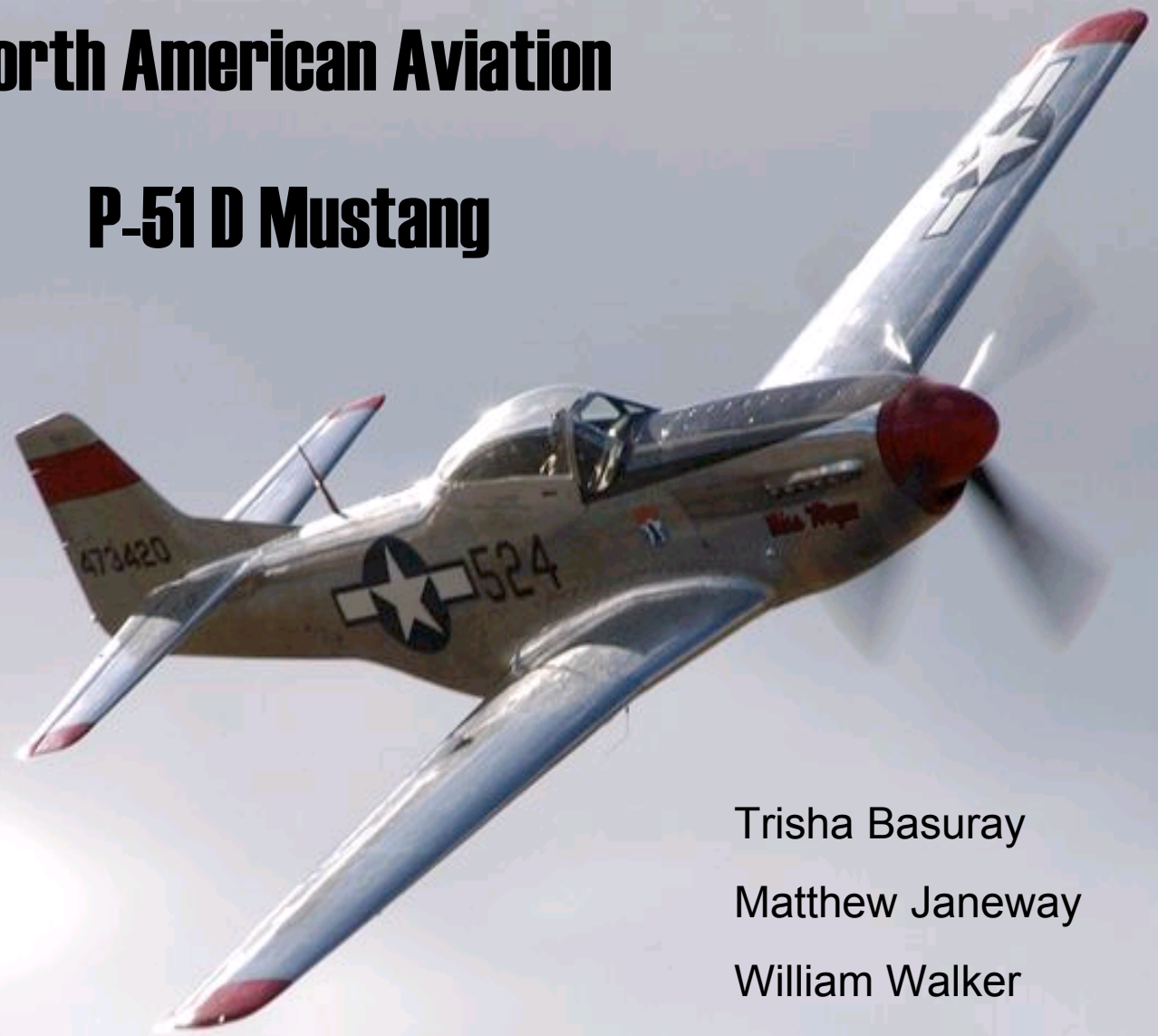
North American Aviation

P-51 D Mustang



Trisha Basuray

Matthew Janeway

William Walker

History

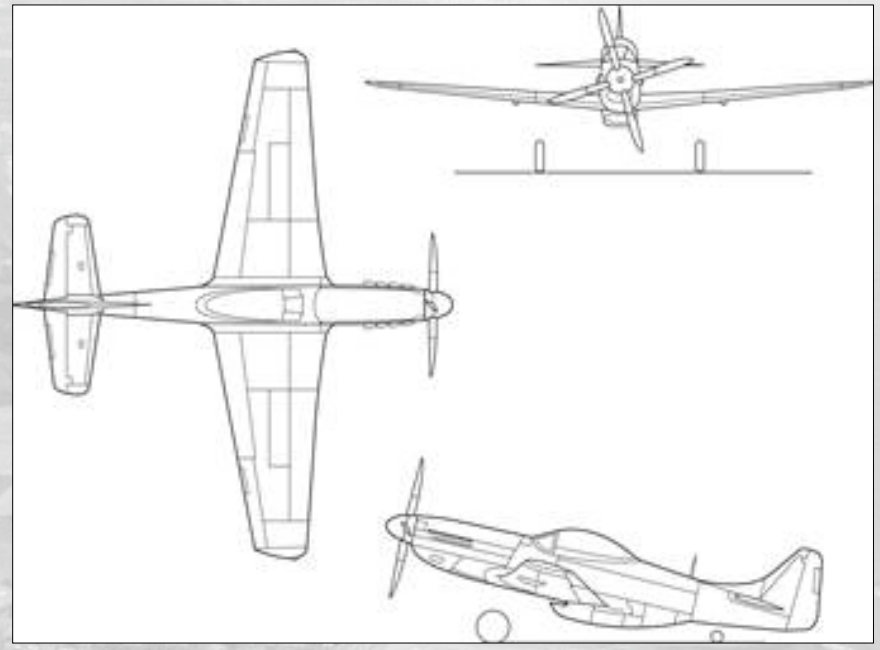
- Commissioned by Royal Air Force in April 1941 to North American Aviation Inc.
- Designers
  - Edgar Schmued (Project Lead Designer)
  - Lee Atwood (Chief Engineer)
  - Ed Horkey (Aerodynamicist)
  - James “Dutch” Kindleberger (General Manager: North American Aviation)
