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Date: 1/30/56

By direction of
Chief of Naval Research (Code 46311)

MAY 1956

Standard Aircraft Characteristics

MODEL D181

DUCTED PROPELLER ASSAULT TRANSPORT AIRCRAFT

REPORT NO. D181-945-008

56AA 46311

MAY 1956

BELL D181
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## Mission and Description

**DESCRIPTION**

The basic mission required a radius of 425 miles at 300 mph with an initial vertical take-off. An 8000-pound payload is carried cut and 4000 pounds back. The general flight plan of all missions was quite similar to the basic mission:

1. Take-off at 6000 ft and 95°F — VTO or STO depending on initial loading. All landings and subsequent take-offs are vertical. Payload out is 8000 pounds or greater.
2. Climb to cruise altitude; fly 80% of radius.
3. Descend to sea level; fly remaining 20%.
4. Land vertically at 6000 ft and 95°F; remove payload; reload a 4000-pound payload. NO FUEL IS ADDED.
5. Take-off vertically at 6000 ft and 95°F and return.
6. Fly first 20% at sea level.
7. Climb to cruise altitude for remainder of distance.
8. Descend and land vertically at 6000 ft and 95°F holding a 10% fuel reserve.

**MISSIONS WITH ALL VTO**

**BASIC MISSION**

1. Minimum vertical take-off gross weight to accomplish this mission.
2. Minimum cruise altitude to accomplish this mission.
3. Highest allowable velocity at altitude and 300 mph at sea level to accomplish this mission.

**BASIC MISSION VARIATIONS**

4. High-speed mission: Cruise at 455 mph at altitude and sea level.
5. Maximum VTO Radius with take-off at sea level standard; cruise for maximum radius at 300 mph at sea level and altitude.

**MISSION WITH INITIAL STO — all other landings and take-offs are vertical.**

1. Maximum radius with 8000-pound payload out.
2. Maximum payload out for 425 miles radius.
3. 450 mph cruise; maximum radius with an 8000-pound payload out.

## WEIG H T S

<table>
<thead>
<tr>
<th>Description</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Vertical Take-off @ 6000 ft and 95°F</td>
<td>70,000 lb</td>
</tr>
<tr>
<td>Max. Vertical Landing @ 6000 ft and 95°F</td>
<td>70,000 lb</td>
</tr>
<tr>
<td>Weight Empty</td>
<td>43,815 lb</td>
</tr>
</tbody>
</table>

## F U E L

<table>
<thead>
<tr>
<th>Description</th>
<th>Capacity</th>
<th>Fuel Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
<td>2308 gal.</td>
<td>6.5 lb/gal</td>
</tr>
</tbody>
</table>

## ELECTRONICS

- AN/ARC-34 UHF Radio
- AN/ARC-49 VHF Radio
- AN/APN-22 Radar Altimeter
- AN/ARN-31 Glide Path Rec.
- AN/ARN-21 Nav. Radio
- AN/APX-25 Transponder (IFF)
- AN/ARN-32 Marker Beacon Rec.
- 618S-1 HF Radio (provision only)
## Loading and Performance - Typical Mission

