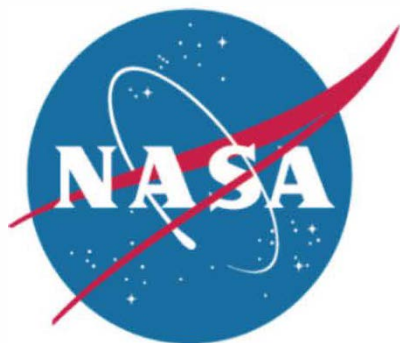




National Aeronautics and
Space Administration

Armstrong Flight Research Center
Edwards, CA 93523-0273



X-57 Maxwell

Operational Flight Envelope

TP-CEPT-010

Release: Baseline Date: April 14, 2021

Prepared By:

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X-57 Flight Envelope

Revision History

[illegible]

Nomenclature

ft	Feet
HL	High Lift
VA	Design Maneuvering Speed
VFE_Full	Maximum Flaps Extended Speed (Full)
VFE_TO	Maximum Flaps Extended Speed (Takeoff)
VHAX_gnd	Max Level Flight Speed at ground level
VHMAX_Hmax	Max Level Flight Speed at 15k feet
VHMC_gnd	Max Continuous Level Flight Speed at ground level
VHMC_Hmax	Max Continuous Level Flight Speed at 15k feet
VLE	Maximum Landing Gear Extended Speed
VNE	Never Exceed Speed
VNO	Max Structural Cruising Speed - Exceed only in smooth air with caution
Vref	Reference Speed
VS	Gross Weight Power Off stall speed in the Cruise Configuration
VS1	Gross Weight Power-off stall speed in the takeoff configuration
VSO	Gross Weight Power-off stall speed in the landing configuration

1. Purpose & Scope

This document contains the operational flight envelopes for the X-57 Mod II and the Mod III/IV configurations. These flight envelopes detail airspeeds and altitudes at which the X-57 aircraft will be cleared to fly in the Mod II and the Mod III/IV configurations. Analysis done by individual disciplines may exceed the airspeeds and altitudes shown here in order to clear these operational flight envelopes.

Analysis for the Mod II and Mod III/IV configurations is ongoing, which may result in changes to several of the airspeeds shown below. Airspeeds for which there is uncertainty, are marked as “TBR” (To Be Resolved), and a resolution plan is shown in

2. Mod II Flight Envelope

The flight envelope for the Mod II configuration is shown in Figure 1. The stall speeds displayed in the table assume a gross weight of 3,000 lbs. Stall speeds referenced in flight cards are to be adjusted for weight per the Mod-II Airspeed Document, OPS-CEPT-006 The speeds used to form the flight envelope along with the source for each speed are listed in Table 1.

The maximum operating altitude for the X-57 Mod II configuration is 14,000 ft. The maximum operating altitude limit is sourced from the P2006T Aircraft Flight Manual page 2-11.

