logistics transport support system

SUPER HERCULES · GL207-45

Summary briefing

LOCKHEED AIRCRAFT CORPORATION

476L

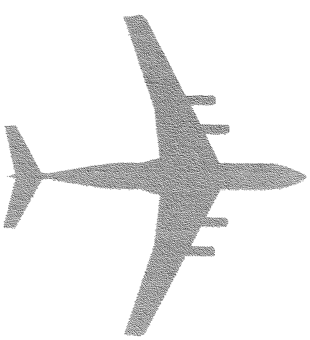
ETP 251

26 JANUARY 1961

summary briefing

W. A. Pulver Vice President and General Manager

SUPER HERCULES · GL207-45



476 Lockheed


MATS
U.S. AIR FORCE
USAF

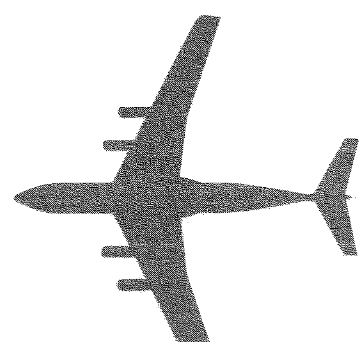
FIGURE INDEX

FIGURE INDEX (Cont'd.)

FIGURE INDEX (Cont'd.)

SUPER HERCULES · GL207-45

section 1



INTRODUCTION

This document contains the text and reproductions of the slides of the System 476L Proposal Summary Briefing presented by the Lockheed Aircraft Corporation to the USAF Evaluation Board on 31 January 1961. This briefing, covering as it does much of the significant material of the System 476L Proposal, is in fact a capsule version of the written proposal submitted 27 January 1961 in Lockheed Report ETP-250, Volumes 1 through 7.

Because of the 60-minute time limit on the briefing, certain important areas are touched on only lightly or not at all. It seemed more important to emphasize those areas which *are* covered in an *adequate* fashion than to attempt to mention every major subject inadequately. The briefing was prepared as a unit without the many distinct separations of subject areas typical of a proposal report. For this reason, there is no Table of Contents in this report.

Both introductory and concluding remarks were made by Mr. Robert E. Gross, Chairman of the Board and Chief Executive Officer. The text and slides of the complete briefing were presented as follows.

Opening Remarks—Mr. R. E. Gross

Technical Proposal—Mr. F. A. Cleveland

Program Management and Funding—Mr. W. A. Pulver

Summary—Mr. R. E. Gross

The relationship between the figures (which are black and white reproductions of colored slides) and the text is established by slide numbers appearing in the right hand margin of the latter. Where two slides are grouped on one page, that page appears immediately after the mention of the first slide number. A figure index is included to aid in locating specific slides.

SUPER HERCULES · GL207-45

section 2

OPENING REMARKS

R. E. GROSS

First, gentlemen, let me say that Lockheed considers this competition to be critically important. We know that it is important to you, also, and to the nation, and we are sympathetic with the demanding role you play in objectively appraising proposals from four major contractors. Lockheed, like the Air Force, has assigned high priority to the program.

I want you to meet several of my associates:

C. S. Gross, President of Lockheed,

H. L. Hibbard, our Senior Vice President — Engineering,

D. J. Haughton, Executive Vice President,

A. C. Kotchian, Group Vice President — Aircraft,

W. A. Pulver, Vice President and General Manager of the Georgia Division,

W. B. Rieke, Assistant General Manager of the Georgia Division and our proposed Program Manager for Support System 476L, and

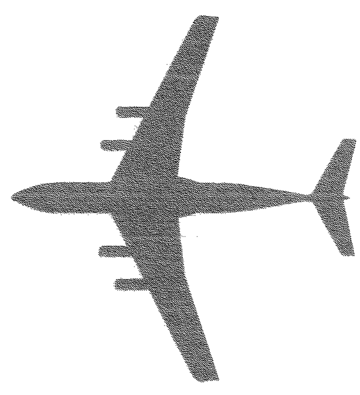
F. A. Cleveland, Chief Advanced Design Engineer and our proposed 476L Engineering Program Manager.

We have other men closely associated with the 476L program here with us today that I would introduce if time permitted. These men represent the specialized skill that makes the Georgia Division our cargo airplane headquarters.

The most important introduction to be made today is of the airplane. To Mr. Cleveland goes the privilege of introducing it to you and acquainting you with its characteristics and capabilities. Mr. Pulver will discuss the management aspects of our proposal. I will close the formal presentation for Lockheed with a few summary remarks.

SUPER HERCULES · GL207-45

section 3



TECHNICAL PROPOSAL

F. A. CLEVELAND

C620

"The Air Force is concerned over the trend toward steadily increasing unit costs of major weapon systems. Small increments of increased capability, marginal in relationship to overall weapon system effectiveness, have contributed to this increase in cost, particularly when a high degree of complexity is a factor. It is not necessary that each new weapon system have higher orders of complexity to achieve acceptable mission effectiveness. On the contrary, it is frequently this very complexity and higher-than-budgeted cost which either results in premature program termination or marginal effectiveness in operational service." C614

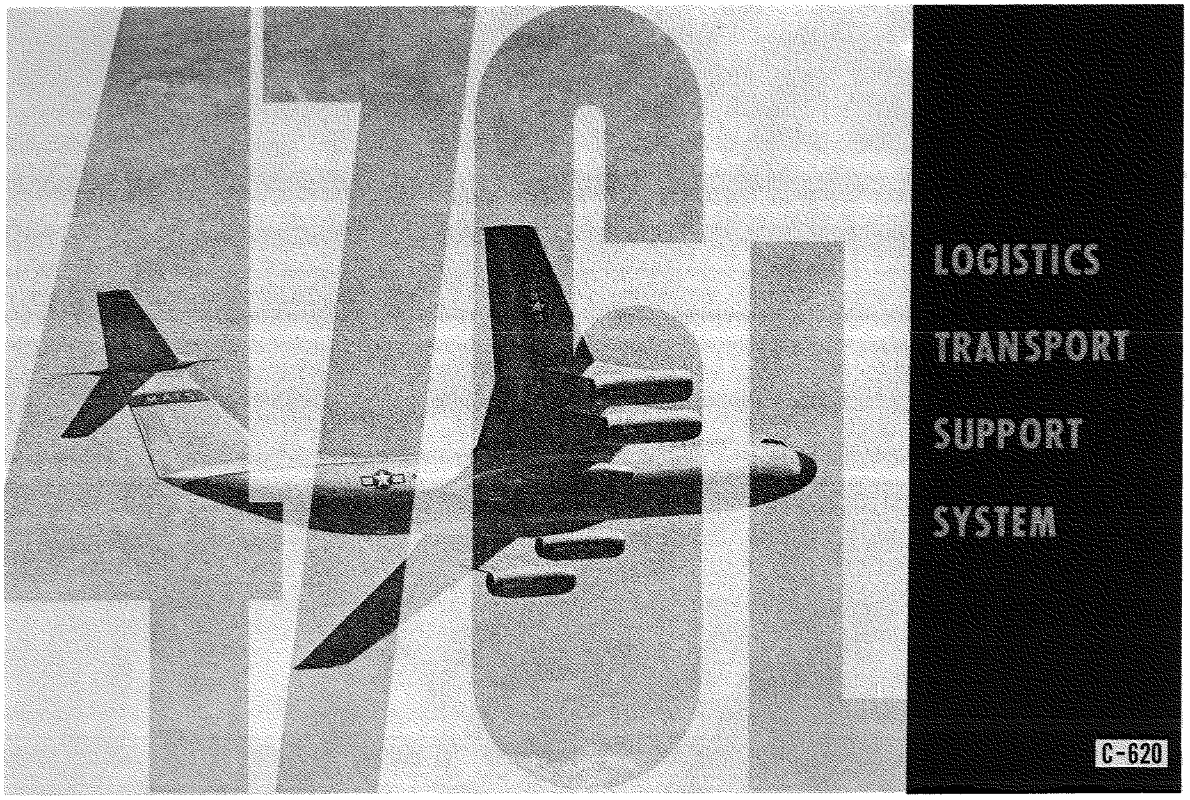
I know that you recognize these words. You stated them in the first portion of your work statement. I have taken the liberty of using them here since they state so completely and succinctly the philosophy which we have followed in the development of the GL 207 Super Hercules. We hope to satisfy you today as to the identity of your philosophy and that of our proposed system. C567

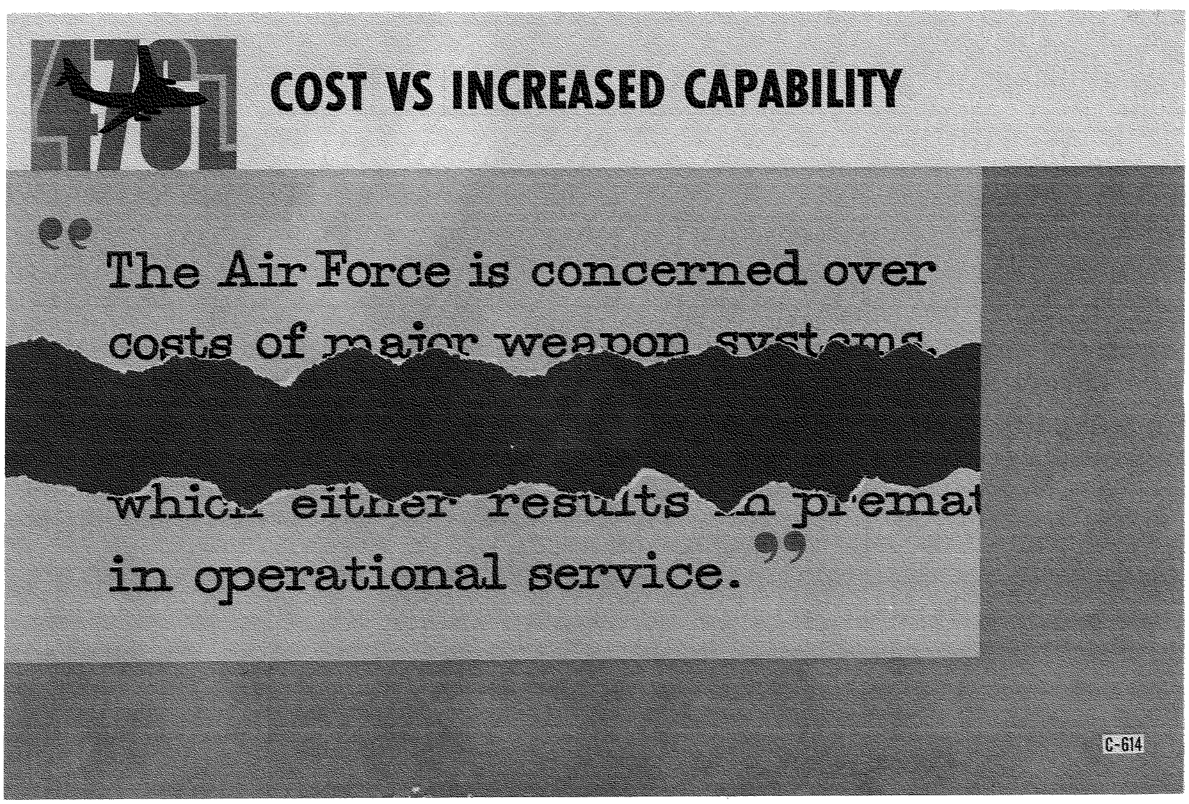
We will make our presentation in six basic sections: Background Studies and Philosophy; Selected Aircraft System; Aircraft System Performance and Flying Qualities; Proposed Developmental Program; Management, Production, and Support; and Funding. C597

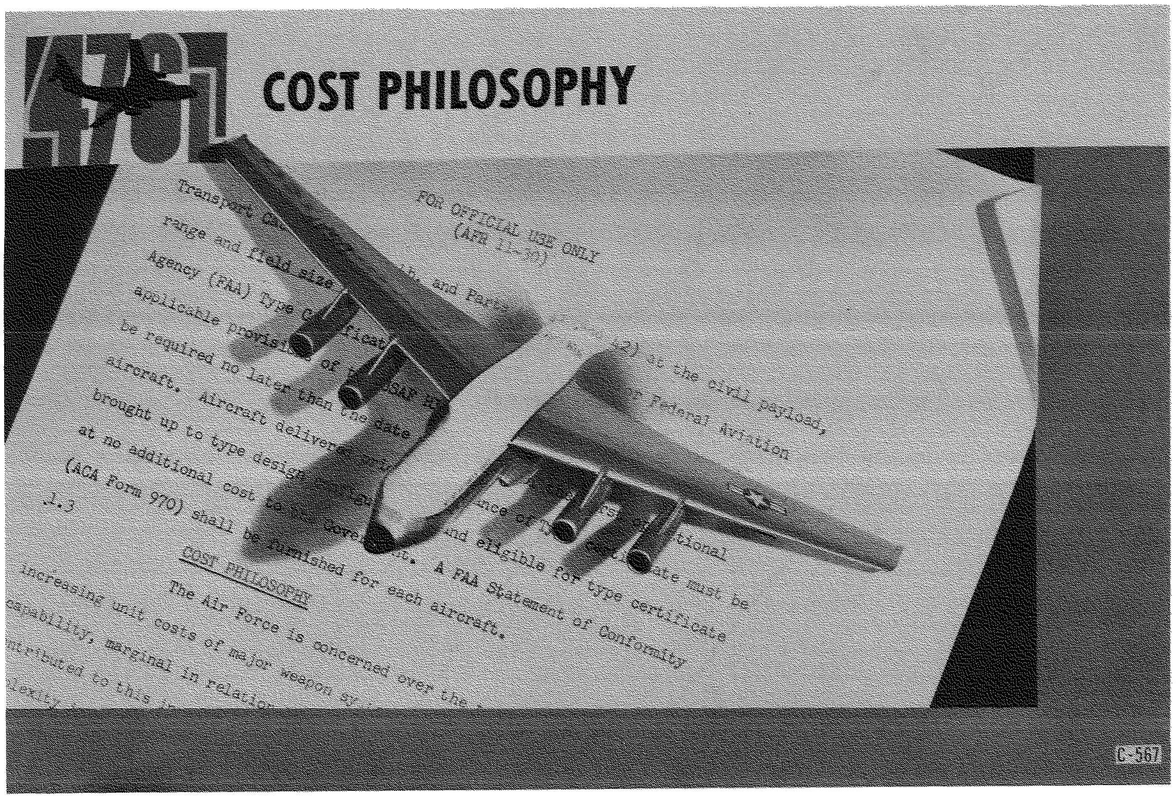
Lockheed has been constantly engaged in design study and analysis contemplating the modernization of the MATS' fleet since mid-1957. The very recent updating of all our work in this area has confirmed to us again the validity of certain convictions about basic parameters for the 476L airplane design. C611

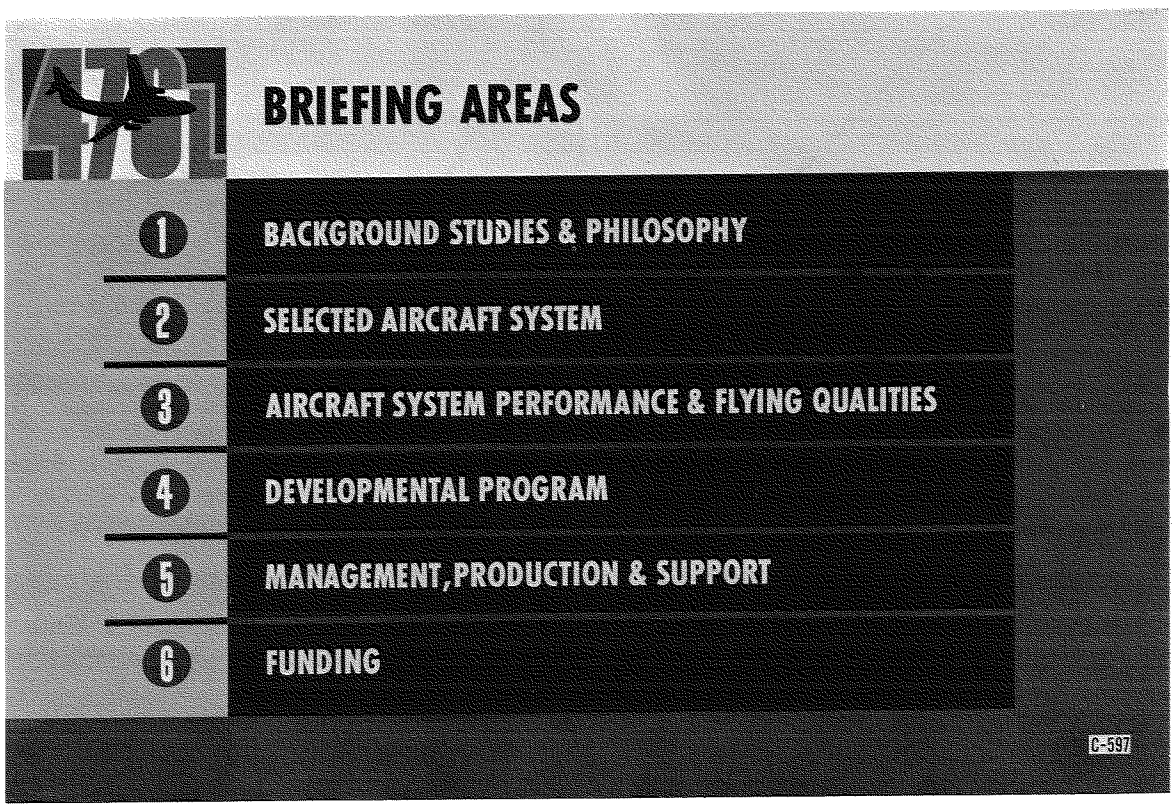
On a conventional configuration like the Super Hercules, where complete freedom of optimization of airframe design is permitted, cruise speed at a given level of thrust is primarily a function of wing sweep. For a thrust level of 18,000 pounds, as typified by the Pratt and Whitney JT3D-4, the optimum wing sweep is 25° and the most economical average cruise speed for the required mission is about 440 knots. If high-thrust power plants like the General Electric MF 239C-3 are available, the cruise speed can be 466 knots with 25° of sweep or 473 knots with 35° of sweep; the engine is insufficient for 45° of sweep. The possible increase in cruise speed then is only 7 knots if all other 476L performance requirements are met. This speed margin at 4,000 nautical mile range will result in a direct operating cost advantage of less than ¼ cent per ton mile for the most sophisticated airplane based on the highest thrust power plant. C581

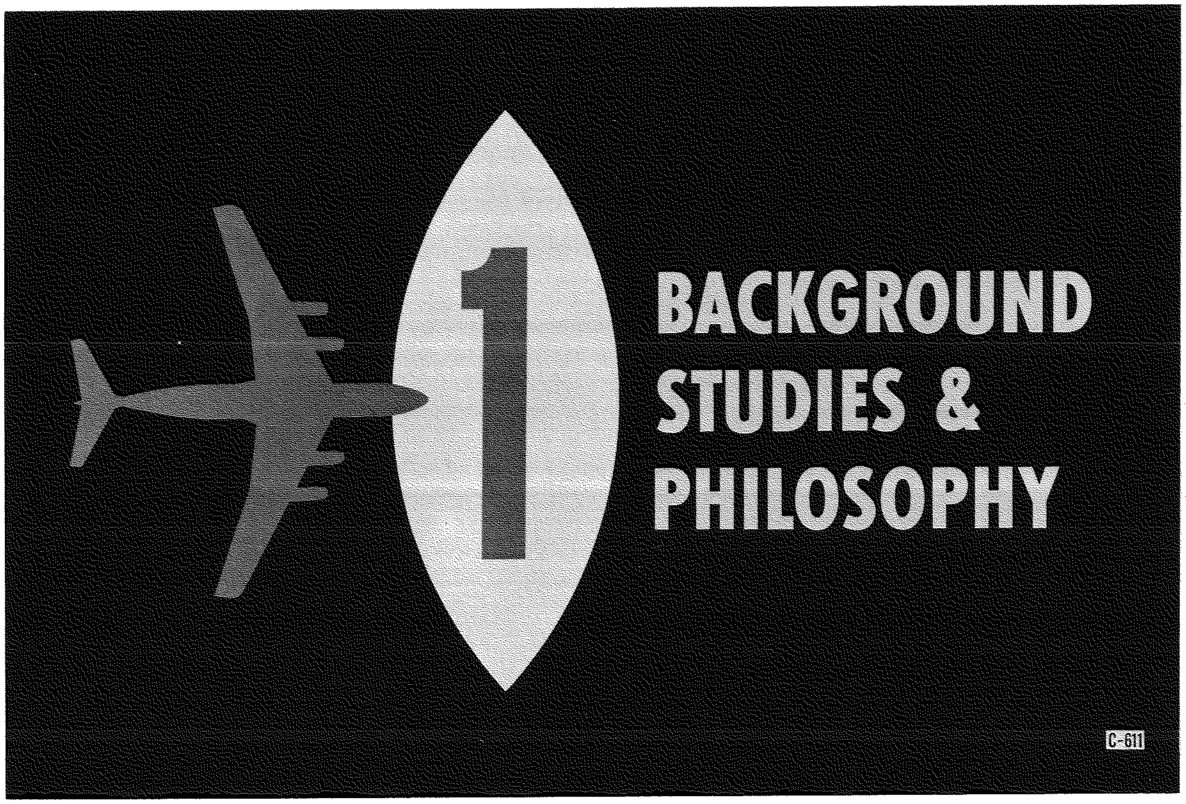
If, instead, the additional thrust is used to obtain more payload at a fixed cruise speed, the advantage is clearly with the airplane optimized at the lower C607

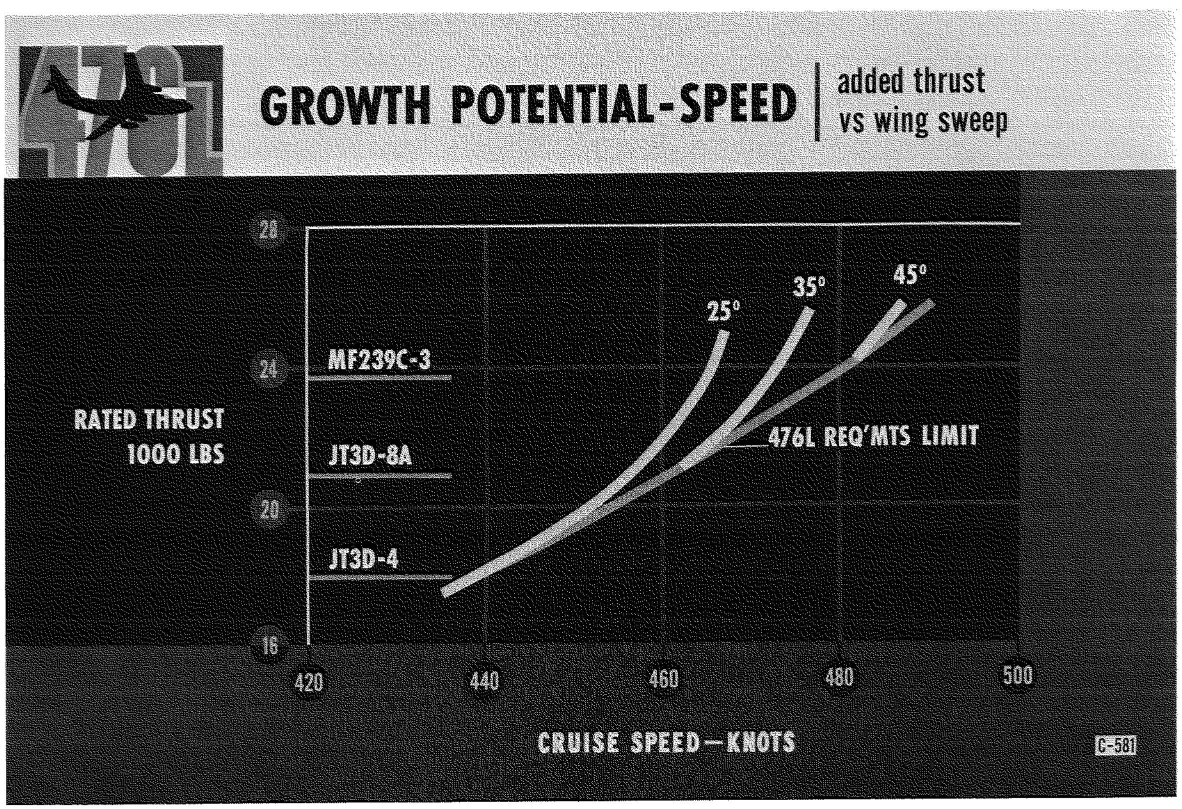

476L
LOGISTICS
TRANSPORT
SUPPORT
SYSTEM
C-620

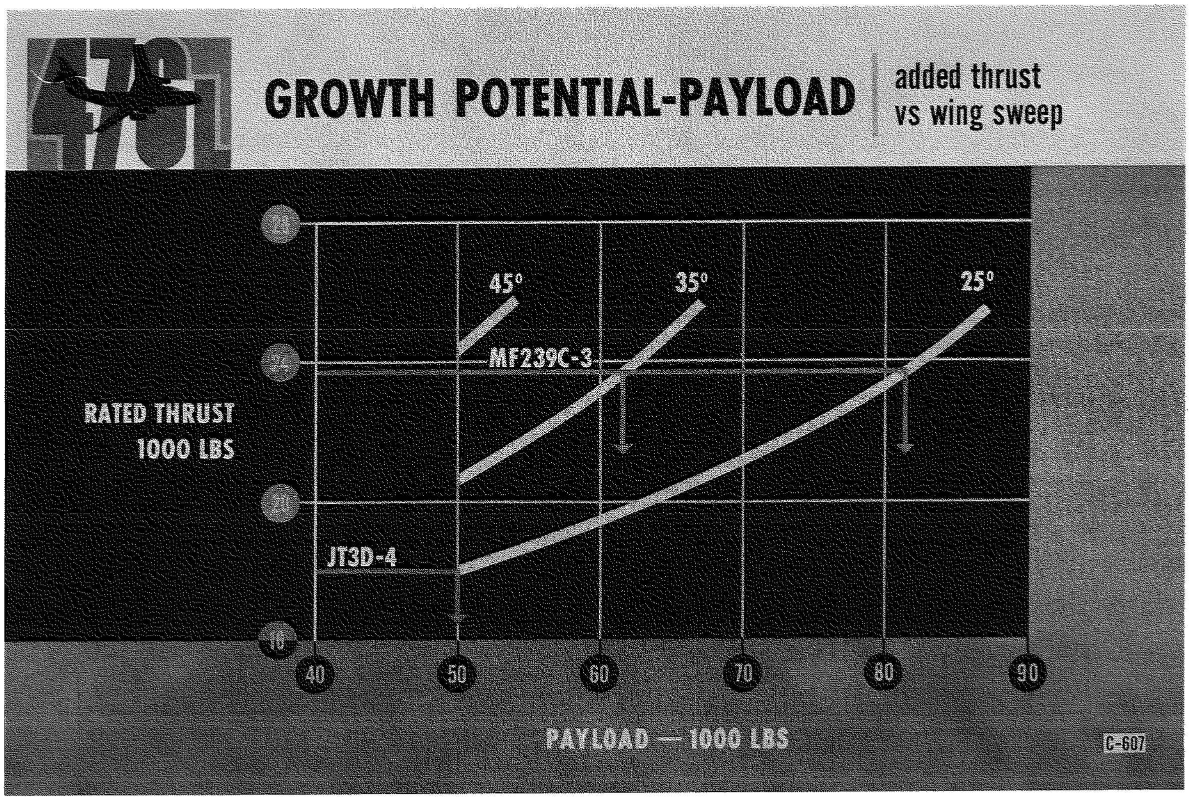

COST VS INCREASED CAPABILITY
"The Air Force is concerned over
costs of
in operational service."
C-614

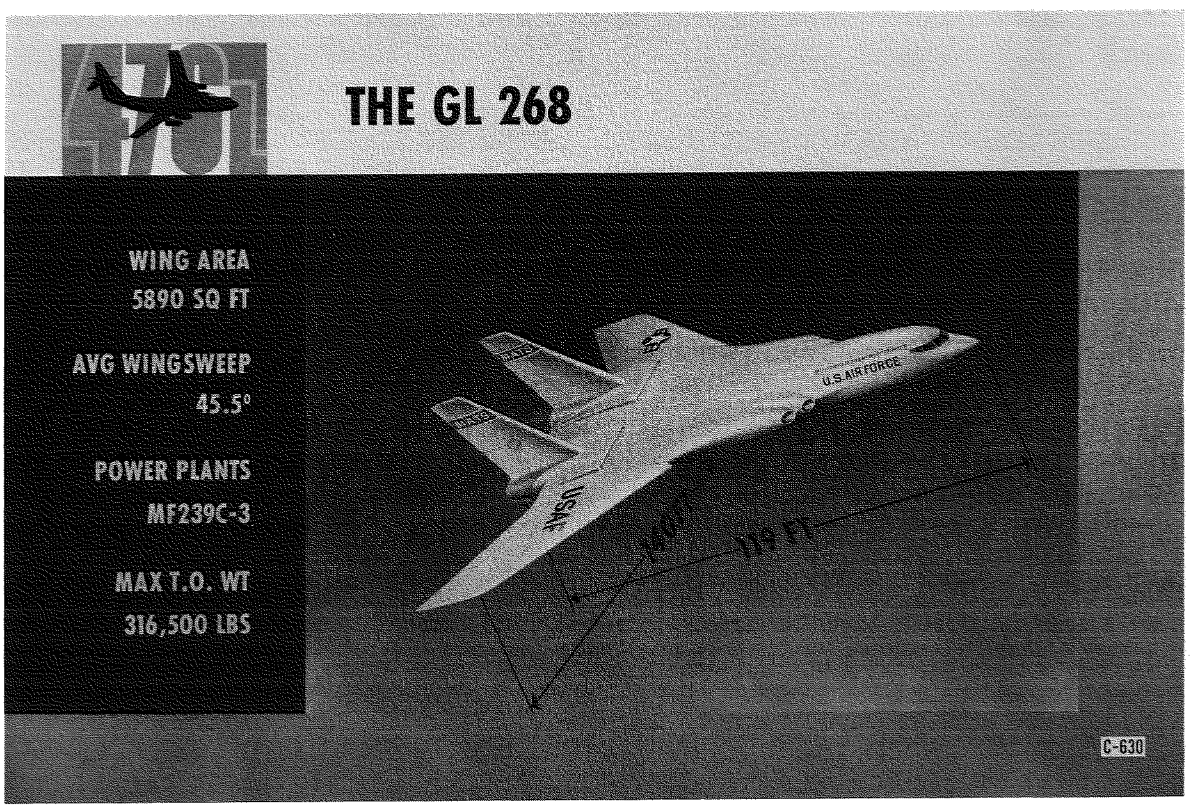

476L
COST PHILOSOPHY
FOR OFFICIAL USE ONLY
(AFR 11-30)
COST PHILOSOPHY
C-567


476L
BRIEFING AREAS
1 BACKGROUND STUDIES & PHILOSOPHY
2 SELECTED AIRCRAFT SYSTEM
3 AIRCRAFT SYSTEM PERFORMANCE & FLYING QUALITIES
4 DEVELOPMENTAL PROGRAM
5 MANAGEMENT, PRODUCTION & SUPPORT
6 FUNDING
C-597


1
BACKGROUND
STUDIES &
PHILOSOPHY
C-611


476L
GROWTH POTENTIAL-SPEED
added thrust
vs wing sweep
RATED THRUST
1000 LBS
28
24
20
16
MF239C-3
JT3D-8A
JT3D-4
25°
35°
45°
476L REQ'MTS LIMIT
420
440
460
480
500
CRUISE SPEED—KNOTS
C-581


GROWTH POTENTIAL-PAYLOAD
added thrust
vs wing sweep
45°
35°
25°
MF239C-3
JT3D-4
RATED THRUST
1000 LBS
28
24
20
16
40
50
60
70
80
90
PAYLOAD — 1000 LBS
C-607


THE GL 268
WING AREA
5890 SQ FT
AVG WINGSWEEP
45.5°
POWER PLANTS
MF239C-3
MAX T.O. WT
316,500 LBS
U.S.AIR FORCE
USAF
MATS
140 FT
119 FT
C-630

wing sweep. The margin in this case is over 20,000 pounds of payload for the required 4,000 nautical miles. This margin, reflected in direct operating costs, means that the airplane with 25° of sweep will enjoy a direct operating cost 1.0 cent per ton mile less than that with 35° of sweep.

