

Revised

**National Business Aviation Association (NBAA)
Noise Abatement Departure Procedures (NADPs)**



Presentation to:

Noise Compatibility Committee

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What are NADPs?

- **Departure procedures designed to minimize noise, by:**
 - Adjusting power settings, rates of climb, speeds, etc.
 - Cutting thrust at defined altitudes and speeds
- **NBAA is a leader in promoting NADPs for g.a. jets**
- **Until October 2014, NBAA recommended two NADP options**
 - “Close-In” where there are sensitive land uses within two miles of the runway end (this is the recommended procedure at APF)
 - “Standard” where sensitive land uses generally start beyond two miles from the runway end
- **In October 2014 NBAA published revised NADP options**
 - Retain the “Standard” procedure
 - Add a new “High Density Airport” procedure
 - Eliminate the “Close-In” procedure

Why did NBAA develop revised NADPs?

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- **To address the general aviation jet fleet operating today**
 - Former NADPs were designed for models operating in the late 1970s
 - Stage 1 and 2 models, and the earliest Stage 3 models, such as the Lear 35
 - 84% of jets operating at APF in January - March 2015 met Stage 4 or 5
- **Manufacturers, operators, pilots, and airports came to realize that the procedures were counterproductive in many cases**
- **To address the increasingly congested air traffic environment at “high-density” airports, where NADPs can:**
 - Conflict with minimum speed and climb criteria for use of Performance-Based Navigation (PBN) procedures
 - Raise concerns about maintaining safe aircraft separation at airports in areas with a high density of flight traffic

How do the procedures compare?

NBAA requested analysis of three aircraft models

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- **Learjet 35 - *mid-1970s technology***
 - Small cabin business jet falling between Stage 4 and 5 standards
 - Typical takeoff weight 18,000 pounds
- **Gulfstream IV (GIV) - *mid-1980s technology***
 - Large cabin business jet meeting Stage 5 standards
 - Typical takeoff weight 75,000 pounds
- **Cessna Citation X (C750) - *mid-1990s technology***
 - Medium cabin business jet significantly quieter than Stage 5 standards
 - Typical takeoff weight 36,000 pounds
- **Sound exposure level (SEL) contours prepared for a sea-level airport at 59°F (“standard day conditions”)**

