

# P-51 Mustang

## Flight Simulation Data

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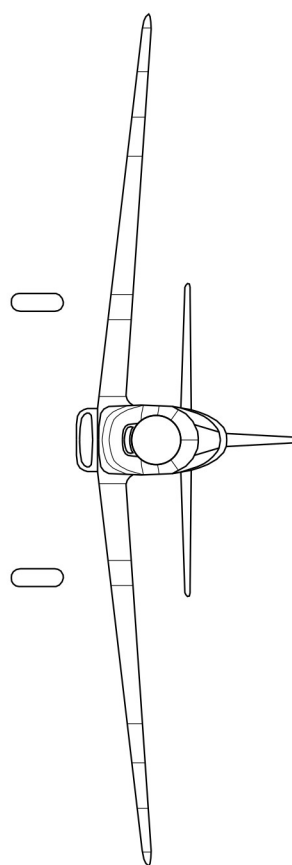
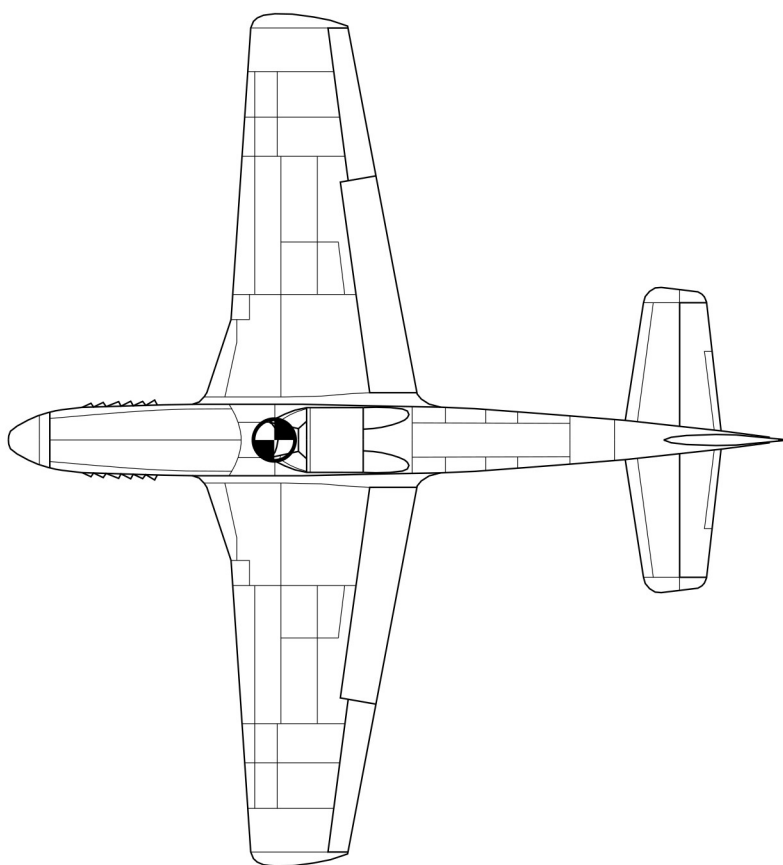
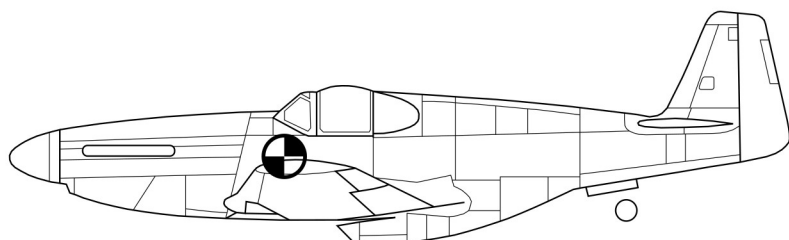
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0 1 2 3 4 5 m

## 1. General Data

Parameter	Value	Reference
Length	9.83 m	[1]
Wingspan	11.28 m	[1]
Height	3.71 m	[1]
Wing area	22.3 m <sup>2</sup>	[1]
Mean aerodynamic chord	2.02 m	[1]
Wing airfoil	NAA-NACA 45-100	[2]
Wing incidence	+1°	[1]
Horizontal tail area	3.81 m <sup>2</sup>	[1]
Horizontal tail incidence	+2°	[1]
Vertical tail area	1.86 m <sup>2</sup>	[1]
Ailerons area (total)	1.18 m <sup>2</sup>	[1]
Ailerons deflection limit	±10, 12 or 15°	[1]
Ailerons trim tab deflection limit	±10°	[1]
Elevator area (including tabs)	1.21 m <sup>2</sup>	[1]
Elevator trim tabs area	0.18 m <sup>2</sup>	[1]
Elevator deflection limit	up 30°, down 20°	[1]
Elevator trim tab deflection limit	up 10°, down 25°	[1]
Rudder area (including tabs)	0.97 m <sup>2</sup>	[1]
Rudder trim tabs area	0.07 m <sup>2</sup>	[1]
Rudder deflection limit	±30°	[1]
Rudder trim tab deflection limit	±10°	[1]
Flaps area (total)	2.99 m <sup>2</sup>	[1]
Flaps deflection limit	47°	[1]
Empty weight	3 311 kg	[3]
Loaded weight	4 540 kg	[4]
Internal fuel tanks capacity (wings)	696 l	[1]
Internal fuel tanks capacity (fuselage)	322 l	[1]
Engine model	Packard V-1650-3	[4]
Engine rated power (at 3 000 RPM) - take-off	1 111 kW	[5]
Engine displacement	27.02 l	[5]