- 120 days from contract to prototype

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

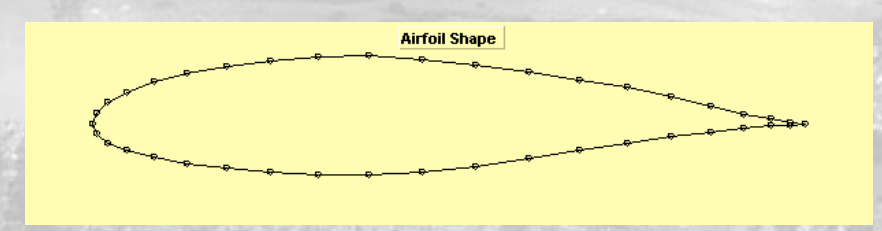
Configuration

- 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”

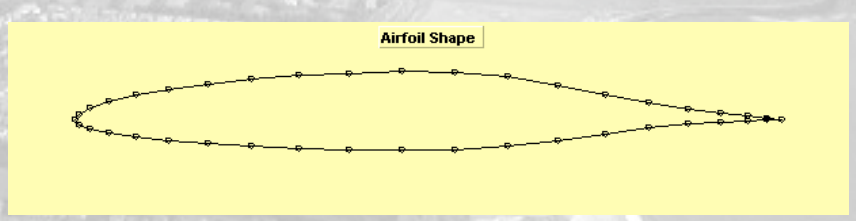


Wing Geometry

- Dimensions
  - Area: S = 233 ft^2
  - Span: b = 37 ft
  - Chord: C_r = 8.48 ft
    C_t=3.87 ft
  - AR = 5.9
- First production use of NACA 6-series



