RESEARCH MEMORANDUM

WEIGHT BAR CHARTS

By B. J. Saelman and H. W. Vick

Lockheed Aircraft Corporation

CLASSIFICATION CANCELLED

Authority

Date 12-16-53

By

See

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

WASHINGTON

June 25, 1953

UNCLASSIFIED
INTRODUCTION

The weight breakdowns in bar chart form in the present report have been prepared to give an indication of "how we spend our weight." They are expected to focus attention on the design functions that warrant weight reduction activity on future models.

It will be noted that the weight empty and the gross weight, for each of the three airplanes identified herein as airplanes A, B, and C, are given on the first chart for each airplane and the percentages may be converted into pounds by using these weight figures. An index of these charts is presented as table I.

The present paper was originally prepared in 1951 for internal use by the Lockheed Aircraft Corporation, California Division as Report No. 8178, and it was subsequently made available to the National Advisory Committee for Aeronautics in connection with certain studies being made at the Langley Aeronautical Laboratory for the NACA Subcommittee on Aircraft Loads. It was later decided that the information in the paper would be helpful to many persons interested in the aircraft design and the present adaptation of the original report was thus prepared for NACA release.

Lockheed Aircraft Corporation,
Burbank, Calif., May 6, 1953.
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<td>Airplane B</td>
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### GROSS WEIGHT

**WEIGHT EMPTY & USEFUL LOAD**

**AIRPLANE A**

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### WEIGHT EMPTY

### USEFUL LOAD

- **FUEL & OIL**
- **PAYLOAD**
- **CREW & OPER. EQUIP.**

### NOTES:

1. THIS BREAKDOWN IS REPRESENTATIVE OF THE AIRPLANE-A STANDARD ARRANGEMENT. WEIGHT EMPTY = 59,423 LBS., AND GROSS WEIGHT = 107,000 LBS.
2. PAYLOAD CONSISTS OF 46 PASSENGERS AT 165 LBS. EA., AND 434 CU. FT. OF CARGO AT 13 LBS. PER CU. FT.
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<th>% OF GROSS WEIGHT</th>
<th>% OF WEIGHT EMPTY</th>
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**POWER PLANT**
- ENGINES
- PROP INST.
- FUEL & OIL SYSTEMS
- OTHER SYSTEMS

**FIXED EQUIPMENT**
- AIR COND. & ANTI-ICING
- SURFACE CONTROLS
- ELECTRICAL POWER SYSTEMS
- RADIO
- HYDRAULIC POWER SYSTEMS
- INSTRUMENTS

**WING BEAM STRUCTURE**
- SECONDARY STRUCTURE
- CONTROL SURFACES

**FUSELAGE**
- SHELL STRUCTURE
- FLOOR & SUPPORTS
- DOORS, WINDOWS, WINDSHIELD
- PASSAGE COMP.

**LANDING GEAR**
- STRUCTURE
- ROLLING STOCK
- MECHANISM & HYDRAULICS

**ENGINE SUPT. SECTION**
- AFT OF FIREWALL
- COWLING

**TAIL**
- BOX BEAM STRUCTURE
- CONTROL SURFACES
- SECONDARY STRUCTURE

**WEIGHT EMPTY-BY GROUPS**
- AIRPLANE A

**NACA**
### Chart A-3

#### WEIGHT EMPTY BY FUNCTION

**AIRPLANE A**

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**NOTES:**

- **BASIC STRUCTURE** is all material which takes flight or ground loads less structural portions of the above functions. See page 11.
- **AERODYNAMIC REFINEMENTS**—smoothness, flushness, and fairings.