We have also studied more radical design approaches directed toward exploiting high-thrust power plants to achieve maximum cruise speeds. This lambda-wing GL 268 represents the degree of sophistication required to achieve highest possible cruise speeds. C630

At a take-off weight of 316,500 pounds the 268 can, from a 6,000 foot CAR runway, transport 50,000 pounds of payload for 4,000 nautical miles at an average cruise speed of Mach 0.91; or at an average cruise speed of Mach 0.88, the payload can be raised to 59,300 pounds. C590

We have analyzed this airplane quite thoroughly and have a substantial amount of data, including wind tunnel tests, in support of it, but its operational cost per flight hour is higher than any conventional arrangement and its operating cost per ton mile at 4,000 nautical miles is about 1.0 cent higher than that of a Super Hercules powered with the same high-thrust power plants. Its developmental costs are greater and its date of operational availability would be about a year later than that of the Super Hercules. We feel that it gives you much more than you requested, later than you want it, for more than we think you want to pay. C568

Perhaps the essence of all this is best indicated by considering possible airplane and engine choices in terms of their operating cost savings to MATS, compared to the costs of the present MATS channel traffic fleet. If all airplanes are flown an average of 5 hours per day, the cumulative operating cost saving for a Super Hercules with a JT3D-4 fan is indicated by the white curve. The same airplane, if initially powered by the JT3D-8A, would be available six months later and results in the orange curve. Or, combining these, 36 JT3D-4 powered airplanes can be delivered, and all subsequent ones can be equipped with the JT3D-8A, resulting in the dashed orange curve taking off from the white one at the 37th airplane. This approach, of course, has the additional virtue of easing the tremendous engine schedule pressure dictated by an airplane which *must* have a high-thrust engine initially and gives you the opportunity to program the high-thrust engine development in an orderly fashion. The curves for MF239C-3 powered airplanes—a Super Hercules in yellow or a lambda-wing GL 268 in green—start somewhat later as dictated by engine and airplane development schedules, respectively. It is obvious that no airplane program dependent initially on any high-thrust power plant can ever catch up, in terms of cost savings, with a program initially using the JT3D-4 and subsequently using the JT3D-8A. The possibility of further growth to an -8B enhances the validity of the comparison. C631

Based on this background we have developed and present for your consideration the Lockheed GL 207-45 Super Hercules airplane, designed to comply with all military and F.A.A. specifications and requirements and to meet or better every single stipulation of your 476L work statement. C609

In its basic design and manufacturing philosophy, it leans heavily on the C-130 series. It has the identical fuselage cross section. The structural design concept C618

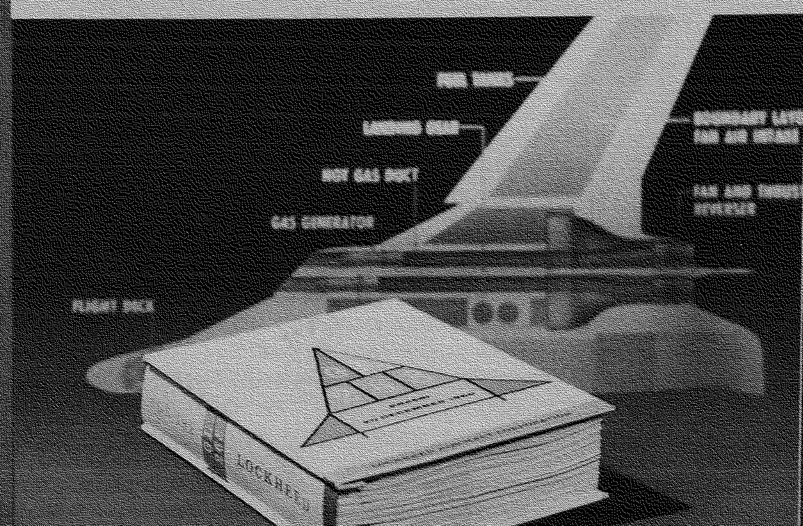
GL 268 PERFORMANCE SUMMARY

powered with 4 GE MF239C-3 turbofans

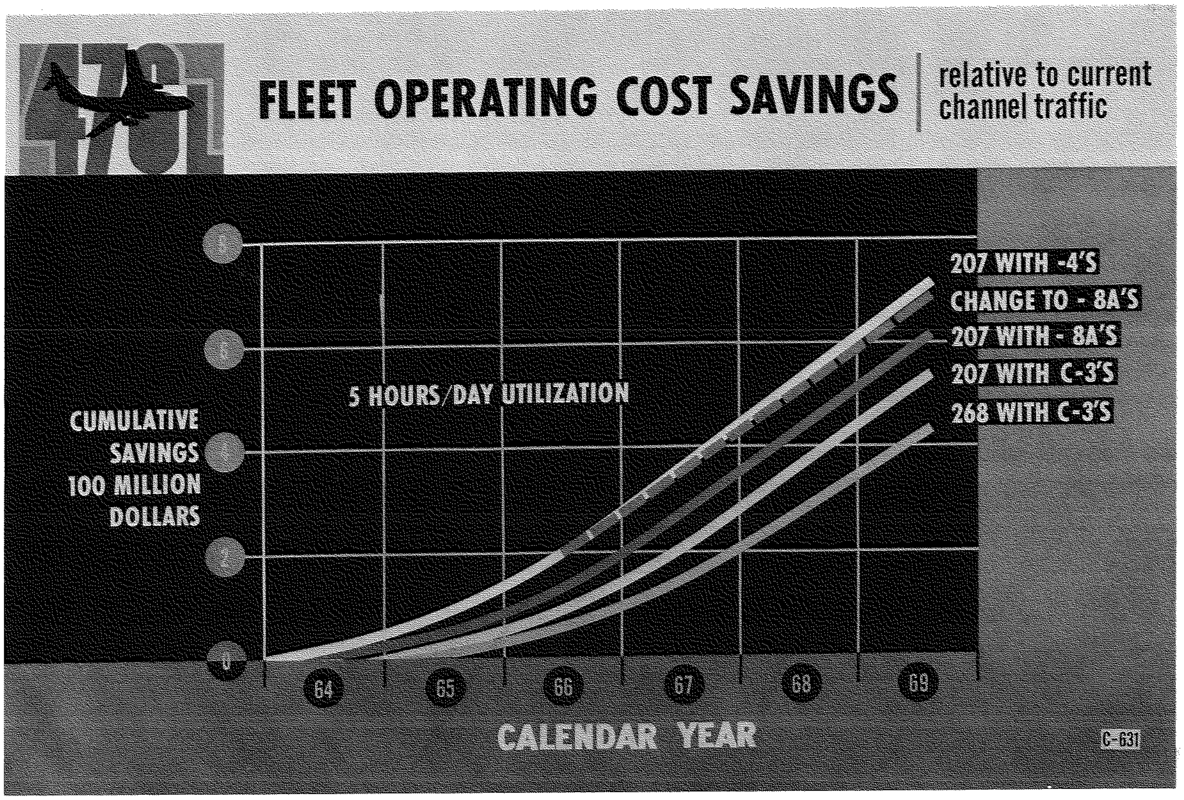
316,500	LBS	TAKEOFF WEIGHT
6,000	FT	CAR CRITICAL FIELD LENGTH
50,000	LBS	PAYLOAD
4,000	N.M.	RANGE
0.907	MACH	AVERAGE CRUISE SPEED
	OR	
0.88	MACH	AVERAGE CRUISE SPEED
59,300	LBS	PAYLOAD
4,000	N.M.	RANGE

C-590

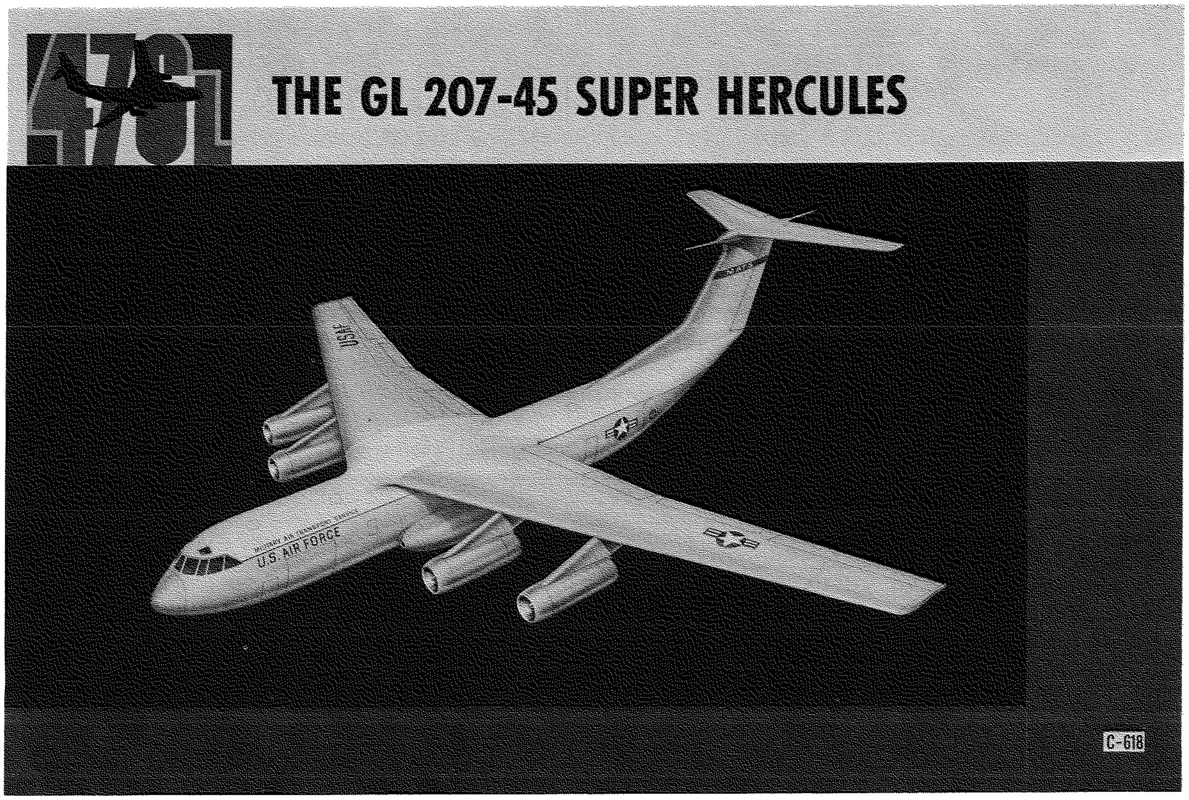
GL 268 DATA | description performance & substantiating data

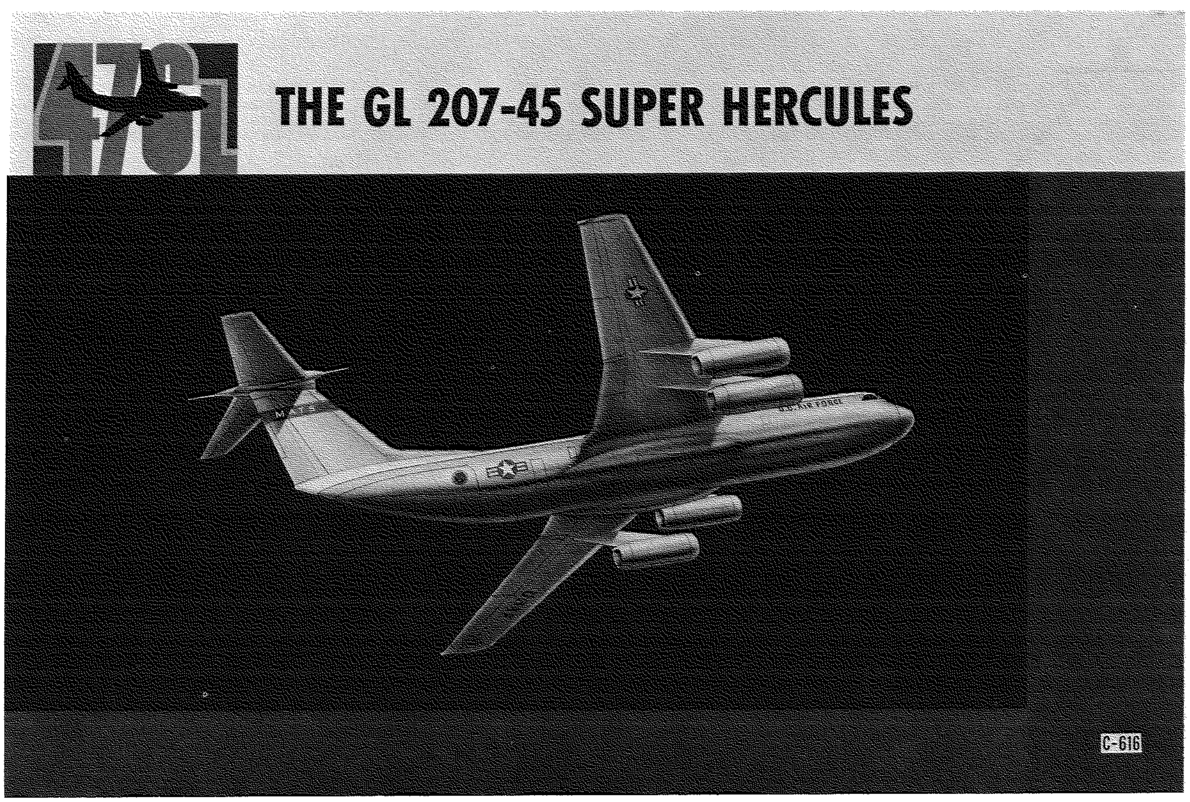


C-568


FLEET OPERATING COST SAVINGS
relative to current channel traffic
5 HOURS/DAY UTILIZATION
CUMULATIVE SAVINGS 100 MILLION DOLLARS
207 WITH -4'S
CHANGE TO - 8A'S
207 WITH - 8A'S
207 WITH C-3'S
268 WITH C-3'S
64
65
66
67
68
69
CALENDAR YEAR
C-631


2
SELECTED
AIRCRAFT
SYSTEM
C-609


THE GL 207-45 SUPER HERCULES
USAF
U.S. AIR FORCE
C-618


THE GL 207-45 SUPER HERCULES
C-616

and much of the functional subsystems are developed directly from those of the C-130 series. It is designed from start to finish with the intent of providing at the earliest possible date and at the least possible cost an outstanding 476L cargo airplane. It is based on both the JT3D-4 and its growth into the higher thrust JT3D-8A. C616

Let's see how this growth compatibility comes about. The maximum gross weight with the JT3D-8A engine which will meet your take-off critical field length is 315,000 pounds; when the structure is designed for this weight, this exact airframe, when powered with JT3D-4 power plants, meets all of the Statement of Work performance requirements at a take-off gross weight of 287,200 pounds. This complete compatibility of design between initial and growth versions of the airplane and initial and growth versions of its power plant has further strengthened our assurance regarding our propulsion system selection. C602 C579

Looking now at the airplane in more detail: C598

—Design equipped-weight empty is 127,000 pounds, including 463L pallets & rails.

—Design payload is 70,000 pounds. Alternate payloads of 80,000 pounds to 93,000 pounds are useable.

—Maximum fuel load is 150,000 pounds.

—Though maximum take-off weight is 315,000 pounds, that required to meet all system 476L requirements is only 287,200 pounds.

—Maximum landing weight is 257,500 pounds, substantially greater than the minimum permitted by 476L requirements.

The interior arrangement is conventional and much like that of the C-130 series. The combination cargo ramp and pressure door is a very important feature. When in the closed position, as shown here, it eliminates pressurization loads from the aft fuselage doors, which greatly reduces the structural design and sealing problems there. C608

The basic airplane structure is conventional and is derived from the C-130 design. The wing is of conventional box-beam construction with aluminum alloy sheet for leading edges and trailing edges and integrally stiffened box-beam skins which fuel seal the entire box. C628

The empennage structure is conventional multi-spar skin and rib for fixed surfaces and single spar skin and rib for movable surfaces. Lockheed has, of course, successfully built 325 Mach 2.0 F-104's with T-tails. The high stabilizer of the 207 is completely out of danger from equipment in the loading area on the ground. Because boosted, rather than irreversible, controls are used, failures like those of the Navy Seamasters cannot occur.

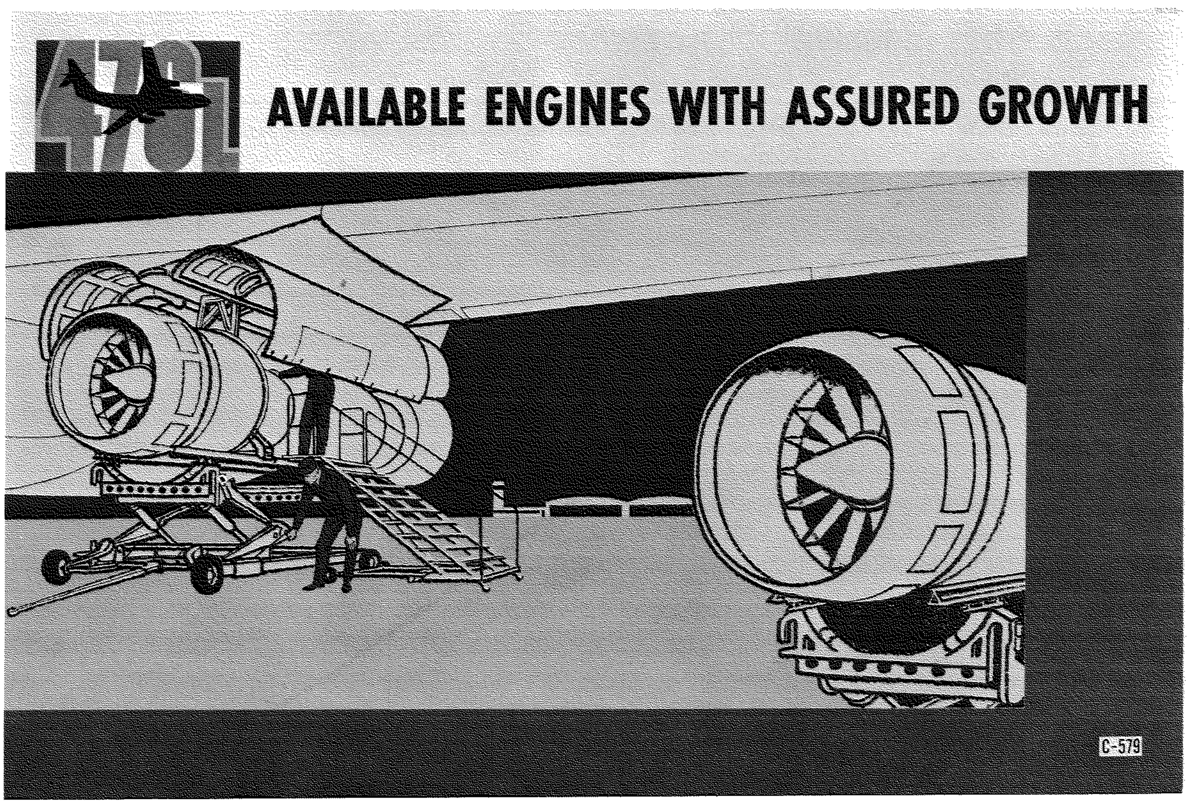
The fuselage is mainly of conventional longeron, ring, and skin construction. Fatigue-resistant fail-safe structural design is used throughout. Three large built-up frames carry wing and gear loads into the fuselage. This arrangement C638

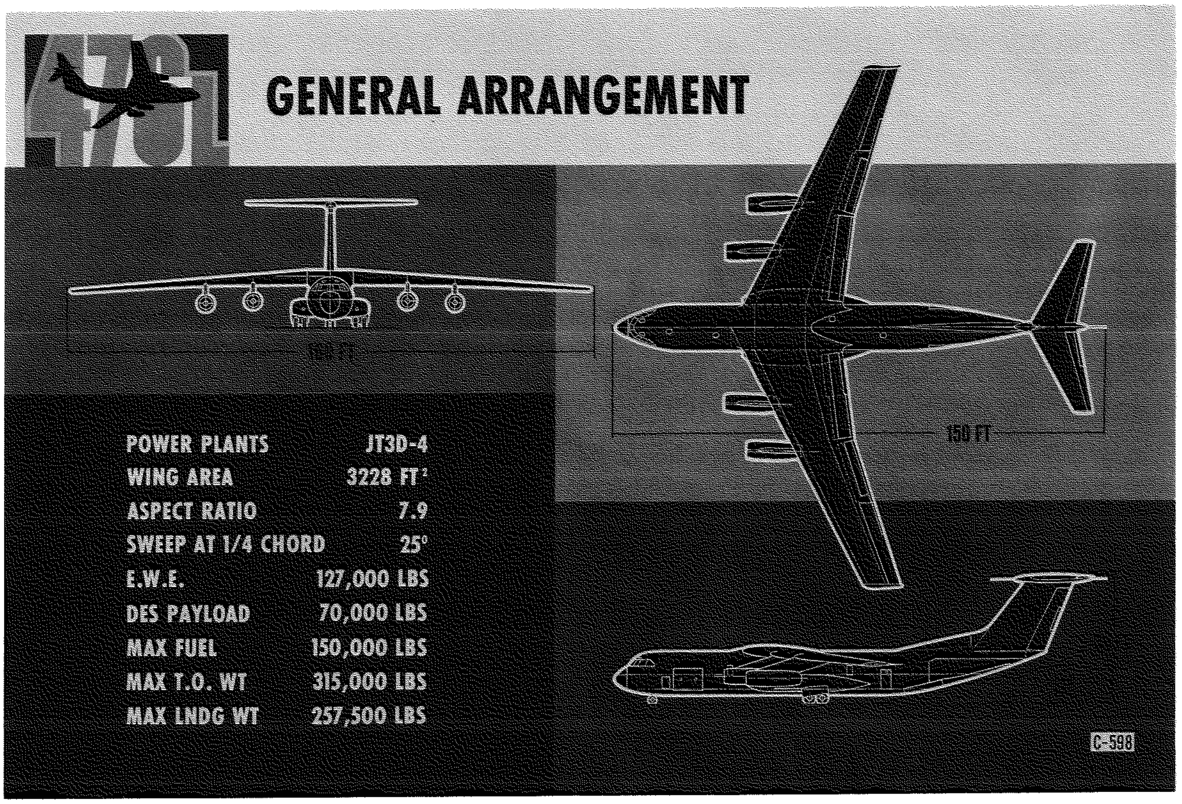
476L AIRPLANE COMPATIBILITY WITH -4 AND -8A

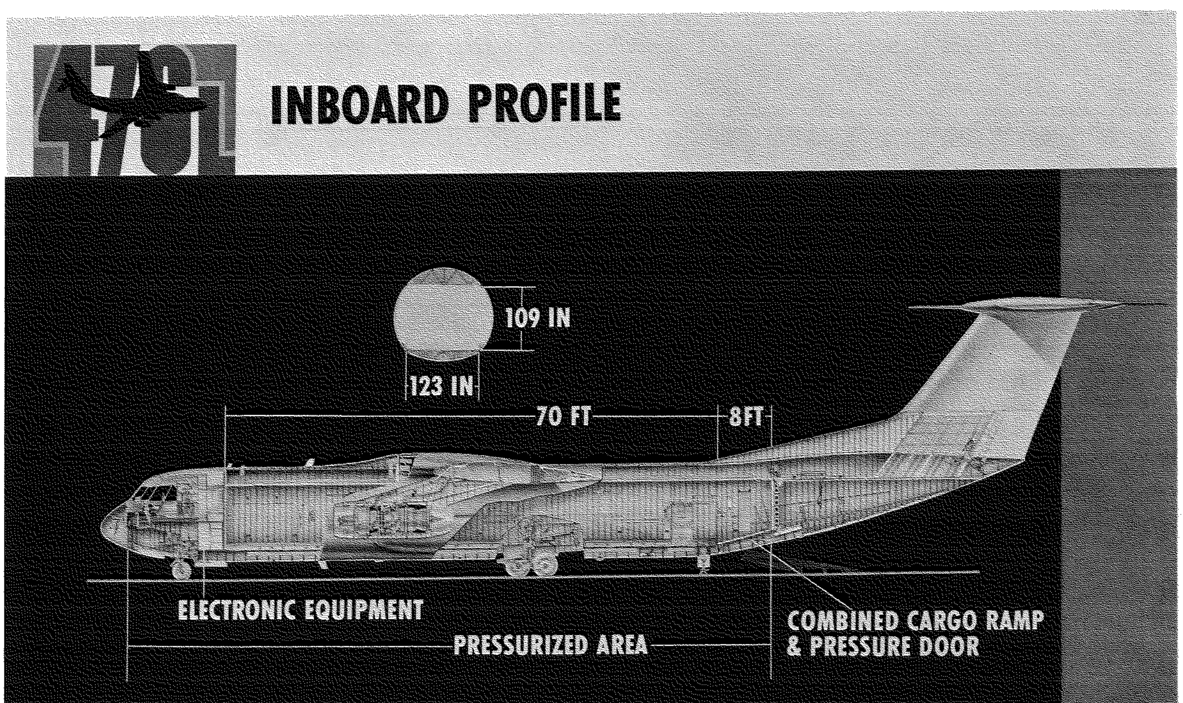
1. MAX T.O. WT FOR 6,000 FT WITH JT3D-8A = 315,000 LBS

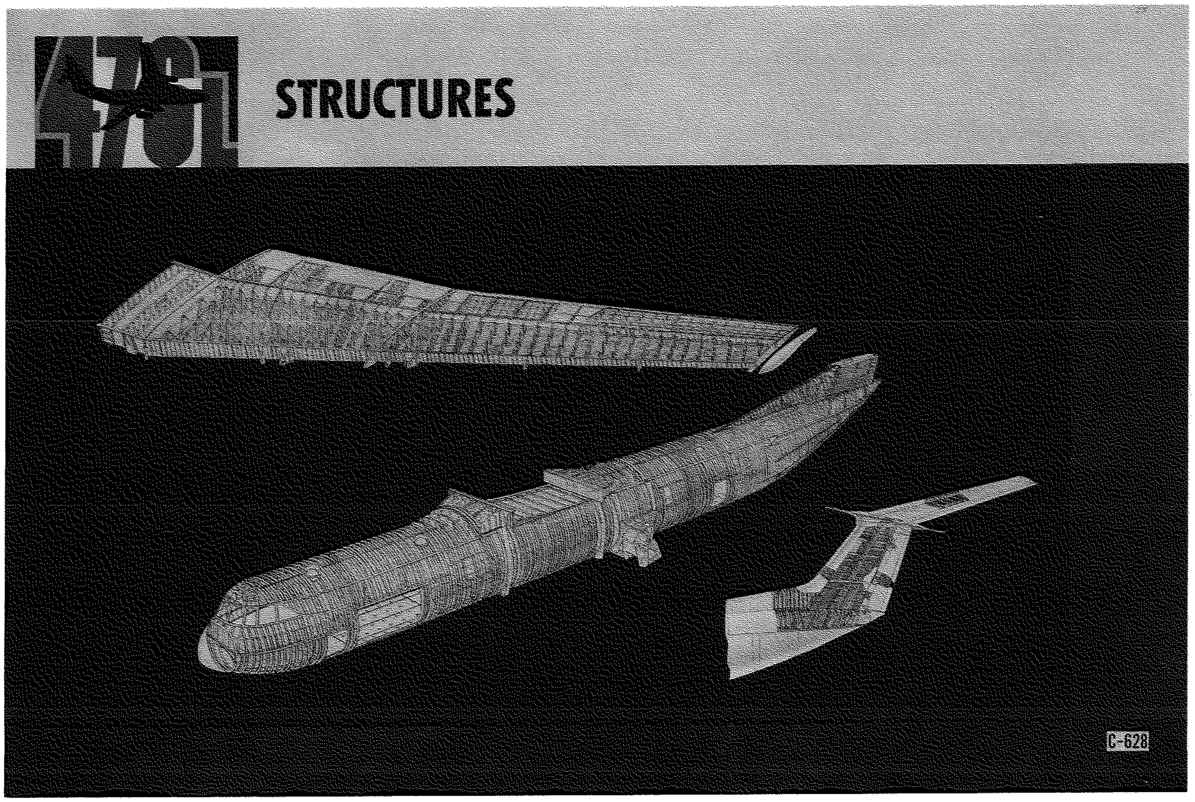
2. THIS A/C AT 287,200 LBS T.O. GROSS WEIGHT AND WITH JT3D-4'S MEETS ALL MISSION REQUIREMENTS

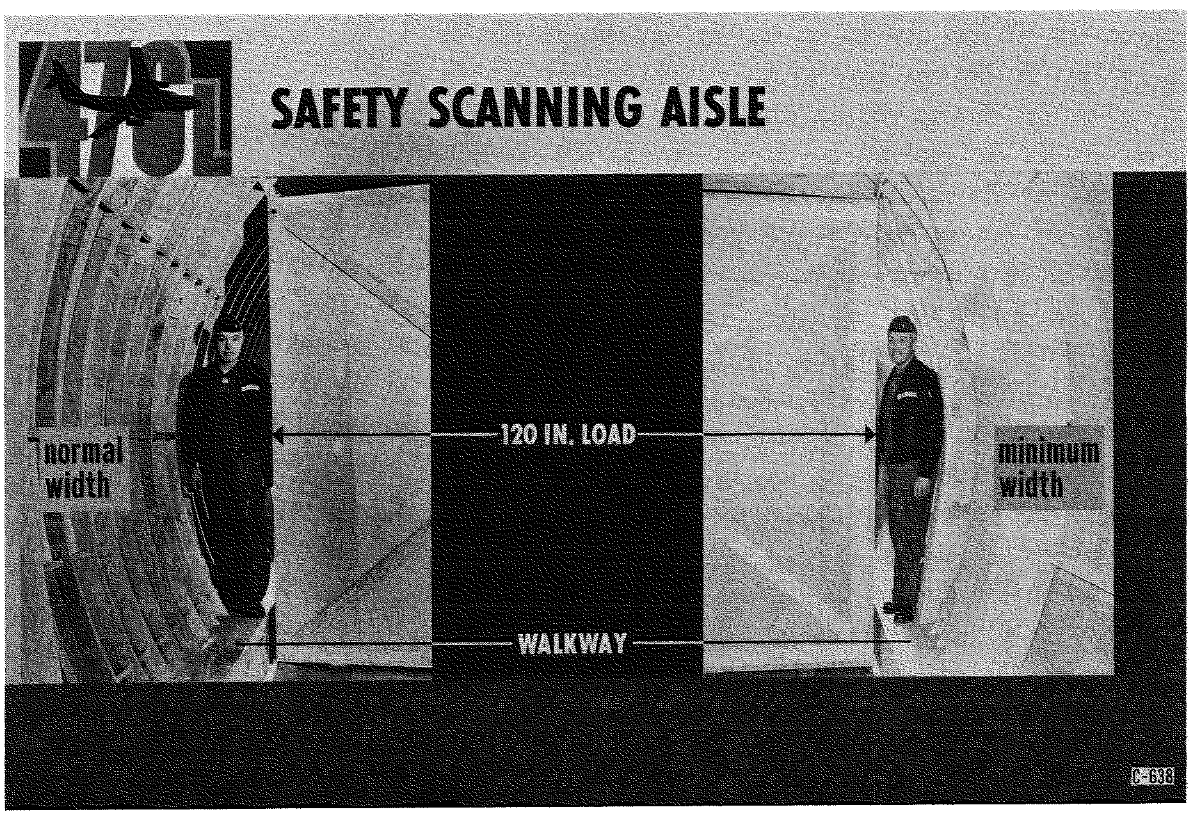
C-602




476L
GENERAL ARRANGEMENT
POWER PLANTS JT3D-4
WING AREA 3228 FT²
ASPECT RATIO 7.9
SWEEP AT 1/4 CHORD 25°
E.W.E. 127,000 LBS
DES PAYLOAD 70,000 LBS
MAX FUEL 150,000 LBS
MAX T.O. WT 315,000 LBS
MAX LNDG WT 257,500 LBS
150 FT
C-598


476L
INBOARD PROFILE
109 IN
123 IN
70 FT
8FT
ELECTRONIC EQUIPMENT
PRESSURIZED AREA
COMBINED CARGO RAMP
& PRESSURE DOOR
C-608


STRUCTURES
C-628


SAFETY SCANNING AISLE
normal width
120 IN. LOAD
minimum width
WALKWAY
C-638

provides space for the required fourteen inch wide full-length safety scanning aisle down each side of the cargo compartment, as shown in the mockup photo.