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Parameter	Value	Reference
Engine height	1.056 m	[5]
Engine width	0.762 m	[5]
Engine length	2.212 m	[5]
Engine weight	766 kg	[5]
Specific fuel consumption	274.9 g/(kW·h)	[5]
Engine gear ratio	0.479	[1], [5]
Propeller manufacturer	Hamilton Standard	[1]
Propeller hub model no.	24D50-65	[1]
Propeller blade model no.	J6523A-24	[1]
Propeller diameter	3.40 m	[1]
Minimum propeller pitch	23°	[1]
Maximum propeller pitch	65°	[1]
Supercharger low speed gear ratio	5.80	[5]
Supercharger high speed gear ratio	7.35	[5]
Supercharger boost	2.07 bar	[5]



## 2. Performance

Parameter	Value	Reference
Maximum speed (at 9 000 lb gross weight, 20 000 ft, war emergency power)	439 mph	[3]
Maximum speed (at 9 000 lb gross weight, 20 000 ft, maximum continuous power)	405 mph	[3]
Maximum climb rate (at 9 000 lb gross weight, 5 000 ft, war emergency power)	3 560 ft/min	[3]
Maximum climb rate (at 9 000 lb gross weight, 5 000 ft, maximum continuous power)	3 150 ft/min	[3]
Service ceiling	40 000 ft	[4]
Range (at 9 000 lb gross weight, at 10 000 ft, with 184 US gal fuel)	525 mi	[3]
Endurance (at 9 000 lb gross weight, at 10 000 ft, with 184 US gal fuel)	1.7 h	[3]

### **3. Aerodynamic Characteristics**





## 4. Mass Data

Parameter	Value
Center of mass x-coordinate	-0.20 m
Center of mass y-coordinate	0.00 m
Center of mass z-coordinate	0.21 m
Moment of inertia $I_x$	11 022.1 kg·m <sup>2</sup>
Moment of inertia $I_y$	15 381.0 kg·m <sup>2</sup>
Moment of inertia $I_z$	24 934.2 kg·m <sup>2</sup>
Cross product of inertia $I_{xy}$	0.0 kg·m <sup>2</sup>
Cross product of inertia $I_{xz}$	-227.9 kg·m <sup>2</sup>
Cross product of inertia $I_{yz}$	0.0 kg·m <sup>2</sup>

*Empty aircraft inertia tensor and center of mass coordinates*

Structure group	Weight [kg]	Coordinates [m]			First moment of mass [kg·m]			Moment of inertia [kg·m <sup>2</sup> ]			Moment of inertia (Body Axis System) [kg·m <sup>2</sup> ]					
		<i>x</i>	<i>y</i>	<i>z</i>	<i>S<sub>X</sub></i>	<i>S<sub>Y</sub></i>	<i>S<sub>Z</sub></i>	<i>I<sub>x,0</sub></i>	<i>I<sub>y,0</sub></i>	<i>I<sub>z,0</sub></i>	<i>I<sub>x</sub></i>	<i>I<sub>y</sub></i>	<i>I<sub>z</sub></i>	<i>I<sub>xy</sub></i>	<i>I<sub>xz</sub></i>	<i>I<sub>yz</sub></i>

Structure groups breakdown

## **Bibliography**

- [1] Erection and Maintenance Instructions for Army Models P-51D-5, -10, -15, -20, -25 P-51K-1, -5, -10, -15 British Model Mustang IV Airplanes. North American Aviation, AN 01-60JE-2, 1944
- [2] Hansen J, et al.: The Wind and Beyond: A Documentary Journey into the History of Aerodynamics in America. Volume II: Reinventing the Airplane. National Aeronautics and Space Administration, SP-2007-4409, 2007
- [3] P-51 Tactical Planning Characteristics & Performance Chart.
- [4] Gunston B.: Jane's Fighting Aircraft of World War II. Crescent Books, 1989
- [5] Wilkinson P.: Aircraft Engines of the World 1945. New York, 1945