North American Aviation

P-51 D Mustang

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History

• Commissioned by Royal Air Force in April 1941 to North American Aviation Inc.
• Designers
  – Edgar Schmued (Project Lead Designer)
  – Lee Atwood (Chief Engineer)
  – Ed Horkey (Aerodynamicist)
  – James “Dutch” Kindleberger (General Manager: North American Aviation)
• 120 days from contract to prototype
History

• First fighter capable of full length bomber escort missions
• 14,819 P-51’s built for US Army in WWII
• Highest scoring US aircraft in European theater
  – 4950 air victories
  – 4131 aircraft destroyed on the ground
  – Only 840 lost P-51’s
Configuration

- Fuselage
  - Slender design
  - Length 32.25 ft
  - Bubble Canopy
- Gear
  - Tail-dragger
- Wing
  - NACA 6-series airfoil
  - Low, tapered wing
- Tail
  - Low, conventional tail
  - Strake on vertical stabilizer
- Weapons
  - Six 0.50 caliber M2 machine guns
  - Under-wing rockets (later models)
- Propulsion System
  - 1695 hp Merlin V-1650 engine
  - Radiator Cooling Duct
    - Provided thrust with duct system similar to a jet.
    - Boundary Layer “gutter”
Wing Geometry

- Dimensions
  - Area: \( S = 233 \text{ ft}^2 \)
  - Span: \( b = 37 \text{ ft} \)
  - Chord: \( C_r = 8.48 \text{ ft} \)
  - \( C_t = 3.87 \text{ ft} \)
  - \( AR = 5.9 \)

- First production use of NACA 6-series
Aerodynamics

- $C_{L_{\text{max}}} = 1.5$  $C_{L_{\text{cruise}}} = 0.2$
- $C_{D_{o}} = 0.0055$  $C_{D_{i}} = 0.0025$
Tail Geometry

• Horizontal
  – Area: 45.4 ft$^2$
  – Span: 13.1 ft
  – Chord: $C_r = 4.6$ ft, $C_t = 2.3$ ft

• Vertical
  – Area: 14.8 ft$^2$
  – Span: 4.7 ft
  – Chord: $C_r = 4.7$ ft, $C_t = 1.6$ ft
Engine

• Packard-Merlin V-1650-7
  – Liquid-cooled, supercharged V12
  – 5.4 in bore, 6 in stroke
  – Displacement: 1,647 in$^3$ (27 L)
  – 1695 hp
Performance

• Drag
  – $C_{Do} = 0.0055$ (cruise)
  – Aspect Ratio = 5.876
  – $C_{Di} = 0.002549$
  – $D_i = 198.396\ \text{lb (cruise)}$
  – $D_{total} = 626.4\ \text{lb (cruise)}$

• Minimum Drag
  – $C_{D\ min\ drag} = 0.0051$
  – $C_{L\ min\ drag} = 0.2938$
  – $V_{min\ drag} = 385.59\ \text{ft/s}$
  – Airfoil $L/D_{max} = 91$

• Minimum Power
  – $C_{D\ min\ power} = 0.022$
  – $C_{L\ min\ power} = 0.5088$
  – $V_{min\ power} = 293.05\ \text{ft/s}$
  – Airfoil $L/D_{min\ power} = 78.8$
Performance

Range and Endurance

• Range
  – 950 miles
  – 2003 miles (with drop tanks)

• Endurance
  – 3.0218 hours (constant altitude)
  – 2.6289 hours (constant velocity)
  – 6.4667 hours (constant altitude with drop tanks)
  – 5.5427 hours (constant velocity with drop tanks)
Performance

- Fuel tank size
  - 105 gallons
  - 215 gallons (with drop tanks)
- Take off distance – 3201 ft
Overall Assessment

The P-51D proves itself as a remarkable fighter aircraft during World War II

– Bomber escort missions to Germany
– Operation Pointblank
  • Destroy Luftewaffe
– Rocket interception
  • V-1
  • Me 262
  • Me 163 Komet
Questions
References

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