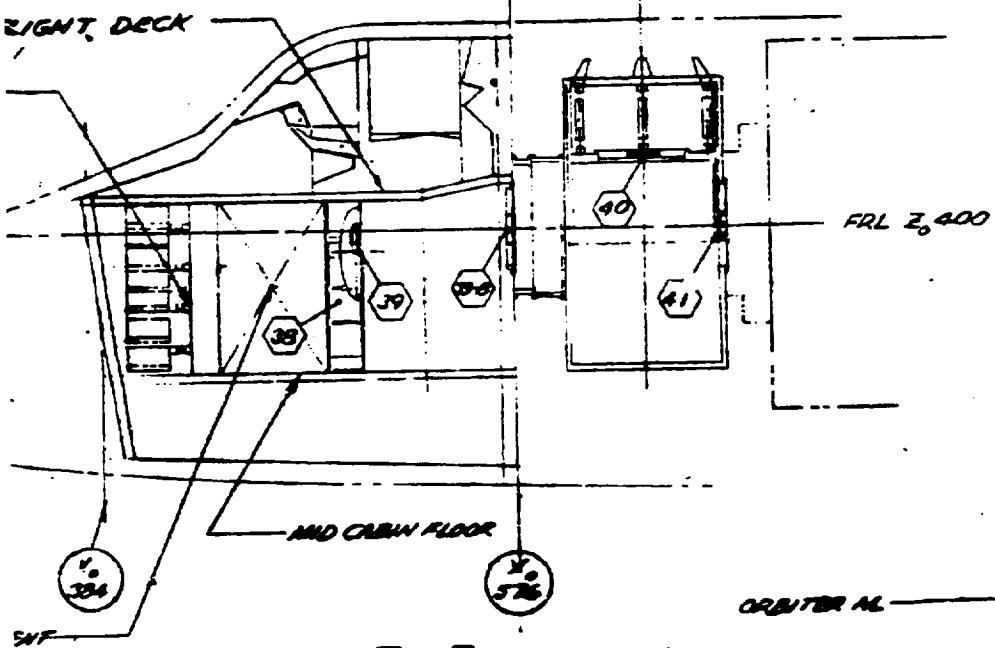
OUT FRAME

3 VIEW B-B SCALE 1/40

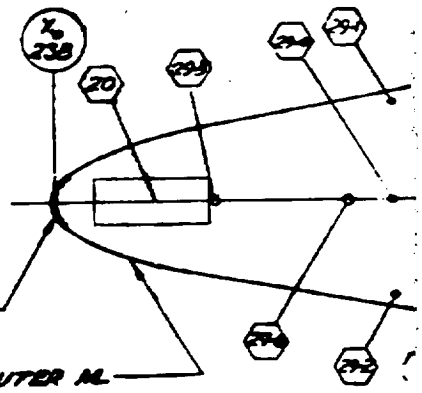


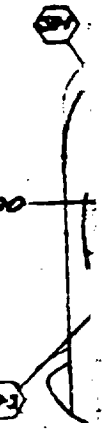


VIEW A - A SCALE 1/40



