



A New Approach to the H-V Envelope Definition

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Height-Speed Envelope

CS 27,79

- (a) If there is any combination of height and forward speed, including hover, under which a safe landing cannot be made under the applicable power failure condition in subparagraph (b), a limiting height-speed envelope must be established, including all pertinent information, for that condition, throughout the ranges of....

“limiting height-speed” but is a performance information

CS 29,87

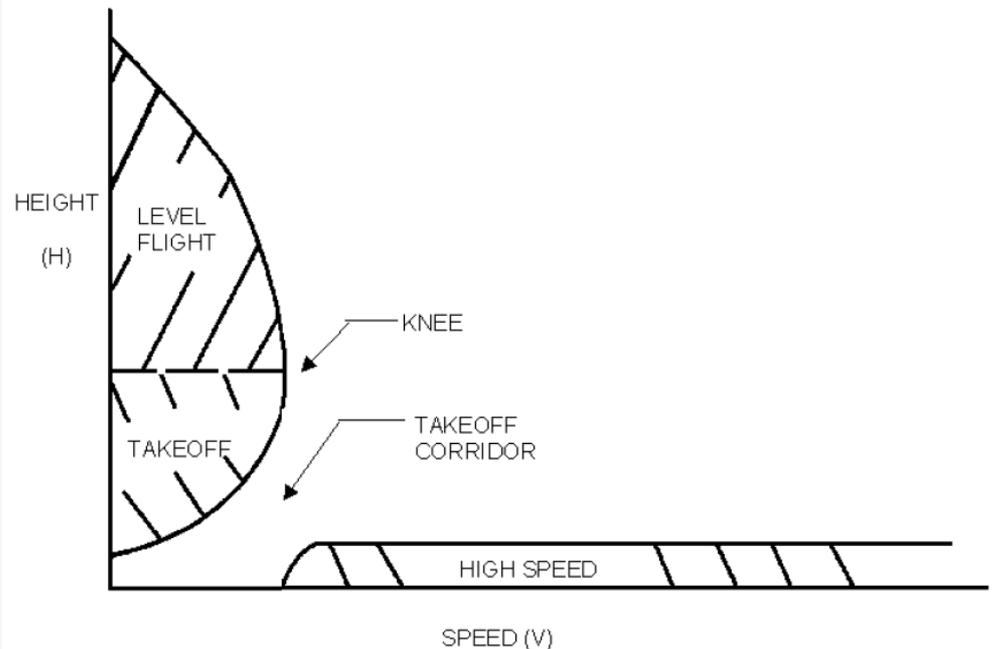
- (a) If there is any combination of height and forward velocity (including hover) under which a safe landing cannot be made after failure of the critical engine and with the remaining engines (where applicable) operating within approved limits, a height velocity envelope must be established for:

This is a Limitation for more than 9 pax seats conf. but still a performance info for less than 10 pax seats.