**AIRPLANE PROPULSION BASIC STRUCTURE**

**PAYLOAD ACCOMMODATIONS**

**STRUCTURAL PRODUCIBILITY** (includes sealing)

**AIRPLANE CONTROL**

**SAFETY FEATURES**

**SERVICE FEATURES**

**CREW ACCOMMODATIONS**

**FLUTTER PREVENTION**

**AERODYNAMIC REFINEMENTS**
Chart A-4

Weight Empty Structure and Non-Structure by Groups

Airplane A

% of Gross Weight

% of Weight Empty

Non-Structure

Power Plant

Fixed Equipment

Wing

Fuselage

Nacelle

Landing Gear

Tail

Structure

Wing

Fuselage

Landing Gear

Nacelle

Tail

Fixed Equipment

Note: Structure is all material which takes flight or ground loads.
### Chart A-5

#### Weight Empty Structure and Non-Structure by Materials

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<tr>
<th>% of Weight Empty</th>
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#### Materials
- Steel
- Alum. Alloy
- Magnesium
- Misc. Materials, Power Plant & Equipment
- Electric wiring
- Paint & sealing
- Wood
- Upholstery materials
- Trim cloth & carpeting
- Lead
- Fluid
- Soundproofing & insulation
- Plastic & glass
- Rubber
- Cables, fluid in shock struts, MISC.
- Copper

#### Structure
- Steel
- Alum. Alloy

#### Non-Structure
- Rubber
- Magnesium
- Plastic & glass

**Note:**
Structure is all material which takes flight or ground load.
WEIGHT EMPTY
LOCKHEED AND NON-LOCKHEED DESIGN
BY GROUPS
AIRPLANE A

% OF GROSS WEIGHT:

% OF WEIGHT EMPTY:

NOT DESIGNED BY LOCKHEED
POWER PLANT
FIXED EQUIPMENT
LANDING GEAR
NACELLE

DESIGNED BY LOCKHEED
WING
FIXED EQUIPMENT
FUSELAGE
NACELLE
TIE AL
POWER PLANT
LANDING GEAR
NACELLE
WEIGHT, EMPTY
LOCKHEED AND NON-LOCKHEED DESIGN
BY MATERIALS
AIRPLANE A

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

DESIGNED BY LOCKHEED

STEEL
PAINT & SEALING
WOOD
MISC. MATERIALS - POWER PLANT & EQUIPMENT
ELECTRIC WIRING
PLASTIC & GLASS
CLOTH & CARPETING
LEAD
FLUID
SOUNDPROOF & INSULATION
RUBBER

NOT DESIGNED BY LOCKHEED

STEEL
ALUM. ALLOY
MAGNESIUM
RUBBER
MISC. MATERIAL - POWER PLANT & EQUIPMENT
UPHOLSTERY MATERIALS
ELECTRIC WIRING
COPPER
PLASTIC & GLASS

NACA
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**NOT DESIGNED BY LOCKHEED**

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<td>CASTINGS</td>
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<tr>
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% OF WEIGHT EMPTY

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**WEIGHT EMPTY**

**LOCKHEED AND NON-LOCKHEED DESIGN**

**BY FORMS OF MATERIALS**

**AIRPLANE A**

% OF GROSS WEIGHT

% OF WEIGHT EMPTY
<table>
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<th>STRUCTURE</th>
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<table>
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<th>% OF STRUCTURE</th>
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<td>SAFETY FEATURES</td>
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<tr>
<td>PAYLOAD ACCOMMODATIONS</td>
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<tr>
<td>AERODYNAMIC REFINEMENTS</td>
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**NOTE:** STRUCTURE IS ALL MATERIAL WHICH TAKES FLIGHT OR GROUND LOADS.
Structure designed by flight loads, ground loads

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Structure designed by flight loads:
- Wing
- Nacelle
- Fuselage
- Tail
- Fixed equipment
- Landing gear

Structure designed by ground loads:
- Landing gear
- Fuselage
- Wing

Note: Structure is all material which takes flight or ground loads.
STRUCTURAL PRODUCIBILITY
BY GROUPS
AIRPLANE A