Incidentally, we prepared this fuselage mockup in anticipation of a visit of your group to our facility, and it is available for your inspection. C637

The cargo floor provides an overall length of 70 feet. Its width, like that of the C-130, is 10′ 3″. The cargo floor is 50 inches above, and parallel with, the ground. Its detailed design is based on Lockheed's long experience in the development of the C-130 series and it meets every requirement of system 476L. When used with 463L pallets, the integral rollers and rails are positioned as shown in the left section; when a flat floor is desired, the rails and rollers are flipped as shown at the right. C636

For bulk cargo the gross volume including the ramp is 7,153 cubic feet. For palletized cargo with 9 pallets on the cargo floor and one on the ramp, the volume is 5,484 cubic feet. The forward cargo door on the left side is 78 inches high and 109 inches wide, almost identical to the door on the C-130. C627

An extra crew compartment, which meets all requirements, is designed to mate with the 463L pallet system provisions, and may be installed at the forward end of the cargo compartment where power provisions are made to supply the integral lighting, air conditioning, food preparation and other services of this well-furnished and comfortable unit. C593

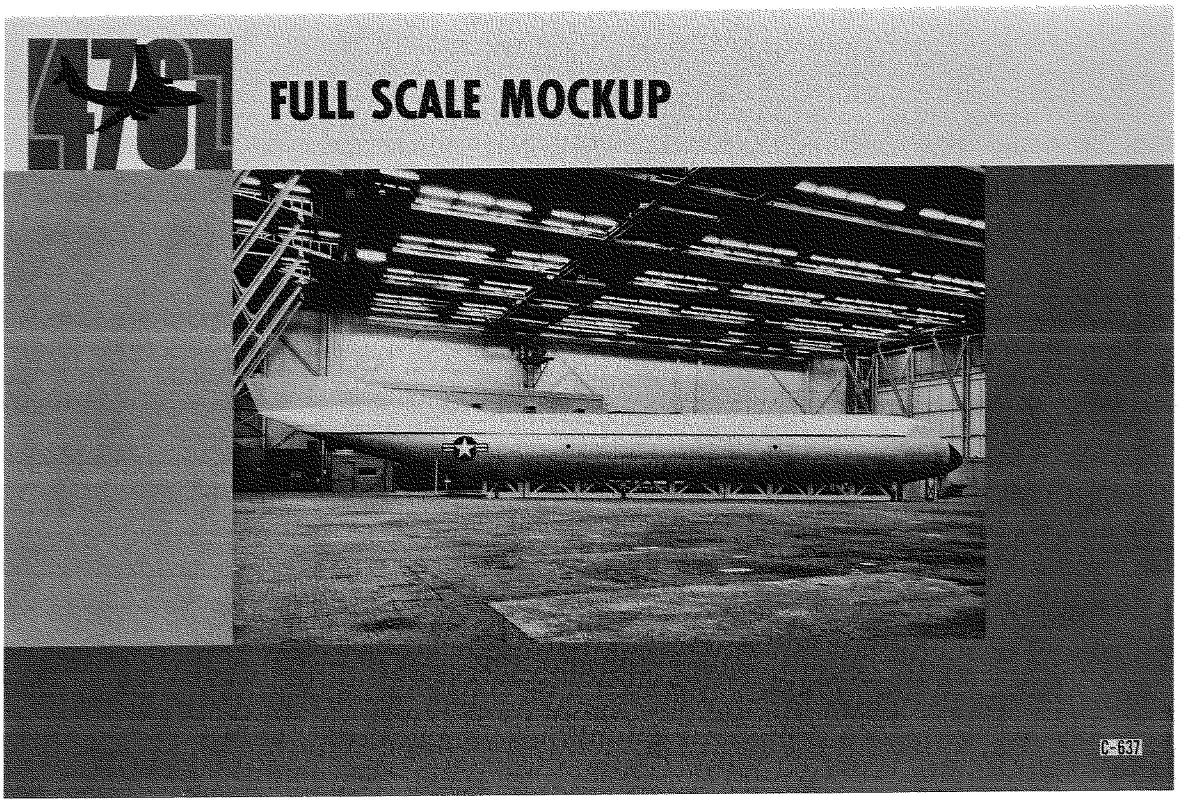
The extra crew compartment facilities are in addition to the two permanent bunks and galley installed in the flight station. The flight station arrangement of the -45 has been modified from that of the C-130 to meet all of the requirements for F.A.A. certification. The five crew positions required are as shown. Complete galley provisions are made for eight meals. Although the crew C610
station is optimized for four-way division of work assignments, control equipment arrangement is such that flight can be safely accomplished by three, or even two, crew members. This flight station arrangement has been installed in complete detail in the full scale mockup. C639

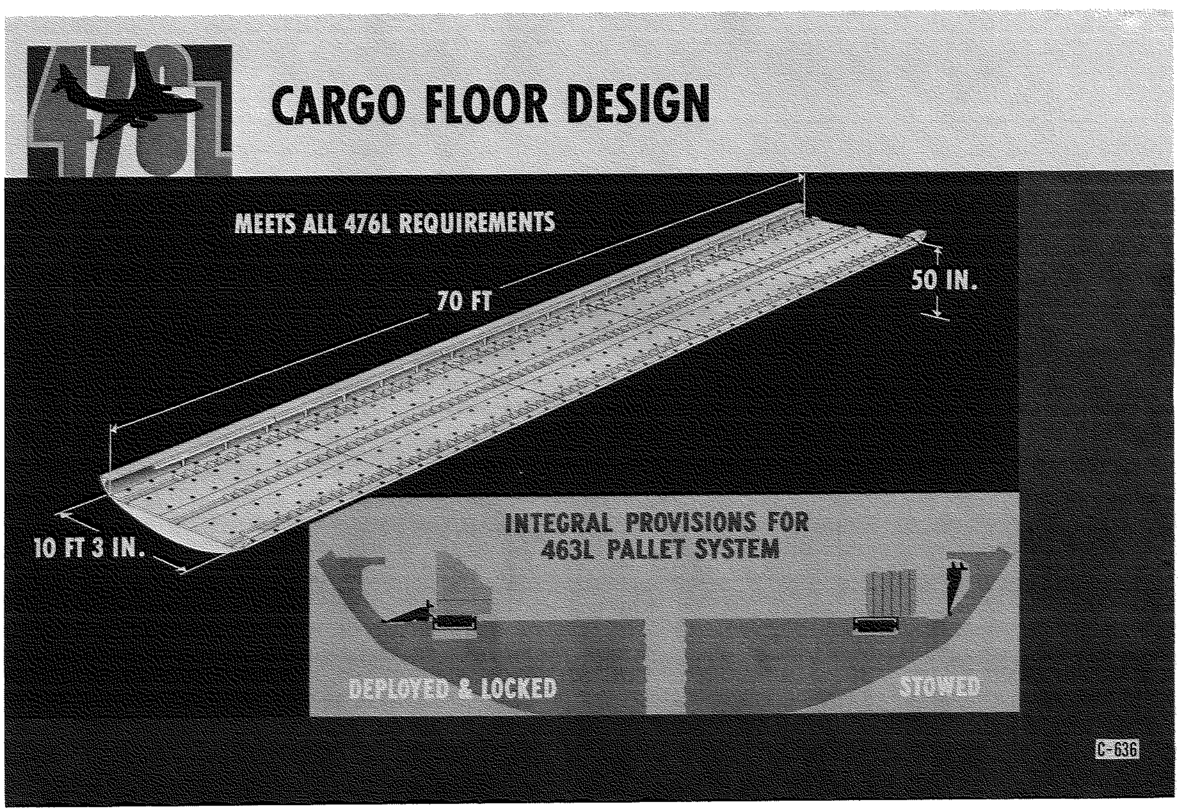
The faired afterbody on our mockup illustrates a vital feature of our airplane, since the low drag levels we have achieved with this arrangement permit us to meet all system 476L requirements with the JT3D-4 power plant. C606

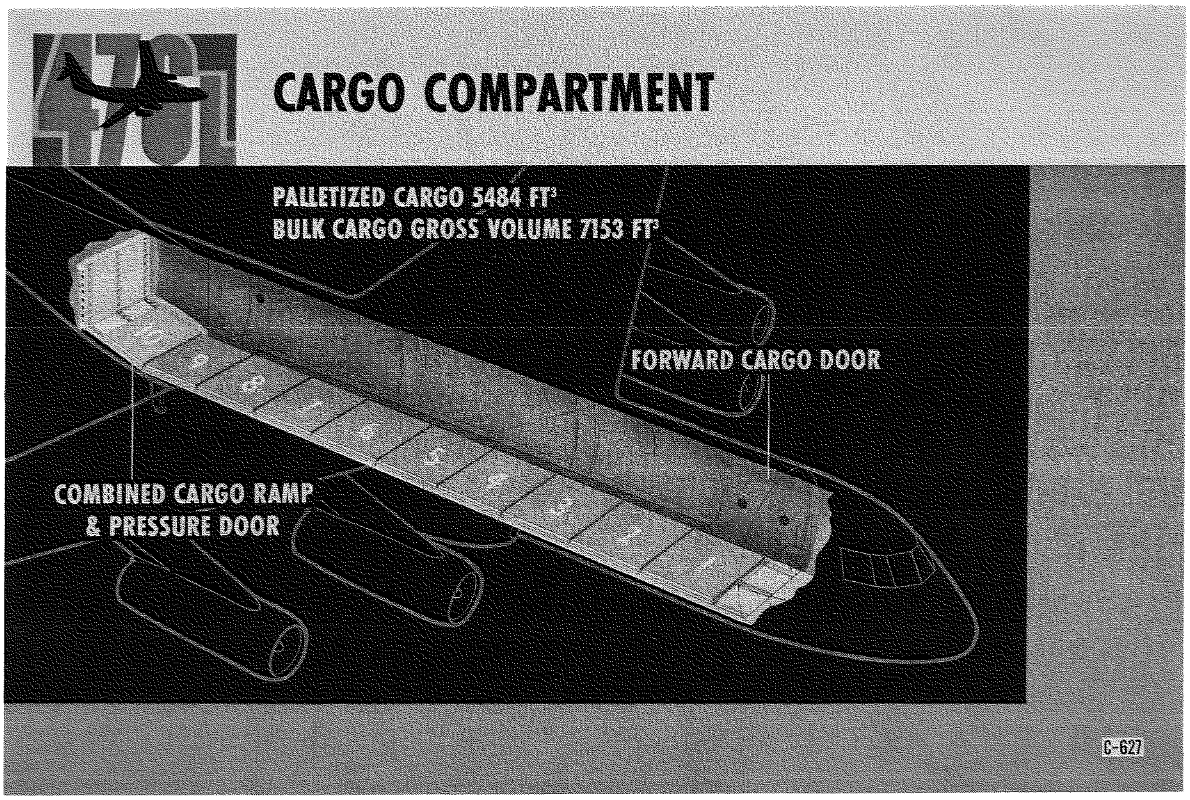
This afterbody is a result of a very comprehensive wind tunnel program conducted over a period of a year in which many arrangements were tested to determine the lowest drag configuration for aft-loading fuselages. C645

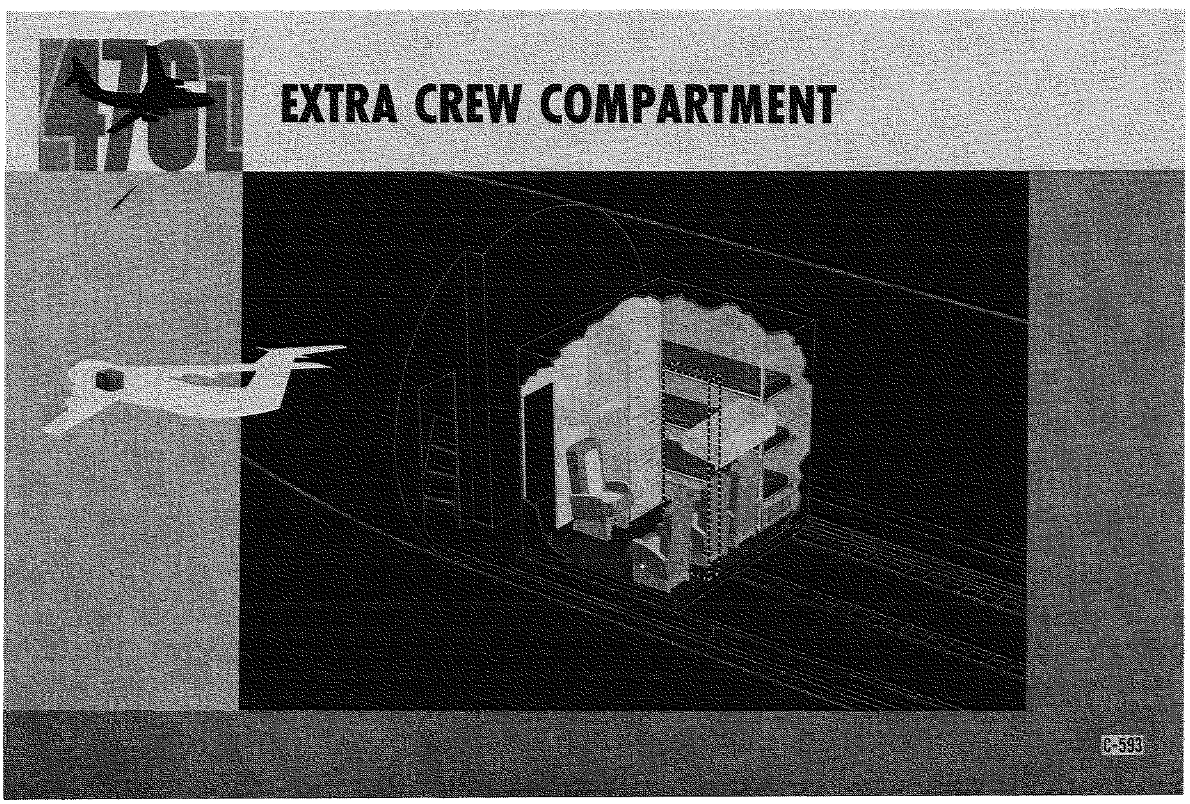
As shown by these wind tunnel drag polars, in the range of lift coefficients for cruise flight, this new aft fuselage actually has identical drag to that of a symmetrical fairing. C626

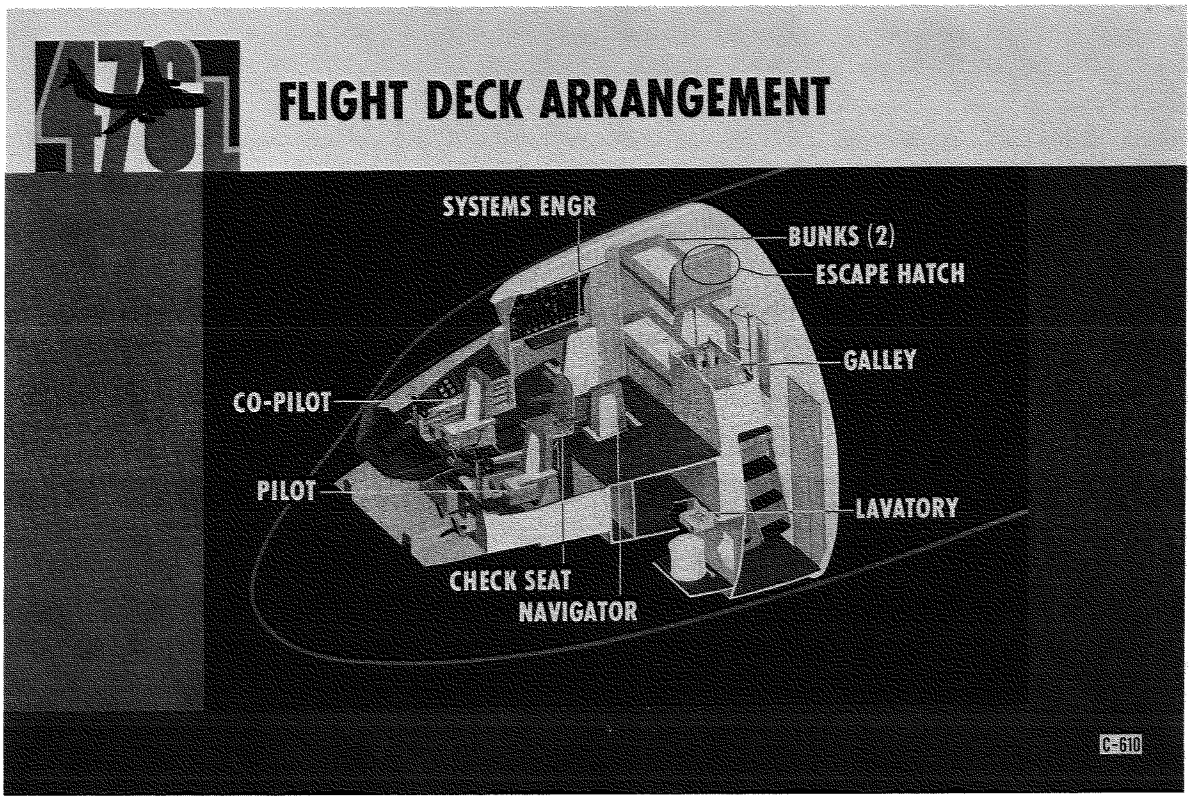
Our unique door and ramp arrangement provides air drop capability and full cross-section straight-in access to the cargo compartment for ground loading at truck-bed height. Hydraulic operation places both segments of each door in a position approximately parallel to the fuselage centerline as shown on the right, minimizing air loads in flight. The combination pressure door and loading ramp is hydraulically actuated to the desired position. When open on the C613

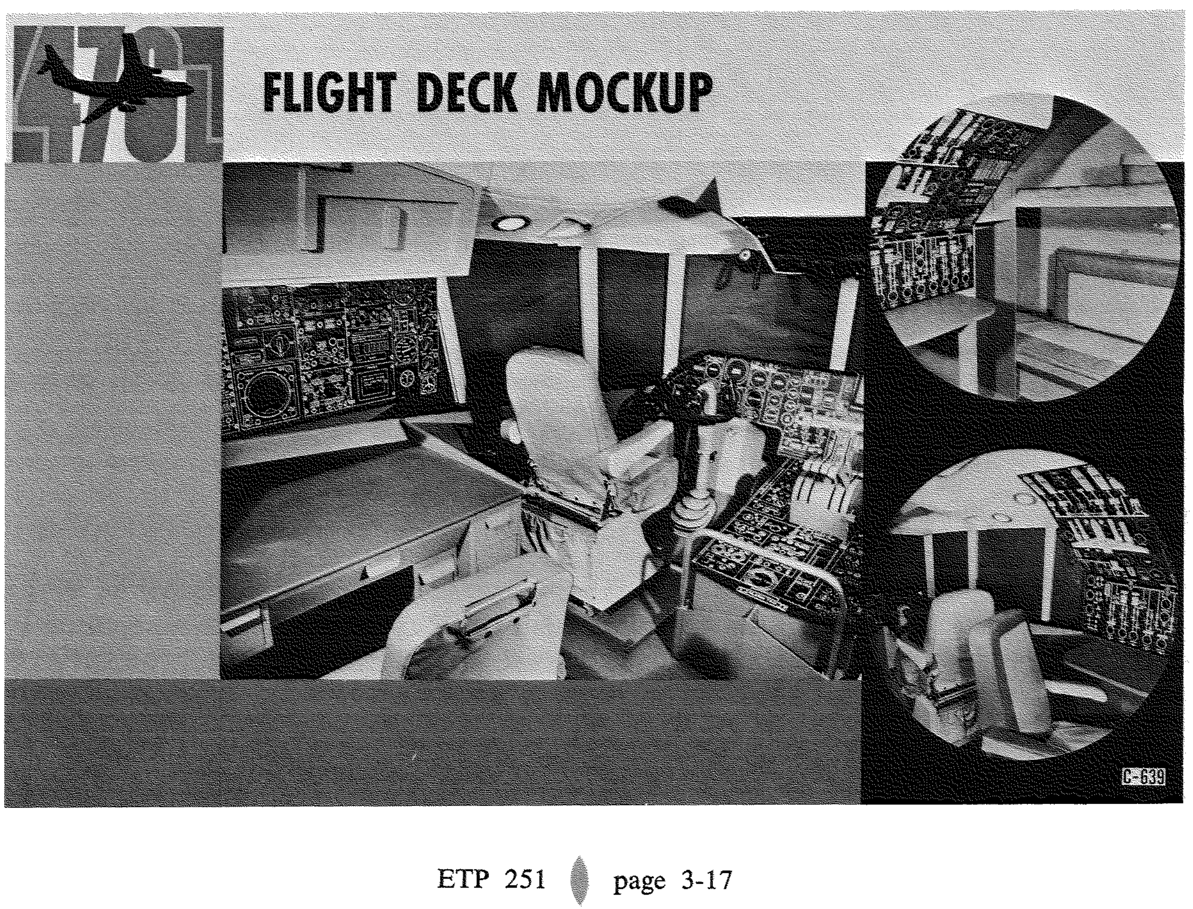

476L
FULL SCALE MOCKUP
C-637


476L
CARGO FLOOR DESIGN
MEETS ALL 476L REQUIREMENTS
70 FT
50 IN.
10 FT 3 IN.
INTEGRAL PROVISIONS FOR
463L PALLET SYSTEM
DEPLOYED & LOCKED
STOWED
C-636

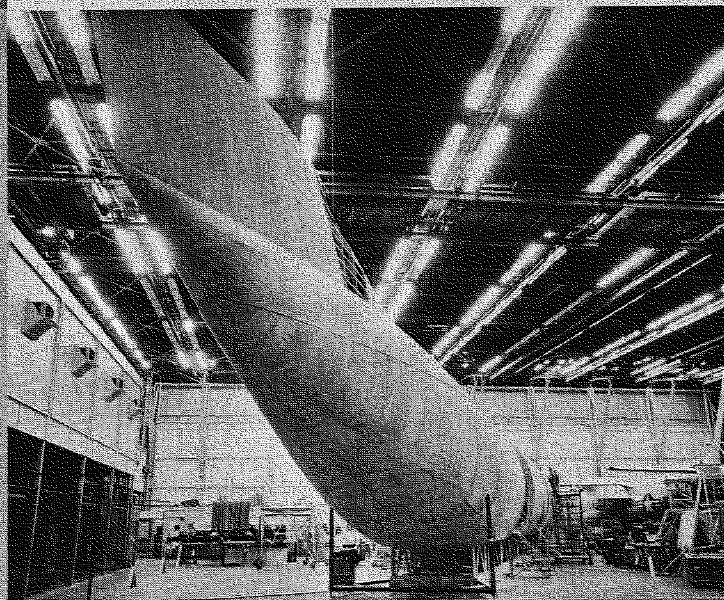

CARGO COMPARTMENT
PALLETIZED CARGO 5484 FT³
BULK CARGO GROSS VOLUME 7153 FT³
FORWARD CARGO DOOR
COMBINED CARGO RAMP
& PRESSURE DOOR
C-627


EXTRA CREW COMPARTMENT
C-593


476L
FLIGHT DECK ARRANGEMENT
SYSTEMS ENGR
BUNKS (2)
ESCAPE HATCH
GALLEY
CO-PILOT
PILOT
LAVATORY
CHECK SEAT
NAVIGATOR
C-610

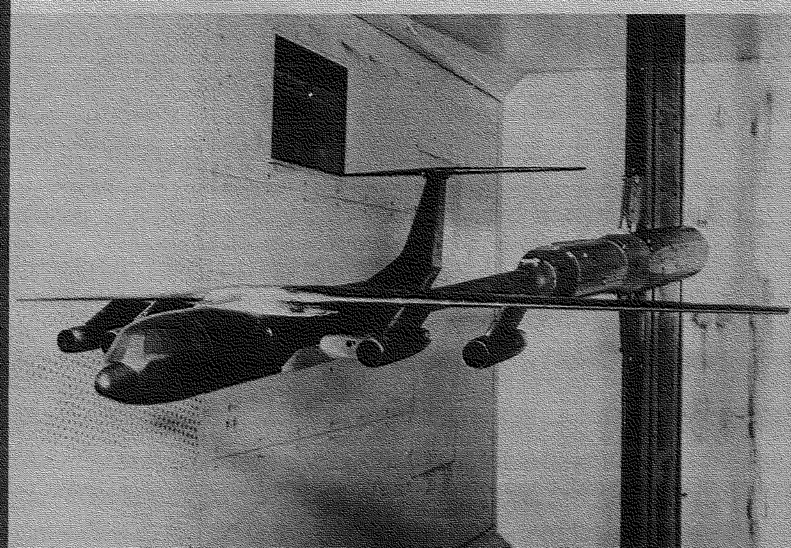

476L
FLIGHT DECK MOCKUP
C-639

FAIRED AFTERBODY

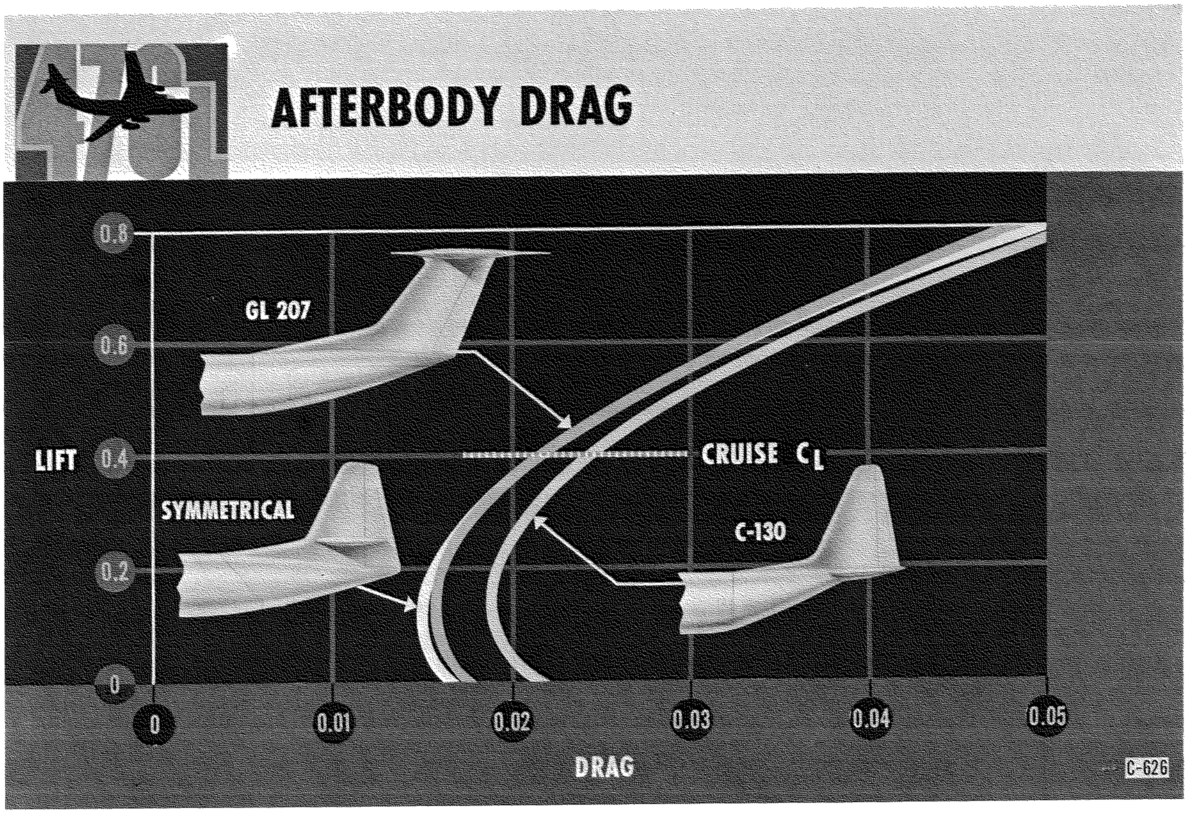


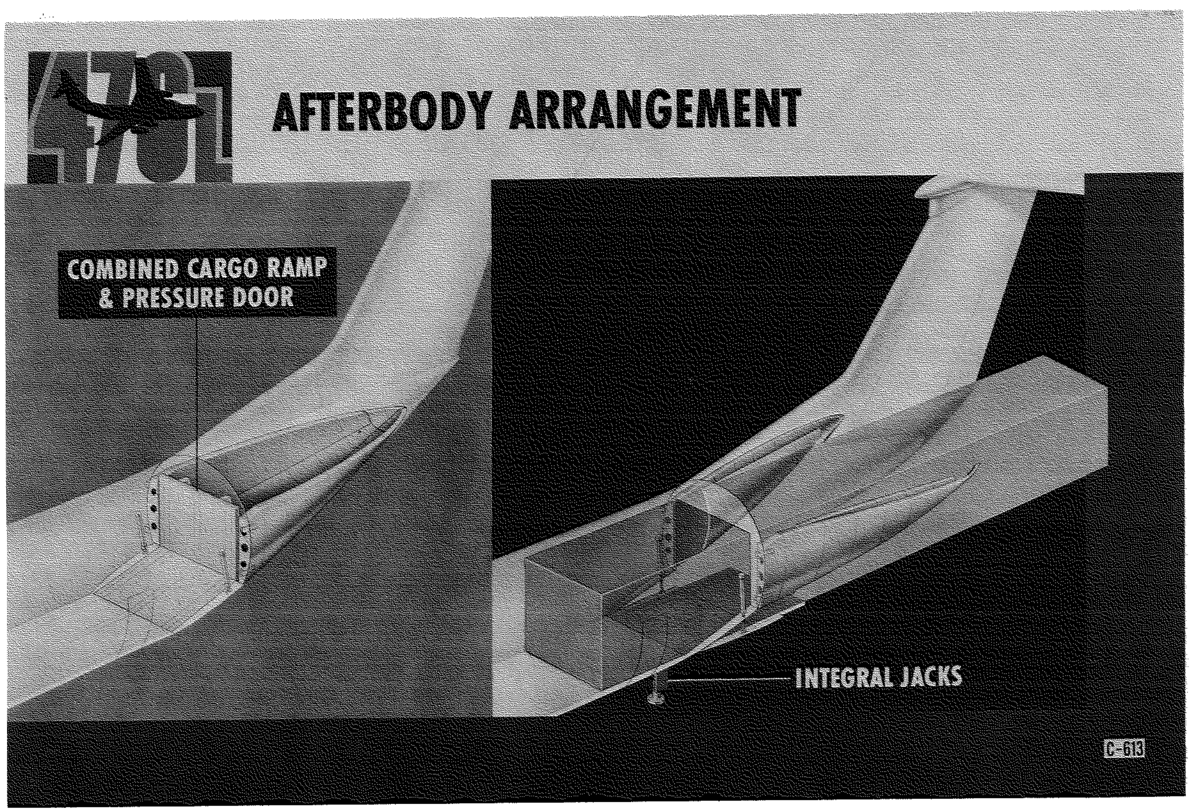
C-606

HIGH SPEED WIND TUNNEL MODEL



C-645


AFTERBODY DRAG
GL 207
SYMMETRICAL
C-130
CRUISE C_L
LIFT
0.8
0.6
0.4
0.2
0
0.01
0.02
0.03
0.04
0.05
DRAG
C-626


AFTERBODY ARRANGEMENT
COMBINED CARGO RAMP
& PRESSURE DOOR
INTEGRAL JACKS
C-613

ground, the pressure ramp door cannot be actuated to the closed position until the stabilizing jacks are retracted and stowed.

Our choice of a wing, made only after extensive parametric studies and wind tunnel testing to pin down the effects of all of the variables which must be considered, has the best sweep angle when the desired average cruise speeds, fuel volumes, thickness ratio variations, and taper ratio are considered. C582

Twenty-five degrees of sweep is low enough to greatly reduce most of the problems usually encountered in large swept-wing aircraft.

—There will not be strong roll due to yaw and/or side-slip.

—Decrease of aileron effectiveness will not be so great as to dictate the complexities of both inboard and outboard ailerons plus control spoilers.

—The tip stall problem is greatly alleviated so that very good maximum lift coefficients are attainable at lower angles of attack for landing, permitting a normal landing gear design.

—The rigid lift curve slope is high and aeroelastic effects are not so great.

—There will be very little change in longitudinal stability with speed.