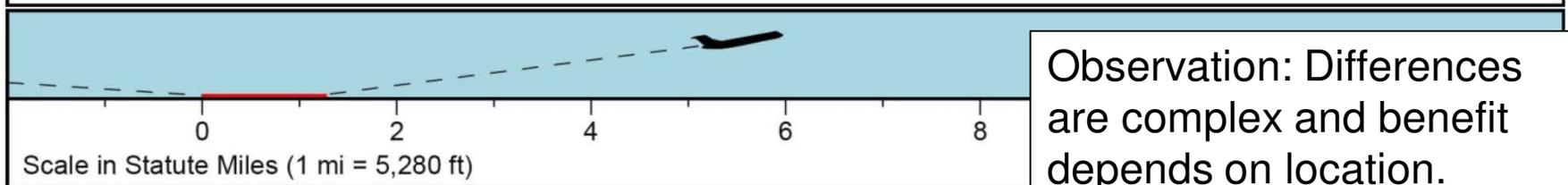
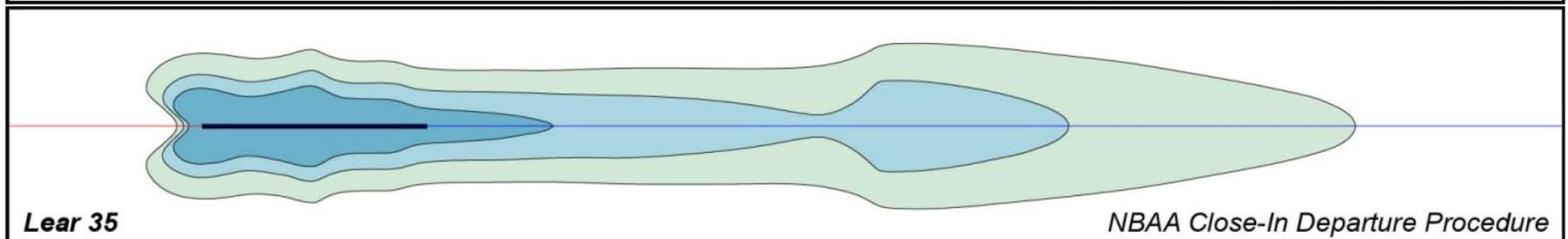
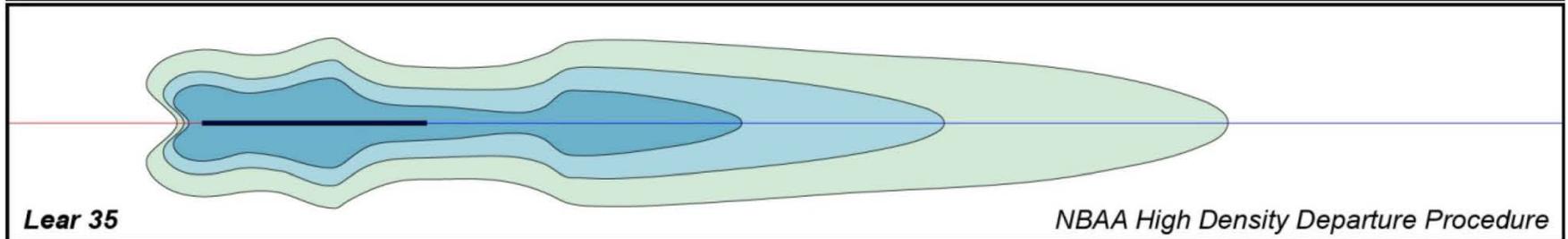
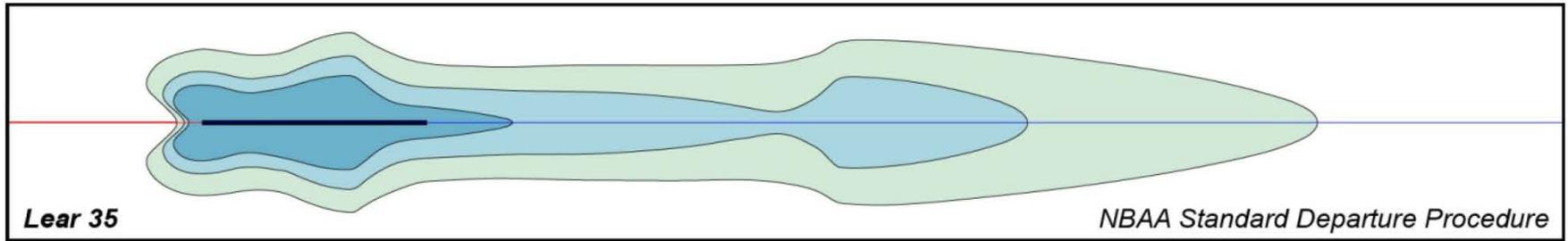
Major conclusion:

Aircraft technology is far more important than the procedure used.

How do the procedures compare?