<table>
<thead>
<tr>
<th></th>
<th>BASIC MISSION</th>
<th>ALL VTOL</th>
<th>INITIAL STO, All Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td>Take-off Weight</td>
<td>Cruise at Altitude</td>
<td>Altitude and Level</td>
</tr>
<tr>
<td></td>
<td>lb 87,800</td>
<td>70,000</td>
<td>70,000</td>
</tr>
<tr>
<td>Payload: 60,000 lb</td>
<td>8,000</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Fuel: 13,290 lb</td>
<td>15,920</td>
<td>15,920</td>
<td>15,920</td>
</tr>
<tr>
<td>Wing Loading: 55.1 psf</td>
<td>57.4</td>
<td>57.4</td>
<td>57.4</td>
</tr>
<tr>
<td>Stall Speed, Power Off</td>
<td>142</td>
<td>146</td>
<td>146</td>
</tr>
<tr>
<td>Take-Off Ground Run at 6000 ft</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>&amp; 95°F</td>
<td>fpm 9.440</td>
<td>9.000</td>
<td>9.000</td>
</tr>
<tr>
<td>Rate of Climb at S.L.</td>
<td>min 2.51</td>
<td>2.63</td>
<td>2.63</td>
</tr>
<tr>
<td>Time: S.L. to 30,000 ft</td>
<td>2.43</td>
<td>4.54</td>
<td>4.54</td>
</tr>
<tr>
<td>Service Ceiling (100 fpm)</td>
<td>ft 49,900</td>
<td>49,500</td>
<td>49,500</td>
</tr>
<tr>
<td>FERRY RANGE WITH PAYLOAD</td>
<td>mi 1,120</td>
<td>950</td>
<td>1,360</td>
</tr>
<tr>
<td>Average Cruising Speed</td>
<td>mph 320</td>
<td>300</td>
<td>320</td>
</tr>
<tr>
<td>Average Cruising Altitude</td>
<td>ft 30,000</td>
<td>11,300</td>
<td>30,000</td>
</tr>
<tr>
<td>COMBAT RADIUS: 20% at S.L.</td>
<td>mi 425</td>
<td>425</td>
<td>425</td>
</tr>
<tr>
<td>Average Cruising Speed-Out</td>
<td>mph 450</td>
<td>300</td>
<td>425</td>
</tr>
<tr>
<td>*Average Cruising Altitude-Out</td>
<td>ft 24,800</td>
<td>11,300</td>
<td>30,000</td>
</tr>
<tr>
<td>LANDING WEIGHT: at Radius Point</td>
<td>lb 61,150</td>
<td>62,770</td>
<td>62,700</td>
</tr>
<tr>
<td>Ground roll at 6000 ft &amp; 95°F</td>
<td>ft 0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total from 50 ft</td>
<td>lb 56,000</td>
<td>58,620</td>
<td>58,550</td>
</tr>
<tr>
<td><strong>TAKE-OFF WEIGHT: RETURN</strong></td>
<td>lb 4,000</td>
<td>4,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Payload: 60,000 lb</td>
<td>mph 131</td>
<td>134</td>
<td>134</td>
</tr>
<tr>
<td>Stall Speed, Power Off</td>
<td>ft 0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Take-Off Ground Run at 6000 ft &amp; 95°F</td>
<td>fpm 0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rate of Climb at S.L.</td>
<td>fpm 11,710</td>
<td>11,120</td>
<td>11,120</td>
</tr>
<tr>
<td>Time: S.L. to 30,000 ft</td>
<td>min 2.02</td>
<td>2.13</td>
<td>2.13</td>
</tr>
<tr>
<td>Service Ceiling (100 fpm)</td>
<td>ft 52,000</td>
<td>50,800</td>
<td>50,800</td>
</tr>
<tr>
<td>Average Cruising Speed: back</td>
<td>mph 300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>*Average Cruising Altitude: back</td>
<td>ft 29,000</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>LANDING WEIGHT: RETURN</td>
<td>lb 51,560</td>
<td>51,820</td>
<td>51,820</td>
</tr>
<tr>
<td>Ground roll at 6000 ft &amp; 95°F</td>
<td>ft 0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total from 50 ft</td>
<td>lb 1,330</td>
<td>1,590</td>
<td>1,590</td>
</tr>
<tr>
<td>Reserve fuel (10% of total)</td>
<td>min 6,24</td>
<td>7.46</td>
<td>7,46</td>
</tr>
<tr>
<td><strong>Best Altitude Lotter</strong></td>
<td>lb 53</td>
<td>64</td>
<td>64</td>
</tr>
</tbody>
</table>

**NOTES**

- This is the average altitude which does not include the portion flown at sea level.
- No fuel in added.
- † Velocity at 30,000 feet. Velocity at Sea Level = 300 mph
- †† Available with reserve of 10% initial fuel.
SUPPLEMENTAL

VERTICAL TAKE-OFF FLIGHT PATH
T.O.G.W. = 70,000 LB, \( T/W = 1.03 \)

VERTICAL RISE
\( v = 5 \text{ FT/SEC} \)

NORMAL GLIDE
LEVEL DECELERATION
CONSTANT ANGLE OF ATTACK, \( C_L = 0 \),
INCREASING POWER

VERTICAL LANDING FLIGHT PATH
G.W. = 50,000 LB

VERTICAL LETDOWN
\( v = 5 \text{ FT/SEC} \)
GENERAL NOTES

1. It was not necessary to comply with Specification MIL-C-5011A by verbal agreement with ONR. For presentation purposes the general format of the specification was used and the intent was followed with the following deviations:

   a. The actual fuel used to take-off and accelerate to climb speed, as determined by a numerical integration was used.

   b. The reserve used was 10% of the total fuel on board at take-off. No fuel was added during the mission.