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

% OF STRUCTURE

STRUCTURAL PRODUCIBILITY
WING
FUSELAGE
TAIL
NACELLE
LANDING GEAR
Chart A-12

STRUCTURAL PRODUCIBILITY
BY FUNCTION
AIRPLANE A

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

% OF STRUCTURE

STRUCTURAL PRODUCIBILITY
NON-INTEGRAL DESIGN

NON-TAPERED MATERIAL
TOLERANCES
JOINTS-MAJOR ASSEMBLY
SPLICES
MISC.
LOCKHEED DESIGN

STRESSED AND NON-STRESSED

AIRPLANE A

% OF GROSS WEIGHT

% OF WEIGHT, EMPTY

% OF LOCKHEED DESIGN

STRESSED REGIONS

- WING
- FUSELAGE
- NACELLE
- FIXED EQUIPMENT
- TAIL
- POWER PLANT
- LANDING GEAR

NON-STRESSED

- FIXED EQUIPMENT
- WING
- FUSELAGE
- POWER PLANT
- TAIL
- NACELLE
### SAFETY FEATURES BY GROUPS

**AIRPLANE A**

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<table>
<thead>
<tr>
<th>% OF WEIGHT EMPTY</th>
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### SAFETY FEATURES

**FIXED EQUIPMENT**

- POWER PLANT
- NACELLE
- FUSELAGE
- LANDING GEAR
- WING

**NOTE**

Does not include items in operating equipment amounting to 1.1% of weight empty of which 0.8% is for crash protection.
<table>
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<th>SAFETY FEATURES</th>
<th>FIRE PROTECTION</th>
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<td>NAVIGATION</td>
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<td>OXYGEN SYSTEM</td>
<td>EXTERNAL LIGHTING</td>
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<td>WINDSHIELD</td>
<td>BIRDPROOFING</td>
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**NOTE:** DOES NOT INCLUDE ITEMS IN OPERATING EQUIPMENT AMOUNTING TO 1.1% OF WEIGHT EMPTY OF WHICH 0.8% IS FOR CRASH PROTECTION.
### Payload Accommodations and Crew Accommodations

#### By Function

**Airplane A**

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<th>% of Weight Empty</th>
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#### Payload Accommodation

- **Pressurization, Heating, Ventilation**
  - Seats
  - Galley Lounges, & Lavatories
  - Insulation & Soundproofing
  - Windows & Curtains
  - Baggage & Magazine Racks
  - Passenger Compt. Lighting & Electrical Instal.
  - Water System
  - Speedpak & Misc. Prov.

#### Crew Accommodations

- **Seats**
- Auto-Pilot
- Pressurization, Heating, & Ventilation
- Insulation & Soundproofing
- Tables, Containers, & Lockers
- Communication & Lighting
- Windows & Curtains
- Trim & Floor Covering
- Miscellaneous

*Note:* Does not include items in operating equipment amounting to 2% of weight empty.
### SERVICE FEATURES BY GROUPS

**AIRPLANE A**

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</tr>
</tbody>
</table>

**NOTE:**

DOES NOT INCLUDE PROVISIONS FOR SERVICE LIFE OTHER THAN PROTECTIVE COATING.
Chart A-18

Service Features by Function

Airplane A

% of Gross Weight

% of Weight Empty

Service Features

- Access Doors
- Service Cowling
- Protective Coating
- Handling
- Standby Equipment
- Miscellaneous

Note:
Does not include provision for service life other than protective coating.
Chart A-20

AIRPLANE CONTROL
BY FUNCTION
AIRPLANE A

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

AIRPLANE CONTROL
INSTRUMENTS, PANELS, & PEDESTAL
ELECTRICAL POWER
RADAR
HYDRAULIC POWER
LANDING GEAR RETRACTION CONTROLS
STEERING CONTROLS
BRAKE CONTROLS
### Chart B-1

**Gross Weight**

#### Weight Empty and Useful Load

**Airplane B**

<table>
<thead>
<tr>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
<th>65</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of Gross Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Weight Empty

- **Useful Load**
  - Fuel & Oil
  - Military Load
  - Crew & Operating Equipment

---

**Note:**

This breakdown is representative of the first 15 airplanes.