All three procedures for the Lear 35

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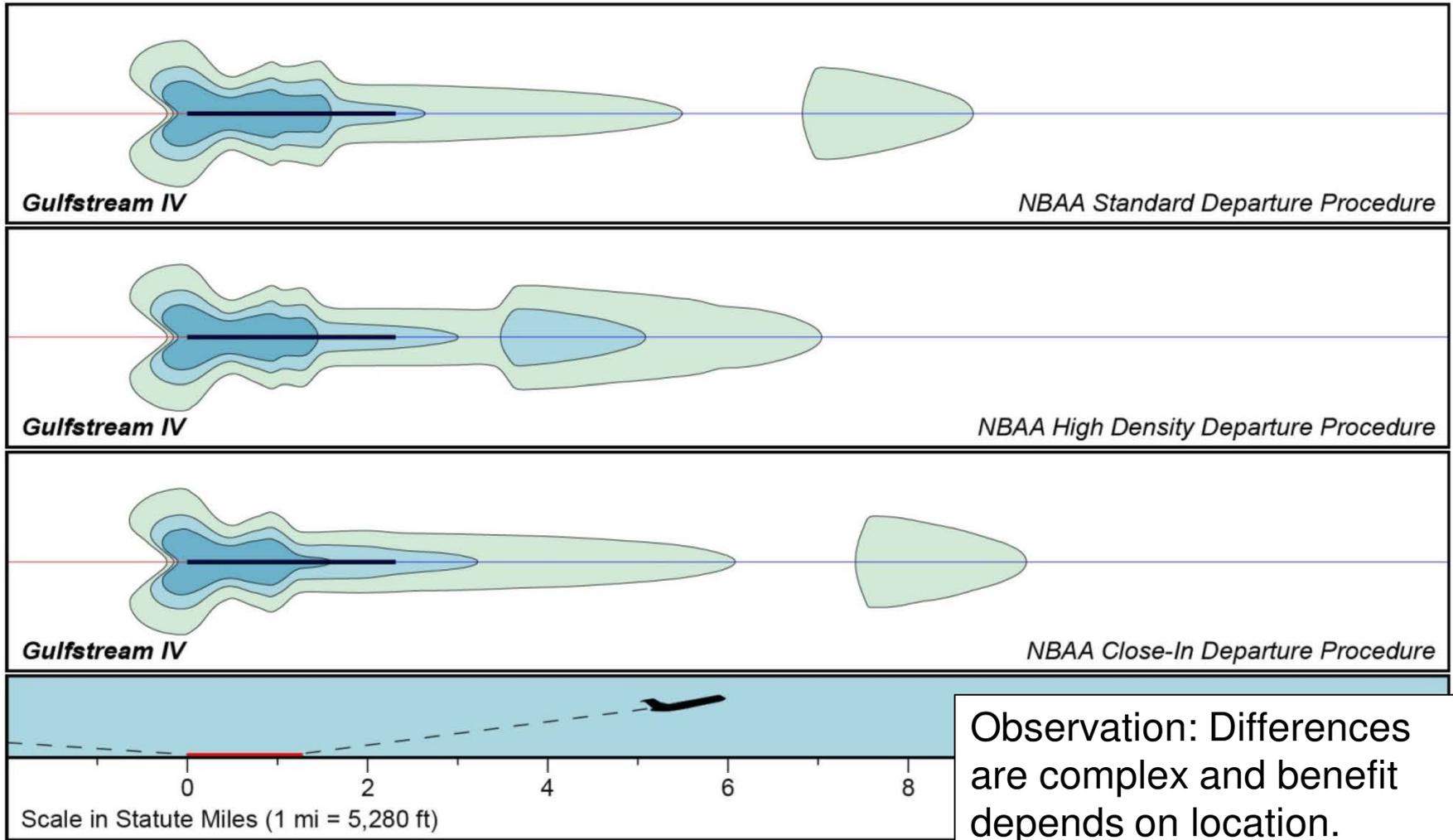


SEL 85 SEL 80 SEL 75

How do the procedures compare?