Wing area is 3,228 square feet. Aspect ratio is 7.9. Average thickness to chord ratio is 11.2%. Sixty percent span Fowler flaps are used and lateral control is by conventional outboard ailerons only. Spoilers located in the wing trailing edge above the flaps are used on the ground to reduce wing lift. C625

The four Pratt & Whitney JT3D-4 turbofan engines are mounted in underwing pods. The pod locations and the design of the pods and pylons provide optimal compromises among aero-theromodynamic efficiency, safety, simplicity, serviceability, and meet Air Force and F.A.A. specification requirements. Each engine installation is fitted with extension fan ducts and a simple target thrust reverser assembly, operable in flight and on the ground. C583

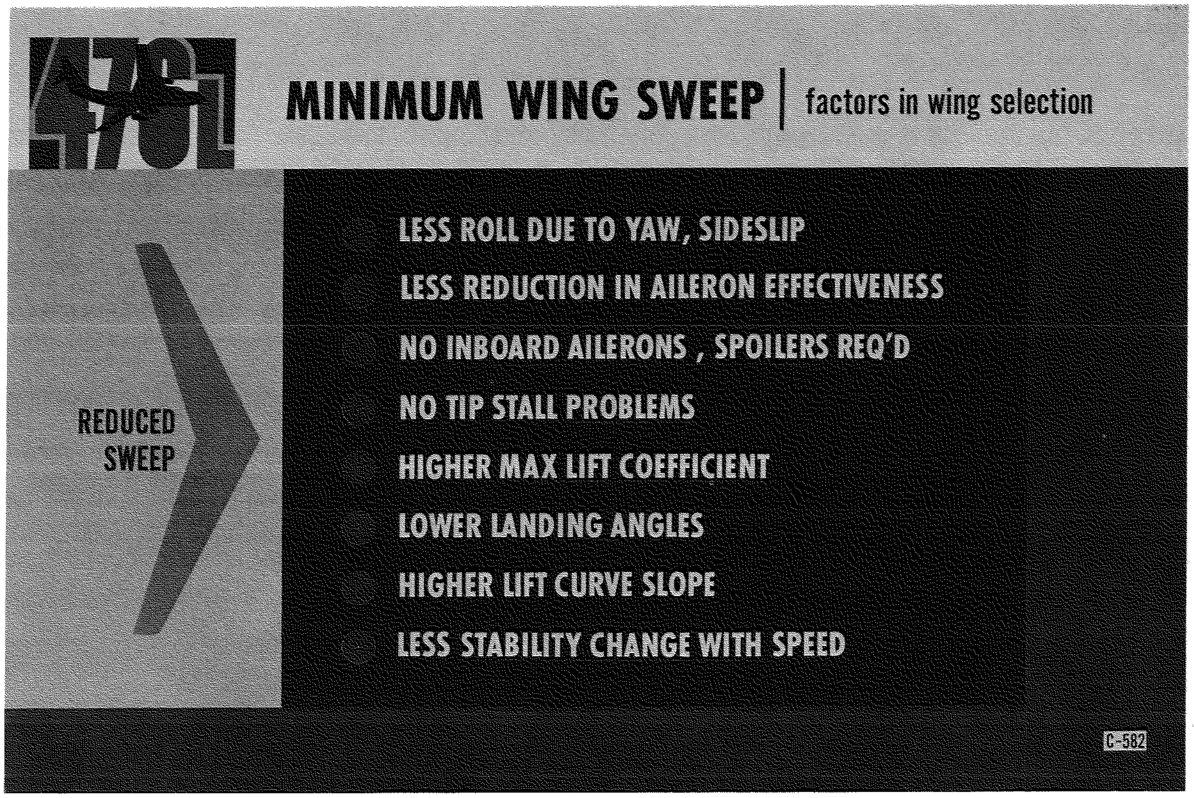
The engines we considered before selecting the JT3D-4 for our initial installation are listed here together with: C635

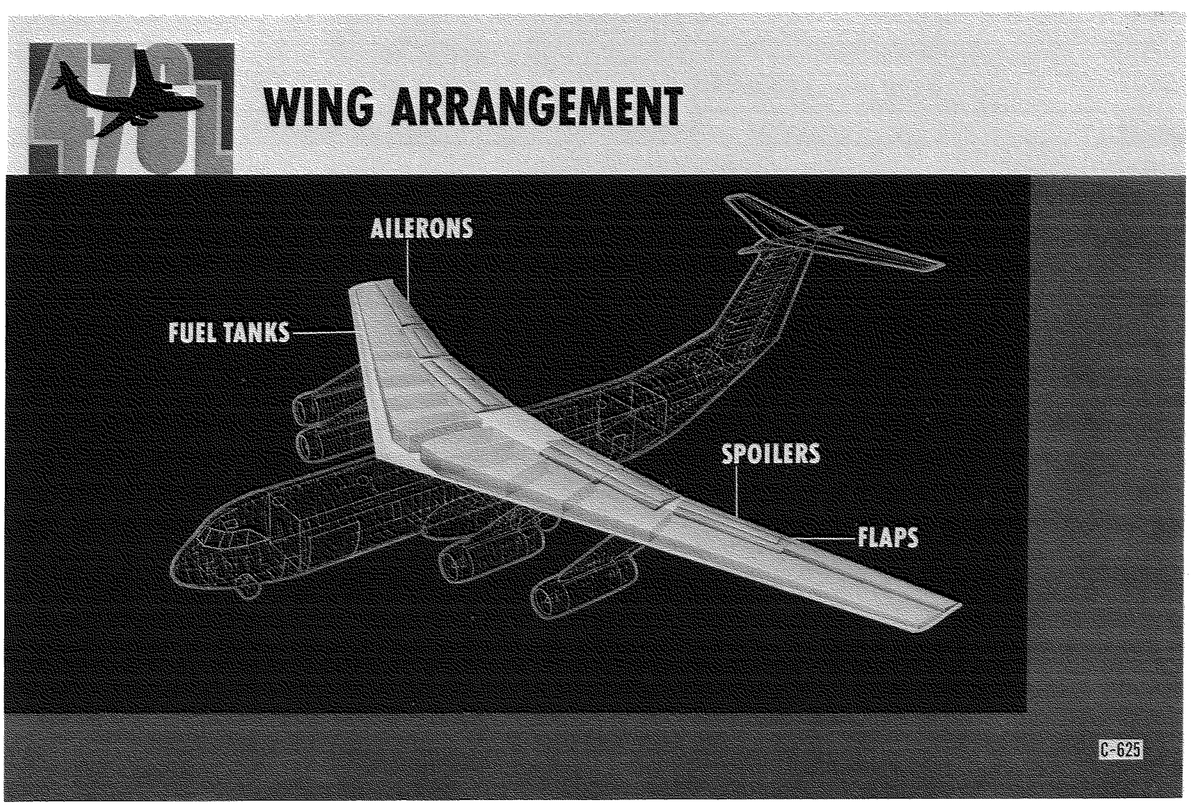
1 Their date of availability,

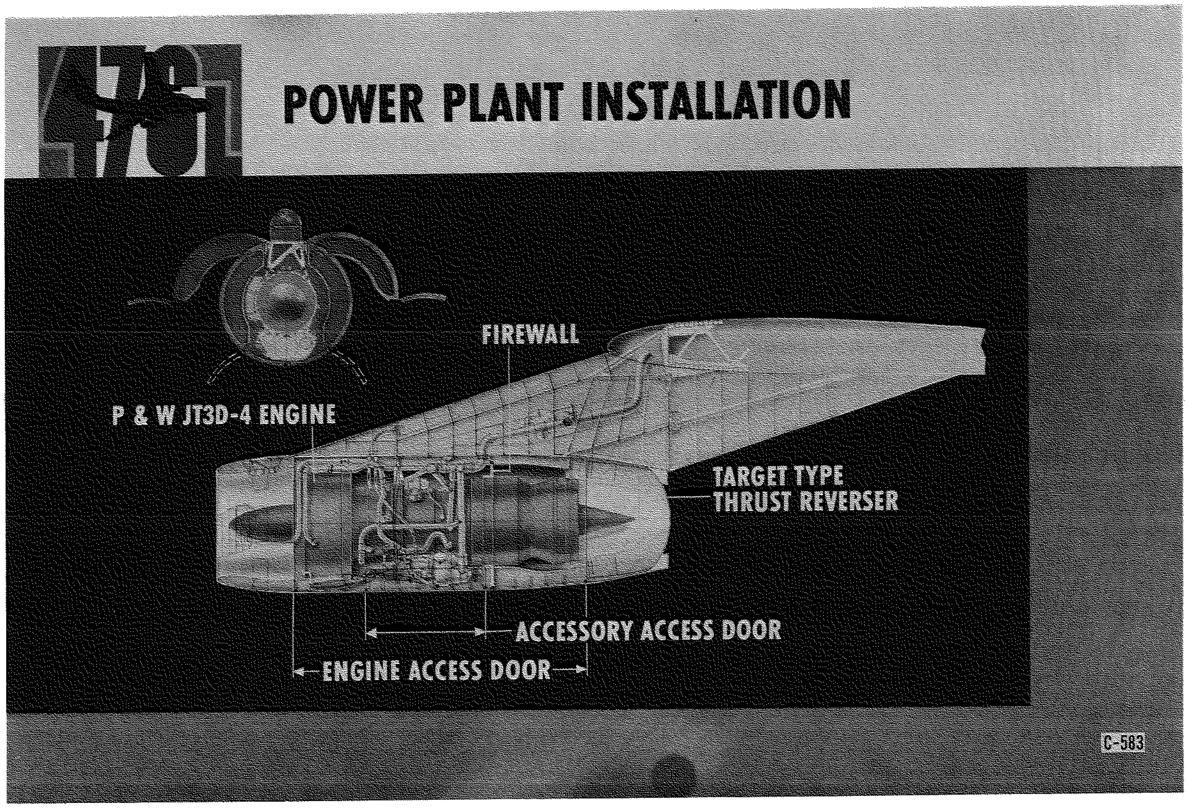
2 Whether developmental funding is required or not, and

3 The number required for the Super Hercules to meet the requirements of system 476L.

Those in yellow have received most of our attention. For some engines it has been difficult for us to determine if direct additional developmental funding is required. However, where indicated, there is no question but that developmental funds must be expended either by the Government or by the engine company.


476L
MINIMUM WING SWEEP | factors in wing selection
REDUCED SWEEP
LESS ROLL DUE TO YAW, SIDESLIP
LESS REDUCTION IN AILERON EFFECTIVENESS
NO INBOARD AILERONS , SPOILERS REQ'D
NO TIP STALL PROBLEMS
HIGHER MAX LIFT COEFFICIENT
LOWER LANDING ANGLES
HIGHER LIFT CURVE SLOPE
LESS STABILITY CHANGE WITH SPEED
C-582


476L
WING ARRANGEMENT
AILERONS
FUEL TANKS
SPOILERS
FLAPS
C-625



ENGINES CONSIDERED

ENGINE	AVAILABILITY	FUNDING	NO.OF ENGINES
AR 978-6	OCT 64	REQ'D	4
P&W JT3D-2 (TF33-P-3)	IN PRODUCTION	NONE	6
P&W JT3D-4	MAY 62	NONE	4
P&W JT3D-8A	MAY 63	REQ'D	4
P&W JT3D-8B	FEB 65	REQ'D	4
P&W JT3D-12A	NOV 63	REQ'D	4
GE CJ805-23	IN PRODUCTION	NONE	6
GE MF239C-3	SEPT 63	REQ'D	4

C-635

The Super Hercules accepts any of these power plants. In the upper view we show how the JT3D-8A or -8B, the growth versions of the JT3D-4, can be simply installed in the original nacelle with the substitution of a longer cowling inlet assembly. We have designed the nacelle, pylon, and the attachment of the pylon to the wing, as well as all power plant service systems and the reverser, so that the JT3D-8A and -8B can be substituted for the JT3D-4 at any time without rework of these components. In the lower view, we compare the nacelle arrangement required for the MF239C-3 with that required for the JT3D-4. For this power plant it will be necessary to provide a new nacelle and pylon, but little else changes. The same comments apply to the AR978-6. C600

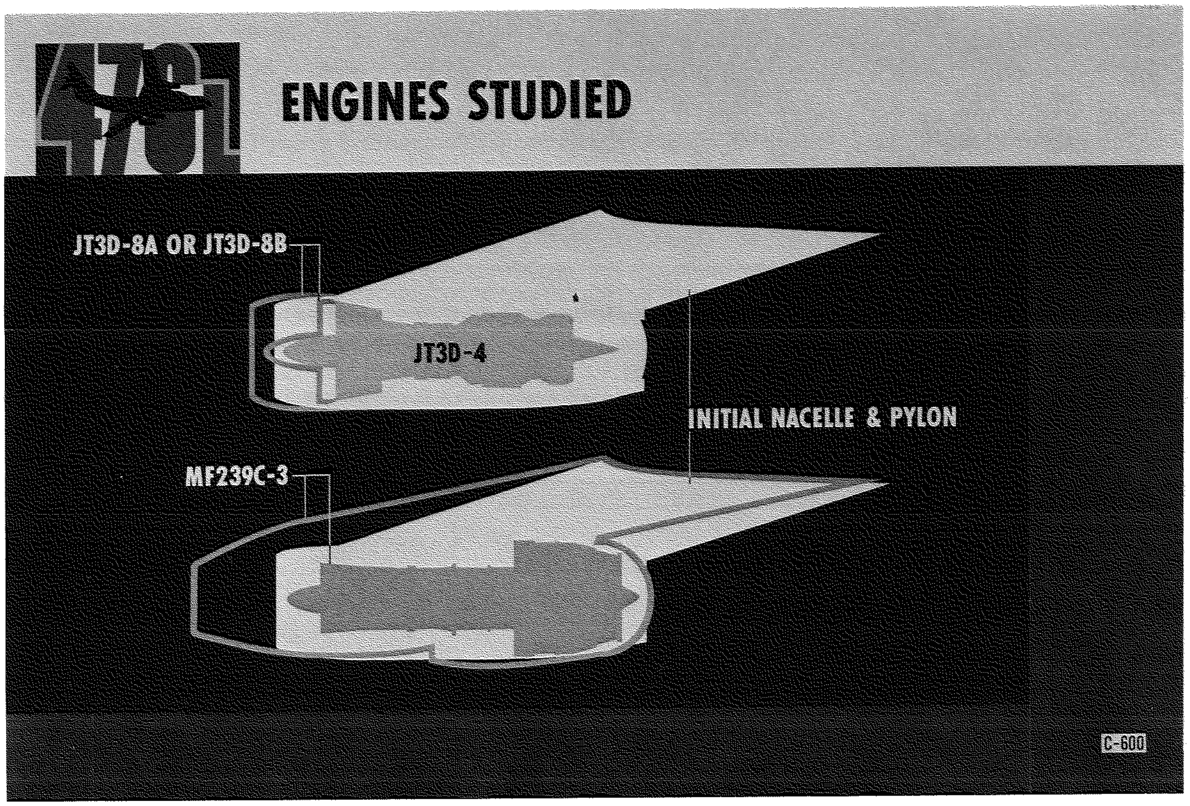
The landing gear is the tricycle type; the minimum runway width for a turn-around is 73 feet. The main gears each have four bogie-mounted wheel and brake assemblies; the runway Unit Construction Index is 38. All gears retract forward hydraulically and will gravity free-fall and lock in an emergency. Oleo struts are charged with Skydrol. All doors are mechanically operated by gear motion. Among the advantages we see for this conventional, well-proven configuration is the fact that it puts the landing gear where it belongs, beneath the primary load, and provides added safety in the event of a gear up belly landing. C595

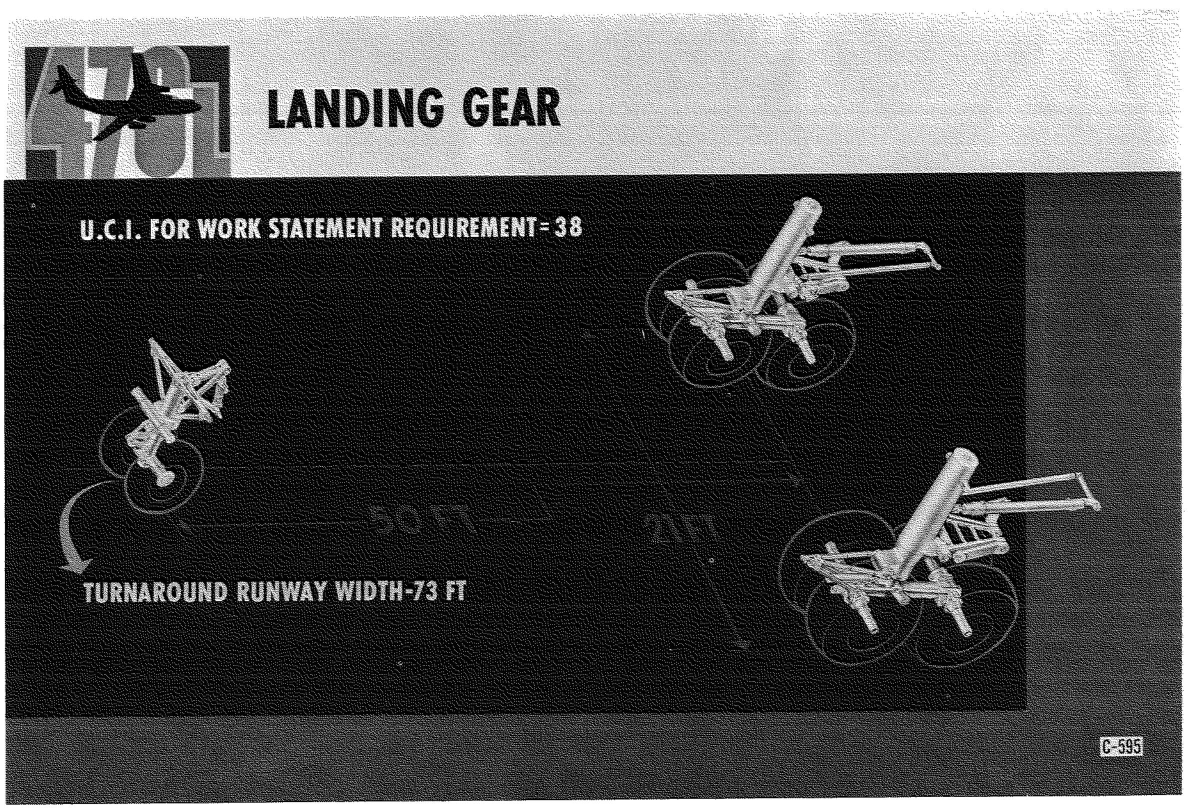
Here we compare the main landing gear geometry with similar gears on the C-123, C-130, and C-133. The ratio A to B is a measure of the anti-tip-over capability of the airplane. The Super Hercules is even better than the C-130, which has proven itself completely in thousands of landings on all kinds of fields. C599

Due to both the press of time and the conventional characteristics of the 207 subsystems, I will mention each only briefly. Each subsystem is fully compliant C585
with Mil Spec and CAR requirements. The 9-tank, 23,080-gallon fuel system C640
incorporates modern practice for engine feed, crossfeed, de-fueling, single-point fueling, over-wing fueling, and jettisoning. The three Skydrol-filled 3,000 psi C641
hydraulic systems consist of boost and utility systems, powered by two engine driven variable volume pumps, and an auxiliary system powered by two electrical pumps; manual emergency subsystems are furnished for all doors, ramps, and locks.

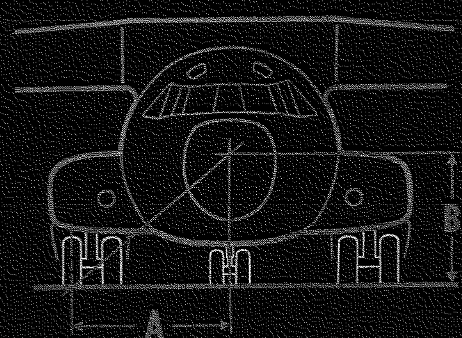
Primary flight controls use cables and Lockheed force-modulating boosters C642
powered by two separate hydraulic systems to operate conventional elevators, rudder, and ailerons with no spoilers or other complicating features; manual ratio-shifters and surface servo tabs permit boost-off flight. Automatic flight control systems, adaptable for the advanced navigation systems of the work statement, include autopilot, yaw damper, and Mach trim. Rudder and aileron trim tabs are manual and dual horizontal stabilizer trim is by either a hydraulic motor, an electric motor, or an emergency manual torque-tube system. Dual C643
hydraulic motor-powered Fowler flaps with multiple screw jack actuators on each section have a manual emergency back-up. Landing lift spoilers are actuated by dual hydraulic cylinders.

Four, engine-driven, 40 KVA, 400 cycle generators with constant speed drives, C644
in flight; an A.P.U.-driven AC generator and a nickel-cadmium battery, on the ground; power, as appropriate, the main 200/115 volt AC and the 28


ENGINES STUDIED
JT3D-8A OR JT3D-8B
JT3D-4
INITIAL NACELLE & PYLON
MF239C-3
C-600


LANDING GEAR
U.C.I. FOR WORK STATEMENT REQUIREMENT=38
50 FT
21 FT
TURNAROUND RUNWAY WIDTH-73 FT
C-595

M.L.G. TREAD EFFECTIVENESS | a comparison

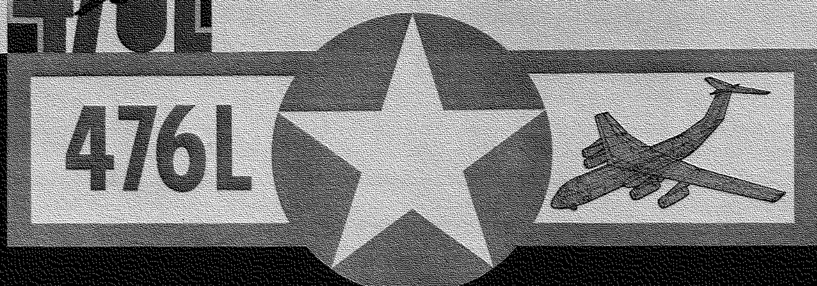


	A	B	A/B*
C-123	82.0	105	.78
C-130	95.6	127.9	.75
C-133	120.5	170	.71
207-45	127.3	143	.89

*HIAD REQUIRES .51 MIN

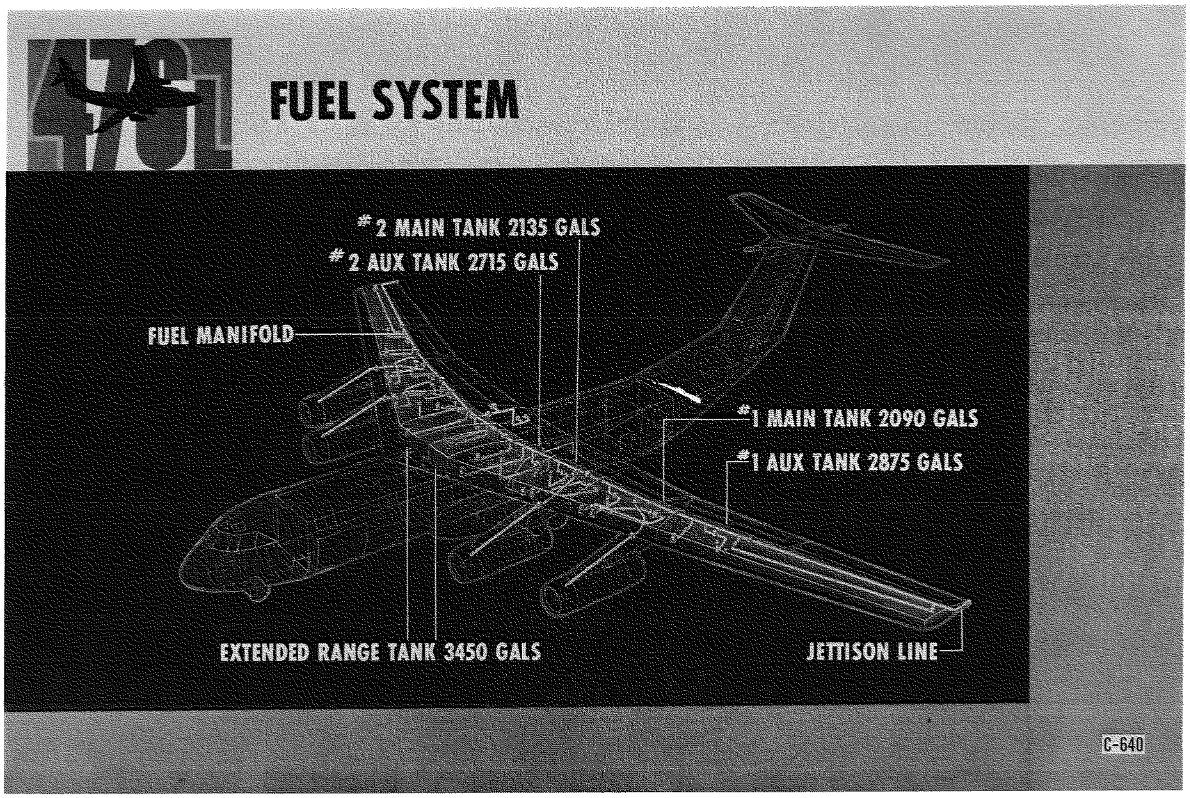
C-599

AIRCRAFT SUBSYSTEMS | Milspec and CAR compliant

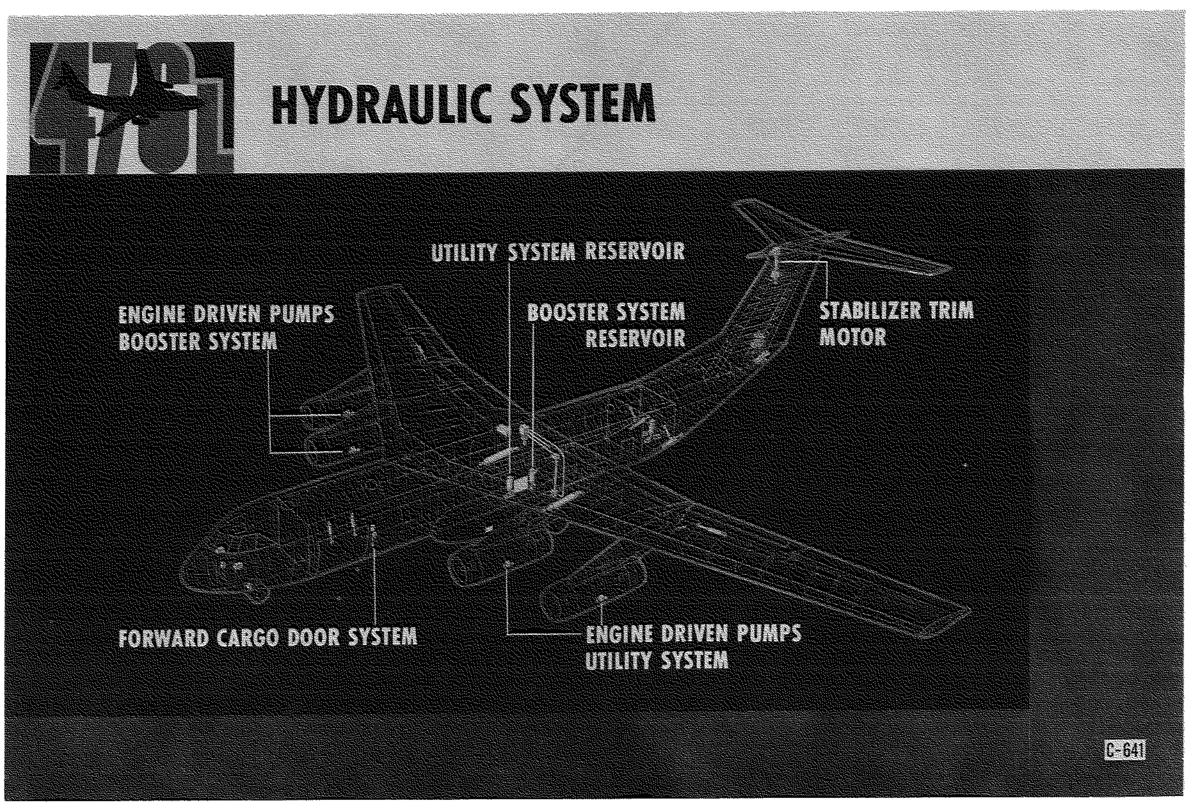


1. FUEL
2. HYDRAULIC
3. FLIGHT CONTROLS
4. ELECTRICAL
5. COM/NAV
6. ENVIRONMENTAL
7. MAINTAINABILITY

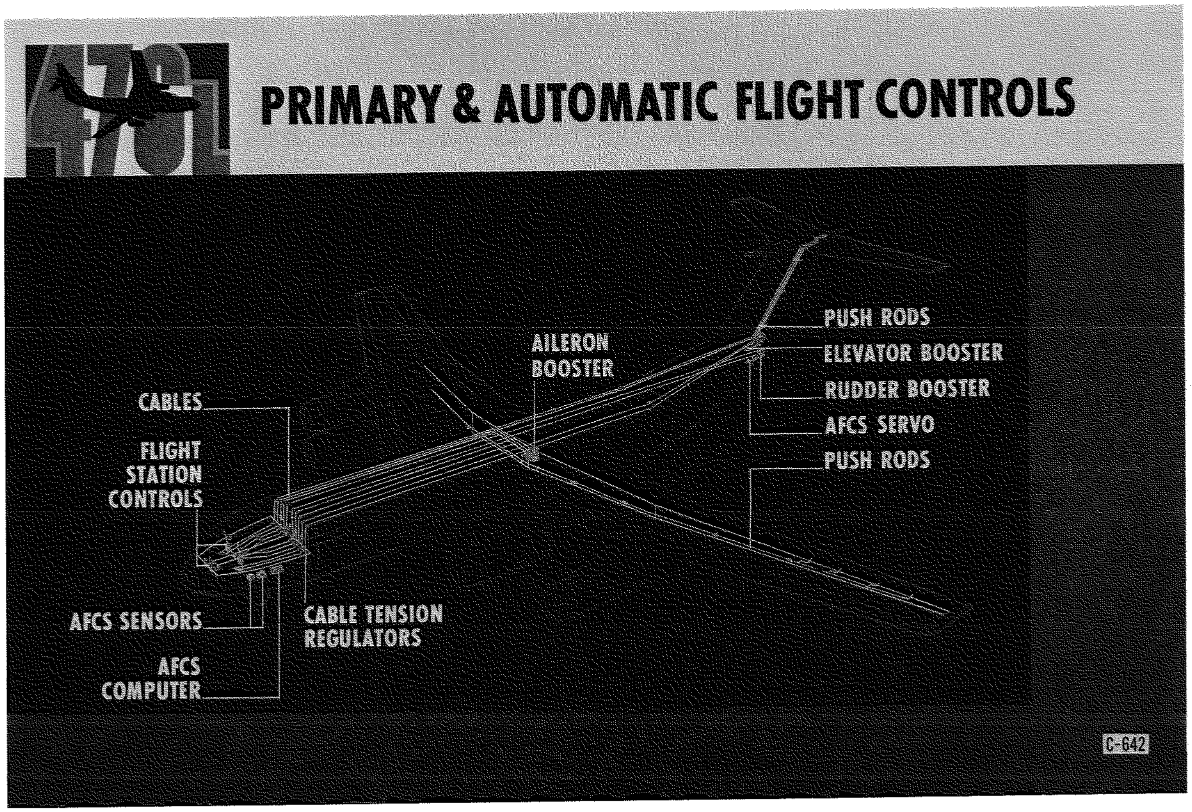
C-585

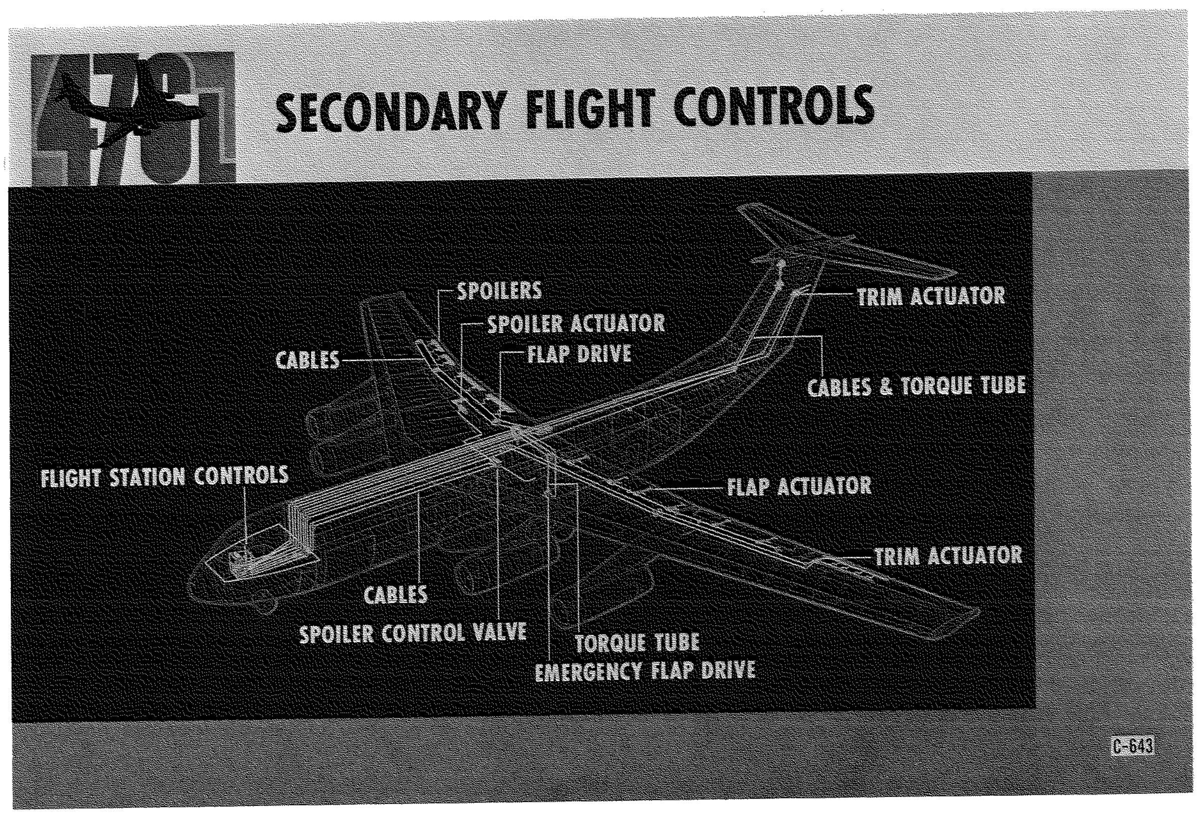


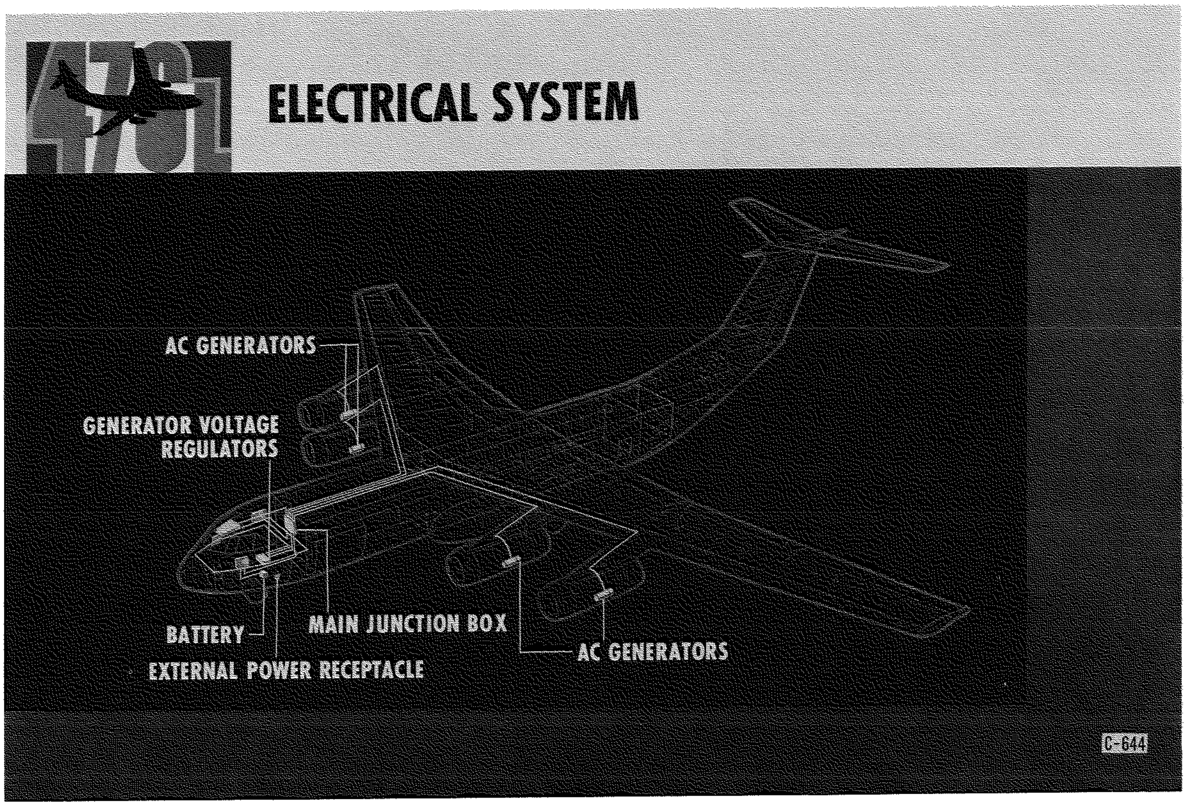
476L
FUEL SYSTEM
#2 MAIN TANK 2135 GALS
#2 AUX TANK 2715 GALS
FUEL MANIFOLD
#1 MAIN TANK 2090 GALS
#1 AUX TANK 2875 GALS
EXTENDED RANGE TANK 3450 GALS
JETTISON LINE
C-640