Weight empty = 44,725 Lbs., and Gross weight = 67,594 Lbs.
### Chart B-3

**Weight Empty by Function**

<table>
<thead>
<tr>
<th>Function</th>
<th>% of Gross Weight</th>
<th>% of Weight Empty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airplane B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Breakdown of Weight Empty

- **Basic Structure**
- **Airplane Propulsion**
- **Mission Accommodations**
- **Safety Features**
- **Airplane Control**
- **Structural Productivity**
- **Crew Accommodations**
- **Service Features**
- **Aerodynamic Refinements**
- **Flutter Prevention**

**Notes:**

- **Basic Structure** is all material which takes flight or ground loads less the structural portions of the above functions. See page 31.
- **Aerodynamic Refinements**—smoothness, flushness, and fairing.
## Chart B-4

### Weight Empty

#### Structure and Non-Structure

**By Groups**

*Airplane B*

<table>
<thead>
<tr>
<th>% of Gross Weight</th>
<th>% of Weight Empty</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Non-Structure</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Plant</td>
<td>Wing</td>
</tr>
<tr>
<td>Landing Gear</td>
<td>Fuselage</td>
</tr>
<tr>
<td>Nacelle</td>
<td>Fixed Equipment</td>
</tr>
<tr>
<td>Wing</td>
<td>Fuselage</td>
</tr>
<tr>
<td>Fuselage</td>
<td>Landing Gear</td>
</tr>
<tr>
<td>Nacelle</td>
<td>Tail</td>
</tr>
</tbody>
</table>

**Note:**

Structure is all material that takes ground or flight loads.
## WEIGHT EMPTY

### LOCKHEED AND NON-LOCKHEED DESIGN

#### BY GRÖVES

**AIRPLANE B**

<table>
<thead>
<tr>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>% OF GROSS WEIGHT</td>
<td>% OF DESIGN WEIGHT</td>
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<td></td>
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<tr>
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<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
</tr>
</tbody>
</table>

**DESIGNED BY LOCKHEED**

- Wing
- Fuselage
- Fixed equipment
- Nacelle
- Landing gear
- Tie
- Power plant

**NOT DESIGNED BY LOCKHEED**

- Power plant
- Fixed equipment
- Landing gear
- Fuselage
- Nacelle
- Wing
WEIGHT EMPTY
LOCKHEED AND NON-LOCKHEED DESIGN
BY MATERIALS

AIRPLANE B

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

DESIGNED BY LOCKHEED
STEEL
ALUM. ALLOY
WIRING
PLASTIC & GLASS
PAINT & SEALING
LEAD
FLUID
RUBBER
WOOD
MAGNESIUM

NOT DESIGNED BY LOCKHEED
STEEL
ALUM. ALLOY
RUBBER
MAGNESIUM
WIRING
MISC. MATERIALS - POWER PLANT & EQUIPMENT
PLASTIC & GLASS

% OF WEIGHT EMPTY
WEIGHT EMPTY
LOCKHEED AND NON-LOCKHEED DESIGNS
BY FORMS OF MATERIALS

AIRPLANE B

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

DESIGNED BY LOCKHEED
EXTRUSIONS
FORGINGS
MISCELLANEOUS SHEET
TUBING
BAR & PLATE
WIRING
CASTINGS
FASTENERS

NOT DESIGNED BY LOCKHEED
FORGINGS
SHEET METAL
CASTINGS
MOULDED RUBBER
BAR & PLATE
WIRING
TUBING
MISCELLANEOUS
MOULDED PLASTIC
FASTENERS
### Structure

#### By Function

**Airplane B**

<table>
<thead>
<tr>
<th>% of Gross Weight</th>
<th>% of Weight Empty</th>
<th>% of Structure</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
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<tr>
<td>10</td>
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<tr>
<td>15</td>
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<td>40</td>
</tr>
<tr>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

**Structural Productivity**
- Basic Structure
- Structural Loadings

**Airplane Propulsion**
- Mission Accommodations

**Airplane Control**
- Service Features

**Safety Features**
- Aerodynamic Refinements

**Note:**
Structure is all material which takes flight or ground loads.
<table>
<thead>
<tr>
<th>% of Weight</th>
<th>% of Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
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<tr>
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<td>40</td>
<td>40</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