All three procedures for the GIV

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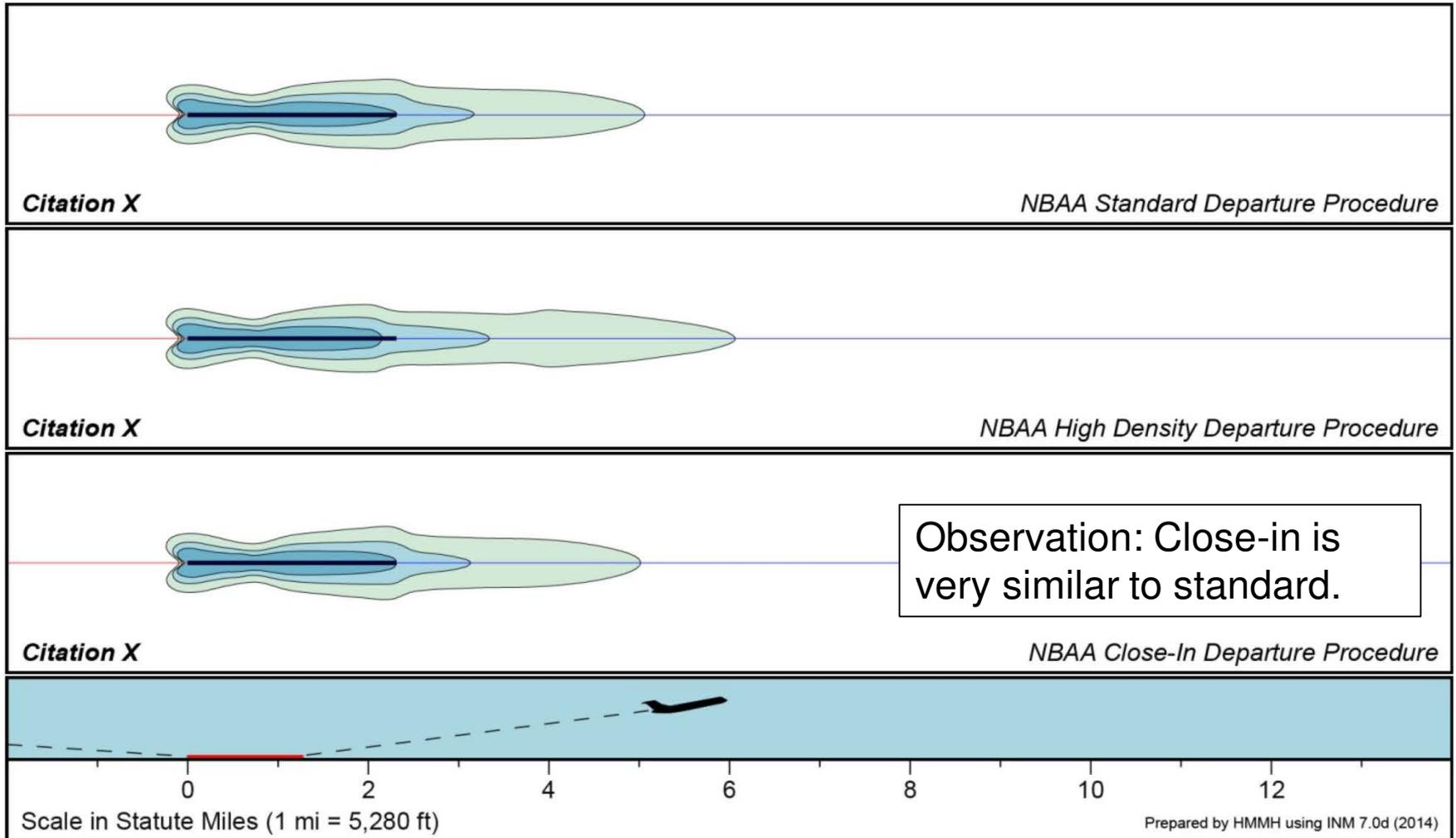


SEL 85 SEL 80 SEL 75

How do the procedures compare?