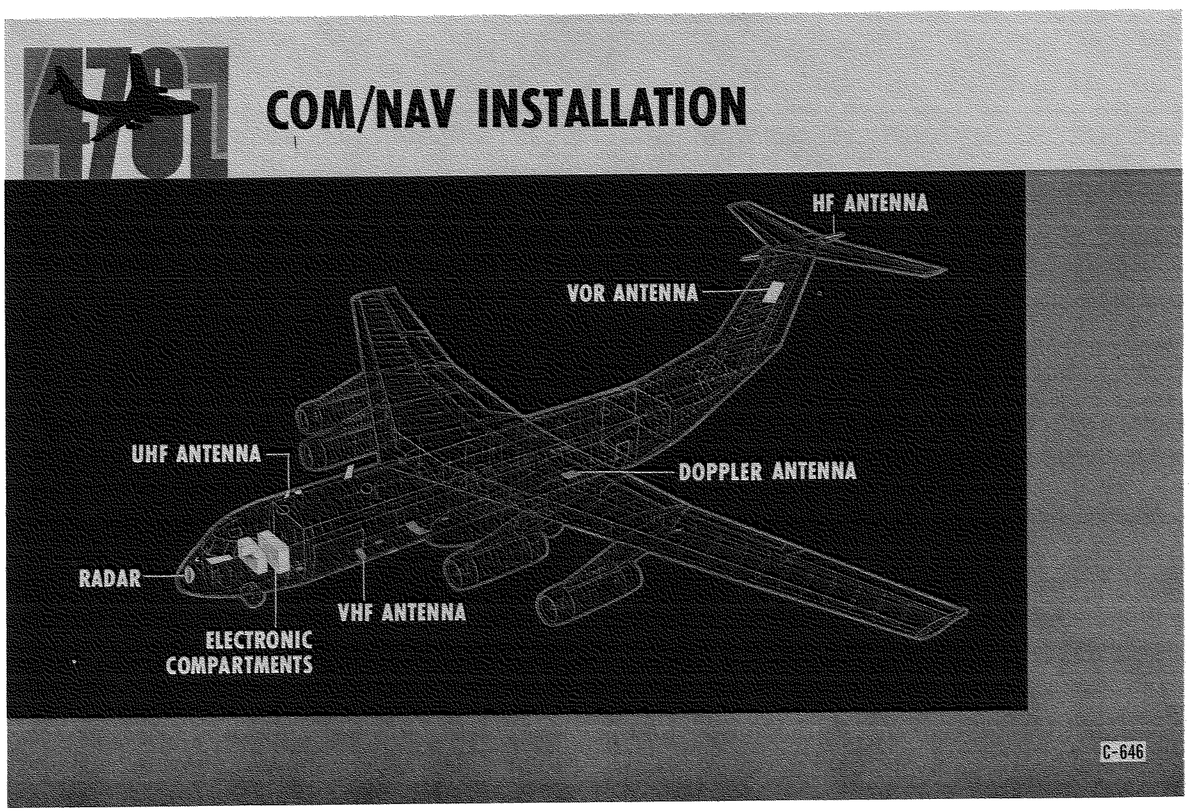


476L
HYDRAULIC SYSTEM
UTILITY SYSTEM RESERVOIR
ENGINE DRIVEN PUMPS
BOOSTER SYSTEM
BOOSTER SYSTEM
RESERVOIR
STABILIZER TRIM
MOTOR
FORWARD CARGO DOOR SYSTEM
ENGINE DRIVEN PUMPS
UTILITY SYSTEM
C-641


476L
PRIMARY & AUTOMATIC FLIGHT CONTROLS
PUSH RODS
AILERON BOOSTER
ELEVATOR BOOSTER
CABLES
RUDDER BOOSTER
AFCS SERVO
FLIGHT STATION CONTROLS
PUSH RODS
AFCS SENSORS
CABLE TENSION REGULATORS
AFCS COMPUTER
C-642


476L
SECONDARY FLIGHT CONTROLS
SPOILERS
TRIM ACTUATOR
SPOILER ACTUATOR
CABLES
FLAP DRIVE
CABLES & TORQUE TUBE
FLIGHT STATION CONTROLS
FLAP ACTUATOR
TRIM ACTUATOR
CABLES
SPOILER CONTROL VALVE
TORQUE TUBE
EMERGENCY FLAP DRIVE
C-643


ELECTRICAL SYSTEM
AC GENERATORS
GENERATOR VOLTAGE REGULATORS
BATTERY
MAIN JUNCTION BOX
EXTERNAL POWER RECEPTACLE
AC GENERATORS
C-644


COM/NAV INSTALLATION
HF ANTENNA
VOR ANTENNA
UHF ANTENNA
DOPPLER ANTENNA
RADAR
VHF ANTENNA
ELECTRONIC COMPARTMENTS
C-646

volt DC electrical systems. The radio aids to navigation—glide slope, ADF, marker beacon and radar—are in the center control console along with the communication system—UHF, VHF, and HF transmitter-receivers and digital automatic ground-to-air communication for traffic. The global navigation gear —inertial platform, doppler radar, digital and dead reckoning computers, and photo electric sextant—are controlled by the navigator. C646

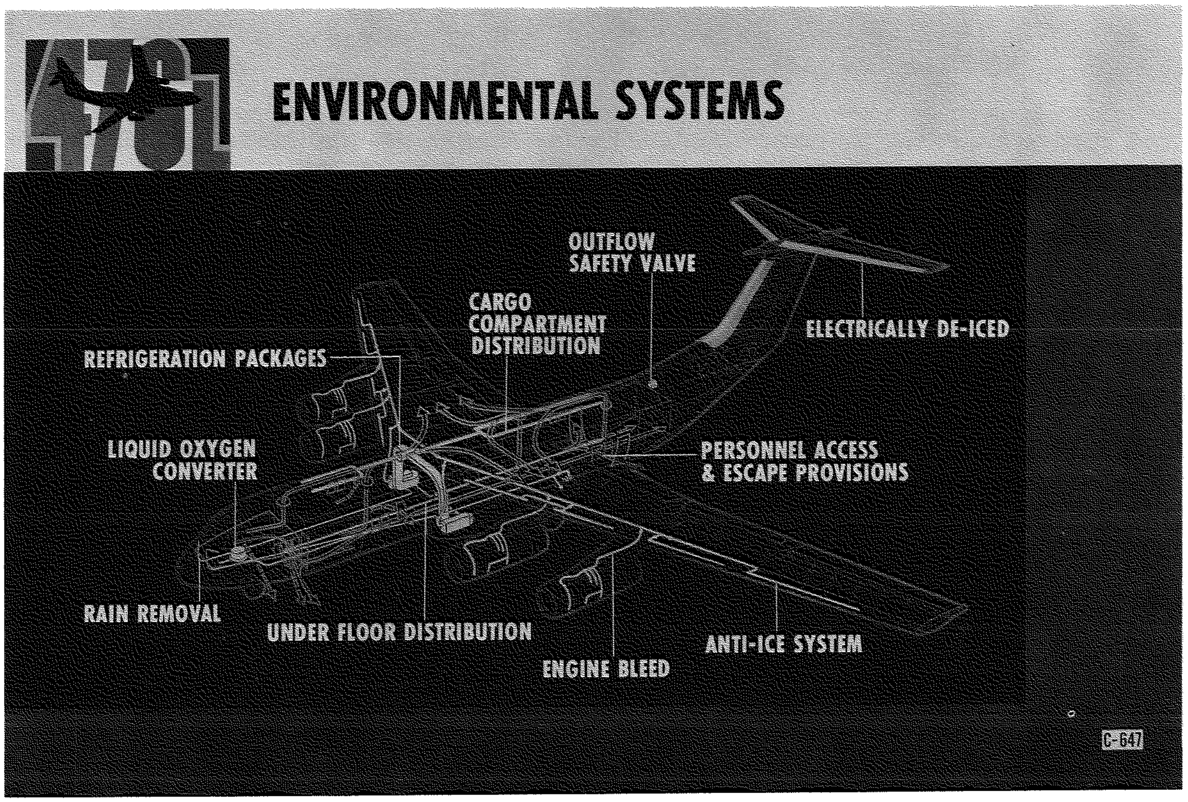
Two independent engine-bleed-supplied air conditioning packages normally operate in parallel; maximum cabin pressure altitude is 8,000 feet. Wing leading edges and engine inlets are bleed air anti-iced; the empennage is electrically de-iced. Transparent areas are electrically anti-iced and defogged. A liquid oxygen system is provided to work statement requirements. Personnel access and escape provisions are ample and easy to use. Maintainability is patterned directly after the C-130, with such improvements as have been learned in service. C647 C648

The utilization of a comprehensive reliability program incorporating capabilities and techniques necessary to meet 476L requirements is a normal way of doing business at Lockheed. Our approach to reliability is an aggressive and practical one, based upon substantial experience with the problems of acquiring reliability data and assessing it. Our objective in all such effort is to minimize cost per mission accomplished. We strive to avoid the extreme at either end; high logistic and maintenance cost accruing from poor reliability, and high development and unit costs resulting from reliability goals too nearly perfect. We have obtained over the last three years the best equipment discrepancy records in the industry on our C-130 aircraft in service. From these records, we have developed computer programs and reliability control techniques that are unique to Lockheed and invaluable in supporting design, procurement, testing, and operational development. C632

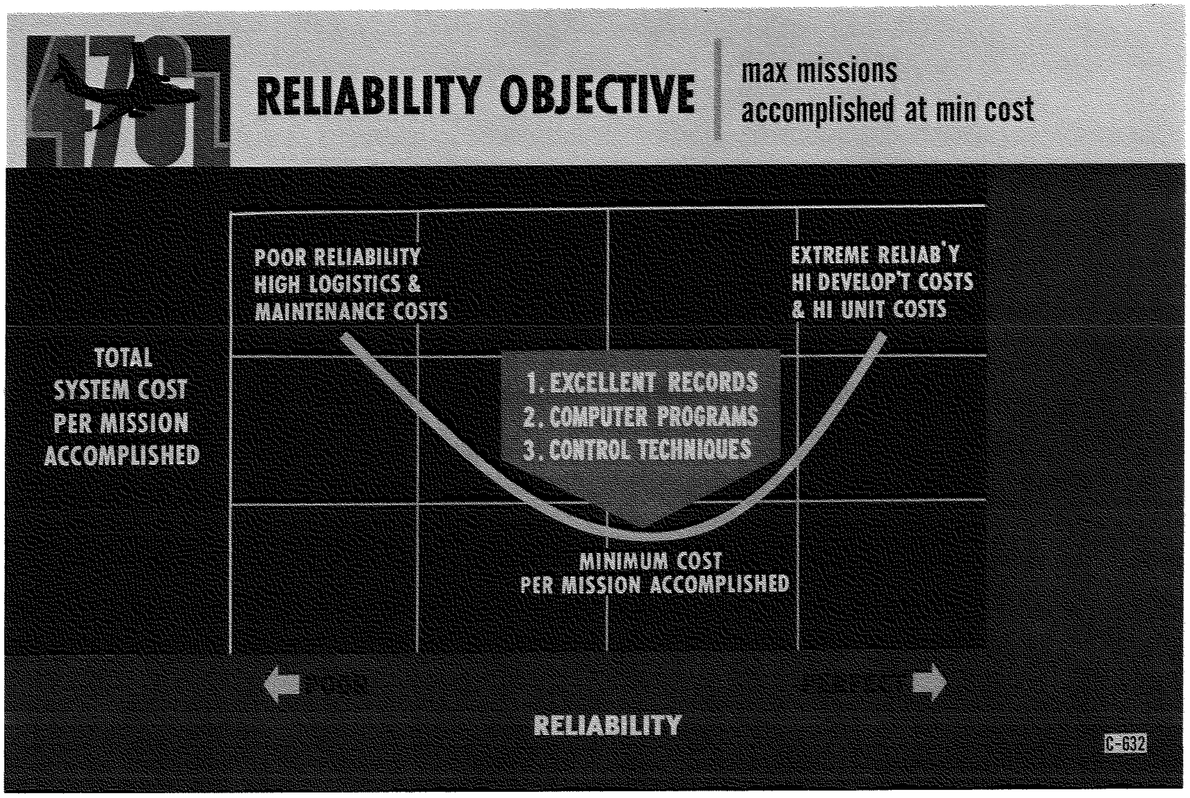
If 100% mission capability means the completion of a flight in which no malfunctions have occurred which could possibly degrade mission capability, the C-130 has a reliability in excess of 80%. Approximately 98% of C-130 flights have been completed without cause for abort. In addition, over 120,000,000 miles have been flown without loss of a single aircraft due to mechanical failure. Our analysis shows that the GL-207 will have an *initial* reliability greater than 80%. C633

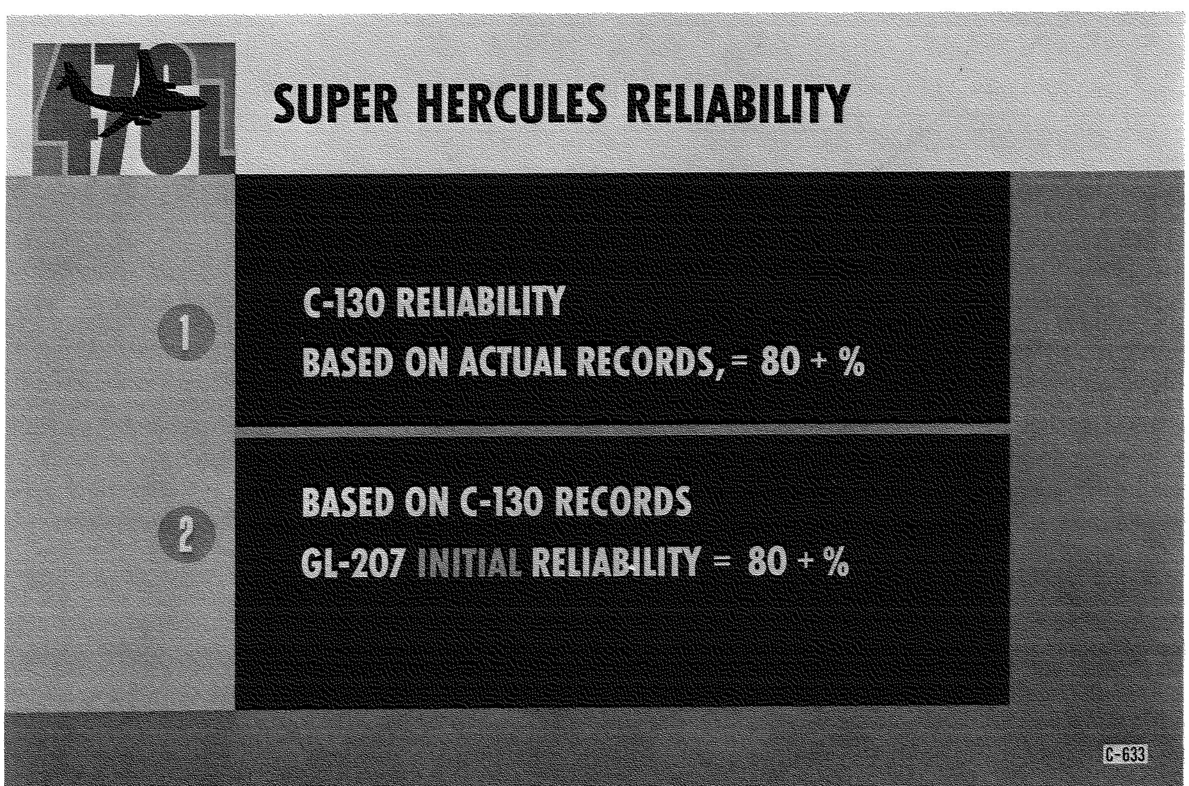
Further, we calculate that the GL-207 will have a predicted reliability of 88% six months after first operational delivery. With the reliability controls programmed, the GL-207 will exceed 90% within less than one year of operational usage. The results of this analysis are that 90 out of 100 flights will be completed without detectable degradation of mission capability. The percentage of flights with no aborts will exceed the 98% attained by the C-130. C634

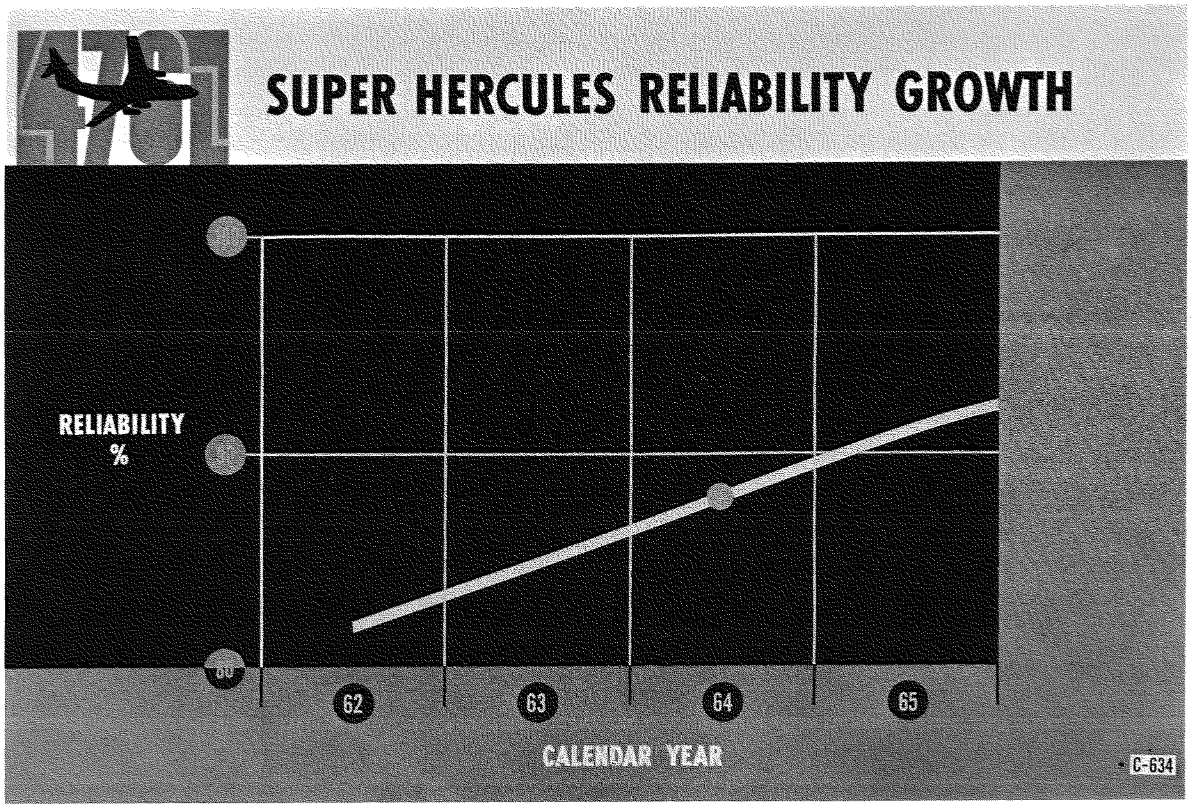
Let's turn now to airplane performance with the JT3D-4 engine. At 287,200 pounds, the maximum weight required to meet all system 476L requirements, a field length of 5,960 feet is required on a standard day. Even at maximum gross weight, 315,000 pounds, the distance required on a standard day is only 7,720 feet. Additionally, CAR requirements for take-off and landing climb-out gradients are bettered even at maximum weights. C622 C577


ENVIRONMENTAL SYSTEMS
OUTFLOW
SAFETY VALVE
CARGO
COMPARTMENT
DISTRIBUTION
ELECTRICALLY DE-ICED
REFRIGERATION PACKAGES
LIQUID OXYGEN
CONVERTER
PERSONNEL ACCESS
& ESCAPE PROVISIONS
RAIN REMOVAL
UNDER FLOOR DISTRIBUTION
ANTI-ICE SYSTEM
ENGINE BLEED
C-647

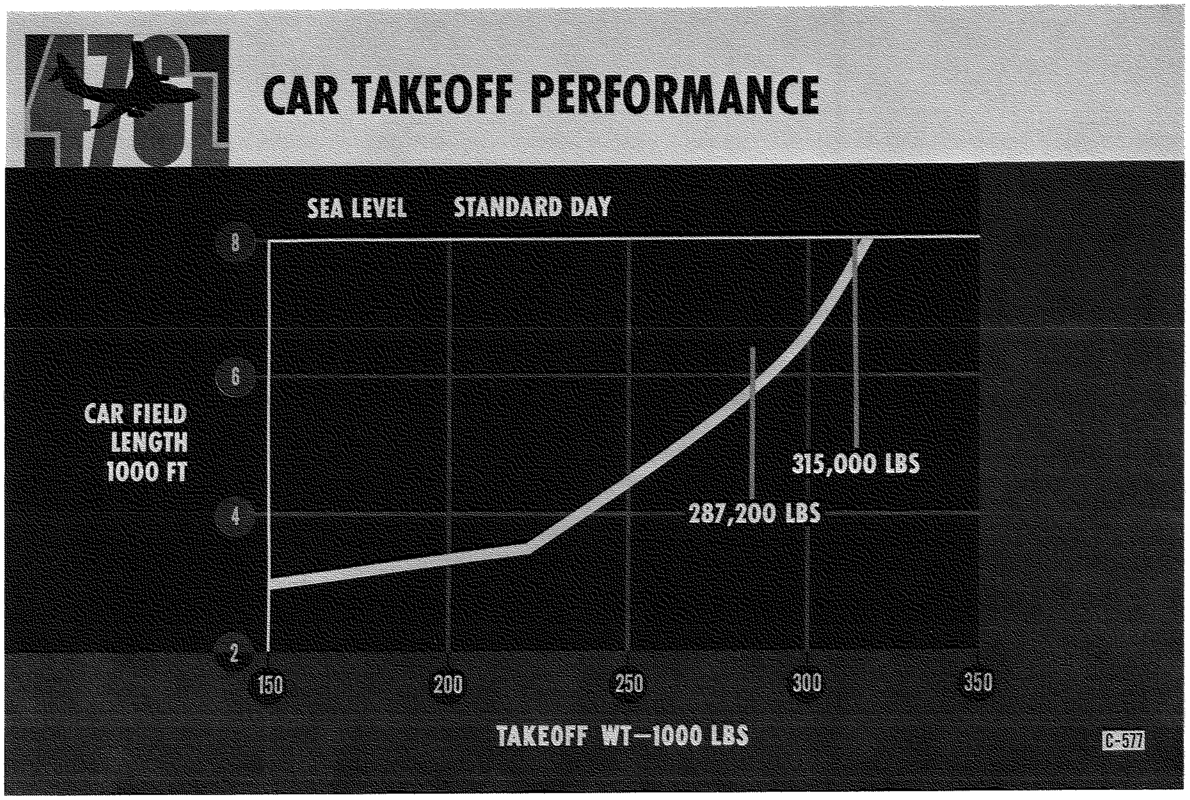

MAINTAINABILITY
ACCESS
MAINT ACCESS
PERSONNEL ACCESS
C-648


RELIABILITY OBJECTIVE
max missions
accomplished at min cost
TOTAL
SYSTEM COST
PER MISSION
ACCOMPLISHED
POOR RELIABILITY
HIGH LOGISTICS &
MAINTENANCE COSTS
EXTREME RELIAB'Y
HI DEVELOP'T COSTS
& HI UNIT COSTS
1. EXCELLENT RECORDS
2. COMPUTER PROGRAMS
3. CONTROL TECHNIQUES
MINIMUM COST
PER MISSION ACCOMPLISHED
RELIABILITY
C-632

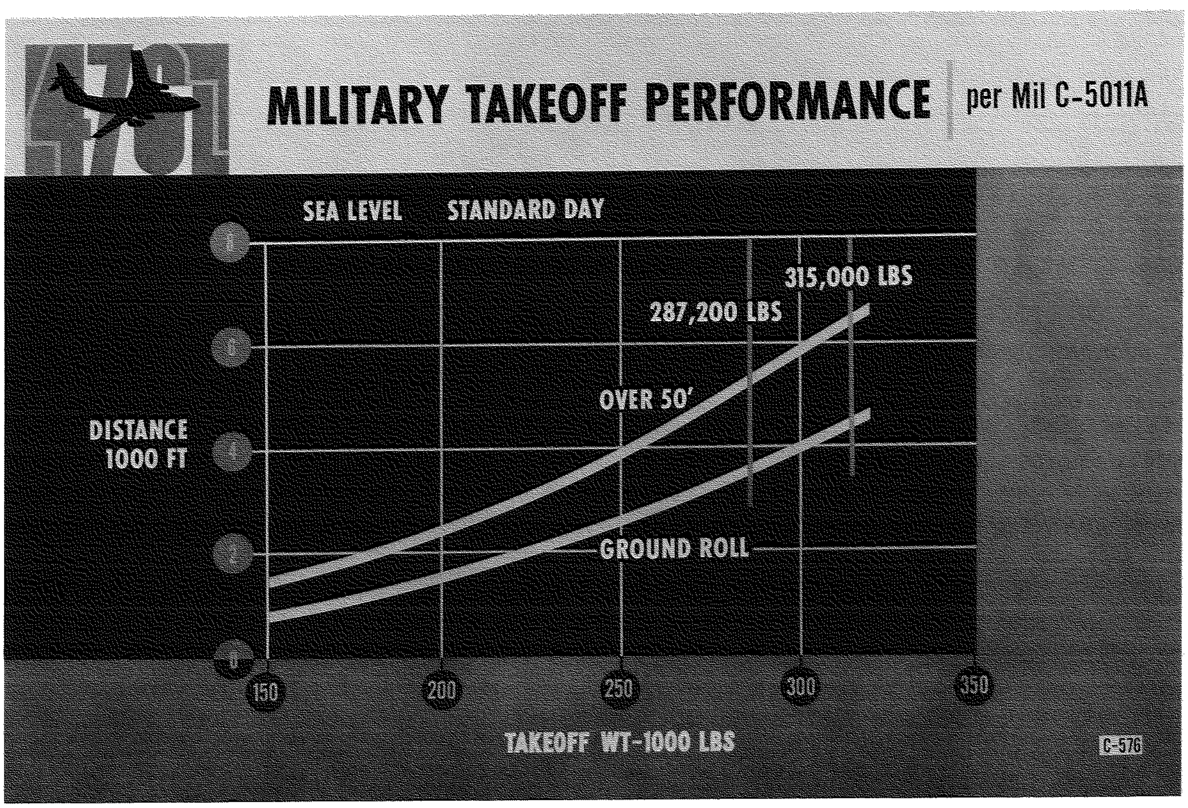

SUPER HERCULES RELIABILITY
1
C-130 RELIABILITY
BASED ON ACTUAL RECORDS, = 80 + %
2
BASED ON C-130 RECORDS
GL-207 INITIAL RELIABILITY = 80 + %
C-633


SUPER HERCULES RELIABILITY GROWTH
RELIABILITY
%
62
63
64
65
CALENDAR YEAR
C-634


3
AIRCRAFT
SYSTEM
PERFORMANCE
& FLYING
QUALITIES
C-622



CAR TAKEOFF PERFORMANCE
SEA LEVEL STANDARD DAY
CAR FIELD LENGTH 1000 FT
8
6
4
2
315,000 LBS
287,200 LBS
150
200
250
300
350
TAKEOFF WT—1000 LBS
C-577



MILITARY TAKEOFF PERFORMANCE
per Mil C-5011A
SEA LEVEL STANDARD DAY
315,000 LBS
287,200 LBS
OVER 50'
DISTANCE 1000 FT
GROUND ROLL
150
200
250
300
350
TAKEOFF WT-1000 LBS
C-576

Military take-off performance at sea level shows that, at 287,200 pounds, a distance of 5,260 feet is required to clear a 50-foot obstacle with a ground run of only 3,590 feet. For 315,000 pounds these distances are 6,440 and 4,430, respectively. C576

The altitude performance data shown here are computed per MIL-C-5011A for a standard day. At 287,200 pounds, initial rate of climb is over 3,000 feet per minute. The maximum true air speed of 487 knots occurs at an altitude of 25,000 feet. C596

At 288,000 pounds take-off weight the airplane carries 50,800 pounds for 4,000 nautical miles, or 22,000 pounds for 5,500 nautical miles. When the airplane is operated at its maximum take-off weight of 315,000 pounds, it can carry a payload of 67,300 pounds for 4,000 nautical miles or a payload of 37,000 pounds for 5,500 nautical miles. The average cruise speed for all ranges is 440 knots. Payloads even greater than 70,000 pounds can be carried when the placard speed is reduced at low altitudes. C594

The GL-207 has very low stall speeds for an airplane of such high performance. Even at the maximum landing weight, 257,500 pounds, the stall speed in the landing configuration is only 100 knots. These low speeds are particularly significant in terms of air drop; as a result, the GL-207 drops at the speeds proven so successful with the C-130. C621

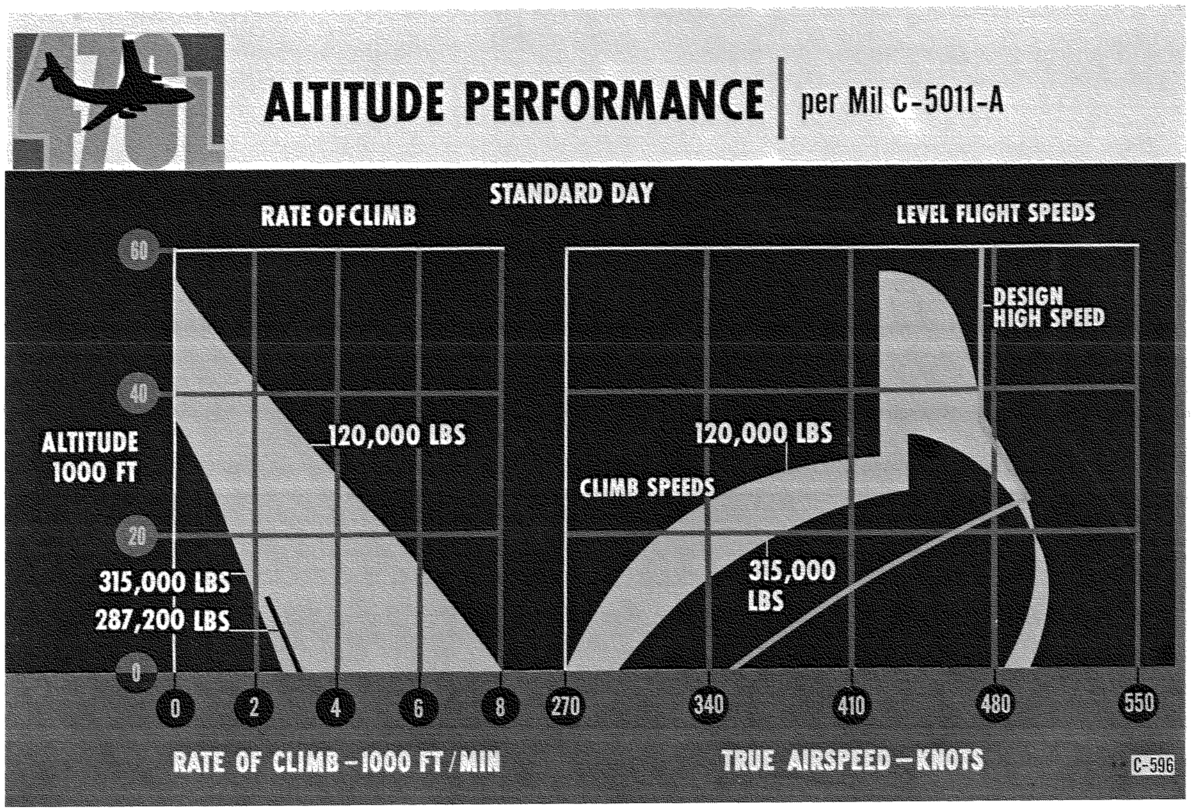
CAR landing field lengths benefit also from the low stall speeds. For a landing weight of 212,030 pounds, the maximum required for all specified system 476L missions, the distance is 5,400 feet. No credit is taken for thrust reversing. C580