**STRUCTURE DESIGNED BY FLIGHT LOADS**
- Wing
- Fuselage
- Nacelle

**STRUCTURE DESIGNED BY GROUND LOADS**
- Landing gear
- Wing
- Fuselage
- Nacelle

**NOTE:**
Structure is all material which takes flight or ground loads.
STRUCTURAL PRODUCIBILITY
BY GROUPS
AIRPLANE B

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

% OF STRUCTURE

STRUCTURAL PRODUCIBILITY
WING
FUSELAGE
TAIL
NACELLE
LANDING GEAR
### Chart B-12

**Structural Produbility by Function**

**Airplane B**

<table>
<thead>
<tr>
<th>% of Gross Weight</th>
<th>% of Weight Empty</th>
<th>% of Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>12</td>
</tr>
<tr>
<td>10</td>
<td>14</td>
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</tr>
</tbody>
</table>

**Structural Produbility**

- Non-integral Design
- Joints - Major Assembly
- Tolerances
- Non-tapered Material
- Splines
- Misc.
SAFETY FEATURES

BY GROUPS

AIRPLANE B

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

SAFETY FEATURES

FIXED EQUIPMENT

POWER PLANT

NACELLE

FUSELAGE

LANDING GEAR

NOTE:

DOES NOT INCLUDE ITEMS IN OPERATING EQUIPMENT AMOUNTING TO 1.6% OF WEIGHT EMPTY OF WHICH 0.6% IS FOR CRASH PROTECTION
SAFETY FEATURES
BY FUNCTION
AIRPLANE B

<table>
<thead>
<tr>
<th>% OF GROSS WEIGHT</th>
<th>% OF WEIGHT EMPTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
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<tr>
<td>2</td>
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<tr>
<td>6</td>
<td>6</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>SAFETY FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>BULLET SEALING TANKS</td>
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<tr>
<td>FIRE PROTECTION</td>
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<tr>
<td>GUNFIRE PROTECTION</td>
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<tr>
<td>ANTI-ICING</td>
</tr>
<tr>
<td>EMERG. FUNCTIONAL PROVISIONS</td>
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<tr>
<td>CRASH PROTECTION</td>
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<tr>
<td>MISCELLANEOUS</td>
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</table>

NOTE
DOES NOT INCLUDE ITEMS IN OPERATING EQUIPMENT AMOUNTING TO 16% OF WEIGHT EMPTY, OF WHICH 0.6% IS FOR CRASH PROTECTION.
MISSION ACCOMMODATIONS AND CREW ACCOMMODATIONS

BY FUNCTION

AIRPLANE B

<table>
<thead>
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<th>% OF GROSS WEIGHT</th>
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</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>% OF WEIGHT EMPTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

MISSION ACCOMMODATIONS

- RADIO & RADAR
- ARMAMENT & GUNNERY PROV.
- BOMBING & TORPEDO PROV.
- TIP NACELLES
- SEARCHLIGHT INSTALLATION
- SONOBUOY & BATHYHERMIOGRAPH PROV.
- PYROTECHNIC & ROCKET PROV.
- CAMOUFLAGE
- PHOTOGRAPHIC PROV.

NOTE: DOES NOT INCLUDE ITEMS IN OPERATING EQUIPMENT AMOUNTING TO 7.8% OF WEIGHT EMPTY.

CREW ACCOMMODATIONS

- SEATS & BUNKS
- AIR CONDITIONING
- AUTOPILOT
- TRIM & SOUNDPROOFING
- TABLES, LOCKERS, & STOWAGE BINS
- LIGHTING & MISC.