All three procedures for the Citation X

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SEL 85

SEL 80

SEL 75

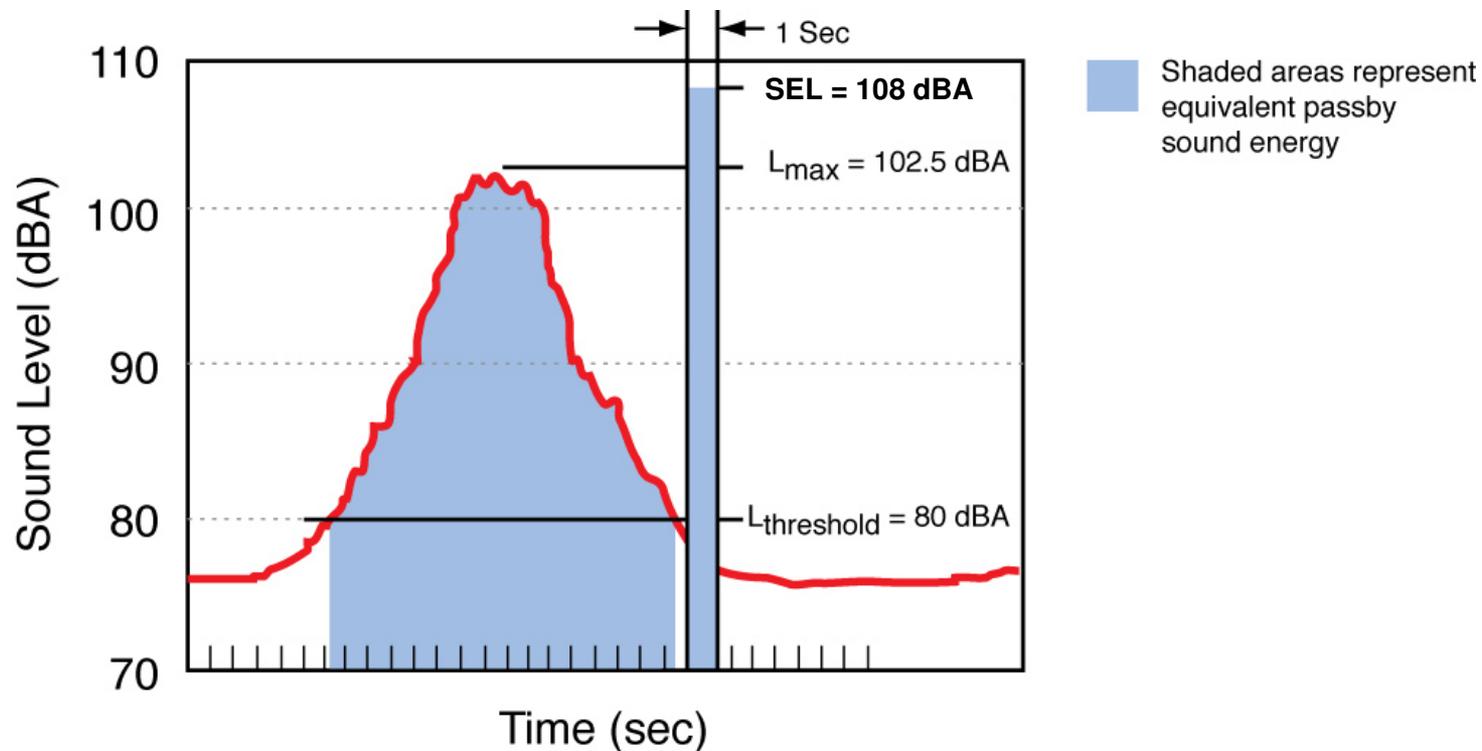
These slides will be used only if needed to answer questions.

How do the procedures compare?

Noise metric used

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- **Sound Exposure Level (SEL) noise analysis**
 - Measure of total noise energy during an aircraft flyover
 - Part 150 requires its use in noise modelling
 - We have used in prior noise studies at APF



How do the procedures compare?

Major procedure steps are complex

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Step	Standard	High Density	Close-In
Brake release	Takeoff flaps and thrust		
Lift off	Max. practical climb rate to 1,000' $\leq V_2+20$	Max. practical climb rate to 800' $\leq V_2+20$	Max. practical rate of climb to 500' at V_2+20
Thrust cutback climb segment	At 1,000', accelerate to V_{fs} , retract flaps, reduce to quiet climb power, maintain 1,000 FPM climb and maximum 190 knot airspeed	At 800', accelerate to V_{fs} , retract flaps, reduce to quiet climb power, maintain 1,000 FPM climb and maximum 190 knot airspeed	At 500', reduce to quiet climb power, maintain 1,000 FPM climb and V_2+20 knots At 1,000', accelerate to V_{fs} , retract flaps, maintain quiet climb power, 1,000 FPM, and maximum 190 knots
Resume normal climb	At 3,000'	At 1,500'	At 1,000'

- Altitudes are feet above airport elevation (AAE)
- V_{fs} is final segment speed, based on one engine out climb, clean configuration, and max. continuous power
- FPM is feet per minute climb rate
- V_2 is best one engine inoperative angle of climb speed

NBAA presents recommendations graphically

Revised procedures example

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