Height-Speed Envelope

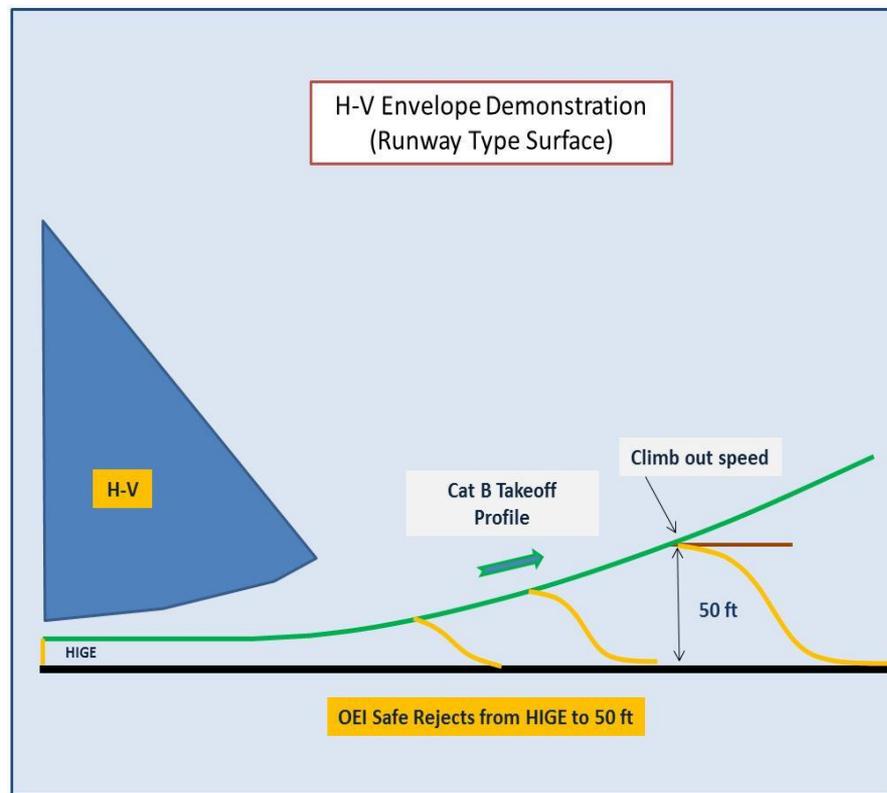
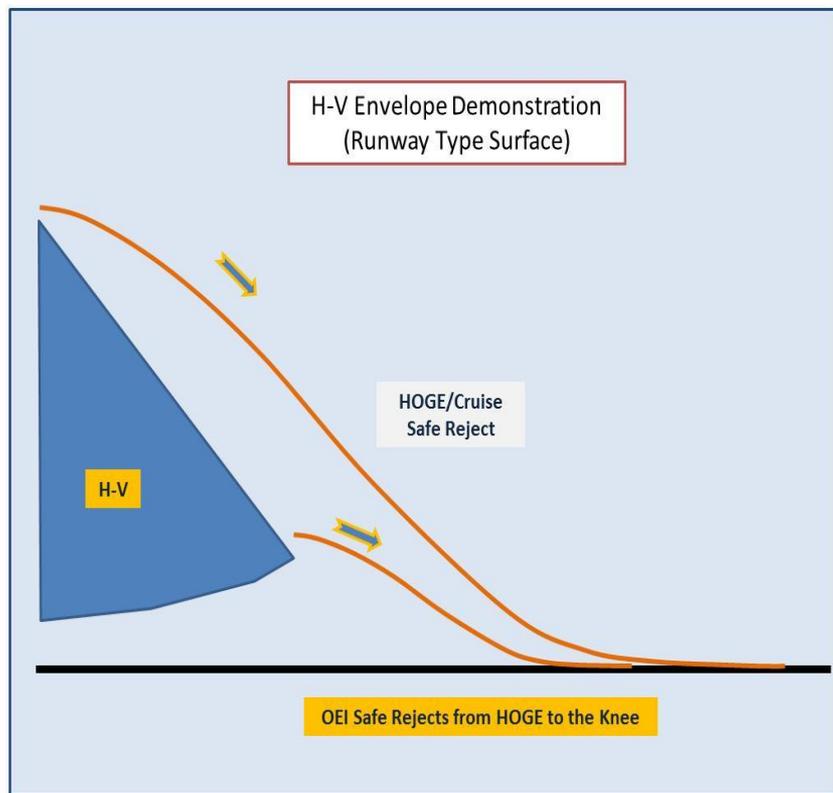
(AC 29) Flight Manual

The flight manual should list any procedures which may apply to specific points (e.g., high speed points) **and test conditions, such as runway surface**, wave height for amphibious tests, marginal areas of controllability or landing gear response, etc. The HV curve should be presented in the RFM using actual altitude above ground level and indicated airspeed.





Height-Speed Envelope (Multi-engine Cat B)





Height-Speed Envelope – CS 29 Multi-engine Cat B

CS 29.1 Applicability

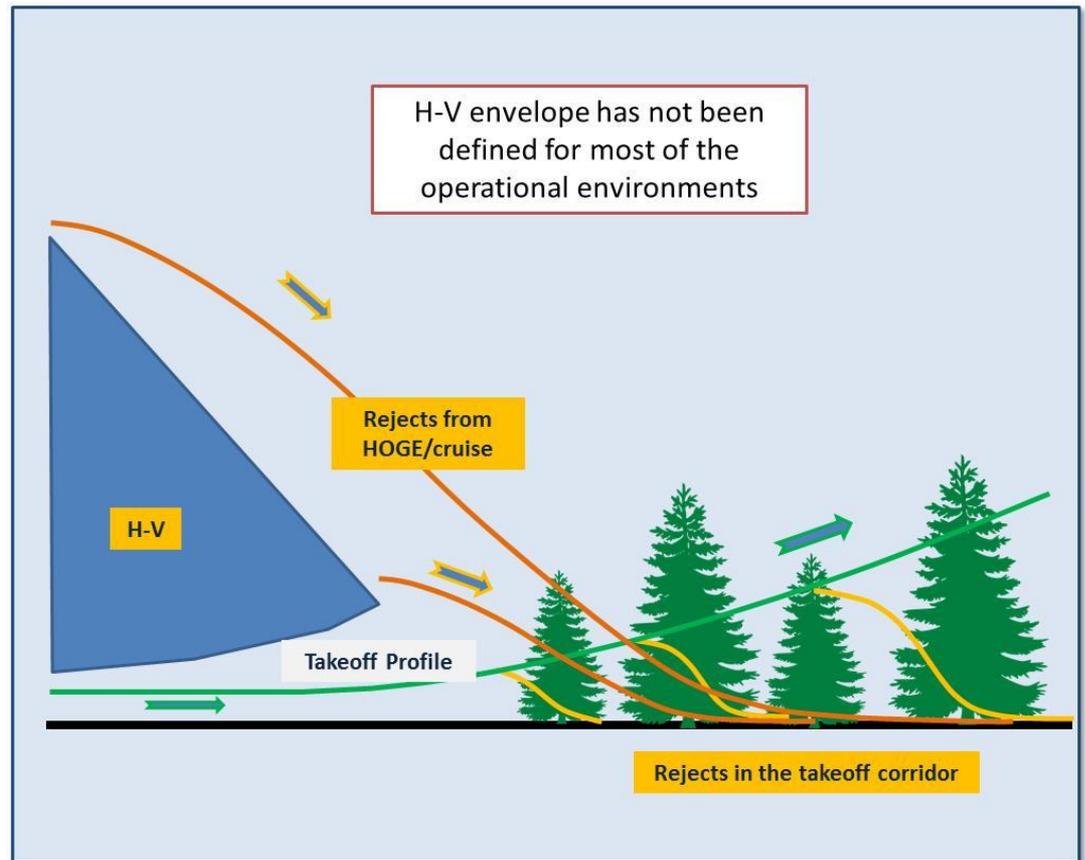
- **The H-V envelope (as intended in the current regulation) should be part of the of Category B requirements only**
- **Category A requirements are already structured to assure safe rejects inside take off & landing corridor**
- **Category A requirements do not include low hover OGE envelope**