NOTE: DOES NOT INCLUDE ITEMS IN OPERATING EQUIPMENT AMOUNTING TO 0.4% OF WEIGHT EMPTY.
SERVICE FEATURES
BY GROUPS
AIRPLANE B

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

SERVICE FEATURES
WING
NACELLE
FUSELAGE
LANDING GEAR
TAIL
POWER PLANT

NOTE:
DOES NOT INCLUDE PROVISIONS FOR SERVICE LIFE OTHER THAN PROTECTIVE COATING.
### SERVICE FEATURES

**by function**

**AIRPLANE B**

<table>
<thead>
<tr>
<th>% of Gross Weight</th>
<th>% of Weight Empty</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td>2</td>
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#### Service Features

<table>
<thead>
<tr>
<th>Service Features</th>
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<tbody>
<tr>
<td>Access Doors</td>
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<tr>
<td>Protective Coating</td>
</tr>
<tr>
<td>Service Cowlings</td>
</tr>
<tr>
<td>Handling</td>
</tr>
<tr>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>

**Note:**

Does not include provisions for service life other than protective coating.
AIRPLANE CONTROL

BY GROUPS

AIRPLANE B

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

AIRPLANE CONTROL

FIXED EQUIPMENT

LANDING GEAR

WING

FUSELAGE

NACA
AIRPLANE CONTROL
BY FUNCTION
AIRPLANE B

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

AIRPLANE CONTROL

ELECTRICAL POWER

SURFACE CONTROLS

INSTRUMENTS, PANELS, & PEDESTAL

LANDING GEAR RETRACTION CONTROLS

HYDRAULIC POWER

STEERING CONTROLS

BRAKE CONTROLS
GROSS WEIGHT

WEIGHT EMPTY AND USEFUL LOAD

AIRPLANE C

<table>
<thead>
<tr>
<th>% OF GROSS WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100</td>
</tr>
</tbody>
</table>

WEIGHT EMPTY

USEFUL LOAD

FUEL & OIL

CREW & OPERATING EQUIPMENT

MILITARY LOAD

NOTE

THIS BREAKDOWN IS BASED ON THE CALCULATED WEIGHT EMPTY OF 12,089 LBS., AND NORMAL GROSS WEIGHT OF 15,541 LBS.
### Chart C-2

#### Weight Distribution

<table>
<thead>
<tr>
<th>Category</th>
<th>% of Gross Weight</th>
<th>% of Weight Empty</th>
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<tbody>
<tr>
<td>FUEL SYSTEM</td>
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<tr>
<td>STARTING SYSTEM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIREBEALS, AFTERBURNER BRKT, &amp; TURBINE BRG, COOLING DUCT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THROTTLE CONTROLS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIXED EQUIPMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RADIO &amp; RADAR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELECTRICAL POWER SYSTEM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIR CONDITION &amp; ANTI-ICEING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SURFACE CONTROLS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARMAMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FURNISHINGS</td>
<td></td>
<td></td>
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<tr>
<td>HYDRAULIC POWER SYST.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INSTRUMENTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FUSELAGE(STRUCTURE)</td>
<td></td>
<td>SHELL STRUCTURE</td>
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<tr>
<td>Doors, Windows, &amp; Enclosures</td>
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<tr>
<td>POOR YIELD FOR EQUIPMENT</td>
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<tr>
<td>FLOORING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WING (SECONDARY STRUCTURE)</td>
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<td></td>
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<tr>
<td>Box Beam</td>
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<td></td>
</tr>
<tr>
<td>SECONDARY STRUCTURE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTROL SURFACES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANDING GEAR</td>
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<td></td>
</tr>
<tr>
<td>STRUCTURE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROLLING STOCK</td>
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<tr>
<td>MECHANISM &amp; HYDRAULICS</td>
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</tr>
<tr>
<td>TAIL</td>
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<td></td>
</tr>
<tr>
<td>BOX Beam</td>
<td></td>
<td></td>
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<tr>
<td>SECONDARY STRUCTURE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTROL SURFACES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BALLAST</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Weight Empty by Groups**

- AIRPLANE C

**NACA**
## Chart C-3

**Weight Empty by Function**

**Airplane C**

<table>
<thead>
<tr>
<th>% of Gross Weight</th>
<th>% of Weight Empty</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>15</td>
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<tr>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

**Mission Accommodations**

**Airplane Control**

**Structural Producibility**

**Safety Features**

**Service Features**

**Crew Accommodations**

**Aerodynamic Refinements**

**Flutter Prevention**

**Ballast**

**Notes:**

Basic structure is all material which takes flight or ground loads less the structural portions of the above functions. See page 51.