2. Alterations in the prescribed format were made to present more satisfactorily the VTOL features of this aircraft.

3. The technical summary report presents complete performance information on this airplane. But due to the nature of the contract, does not contain details of method and sample calculations.
Characteristics Summary Basic Mission

Cruise altitude = 29,000 ft
Cruise altitude = 24,800 ft

Vertical landing with 10% reserve equal to 2.4 minutes hovering or 53 minutes loiter

CRUISE ALTITUDE = 29,000 FEET
CRUISE ALTITUDE = 24,800 FEET

Performance

<table>
<thead>
<tr>
<th>COMBAT RADIUS</th>
<th>FERRY RANGE</th>
<th>MAXIMUM SPEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>425 miles at 300 mph; 20% at sea level</td>
<td>1120 miles at 320 mph Cruise at 30,000 ft.</td>
<td>520 mph at 35,000 ft.</td>
</tr>
</tbody>
</table>

Climb

9440 ft per min at sea level, take-off weight, and military power

11,710 ft per min at sea level, radius point take-off weight, and military power

Ceiling

49,900 ft at 100 ft per min, take-off weight, and military power

52,000 ft at 100 ft per min, radius point take-off weight, and military power

Take-off

No ground run Vertical take-off

Hovering Endurance

Maximum — 70 min
Minimum — 6.24 min

Stalling Speed

143 mph at take-off weight
131 mph at radius point take-off weight

Load

Crew (3) 645 lb
Oil 328 lb
Fuel 13,290 lb
Payload 8,000 lb

Initial take-off 67,380 lb
Radius point take-off 56,000 lb
Maximum VTO at 6000 ft and 95°F with 3% thrust margin 70,000 lb

Time to Climb

To 20,000 ft at T.O.G.W. 2.51 min
To 30,000 ft at T.O.G.W. 4.30 min
To 20,000 ft at radius point G.W. 2.02 min
To 30,000 ft at radius point G.W. 3.35 min

Notes

1. Performance Basis: I0CA standard atmosphere no wind except for take-offs and landings, which were at 6000 ft and 95°F. Fuel consumption corrected for installation and increased 5% per MIL-C-5011A.

2. Missions: Vertical take-off and landing at all points.
   I Minimum cruise altitude for basic mission, 11,300 ft.
   II High-speed cruise at altitude and 300 mph at sea level for basic mission, 420 mph at 30,000 ft.
   IV High-speed cruise of 455 mph at sea level and 30,000 ft radius = 302 miles.
   V Max. VTO Radius with sea level standard take-off and cruise at 300 mph: R = 705 miles.

3. Missions with initial STO; all later take-offs and landings vertical.
   A. Max. Radius. Initial Ground Run = 770 ft. Rad = 987 mi.
   B. Max. payload with 425-mile radius. Initial ground run = 300 ft, payload = 16,720 lb.
   C. High-speed radius at 450 mph, Rad = 607 mi., initial ground run = 660 ft.

Bell D181

MAY 1956
Characteristics Summary

MODEL D181 Ducted Propeller Assault Transport Aircraft

FEATURES
1. Vertical take off and landing in horizontal attitude.
2. Can make overload short take off for increased radius, range, and payload.
3. High speed in excess of 500 mph. and hovering capability of 70 minutes.
4. Superior stability during hovering and transition due to ducted propellers.
5. Good handling and maintenance characteristics.
6. Proven reaction control during vertical take off and landing.
7. Manual pilot control without automatic stabilization or control during vertical take off and landing.

CARGO
1. Max load (16,720 pounds)
2. Clear space.
   35' x 10' 8" x 8'

MAY 1956  BELL D181