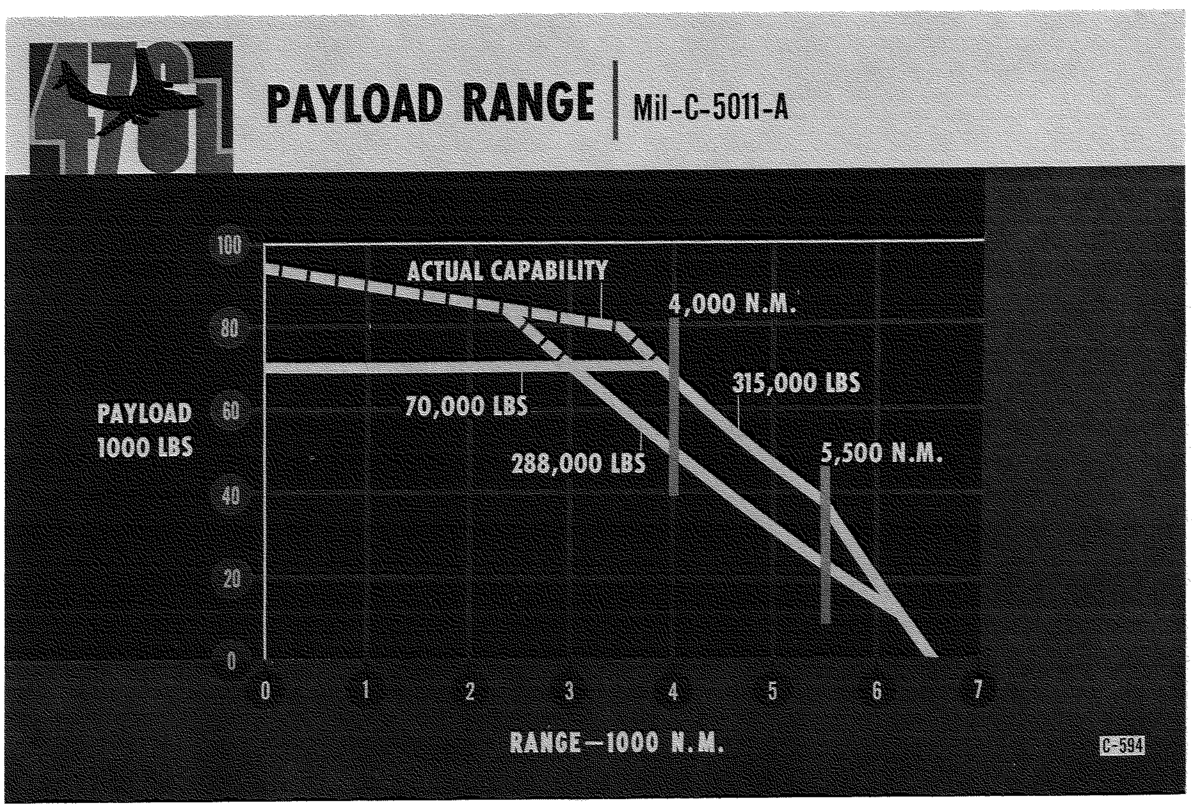
For military rules, at maximum landing weight, a distance of only 3,170 feet is required to clear a 50-foot obstacle on a standard day and ground roll is only 1,500 feet. At 212,030 pounds, these distances are 2,700 and 1,210 feet, respectively. C578

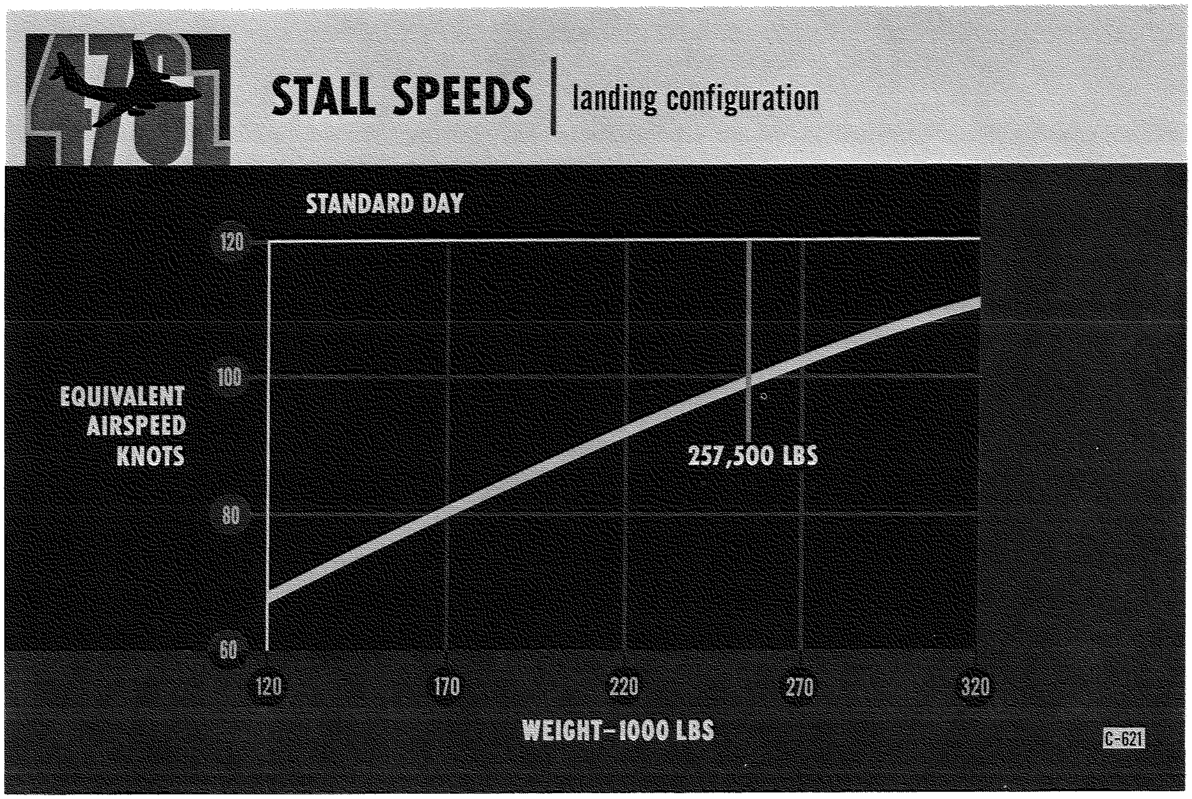
For the basic mission, when powered with the JT3D-4 power plant and when carrying a payload of 50,000 pounds, a fuel load of 110,200 pounds is required which results in a take-off gross weight of 287,200 pounds which can be flown from a critical field length of less than 6,000 feet with a beginning cruise altitude of 34,200 feet and an average cruise speed of 440 knots for a range of 4,000 nautical miles. Landing weight will be 187,500 pounds and CAR landing field length required is 4,910 feet. C591

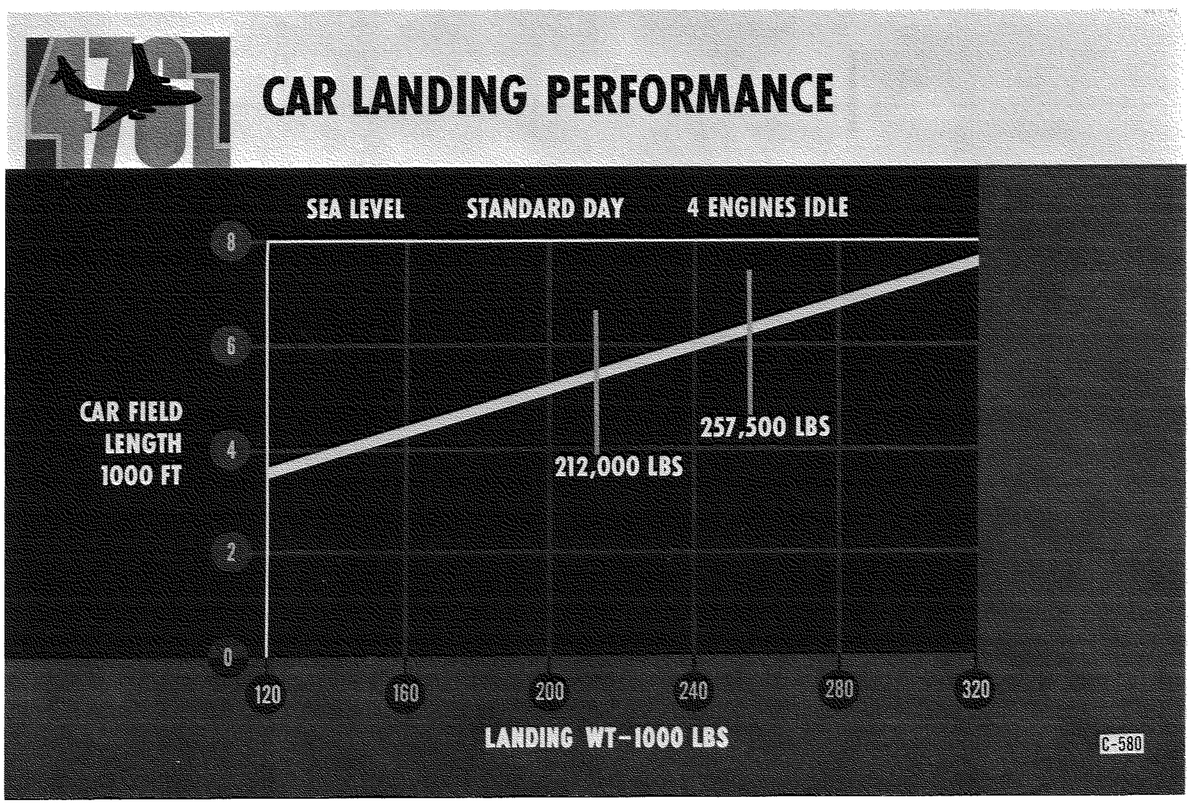
For the alternate mission payload of 20,000 pounds, take-off weight is 283,100 pounds, which requires a CAR critical field-length of 5,780 feet. Beginning cruise altitude is 34,500 feet, average cruise speed is 440 knots, and range is 5,500 nautical miles. The CAR landing field length is only 4,330 feet. C588

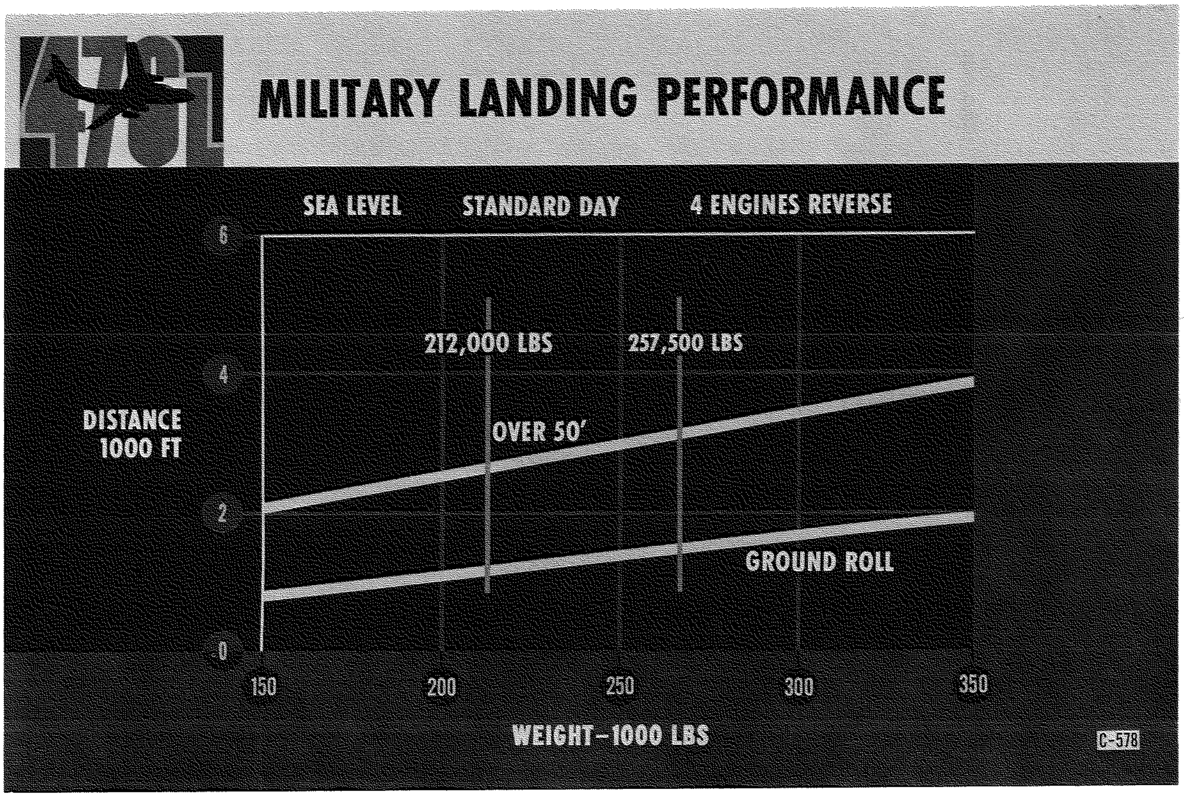
The maximum design take-off weight of 315,000 pounds may be exploited either for maximum productivity by carrying an 80,000 pound payload 3,440 nautical miles, or for maximum cruise speed in which case the basic 50,000 pound, 4,000 nautical mile mission can be flown at 456 knots. This same take-off weight can be used to carry 38,000 pounds 5,500 nautical miles. C624


ALTITUDE PERFORMANCE
per Mil C-5011-A
STANDARD DAY
RATE OF CLIMB
LEVEL FLIGHT SPEEDS
DESIGN HIGH SPEED
60
40
20
0
ALTITUDE 1000 FT
120,000 LBS
315,000 LBS
287,200 LBS
120,000 LBS
CLIMB SPEEDS
315,000 LBS
0
2
4
6
8
270
340
410
480
550
RATE OF CLIMB – 1000 FT/MIN
TRUE AIRSPEED – KNOTS
C-596


PAYLOAD RANGE
Mil-C-5011-A
100
80
60
40
20
0
PAYLOAD 1000 LBS
ACTUAL CAPABILITY
4,000 N.M.
70,000 LBS
315,000 LBS
288,000 LBS
5,500 N.M.
0
1
2
3
4
5
6
7
RANGE – 1000 N.M.
C-594


STALL SPEEDS
landing configuration
STANDARD DAY
EQUIVALENT AIRSPEED KNOTS
60
80
100
120
257,500 LBS
120
170
220
270
320
WEIGHT–1000 LBS
C-621


CAR LANDING PERFORMANCE
SEA LEVEL
STANDARD DAY
4 ENGINES IDLE
CAR FIELD LENGTH 1000 FT
0
2
4
6
8
212,000 LBS
257,500 LBS
120
160
200
240
280
320
LANDING WT–1000 LBS
C-580



PERFORMANCE SUMMARY

basic mission

PAYLOAD (LBS)	50,000
FUEL (LBS)	110,200
T.O. WEIGHT (LBS)	287,200
CAR (T.O.) CRITICAL FIELD LENGTH (FT)	5,960
BEGIN CRUISE ALTITUDE (FT)	34,200
AVERAGE CRUISE SPEED (KTS)	440
RANGE (N.M.)	4,000
LANDING WEIGHT (LBS)	187,530
CAR LANDING FIELD LENGTH (FT)	4,910
RESERVE FUEL PER MIL C-5011A (LBS)	10,530

C-591

PERFORMANCE SUMMARY

alternate mission

PAYLOAD (LBS)	20,000
FUEL (LBS)	136,100
T.O. WEIGHT (LBS)	283,100
CAR (T.O.) CRITICAL FIELD LENGTH (FT)	5,780
BEGIN CRUISE ALTITUDE (FT)	34,500
AVERAGE CRUISE SPEED (KTS)	440
RANGE (N.M.)	5,500
LANDING WEIGHT (LBS)	158,305
CAR LANDING FIELD LENGTH (FT)	4,330
RESERVE FUEL PER MIL C-5011A (LBS)	11,305

C-588

PERFORMANCE SUMMARY

max design t.o. weight

T.O. WEIGHT (LBS) 315,000

	MAX PRODUCTIVITY	MAX SPEED
PAYLOAD (LBS)	80,000	50,000
CRUISE SPEED (KTS)	440	456
RANGE (N.M.)	3,440	4,000

C-624

For a tactical mission to carry 25,000 pounds 1,500 nautical miles, a take-off weight of 191,400 pounds results in a take-off UCI of only 37 and a take-off ground roll of only 1,460 feet. Landing UCI is only 31, and landing ground roll is 900 feet. C601

When the basic military version of the Super Hercules is fitted out for commercial application by removing the military equipment not required and substituting a light-weight cargo floor and the 463L-compatible Lockheed mechanized loading system, the equipped-weight empty is reduced to 123,200 pounds. The maximum payload capability is 93,000 pounds and an 84,000 pound palletized payload can be carried at a loaded density of 14.0 pounds per cubic foot. Using a maximum take-off weight of 315,000 pounds and the minimum-cost cruise speed of 440 knots, the payload can be carried any range from 850 to 3,600 nautical miles at a direct operating cost of 3.9 cents per ton mile. For operators desiring larger payloads at realistic densities for shorter ranges, the fuselage can be lengthened for one, or a maximum of two, more pallets, increasing usable volume by 10 and 20%, respectively. C584

For international commercial operation the equipped-weight empty becomes 124,000 pounds, so that at a take-off weight of 312,400 pounds and for the work statement 3,000 nautical mile over-water range, the maximum payload becomes 83,200 pounds and the direct operating cost is 4.5 cents per ton mile. C592

In addition to the performance already shown, we have computed basic mission performance for the Super Hercules when powered with the JT3D-8A, JT3D-8B, and JT3D-12A and the G.E. MF239C-3. The payload for the 4,000 nautical mile mission increases slightly, in general, as you go to the right. The maximum cruise speed to carry 50,000 pounds increases similarly. Take-off field length decreases, of course, as engine static thrust level increases. The direct operating costs are remarkably constant, however, indicating the fact that the high-thrust engines exhibit only modest improvements in fuel consumption in spite of substantial increases in thrust. C629

The excellent flying qualities of the C-130 airplane have provided a major contribution to its unequaled safety record in military service. Continuing this tradition, careful attention has been given to design features of the GL 207-45 which will insure similarly excellent stability and control characteristics. This center of gravity diagram shows the significant center of gravity limits. C589

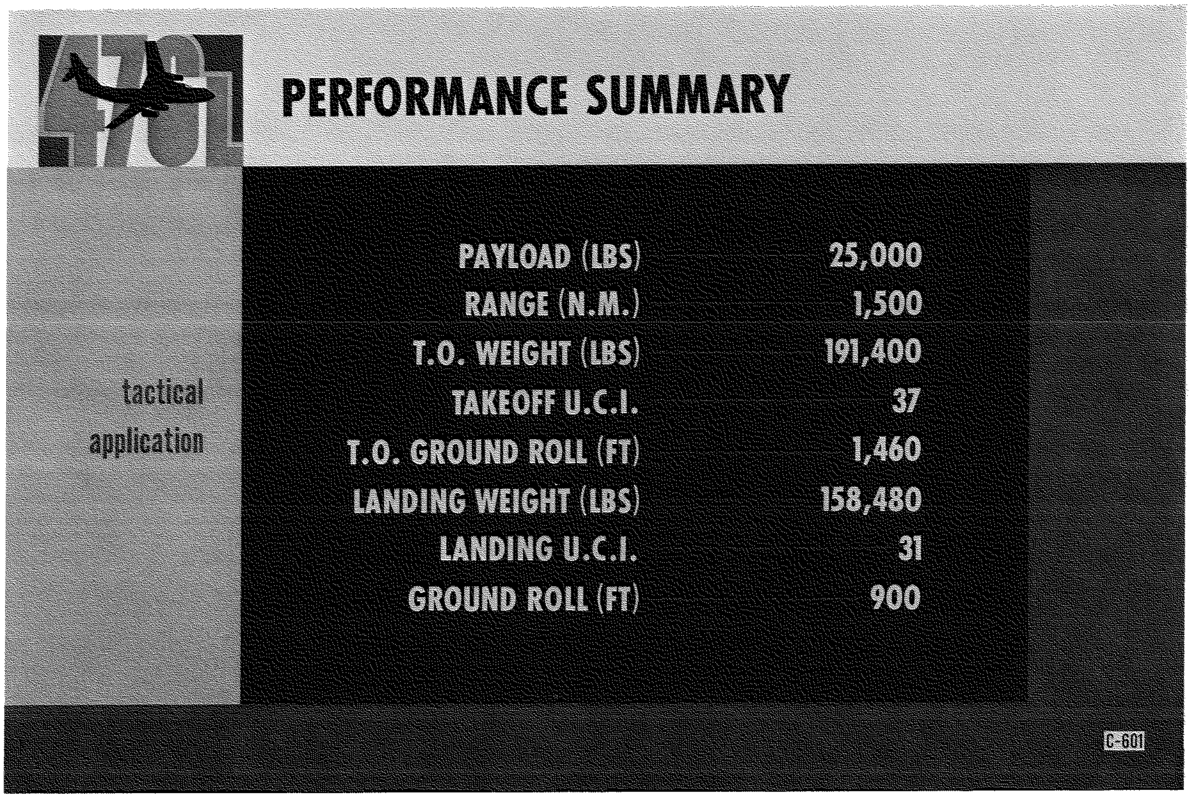
The T-tail, developed through high as well as low speed tunnel tests, provides a high level of stability with excellent control through the stall. This unusually high stability level allows:

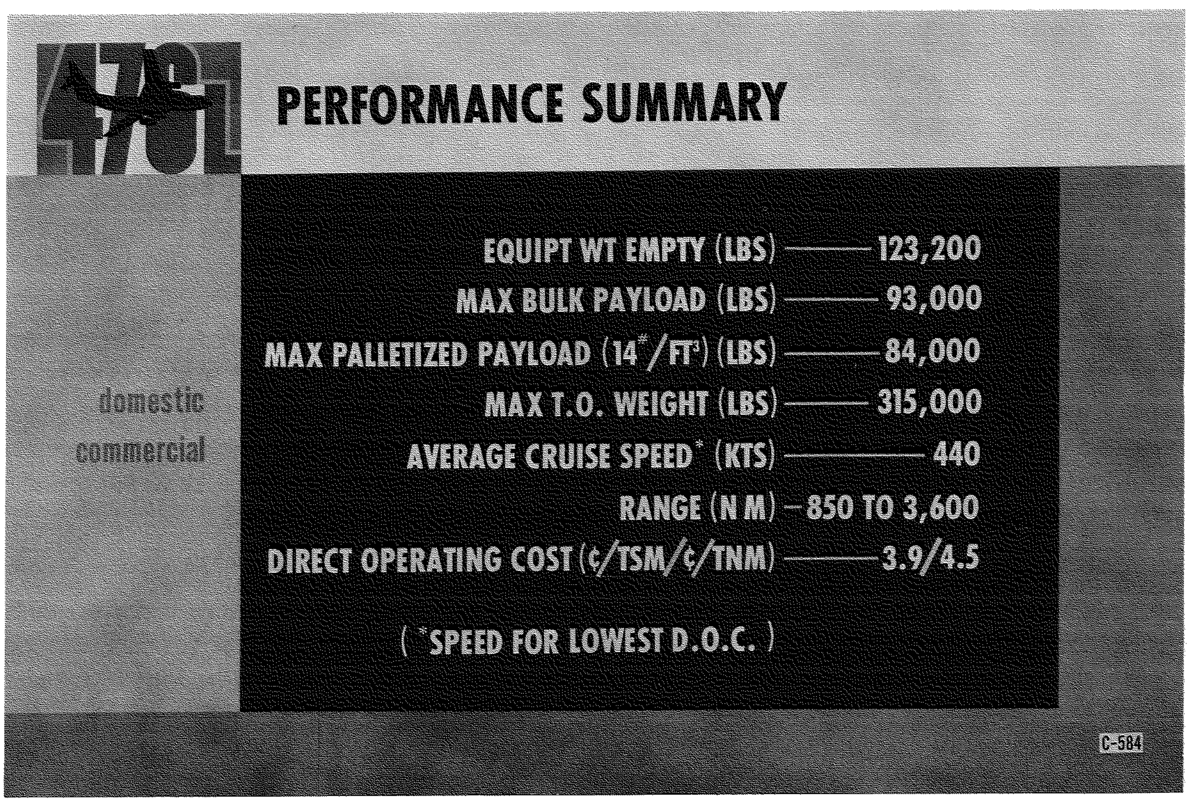
1 Compliance with the stick force requirements of MIL-F-8785.

2 Use of a conventional elevator boost system similar to that which has proven so satisfactory on the C-130—without use of any artificial stability devices.

3 Attainment of the large allowable c.g. travel shown.

Low speed wind tunnel tests have shown that the minimum wing sweep, moderate airfoil thickness, large outboard leading edge radius, and carefully C604


476L
PERFORMANCE SUMMARY
tactical application
PAYLOAD (LBS) 25,000
RANGE (N.M.) 1,500
T.O. WEIGHT (LBS) 191,400
TAKEOFF U.C.I. 37
T.O. GROUND ROLL (FT) 1,460
LANDING WEIGHT (LBS) 158,480
LANDING U.C.I. 31
GROUND ROLL (FT) 900
C-601


476L
PERFORMANCE SUMMARY
domestic commercial
EQUIPT WT EMPTY (LBS) — 123,200
MAX BULK PAYLOAD (LBS) — 93,000
MAX PALLETIZED PAYLOAD (14#/FT³) (LBS) — 84,000
MAX T.O. WEIGHT (LBS) — 315,000
AVERAGE CRUISE SPEED* (KTS) — 440
RANGE (N M) – 850 TO 3,600
DIRECT OPERATING COST (¢/TSM/¢/TNM) — 3.9/4.5
(*SPEED FOR LOWEST D.O.C.)
C-584

PERFORMANCE SUMMARY

international commercial

EQUIPT WT EMPTY (LBS)	124,000
T.O. WEIGHT (LBS)	312,400
MAX PAYLOAD FOR 3,000 NM RANGE	83,200
DIRECT OPER. COST (¢/TSM / ¢/TNM)	4.5 / 5.2

C-592

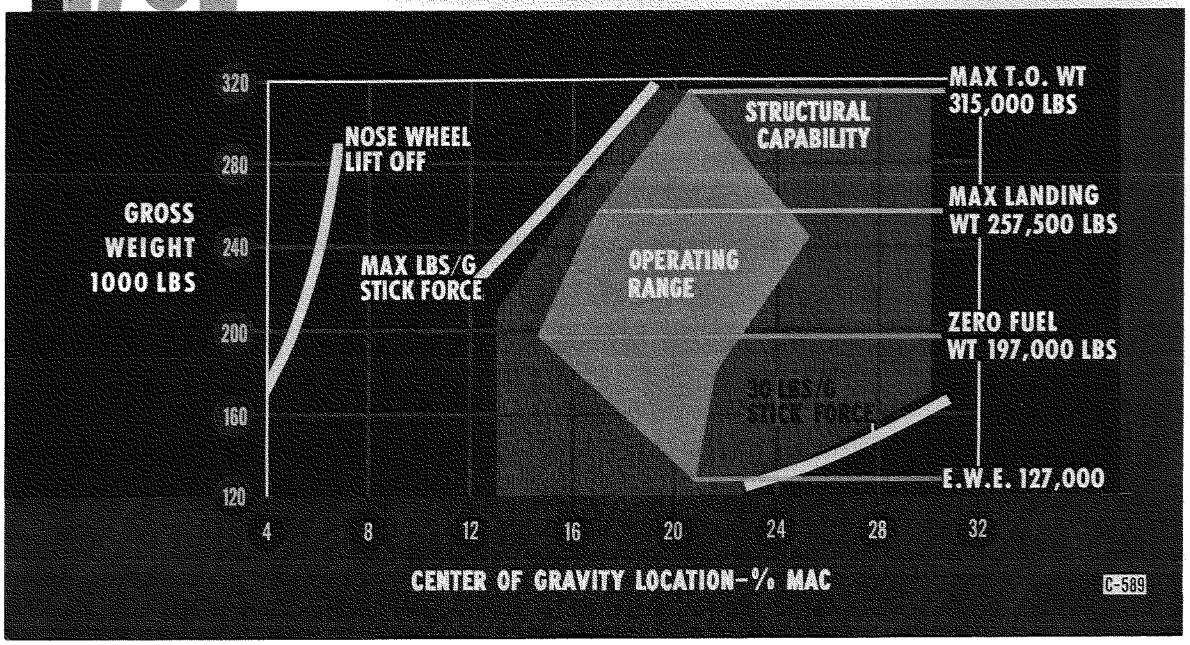
PERFORMANCE SUMMARY | alternate power plants

DATA	JT3D-4	JT3D-8A	JT3D-8B	JT3D-12A	MF239C-3
PAYLOAD FOR 4,000 N.M. AT 440 KTS	67,700 (50,800)	69,000	69,000	67,300	71,200
MAX CRUISE SPEED FOR 50,000 LBS/4,000 N.M.	456 (440)	457	457	457	462
CAR CRIT FLD LENGTH AT MAX T.O. WT	7,720 (6,000)	6,000	5,500	5,600	5,350
MILITARY D.O.C. AT 4,000 N.M.	5.97 (7.86)	5.88	5.88	5.96	5.71

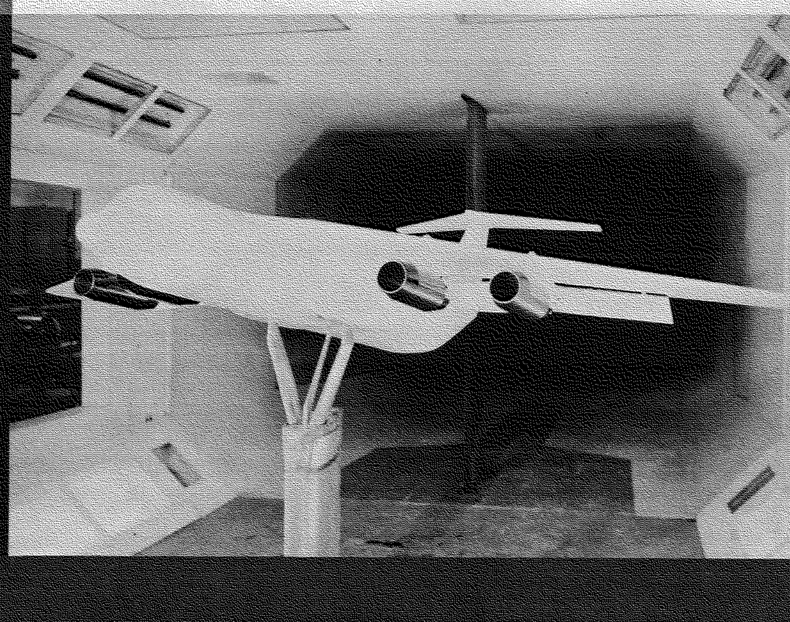
FIGS IN PARENTHESES ARE FOR 288,000 LB T.O. WT

C-629

476L CENTER OF GRAVITY DESIGN LIMITS



476L LOW SPEED WIND TUNNEL MODEL



C-604

tailored camber and twist distribution provide excellent stall characteristics without requiring use of wing leading edge devices.

Excellent roll control is provided throughout the flight speed range through use C619
of conventional ailerons. The data here include the effects of aeroelasticity, which are minimized by the moderate wing sweep. A conventional aileron boost system similar to that on the Lockheed JetStar provides desirable wheel force characteristics throughout the airplane flight regime.

The tunnel data show that excellent sideslip characteristics are attained by C612
the GL 207. Again, the high level of directional stability afforded by the T-tail allows use of a conventional C-130 type rudder boost system to provide better than required sideslip capability with no tendency for pedal force lightening at the greater sideslip angles.

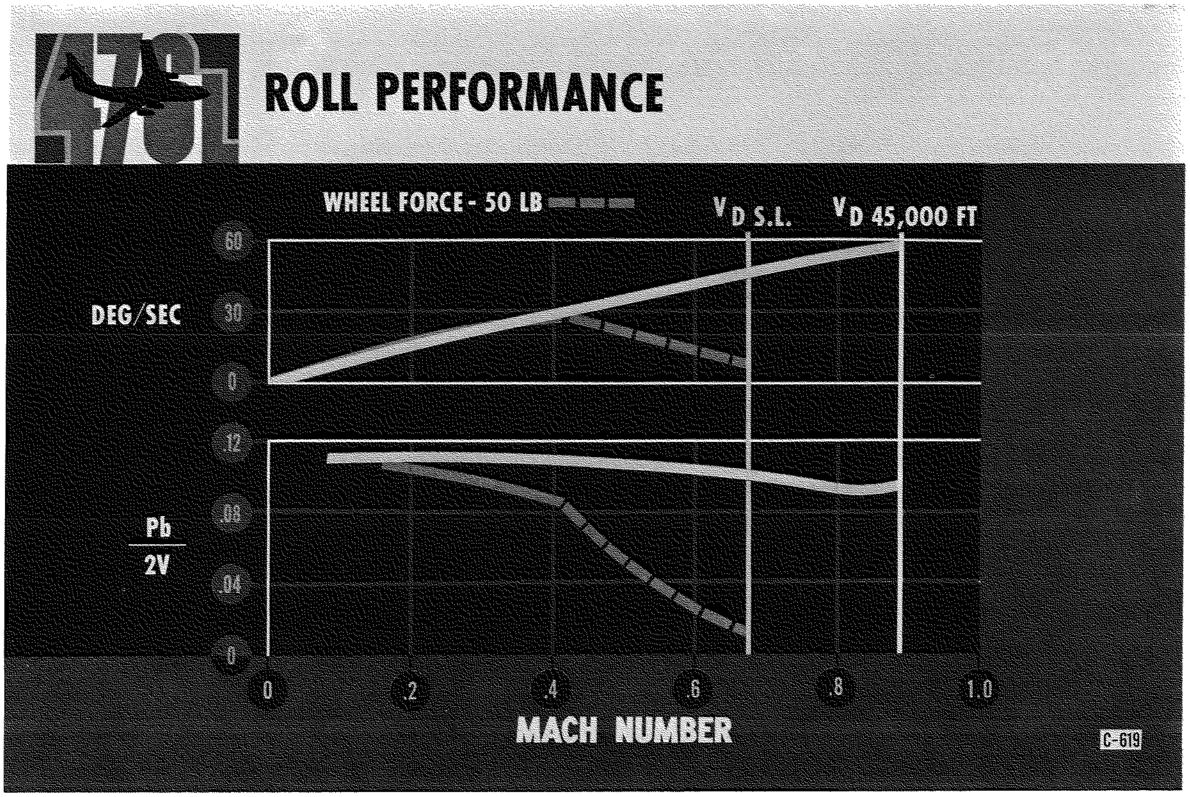
The vertical tail has been sized to enable the GL 207-45 to meet the damper-out dutch roll dynamic stability requirements of MIL-F-8785 throughout its flight regime. A dutch roll damper is provided to insure pleasant, better-than-required, dynamic characteristics.