Aerodynamic refinements — smoothness, flushness, and fairing.
WEIGHT EMPTY STRUCTURE AND NON-STRUCTURE
BY GROUPS
AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

NON-STRUCTURE
POWER PLANT
FIXED EQUIPMENT
WING
BALLAST
LANDING GEAR
TAIL
FUSELAGE

STRUCTURE
FUSELAGE
WING
LANDING GEAR
TAIL
FIXED EQUIPMENT

NOTE
STRUCTURE IS ALL MATERIAL THAT TAKES GROUND OR FLIGHT LOADS
Chart C-5

WEIGHT EMPTY
STRUCTURE AND NON-STRUCTURE
BY MATERIALS
AIRPLANE C

% OF GROSS WEIGHT
0 5 10 15 20 25 30 35 40 45

% OF WEIGHT EMPTY
0 5 10 15 20 25 30 35 40 45 50 55 60

NON-STRUCTURE
ALUM. ALLOY
STEEL
WIRING
RUBBER
MAGNESIUM
MISC. ELECTRICAL & INSULATING MATERIALS
PLASTICS & GLASS
TUNGSTEN & PHOSPHOROUS BRONZE
LEAD
FLUID & FABRIC

STRUCTURE
ALUM. ALLOY
STEEL
PLASTIC & GLASS
MAGNESIUM
RUBBER
MISCELLANEOUS

NOTE:
STRUCTURE IS ALL MATERIAL THAT TAKES GROUND OR FLIGHT LOADS.

% OF WEIGHT EMPTY
0 5 10 15 20 25 30 35 40 45 50 55 60

NACA
WEIGHT, EMPTY
LOCKHEED AND NON-LOCKHEED DESIGN
BY GROUPS
AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGHT, EMPTY

DESIGNED BY LOCKHEED

FUSELAGE
WING
FIXED EQUIPMENT
TAIL
LANDING GEAR
POWER PLANT
BALLAST

NOT DESIGNED BY LOCKHEED

POWER PLANT
FIXED EQUIPMENT
LANDING GEAR
FUSELAGE
WING
WEIGHT EMPTY
LOCKHEED AND NON-LOCKHEED DESIGN
BY MATERIALS
AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

DESIGNED BY LOCKHEED

ALUM ALLOY

STEEL

PLASTICS & GLASS

WIRING

MAGNESIUM

TUNGSTEN & PHOSPHORUS BRONZE

LEAD

RUBBER & PROTECTIVE COATING

MISCELLANEOUS

FLUID

NOT DESIGNED BY LOCKHEED

STEEL

ALUM ALLOY

RUBBER

WIRING

MAGNESIUM

MISC. ELECTRICAL & INSULATING MATERIALS

PLASTICS & GLASS

% OF WEIGHT EMPTY
WEIGHT EMPTY
LOCKHEED AND NON-LOCKHEED DESIGN
BY FORMS OF MATERIALS

AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

DESIGNED BY LOCKHEED
SHEET METAL
EXTRUSIONS
FORGINGS
BAR & PLATE
TUBING
CASTINGS
FLUID, INSULATION, FASTENERS
WIRING
INTEGRALLY STIFFENED SKIN
MOULDED PLASTIC

NOT DESIGNED BY LOCKHEED
SHEET METAL
FORGINGS
BAR & PLATE
CASTINGS
WIRING
MOULDED RUBBER
MISG.
TUBING
SHEET RUBBER
FASTENERS

% OF WEIGHT EMPTY
STRUCTURE BY FUNCTION

AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

% OF STRUCTURE

STRUCTURAL PRODUCIBILITY

AIRPLANE PROPULSION

SERVICE FEATURES

AIRPLANE CONTROL

SAFETY FEATURES

AERODYNAMIC REFINEMENTS

MISSION ACCOMMODATIONS

NOTE:
STRUCTURE IS ALL MATERIAL WHICH TAKES FLIGHT OR GROUND LOADS.
Chart C-10

Structure designed by flight loads, ground loads, and groups by airplane C.