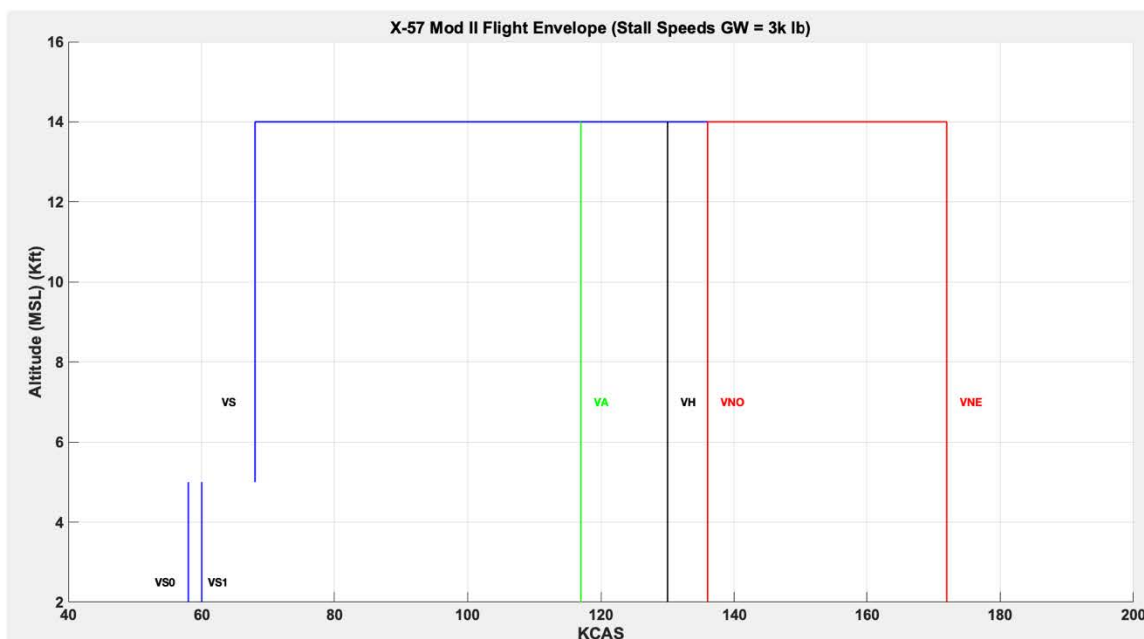


Figure 1: Mod II Flight Test Envelope for 3,000 GTOW

Speed	KCAS	Description	Source	Note
VA	117	Design Maneuvering Speed	P2006T Aircraft Flight Manual, Page 2-5	VA set by vertical tail load documentation which traces to Tecnam MTOW of 2,601
VFE_Full	93	Maximum Flaps Extended Speed (Full)	P2006T Aircraft Flight Manual, Supplement A19, Page W2-5	Using Tecnam MTOW 2,712 value
VFE_TO	119	Maximum Flaps Extended Speed (Takeoff)	P2006T Aircraft Flight Manual, Supplement A19, Page W2-5	Using Tecnam MTOW 2,712 value
VLE	119	Maximum Landing Gear Extended Speed	P2006T Aircraft Flight Manual, Supplement A20, Page A20-5	VLO/VLE = 122KIAS = 119 KCAS per 5-3 of P2006T Aircraft Flight Manual Page
VNE	172	Never Exceed Speed	P2006T Aircraft Flight Manual, Supplement A19, Page W2-5	Using Tecnam MTOW 2,712 value
VNO	136	Max Structural Cruising Speed - Exceed only in smooth air with caution	P2006T Aircraft Flight Manual, Supplement A19, Page W2-5	Using Tecnam MTOW 2,712 value
VH	130	Maximum level flight speed at maximum continuous power	Mod IV CDR, Performance & Sizing IPT Slides, Slide 5	
VS	68	3,000 lb Gross Weight Power Off stall speed in the Cruise Configuration	Mod-II Airspeed Document, OPS-CEPT-006	
VSO	58	3,000 lb Gross Weight Power-off stall speed in the landing configuration	Mod-II Airspeed Document, OPS-CEPT-006	
VS1	60	3,000 lb Gross Weight Power-off stall speed in the takeoff configuration	Mod-II Airspeed Document, OPS-CEPT-006	
Vref	1.3*VS1	Reference Speed	ASTM F3179/F3179M-20 Section 18.1	Vref = 1.3*VS1 per reference.

Table 1: Mod II Flight Envelope Speeds

The maximum and minimum G levels are 2.75G and -1.25G assuming a 3,000 lb weight per X-57 Mod II Landing Gear and Mod II Wing Loads ANALYS-CEPT-007 Rev A. 9/25/18. The VN diagram for the Mod II aircraft with a 3,000 lb gross weight is shown in Figure 2.