VIEW E - E SCALE 1/40





RAMP

ORBITE

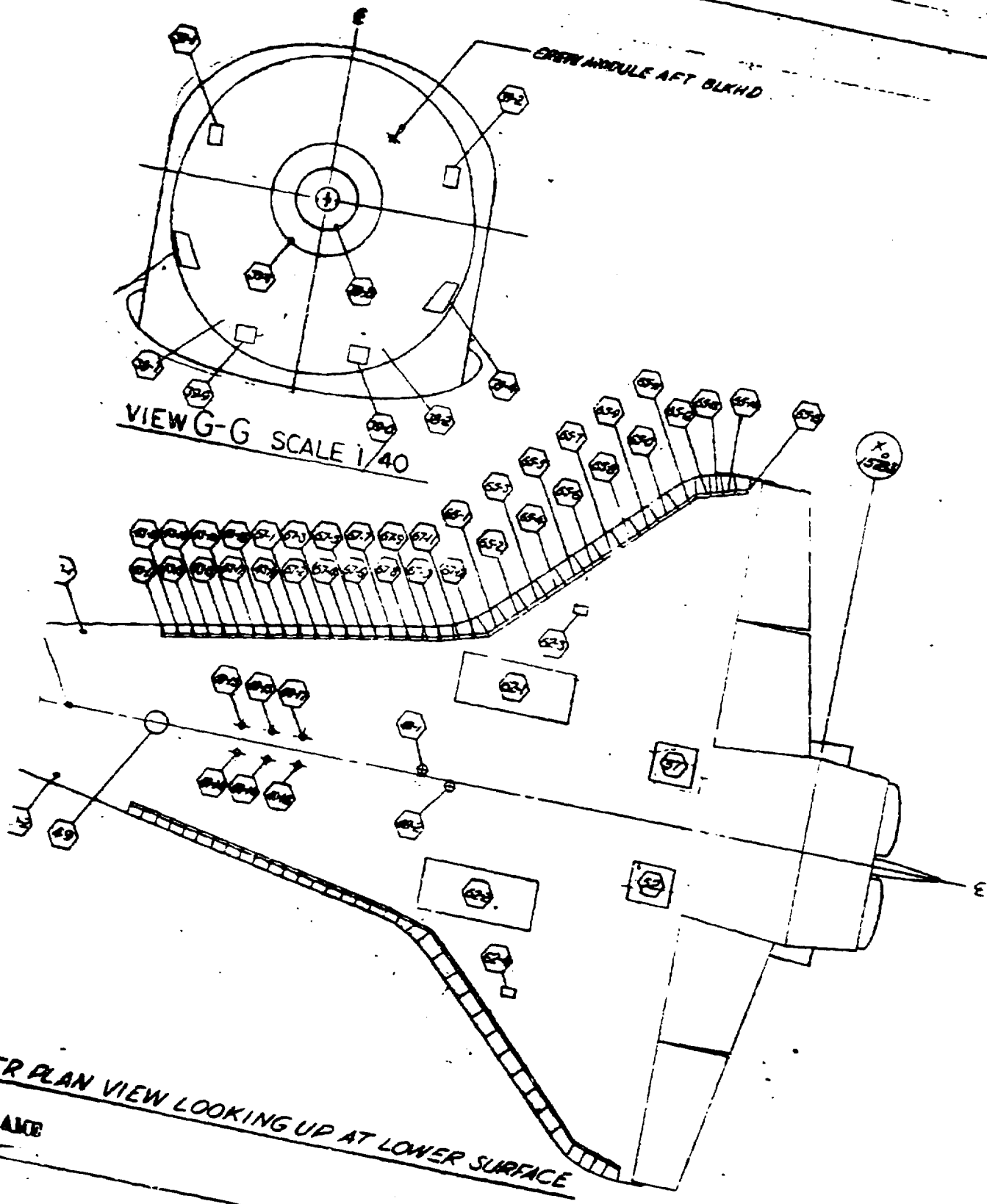
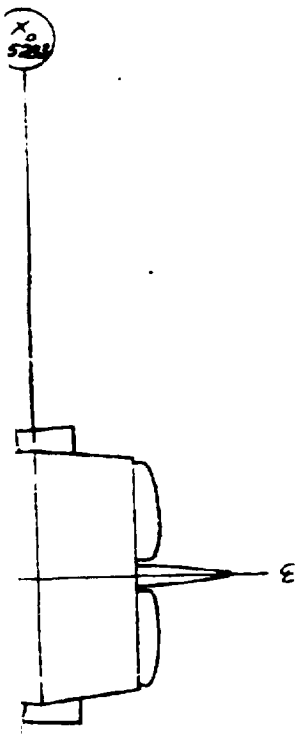


Figure 1.10.5. Shuttle Maintenanc



10.5. Shuttle Maintenance Access