% of gross weight:

% of weight empty:

% of structure:

Designed by flight loads:
- Fuselage
- Wing
- Tail
- Fixed equipment

Designed by ground loads:
- Landing gear
- Wing
- Fuselage

Note: Structure is all material that takes ground or flight loads.
STRUCTURAL PRODUCIBILITY
BY GROUPS
AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGH EMPTY

% OF STRUCTURE

STRUCTURAL PRODUCIBILITY
WING
FUSELAGE
TAIL
LANDING GEAR

NACA
Chart C-12

STRUCTURAL PRODUCIBILITY
BY FUNCTION
AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

% OF STRUCTURE

DIFFERENTIATED STRUCTURAL PRODUCIBILITY

NON-INTEGRAL DESIGN

JOINTS-MAJOR ASSEMBLY

TOLERANCES

NON-TAPERED MATERIAL

SPILGES
SAFETY FEATURES
BY GROUPS
AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

SAFETY FEATURES

FUSELAGE
POWER PLANT
TAIL

NOTE:
DOES NOT INCLUDE ITEMS IN OPERATING EQUIPMENT AMOUNTING TO 0.3% OF WEIGHT EMPTY
SAFETY FEATURES
BY FUNCTION
AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

SAFETY FEATURES

ANTI-ICING
FIRE PROTECTION
EMERGENCY SYSTEMS
GUNFIRE PROTECTION
CRASH & JETTISON PROV.
ELECTRICAL CONDUIT & BATTERY CONTAINER
EXTERNAL LIGHTING

NOTE:
DOES NOT INCLUDE ITEMS IN OPERATING EQUIPMENT AMOUNTING TO 0.3% OF WEIGHT EMPTY
### Chart C-16

#### Mission Accommodations and Crew Accommodations

**By Function**

**Airplane C**

<table>
<thead>
<tr>
<th>% of Gross Weight</th>
<th>% of Weight Empty</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
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<tr>
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<td>10</td>
<td>12</td>
</tr>
<tr>
<td>11</td>
<td>13</td>
</tr>
</tbody>
</table>

**Mission Accommodations**

- Rocket Prov.
- Autopilot
- JATO & Bore Sighting Prov.

**Crew Accommodations**

- Air Conditioning
- Seats
- Shelves, Trim & Center Stand
- Oxygen
- Miscellaneous

**Note:**

Does not include items in operating equipment amounting to 0.4% of weight empty.
# Service Features by Groups

**Airplane C**

<table>
<thead>
<tr>
<th>% of Gross Weight</th>
<th>% of Weight Empty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Service Features

- Wing
- Power Plant
- Landing Gear
- Fixed Equipment
- Tail

**Note:**

Does not include provisions for service life other than protective coating.
SERVICE FEATURES
BY FUNCTION
AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

SERVICE FEATURES

PROTECTIVE COATING
SINGLE POINT REFUELLING
HANDLING
MISCELLANEOUS

ACCESS DOORS

NOTE:
DOES NOT INCLUDE PROVISIONS FOR SERVICE LIFE OTHER THAN PROTECTIVE COATING.
AIRPLANE CONTROL

BY GROUPS

AIRPLANE C

% OF GROSS WEIGHT

0 1 2 3 4 5 6 7

% OF WEIGHT EMPTY

0 2 3 4 5 6 7 8 9

AIRPLANE CONTROL

FIXED EQUIPMENT

LANDING GEAR

FUSELAGE

WING

TAIL

NACA
Chart C-20

AIRPLANE CONTROL
BY FUNCTION
AIRPLANE C

% OF GROSS WEIGHT

% OF WEIGHT EMPTY

AIRPLANE CONTROL
ELECTRICAL POWER
SURFACE CONTROLS
HYDRAULIC POWER
INSTRUMENTS, PANELS, & STAND
BRAKE CONTROLS
LANDING GEAR RETRACTION CONTROLS
SHIMNY DAMPER