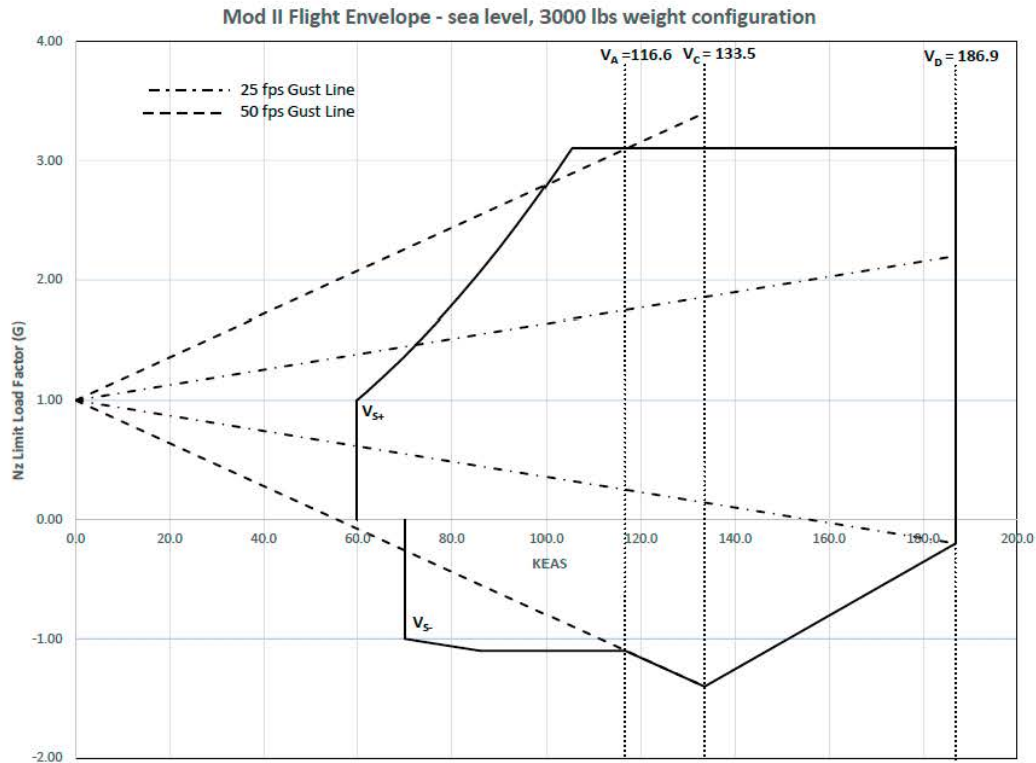


Figure 2: Mod II Diagram for 3,000 Gross Weight

3. Mod III/IV Flight Envelope

The flight envelope for the Mod III/IV configuration is shown in Figure 3. The stall speeds displayed in the table assume a gross weight of 3,000 lbs. Stall speeds referenced in flight cards are to be adjusted for weight. The speeds used to form the flight envelope along with the source for each speed are listed in Table 2. Figure 3 identifies the envelopes in which the High Lift (HL) system will be engaged at altitude, HL System Envelope, and for which the HL system may be engaged for takeoffs and landing, HL System TO/Lnd Envelope. Also shown is the Cruise Envelope.

The maximum operating altitude for the X-57 Mod III configuration is 14,000 ft. The maximum operating altitude limit is sourced from the P2006T Aircraft Flight Manual page 2-11.

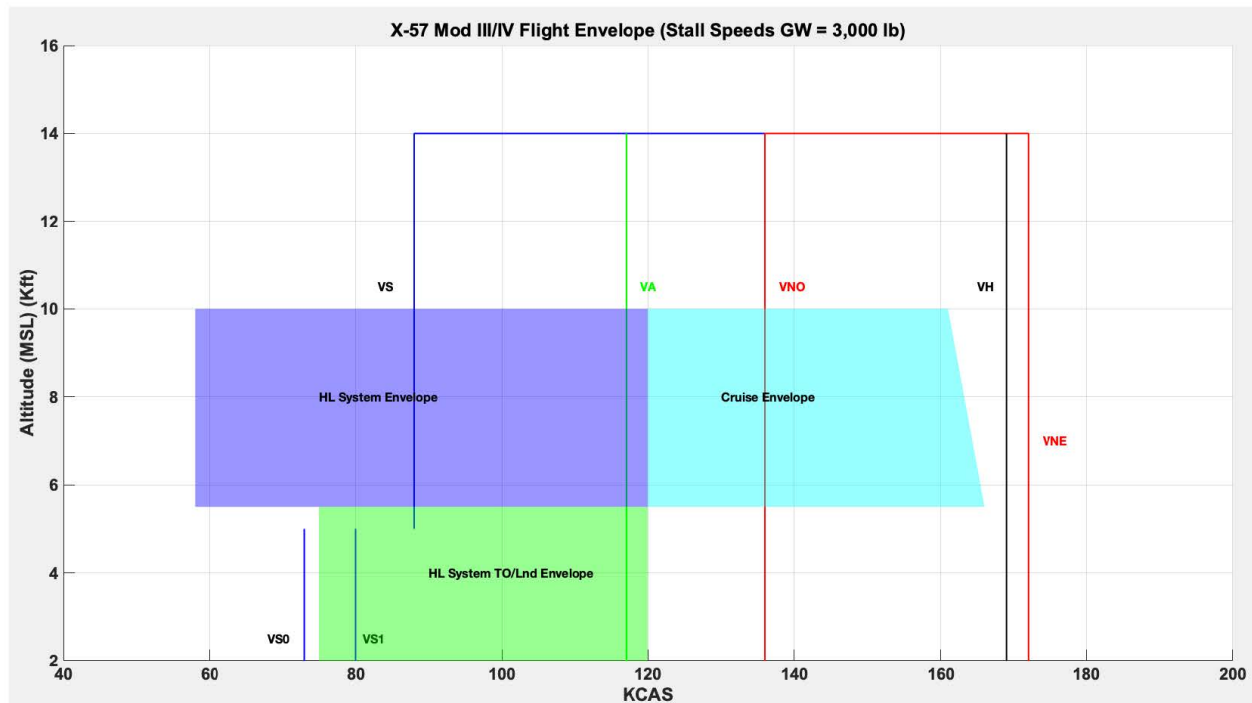


Figure 3: Mod III/IV Flight Envelope

The HL System Envelope is defined to be between 5,500' and 10,000' and VS0hl and 120 KCAS.