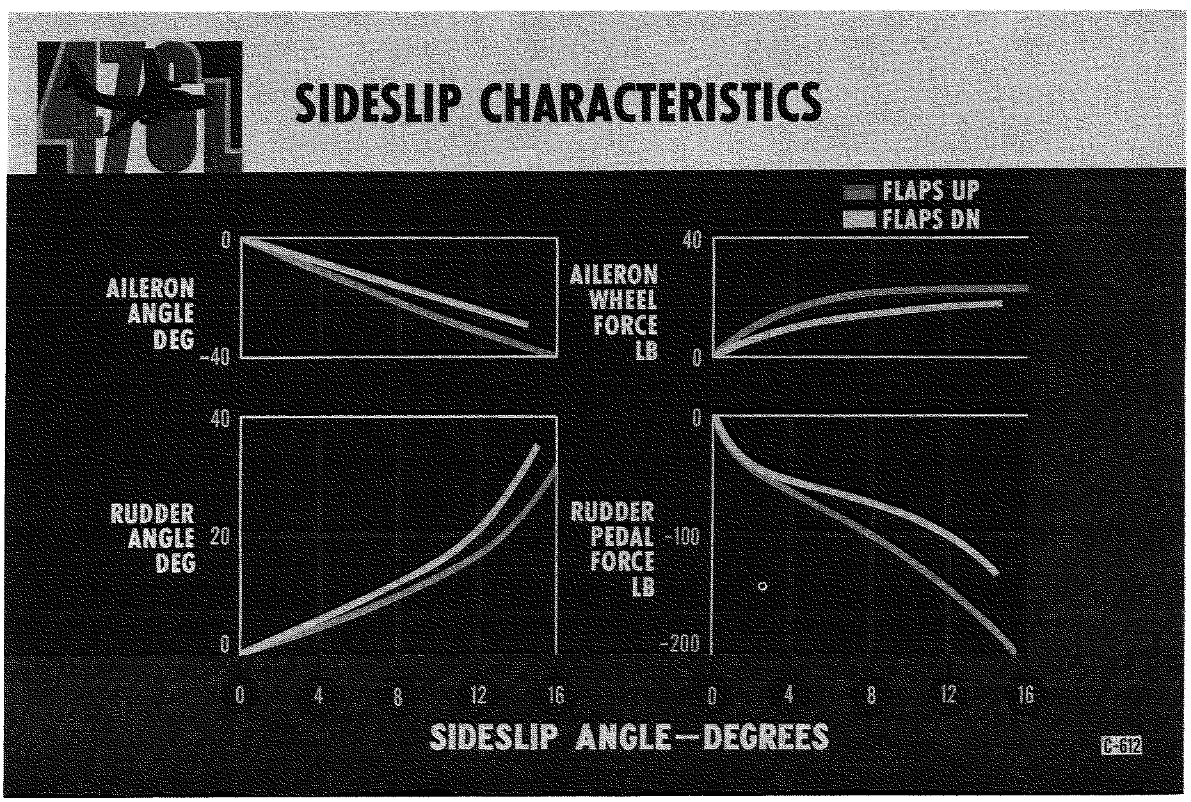
The developmental programs—wind tunnel, structural and functional test, C605
and flight test—are extensive and thorough.

This slide summarizes the wind tunnel programs, both completed and planned. C615
Only minor configuration changes are anticipated in the future, but substantial backup data, such as air load distribution and flutter stiffness criteria, must be accumulated using existing, and some new, models. The Cornell transonic and the Lockheed and Georgia Tech low speed tunnels will be used.

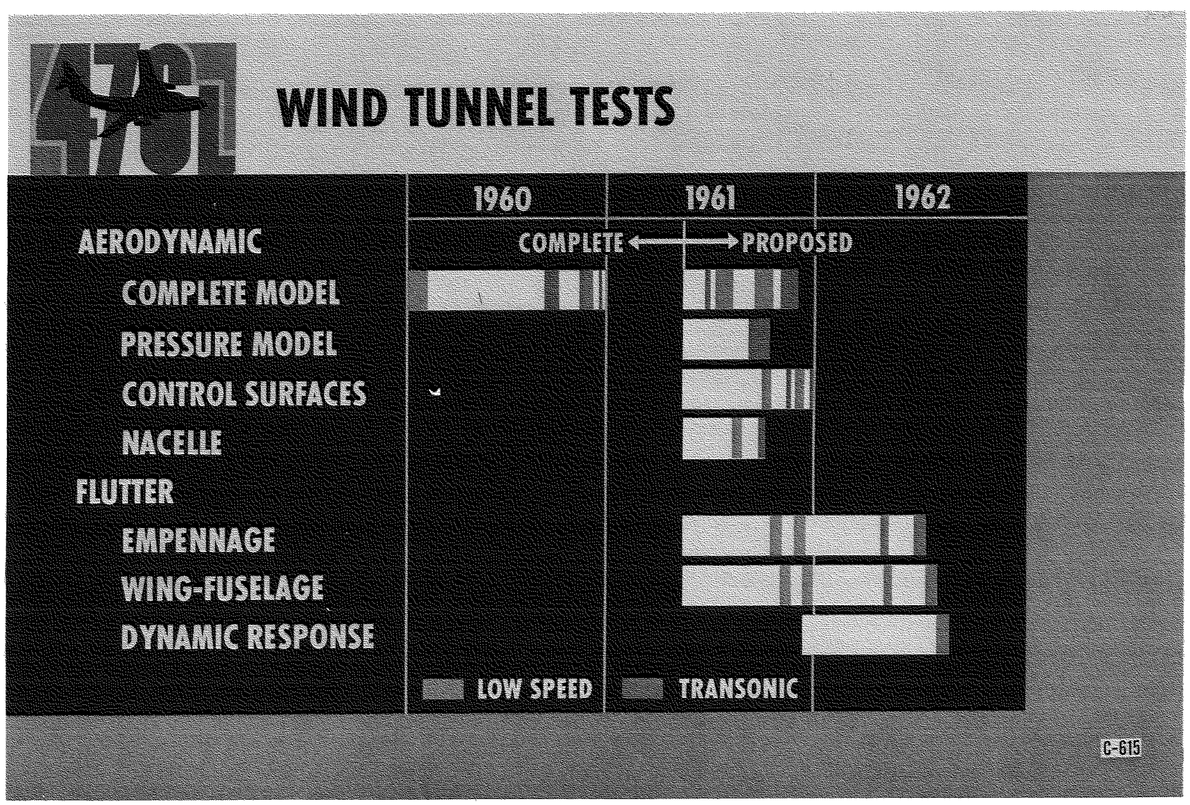
The structural test and functional test programs are aimed at maximum reliability, C623
integrated with the rapid but realistic aircraft development. Full scale mockups, fuel system mockups, and complete antenna and electronic systems tests will provide reliable systems compatible with production schedules.

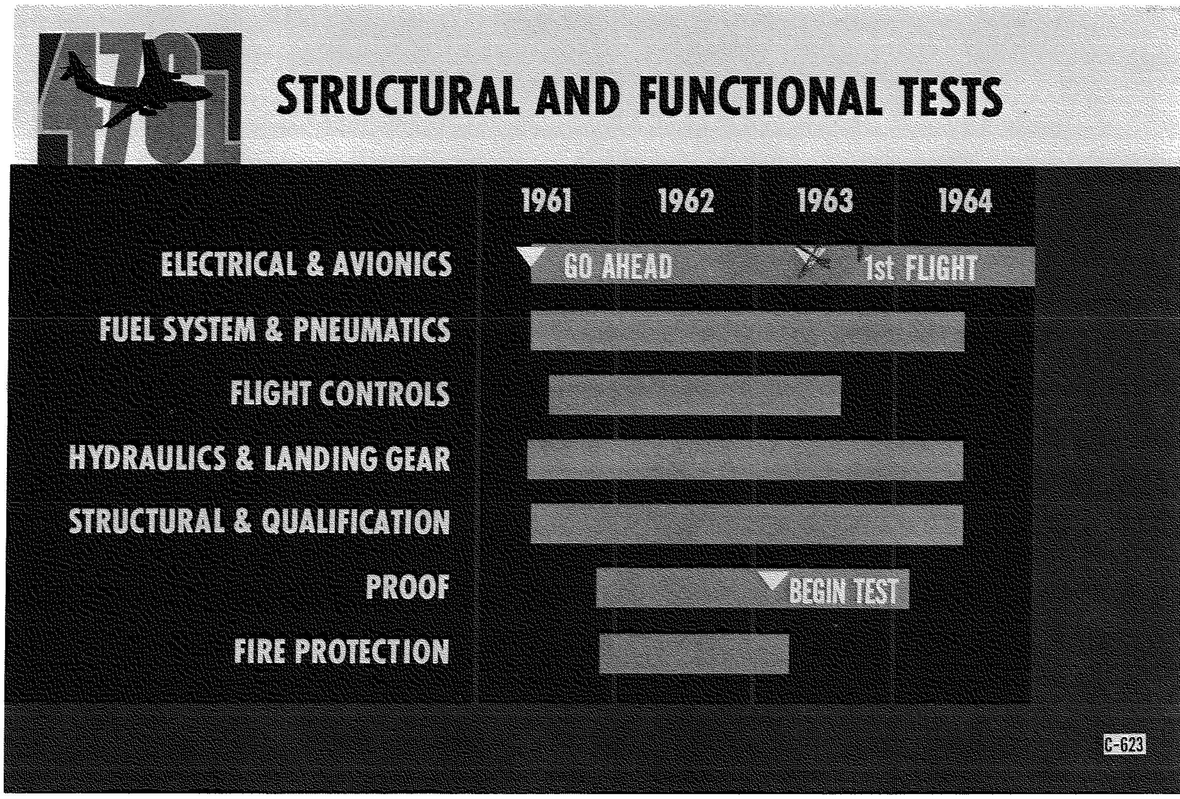
Comprehensive flight and ground test programs, utilizing an engine test stand C587
and five test aircraft (three for Category I and F.A.A. certification and two for Category II), are scheduled for a type certification date of 31 August 1964. Past Lockheed certification experience confirms this as aggressive but realistic.

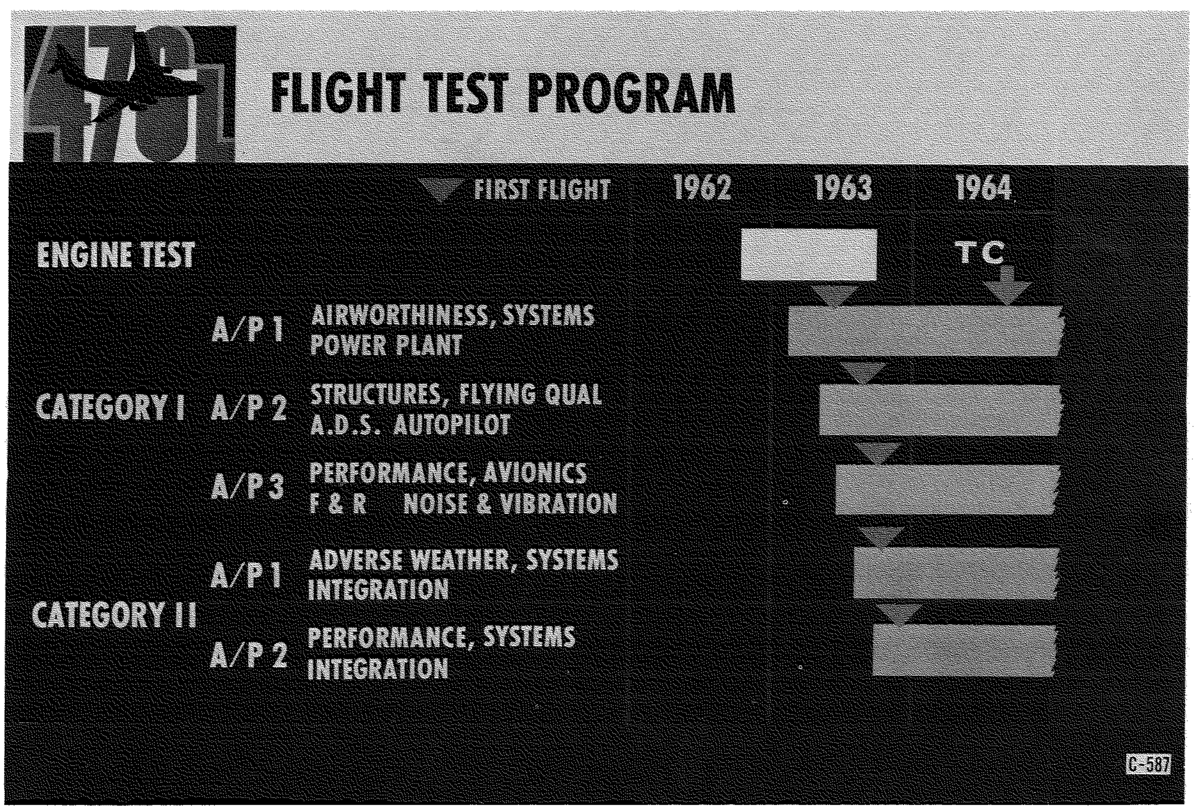

ROLL PERFORMANCE
WHEEL FORCE - 50 LB
V_{D} S.L.
V_{D} 45,000 FT
DEG/SEC
60
30
0
.12
.08
.04
0
Pb
2V
0
.2
.4
.6
.8
1.0
MACH NUMBER
C-619


SIDESLIP CHARACTERISTICS
FLAPS UP
FLAPS DN
AILERON ANGLE DEG
0
-40
AILERON WHEEL FORCE LB
40
0
RUDDER ANGLE DEG
40
20
0
RUDDER PEDAL FORCE LB
0
-100
-200
0
4
8
12
16
0
4
8
12
16
SIDESLIP ANGLE—DEGREES
C-612


4
DEVELOPMENTAL
PROGRAM
C-605

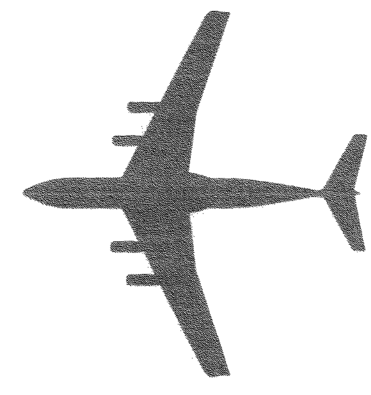

WIND TUNNEL TESTS
1960
1961
1962
COMPLETE ⟷ PROPOSED
AERODYNAMIC
COMPLETE MODEL
PRESSURE MODEL
CONTROL SURFACES
NACELLE
FLUTTER
EMPENNAGE
WING-FUSELAGE
DYNAMIC RESPONSE
LOW SPEED
TRANSONIC
C-615


STRUCTURAL AND FUNCTIONAL TESTS
1961
1962
1963
1964
ELECTRICAL & AVIONICS
GO AHEAD
1st FLIGHT
FUEL SYSTEM & PNEUMATICS
FLIGHT CONTROLS
HYDRAULICS & LANDING GEAR
STRUCTURAL & QUALIFICATION
PROOF
BEGIN TEST
FIRE PROTECTION
C-623


FLIGHT TEST PROGRAM
FIRST FLIGHT
1962
1963
1964
ENGINE TEST
T C
A/P 1
AIRWORTHINESS, SYSTEMS
POWER PLANT
CATEGORY I
A/P 2
STRUCTURES, FLYING QUAL
A.D.S. AUTOPILOT
A/P 3
PERFORMANCE, AVIONICS
F & R NOISE & VIBRATION
A/P 1
ADVERSE WEATHER, SYSTEMS
INTEGRATION
CATEGORY II
A/P 2
PERFORMANCE, SYSTEMS
INTEGRATION
C-587

SUPER HERCULES · GL207-45

section 4



PROGRAM MANAGEMENT AND FUNDING

W. A. PULVER

Our management of the 476L program—encompassing production of the GL 207 Super Hercules, and support of the complete system throughout its operational life—is keyed to the specific requirements expressed in your Statement of Work: urgent need, low cost, and assured operational dependability. C655

In preparation of our 476L Master Program Plan, we found that substantial cost penalties would be incurred through loss of production learning if we interrupted our proposed schedule build-up. In order to produce so that the first operational airplane will be available concurrent with obtaining an FAA type certificate, such a costly interruption would occur. To avoid this, we established a schedule providing a modest, conservative build-up, observing all scheduling premises contained in the Statement of Work. This results in making 15 production airplanes available for delivery in the seven month period prior to type certificate. These airplanes meet all Air Force specifications and we have assumed that delivery will be accomplished when available. We feel strongly that the savings realized far outweigh the potential cost of changes arising from test results obtained during the FAA flight test program. We recognize and accept our responsibility to bring these aircraft up to type certificate design configuration at no additional cost to the Government. C656 ?

To recap this schedule, key development milestones are: C657

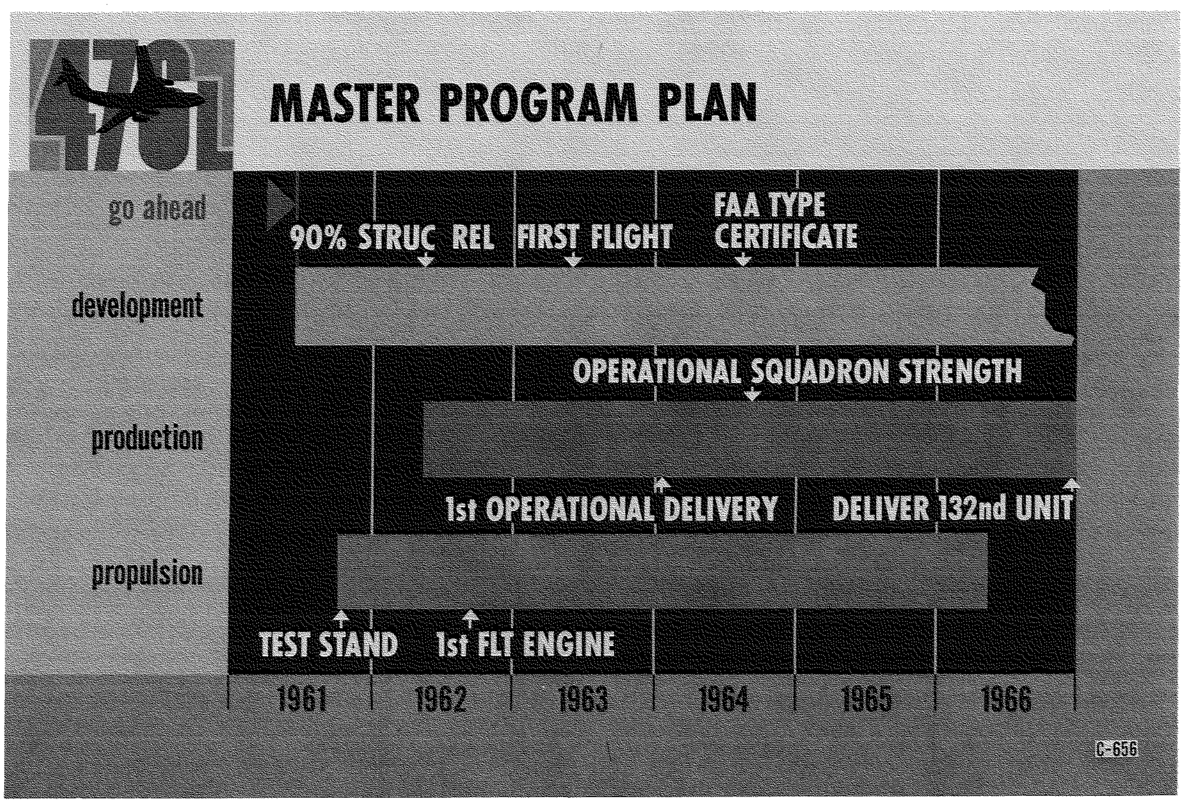
90% Engineering Structures Release	— 12 months from go-ahead
First Flight	— 25 months } 15 months ???
Type Certificate	— 40 months

Major production milestones are:

First Operational Delivery	— 33 months – 7 months ahead of FAA certif. ?
Squadron Strength	— 41 months
Delivery of the 132nd Aircraft	— 68 months

If obtaining the type certificate is mandatory prior to Air Force acceptance of operational airplanes, we recommend a flight test program which utilizes seven test airplanes. With these two additional articles in the program, a type certificate would be received 37 months from go-ahead, or 12 months after first flight, and airplanes with full type certificate eligibility would be available three months sooner than with the basic proposal schedule. Since our production schedule build-up would remain exactly the same, the number of production airplanes available for delivery before type certificate would be reduced from 15, in the basic proposal, to five in this alternate program, after diverting the two additional airplanes to C658


5
MANAGEMENT,
PRODUCTION
& SUPPORT
C-655


476L
MASTER PROGRAM PLAN
go ahead
90% STRUC REL
FIRST FLIGHT
FAA TYPE CERTIFICATE
development
OPERATIONAL SQUADRON STRENGTH
production
1st OPERATIONAL DELIVERY
DELIVER 132nd UNIT
propulsion
TEST STAND
1st FLT ENGINE
1961
1962
1963
1964
1965
1966
C-656

MILESTONES

		MONTHS FROM GO-AHEAD
development	90% ENGINEERING STRUCTURES RELEASED	12
	FIRST FLIGHT	25
	FAA CERTIFICATION	40
production	1st OPERATIONAL DELIVERY	33
	SQUADRON STRENGTH	41
	DELIVERY 132nd AIRCRAFT	68

C-657

ALTERNATE PROGRAM

BASIC PROPOSAL
5 A/C IN FLIGHT TEST

TC 40th MONTH

MO	1	1	1	2	2	2	3	3
CUM	1	2	3	5	7	9	12	15

7 A/C IN FLIGHT TEST

TC 37th MONTH

MO	1	*	*	2	2			
CUM	1	1	1	3	5			

*6TH & 7TH FLIGHT TEST A/C

C-658

the flight test program. We consider this alternate program appropriate only if the delivery of airplanes which are qualified to military specifications must await receipt of civil type certification.

We were pleased to note your attention to Program Evaluation Procedures (PEP) in the Statement of Work. During the past months, we have applied this advanced monitoring technique to phases of our C-130E program. Having worked with the initial participants in this field from our Missiles and Space Division, we are certain we have the background knowledge necessary to implement this program and to utilize the many advantages it affords. It is our intent to use this technique in our internal management control as well as for the prescribed Air Force purposes. C659

Our program schedule will be met with the manpower levels shown here. The yellow line represents the work force required for the combination of firm and anticipated business other than 476L. From a level of approximately 20,000 in 1956-57, we now stand at 10,000 employees. Projections of firm and anticipated business other than 476L continue the downward trend. The red area shown above this yellow line reflects the total of all direct and supporting indirect personnel required for the in-plant portion of the 476L program. At the program production rate of 4 per month, overall plant employment is well under half of plant capacity. C660

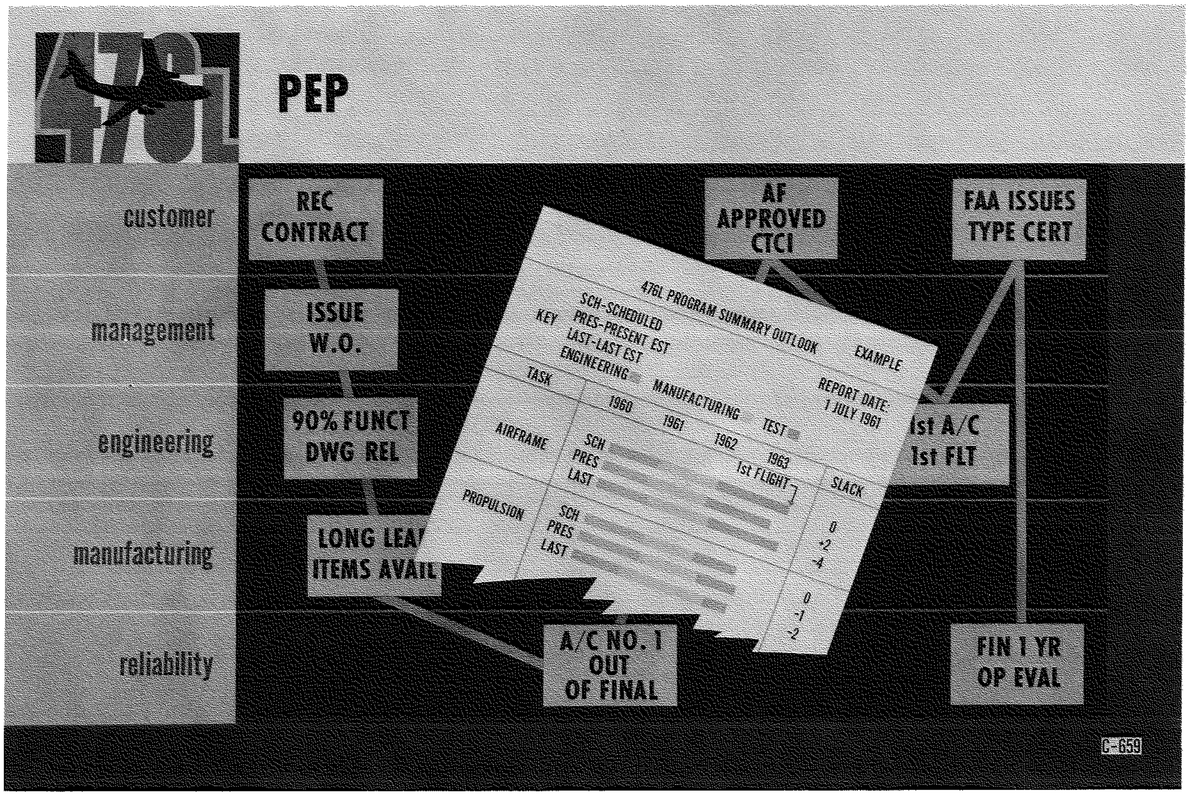
This chart indicates that our manpower peak would occur in September 1964 at approximately 4,500 direct employees. Manning of this program will be accomplished by reassignment of personnel released from other projects or by recall from layoff. Engineering personnel, for example, will be available from both the C-130E and C-140 (JetStar) programs as the 476L program becomes active. C661

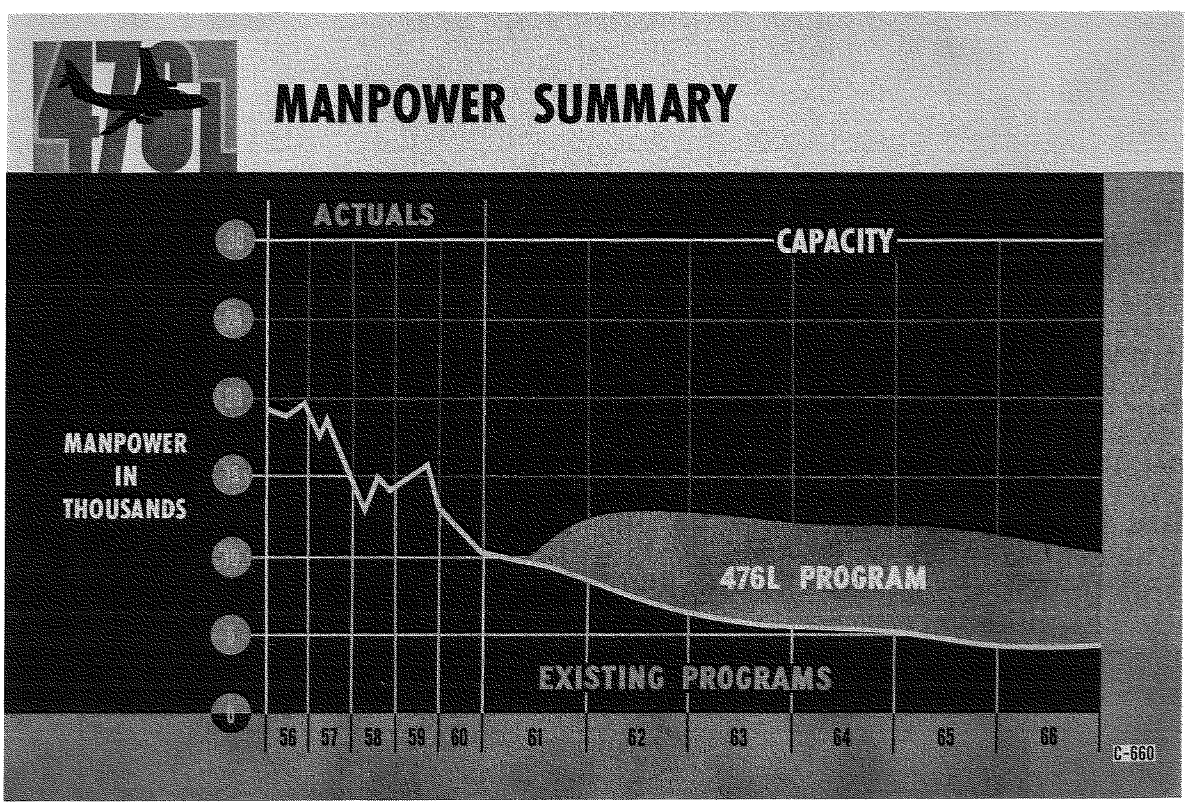
We have given much thought to our organization and staffing, and have concluded that our basic functional organization, which assures the use of the same techniques and principles on all programs, serves best. Considering the importance of the 476L program to the Georgia Division, however, many organizations, as indicated in yellow on the chart, will be established within the functional categories specifically for this program. We believe this Project-within-Functional approach adds strength to our organization by providing the advantages of both concepts. We have planned our 476L personnel assignments carefully, and have included in our formal proposal considerable detail on these organizations and the people who will head them. C662

Existing facilities at Air Force Plant Number 6 provide the physical plant, machinery, test equipment, laboratories and space required to produce GL 207 airplanes in addition to firm and other anticipated business. Lockheed proposes to fund any additional facilities that may be required, including leasehold improvements. C663

The GL 207 production program will begin with minimum cost for plant rearrangement. Sufficient high bay assembly area is presently available. Provision therefore can be made at the outset for rate production, eliminating the need for an expensive multi-phase rearrangement program. C677 C664

Our GL 207 tooling policy and manufacturing plan have been developed in detail, and the major points are included in our formal proposal.