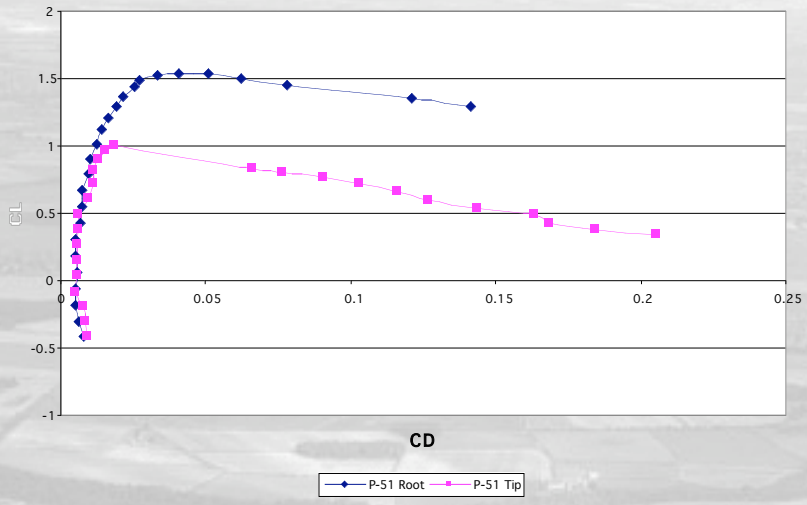
Root



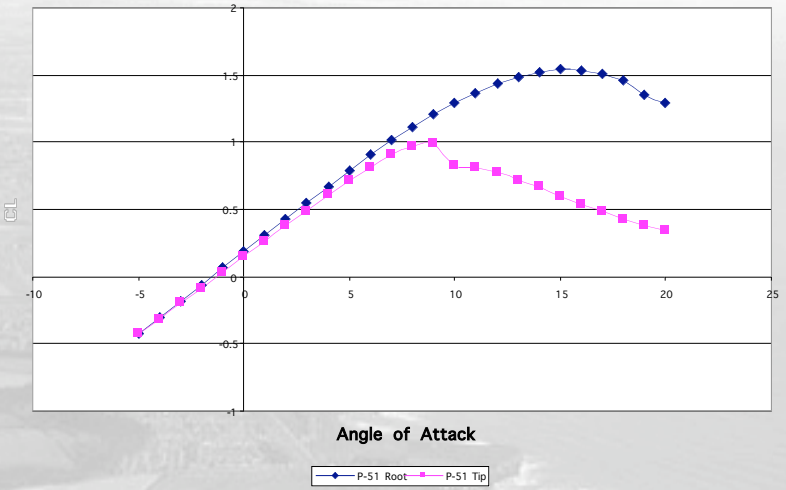
Tip

Aerodynamics

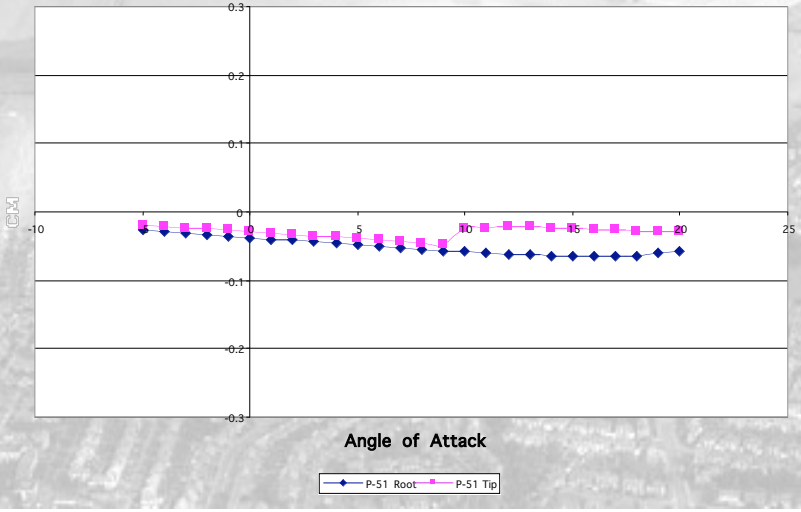
Drag Polar



CL vs Alpha



CM vs. Alpha



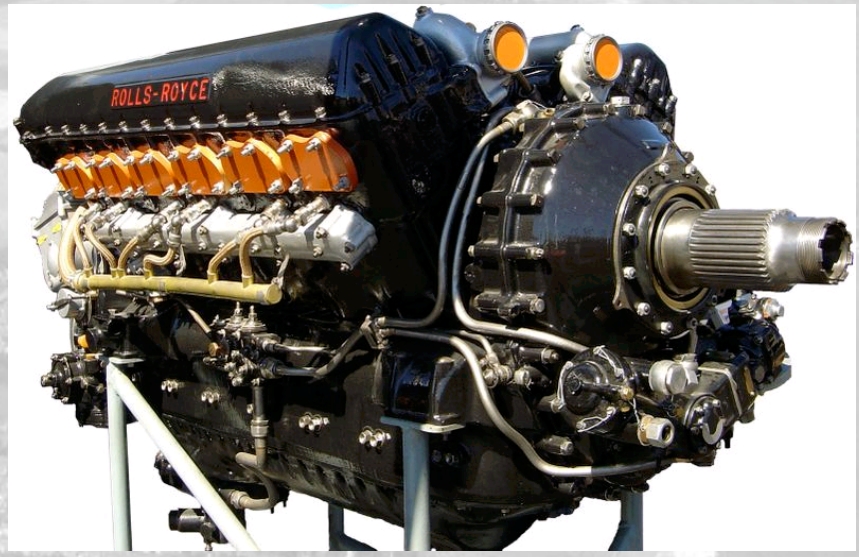
- $C_{Lmax} = 1.5$ $C_{Lcruise} = 0.2$
- $C_{Do} = 0.0055$ $C_{Di} = 0.0025$

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 lb (cruise)
  - D_{total} = 626.4 lb (cruise)

- Minimum Drag
  - $C_{D\ min\ drag}$ = 0.0051
  - $C_{L\ min\ drag}$ = 0.2938
  - $V_{min\ drag}$ = 385.59 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 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

- USAF Museum: Wright-Patterson AFB
  - http://www.wpafb.af.mil/museum/research/p51.htm
- The Boeing Company history
  - http://www.boeing.com/history/bna/p51.htm
- Garrison, Peter. “Who Made the Mustang?” *Air & Space Magazine* Aug./Sept. 1996
- Aviation History Online Museum
  - http://www.aviation-history.com/north-american/p51.html
- Wikipedia: The Free Encyclopedia
  - http://en.wikipedia.org/wiki/P-51_Mustang
- UIUC Airfoil Coordinates Database
  - http://www.ae.uiuc.edu/m-selig/ads/coord_database.html