The HL System TO/Lnd Envelope is defined to be between 2,000' and 5,500' and 75 KCAS and 120 KCAS.

The Cruise Envelope is defined to be between 5,500' and 10,000' and 120 KCAS and 166 KCAS at 5,500' and 161 KCAS at 10,000'.

Speed	KCAS	Description	Source	Note
VA	117	Design Maneuvering Speed	P2006T Aircraft Flight Manual, Page 2-5	VA set by vertical tail load documentation which traces to Tecnam MTOW of 2,601
VFE_Full	132 TBR1	Maximum Flaps Extended Speed (Full)	Mod IV CDR, Performance & Sizing IPT Slides, Slide 5	Need to assess scaling with weight
VFE_TO	132 TBR2	Maximum Flaps Extended Speed (Takeoff)	Mod IV CDR, Performance & Sizing IPT Slides, Slide 5	Need to assess scaling with weight. Need to determine if TO flap setting provides adequate lift when uncertainties are applied.
VLE	119	Maximum Landing Gear Extended Speed	P2006T Aircraft Flight Manual, Supplement A20, Page A20-5	VLO/VLE = 122KIAS = 119 KCAS per 5-3 of P2006T Aircraft Flight Manual Page
VNE	172	Never Exceed Speed	P2006T Aircraft Flight Manual, Supplement A19, Page W2-5	Using Tecnam MTOW 2,712 value

Speed	KCAS	Description	Source	Note
VNO	136	Max Structural Cruising Speed - Exceed only in smooth air with caution	P2006T Aircraft Flight Manual, Supplement A19, Page W2-5	
VH	169 TBR3	Maximum level flight speed at maximum continuous power	Mod IV CDR, Performance & Sizing IPT Slides, Slide 5	Need to assess scaling with weight
VS	88 TBR4	Power Off stall speed in the Cruise Configuration	Mod IV CDR, Performance & Sizing IPT Slides, Slide 5	Need to assess scaling with weight
VSO	73 TBR5	Power-off stall speed in the landing configuration	Mod IV CDR, Performance & Sizing IPT Slides, Slide 5	Need to assess scaling with weight
VS1	80 TBR6	Power-off stall speed in the takeoff configuration	Mod IV CDR, Performance & Sizing IPT Slides, Slide 5	Needs to be updated for latest weight.
Vref	104	Reference Speed	ASTM F3179/F3179M-20 Section 18.1	Vref = 1.3*VS1 per reference.
VS0hl	58 TBR7	Power-off stall speed in the landing configuration with high-lift motors operating	Mod IV CDR, Performance & Sizing IPT Slides, Slide 5	Needs to be updated for latest weight.
VS1hl	70 TBR8	Power-off stall speed in the (takeoff) configuration with the high-lift motors operating	Mod IV CDR, Performance & Sizing IPT Slides, Slide 5	Needs to be updated for latest weight.
Vrefhl	1.3*VS1hl	Reference Speed	ASTM F3179/F3179M-20 Section 18.1	Vref = 1.3*VS1 per reference.

Table 2: Mod III/IV Flight Envelope Speeds

Appendix A: TBR Closure Plan

Speed	Mod	Airspeed	Note	Resolution Plan
TBR1	III/IV	VFE_Full	Need to assess scaling with weight	Resolve by Mod III/IV Delta-CDR
TBR2	III/IV	VFE_TO	Need to assess scaling with weight. Need to determine if TO flap setting provides adequate lift when uncertainties are applied.	Resolve by Mod III/IV Delta-CDR
TBR3	III/IV	VH	Need to assess scaling with weight	Resolve by Mod III/IV Delta-CDR
TBR4	III/IV	VS	Need to assess scaling with weight	Resolve by Mod III/IV Delta-CDR
TBR5	III/IV	VS0	Need to assess scaling with weight	Resolve by Mod III/IV Delta-CDR
TBR6	III/IV	VS1	Need to assess scaling with weight	Resolve by Mod III/IV Delta-CDR
TBR7	III/IV	VS0hl	Need to assess scaling with weight	Resolve by Mod III/IV Delta-CDR
TBR8	III/IV	VS1hl	Need to assess scaling with weight	Resolve by Mod III/IV Delta-CDR