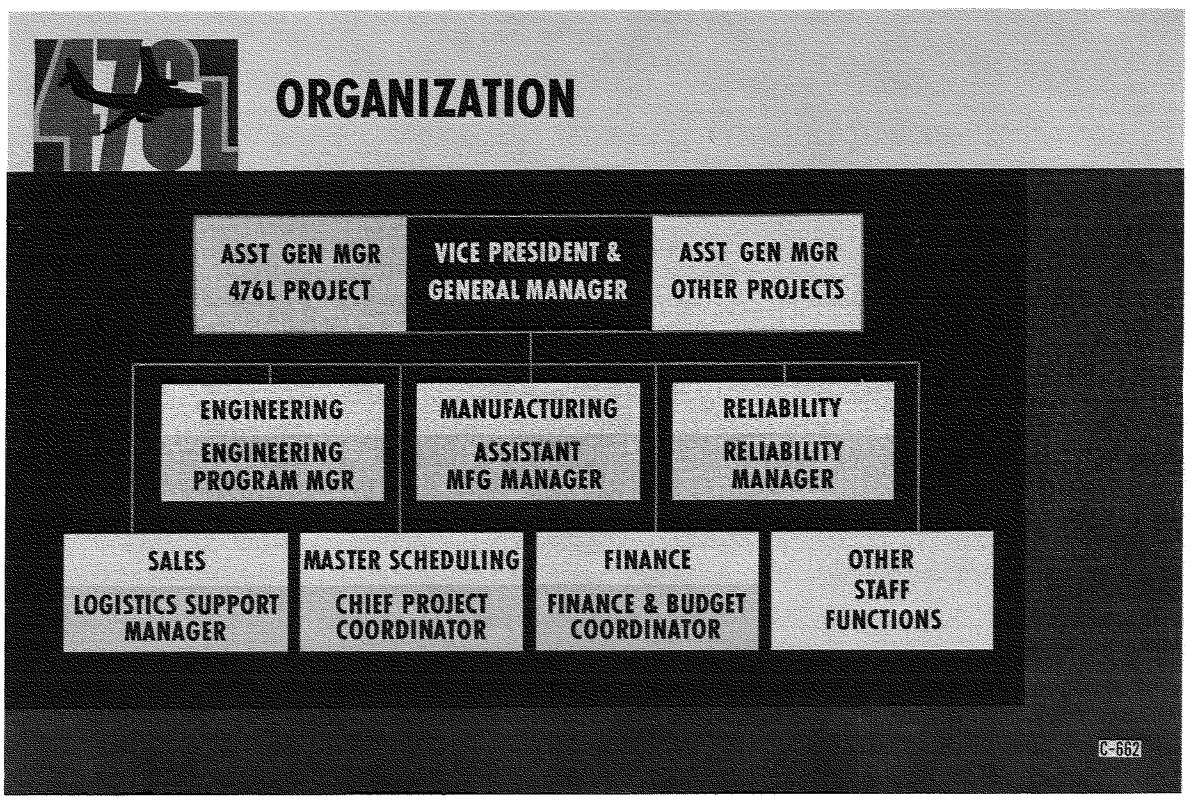

476L
PEP
customer
management
engineering
manufacturing
reliability
REC CONTRACT
ISSUE W.O.
90% FUNCT DWG REL
LONG LEAD ITEMS AVAIL
A/C NO. 1 OUT OF FINAL
AF APPROVED CTCI
FAA ISSUES TYPE CERT
1st A/C 1st FLT
FIN 1 YR OP EVAL
476L PROGRAM SUMMARY OUTLOOK
EXAMPLE
KEY
SCH-SCHEDULED
PRES-PRESENT EST
LAST-LAST EST
ENGINEERING
MANUFACTURING
TEST
REPORT DATE: 1 JULY 1961
TASK
1960
1961
1962
1963
AIRFRAME
SCH
PRES
LAST
1st FLIGHT
SLACK
PROPULSION
SCH
PRES
LAST
0
+2
-4
0
-1
-2
C-659

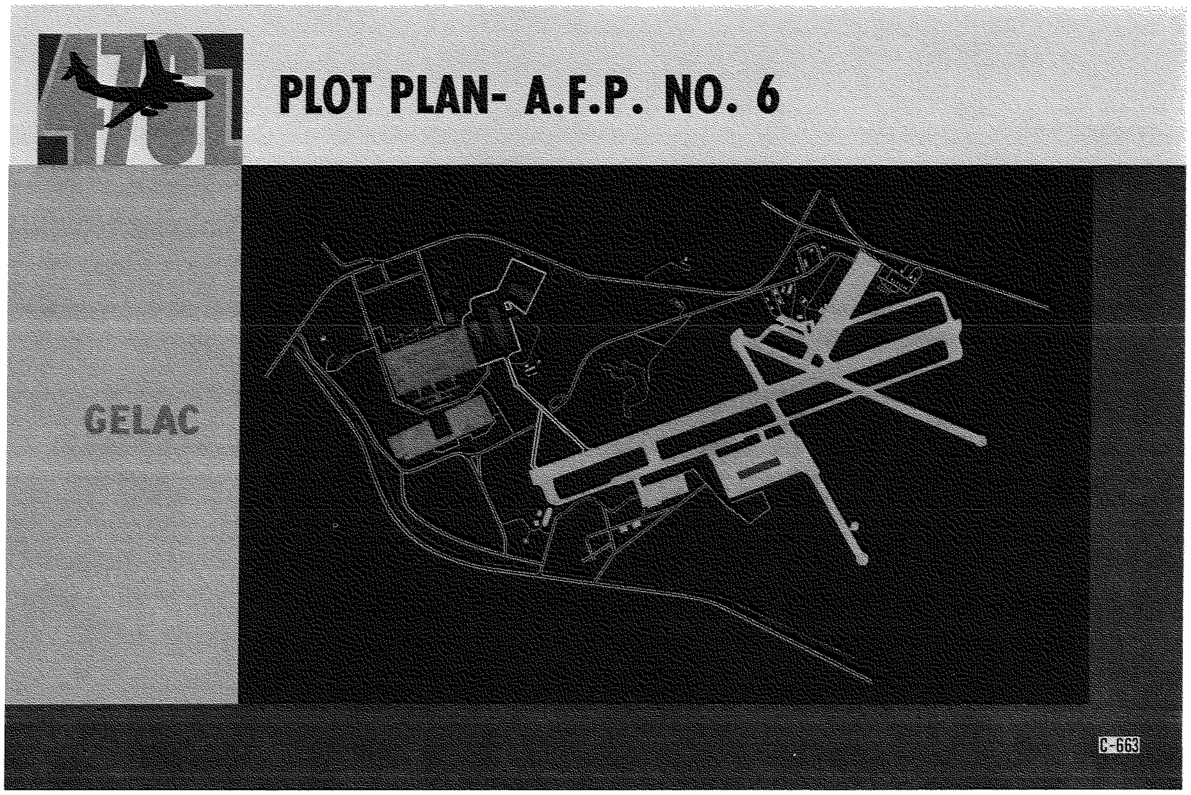

476L
MANPOWER SUMMARY
ACTUALS
CAPACITY
MANPOWER IN THOUSANDS
30
25
20
15
10
5
0
476L PROGRAM
EXISTING PROGRAMS
56
57
58
59
60
61
62
63
64
65
66
C-660

DIRECT MANPOWER PEAKS

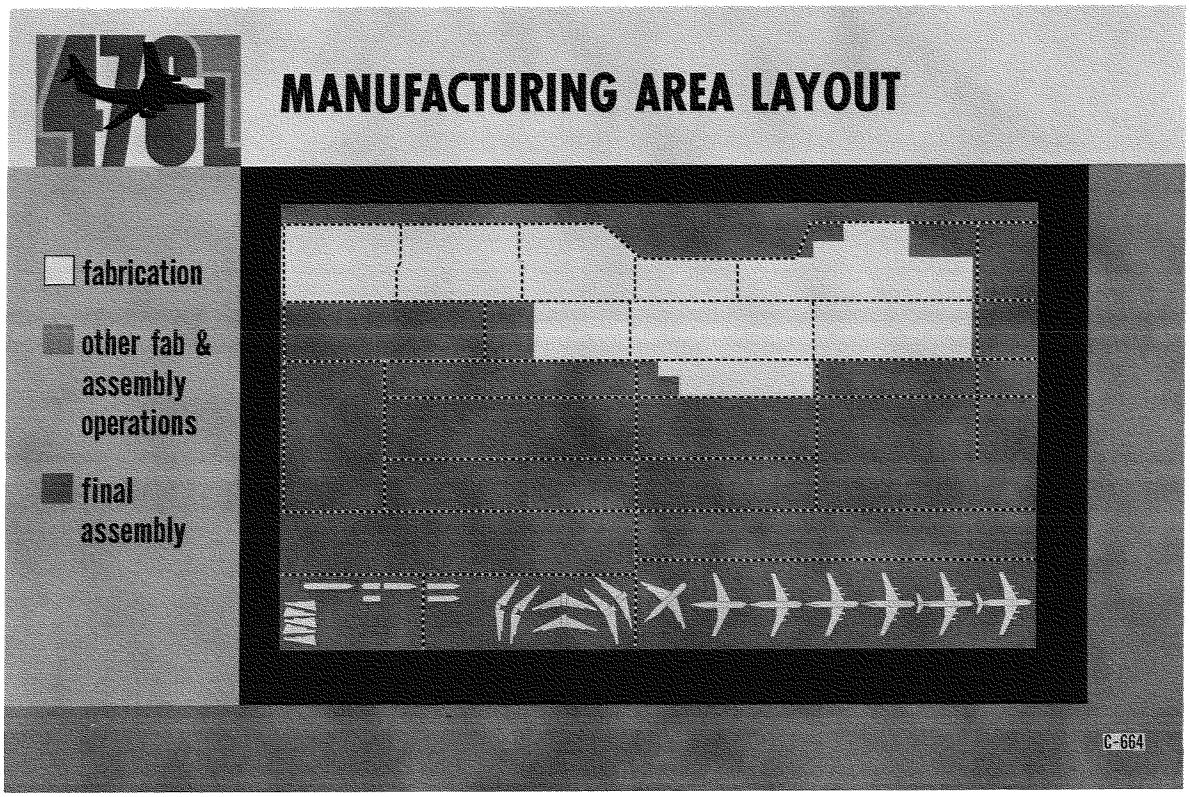
	PERSONNEL	DATE
ENGINEERING	1127	DECEMBER 1962
TOOLING	1659	APRIL 1962
PRODUCTION	3325	SEPTEMBER 1964
RELIABILITY	357	SEPTEMBER 1964
COMPOSITE	4479	SEPTEMBER 1964

C-661

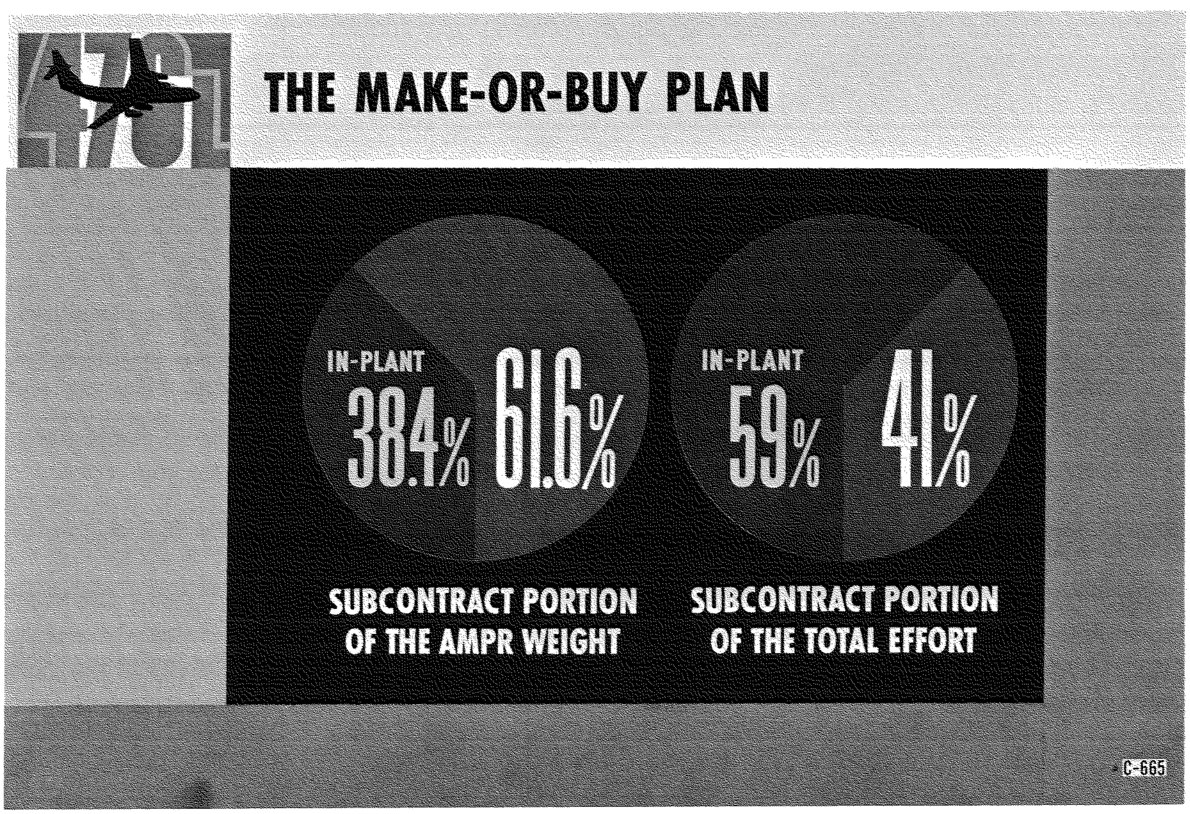



476L
PLOT PLAN- A.F.P. NO. 6
GELAC
C-663


476L
AVAILABLE SPACE
C-677



476L
MANUFACTURING AREA LAYOUT
fabrication
other fab & assembly operations
final assembly
C-664



476L
THE MAKE-OR-BUY PLAN
IN-PLANT
38.4%
61.6%
SUBCONTRACT PORTION OF THE AMPR WEIGHT
IN-PLANT
59%
41%
SUBCONTRACT PORTION OF THE TOTAL EFFORT
C-665

Recognizing the magnitude of this program and its economic impact on the air-frame industry, we have developed a very extensive subcontract plan. Our make-or-buy plans have earmarked 61.6 per cent of the airframe weight for subcontract. Expressed in terms of production effort, thereby recognizing the effect of assembly and flight operations, the subcontract portion is 41 per cent of the total, or $202 million. C665

We have given meticulous attention to make-or-buy decisions which resulted in our proposed plan. Decisions were made on each assembly in terms of producibility, interchangeability and overall economy. Although we have not considered it appropriate to make final selection of subcontractors now, we have surveyed extensively those potential sources with existing capabilities. In making final selections, full consideration will be given to recommendations concerning depressed labor areas, small business sources, and production sharing policies. C666

The capabilities that other major airframe companies could apply are of special significance in meeting the objectives of this program. In recognition of this, we have established major packages of airframe assemblies suited to group manufacture. These major packages are identified in this sketch by the colored segments of the airplane. Particularly in these areas, we intend to subcontract associated engineering and tooling effort to the greatest extent feasible. C667

Other subcontract assemblies are outlined in color on this sketch. These items range in size from wing flaps to access doors. As in the case of the major packages, the subcontract will include the tooling effort associated with these items. C668

The tan area shown here is our proposed "make" portion of the Super Hercules—the forward and mid fuselage and inner wing. The red portion re-emphasizes the scope of the total subcontract plan. In terms of subcontract manhours, this red portion involves approximately one-half million engineering hours, three million tooling hours, and fifteen million production hours. We will use all advanced control techniques—including PEP—to assure effective management of this 476L subcontract program. C669

We recognize fully MATS emphasis on rapid turn-around capability, self-sufficiency, and responsiveness for instant deployment. The functional elements of our 476L logistics support are programmed to help the Air Force achieve maximum operational readiness through minimum AOCP rates. C670

Supply support and technical representation are organized to be immediately responsive to requirements. Utmost attention has been given to design considerations of simplicity, accessibility, and maintainability in order to minimize maintenance requirements. Standard, proved Aerospace Ground Equipment is used to the maximum extent to simplify maintenance support. Transportation and movement of materiel is programmed carefully to meet Air Force needs.

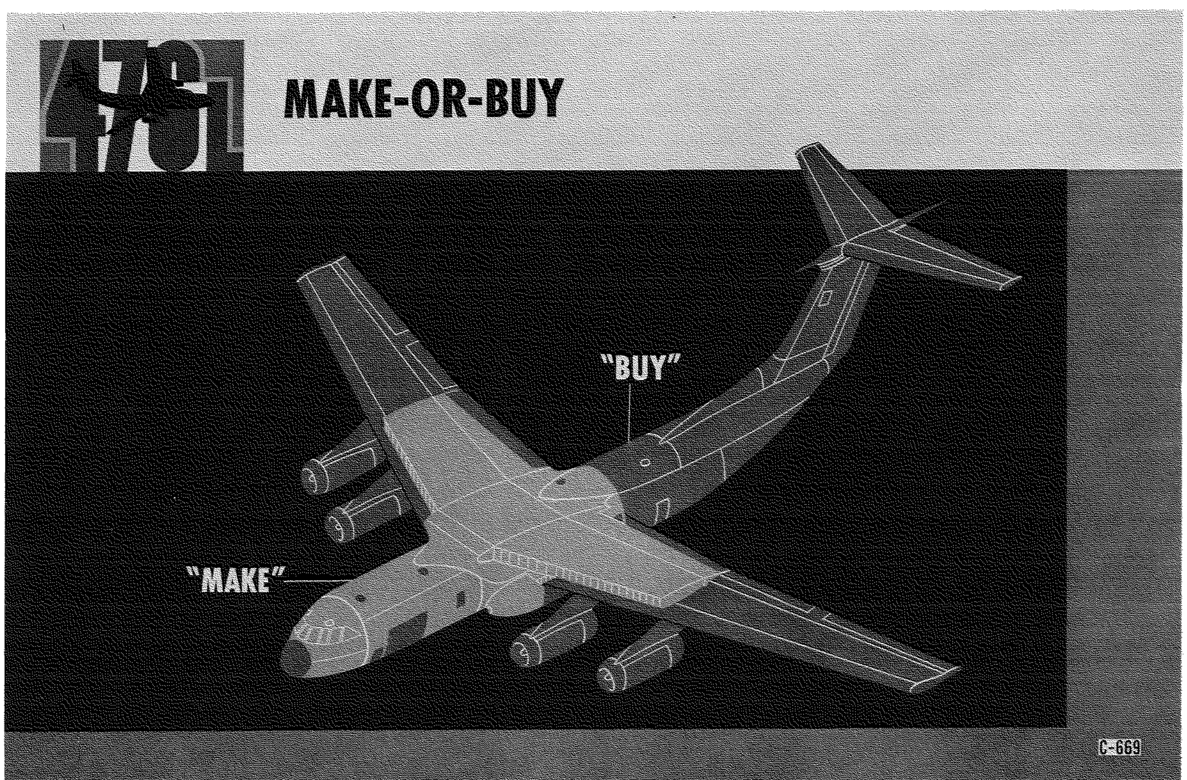
We feel that our experience with the multi-customer C-130, and the opportunity to apply knowledge we will gain supporting MATS C-130E squadrons, will assure our ability to provide the necessary logistics support of 476L

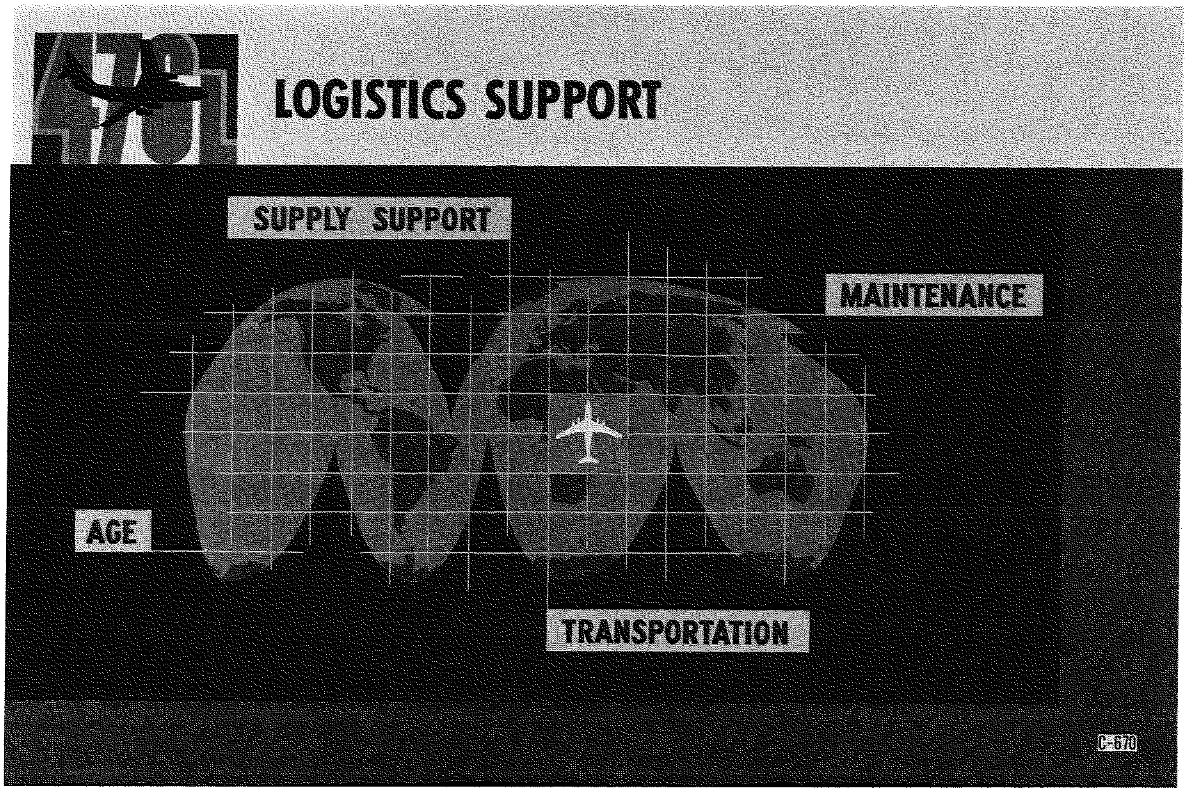
On the subject of funding, our prices are at a realistic level which we strongly feel will result in the 476L objectives at minimum cost to the Government. We know C671


476L
MAKE-OR-BUY ANALYSIS
C-666


476L
MAJOR SUBCONTRACT
C-667


OTHER SUBCONTRACT
C-668


MAKE-OR-BUY
"BUY"
"MAKE"
C-669


LOGISTICS SUPPORT
SUPPLY SUPPORT
MAINTENANCE
AGE
TRANSPORTATION
C-670


6
FUNDING
C-671

that our management controls must be even better than before, and we are determined to accomplish this.

Our pricing is based on the numbers of GL 207 aircraft shown here. The development, test, and evaluation (D, T & E) program for five airplanes is followed by three production programs of 31, 48, and 48 airplanes, for fiscal years 1963 through 1965. Fiscal year production quantities are fixed by reorder lead time and the stipulated military delivery rate of four per month. C672

$4,138,000 is our average airframe price for the program of 132 units. For 132 airframes, the amount is $546.2 million. Adding amounts for "Other" GFAE, spare parts and Aerospace Ground Equipment, and other items such as training, training equipment and technical representation, our total program price is $694.4 million. C673

In accordance with your instructions, this price excludes engines and the communications/navigation equipment package. *

Our prices for the test and production programs are: C674

D, T & E	5 aircraft for $137.2 million
Production Program Number 1	31 aircraft for $177.7 million
Program Number 2	48 aircraft for $194.5 million, and
Program Number 3	the last 48 units in the 132 aircraft program for $185 million.

Price of the one aircraft D, T & E program is $48.5 million, assuming no follow-on airplanes and therefore minimum engineering, tooling, and flight test activities.

Funding requirements are shown here by fiscal year. The five airplane D, T & E program, incrementally funded, is shown in white. The three production programs, based on full commitment type financing, are shown by vertical orange bars for fiscal years 1963 through 1965. The amounts for each fiscal year, rounded to the nearest million dollars, are: C675

FY 61	$ 3 million,
FY 62	$ 69 million,
FY 63	$230 million,
FY 64	$205 million, and
FY 65	$188 million.

Cumulative funding amounts, represented by the step curve, are:

through	FY 62	$ 72 million,
	FY 63	$302 million,
	FY 64	$507 million, and
	FY 65	$694.4 million, the total program price.

Shown here are projected expenditures—a forecast of our fiscal year billings to the Air Force. These expenditures peak in fiscal year 1965 at $186 million. Cumulative expenditures through fiscal year 1964 total $320 million. As shown by the dotted line carried over from the previous chart, the funds committed at that time C676

PROGRAM QUANTITIES

	AIRCRAFT	PROGRAM FISCAL YEAR
D, T & E	5	NO YEAR
PRODUCTION PROGRAM 1	31	1963
PRODUCTION PROGRAM 2	48	1964
PRODUCTION PROGRAM 3	48	1965
TOTAL	132	

C-672

PRICE

	($ IN MILLIONS)
UNIT AIRFRAME PRICE	$4.138
132 AIRFRAMES	546.2
"OTHER" GFAE	39.6
SPARES AND AGE	96.4
OTHER	12.2
TOTAL PRICE*	$694.4

*EXCLUDES ENGINES AND COM/NAV PACKAGE

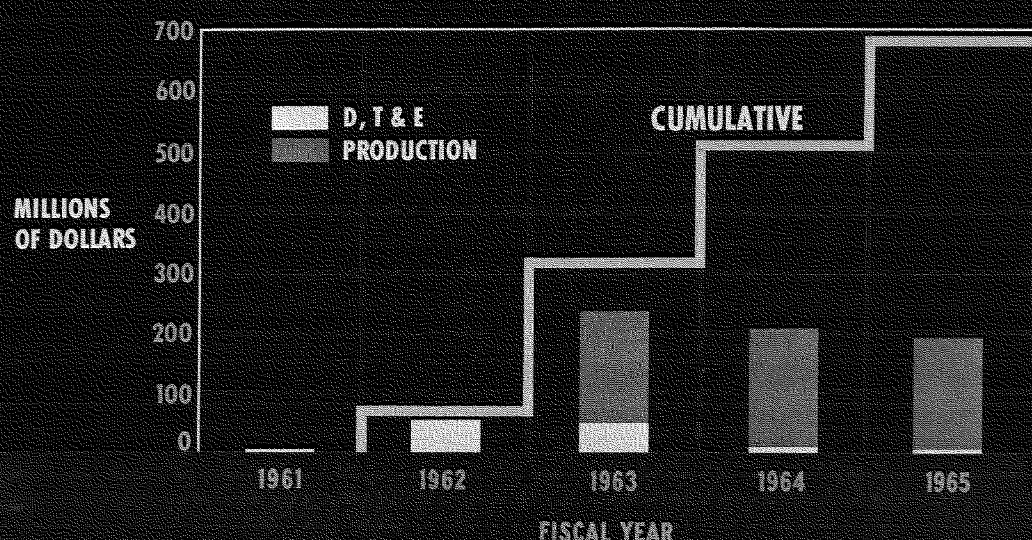
C-673

PROGRAMS

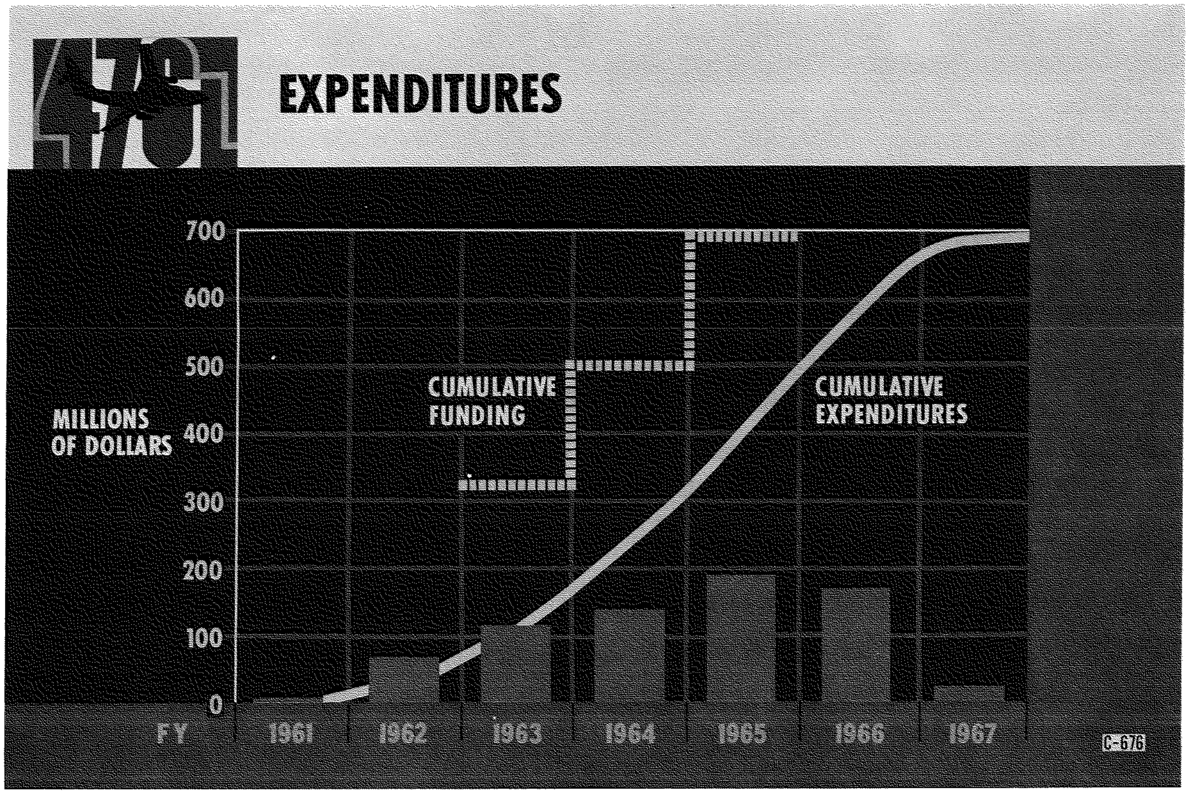
	AIRCRAFT	PRICE ($ IN MILLIONS)
D, T & E	5	137.2
PRODUCTION PROGRAM 1	31	177.7
PRODUCTION PROGRAM 2	48	194.5
PRODUCTION PROGRAM 3	48	185.0
TOTAL PRICE		$694.4
D, T & E	1	$48.5

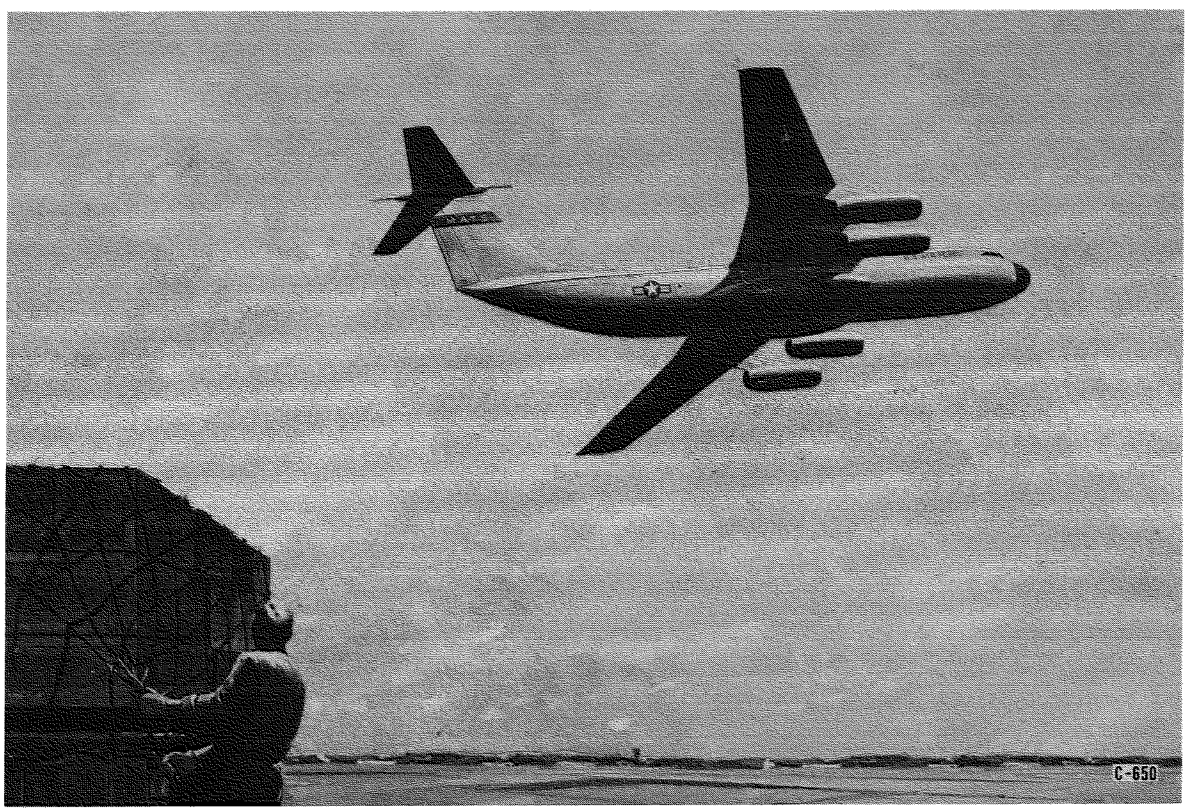
C-674

FUNDING



C-675


476L
EXPENDITURES
700
600
500
400
300
200
100
0
MILLIONS
OF DOLLARS
CUMULATIVE
FUNDING
CUMULATIVE
EXPENDITURES
FY
1961
1962
1963
1964
1965
1966
1967
C-676


C-650

total $507 million. Through fiscal year 1956, expenditures are $506 million and the full program price of $694.4 million has been funded. FY 66 expenditures are $166 million and FY 67, at $22 million, is the last expenditure year of the 132 airplane program.

We know we can do this job for you and do it well. C650

We hope you are convinced that the Super Hercules, available early at low cost, is your logical choice.

In summary, the building of aircraft to satisfy the 476L requirement is our kind of business for our kind of plant.

SUPER HERCULES · GL207-45

section 5

SUMMARY

R. E. GROSS

You have heard a quick summary of our proposal for Support System 476L. You may also have studied the more detailed coverage contained in our written proposal submitted Friday. There are some things I want to repeat now and some things I would like to add.

I would note again that Lockheed has gladly joined with the Air Force in its clear call for a low cost, rapidly available airplane meeting all requirements of the Statement of Work.

The creative ability of our designers was not limited by the requirement to stay within the current state of the art. Our engineers were challenged to design an airplane meeting all the requirements, using already proved, currently available power plants—an airplane offering low acquisition and operating cost and early availability, but capable of conversion to higher thrust engines with relative ease when they are properly and thoroughly developed. The airplane and its performance can grow as new engines prove themselves, but it does not depend on them for your early mission commitments.

The fine response of our designers resulted in the airplane you have seen. It is one that we consider a worthy new member of a family of Lockheed transports, and specifically one that extends and takes advantage of the proved features of the C-130 series.

Lockheed was founded to build transport airplanes and we have been building them constantly for twenty five years. I am personally convinced that this one is our best to date. It is a remarkable balance of considerations of performance capability on the one hand with critical need and national budget considerations on the other. Its ability to perform dual military/commercial roles without compromise to either is further evidence of its outstanding versatility.

Mr. Pulver has described briefly the facilities at Marietta—ideally suited for production of this airplane, well equipped from receiving dock to runway. We have adequate space and facilities and competent people to perform this job.

Let us consider for a moment the vital realism of our cost and schedule proposals. No miracles are offered. We propose to do only that which we know we are capable of doing. The Georgia Division military cargo specialists have examined carefully every detail of this proposal, as have the members of my staff introduced earlier. Let me say that every corporate resource at our command and at the disposal of my staff will support the Georgia Division in delivering these airplanes at the time and price promised.

A rash of international crises has called for the United States Air Force to perform missions around the world with dramatic suddenness. We are proud of the distinction with which our C-130 has served our country in the sure hands of our Air Force. We look forward with confidence to our mutual future successes.

And now, Mr. Pulver will take over again to direct your questions to the proper source for our answers. We hope you will permit us to expand and clarify the particular areas in which your interests are the strongest.