Height-Speed Envelope (Multi-engine Cat B)

COMMON MISCONCEPTIONS:

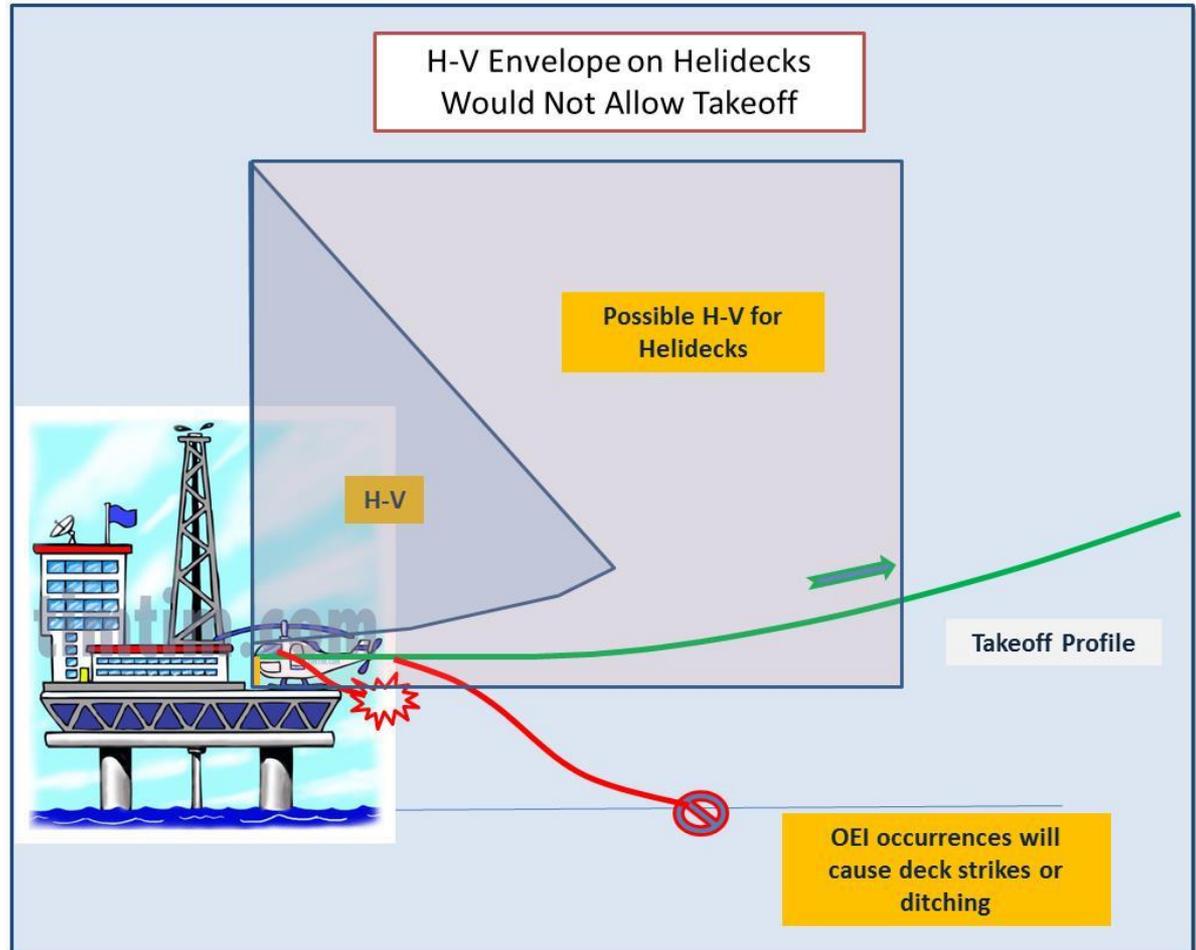
- If I fly outside the H-V area I'm always safe
- A safe power off landing or one engine inoperative can always be carried out when outside of the H-V curve
- Outside of H-V allows a safe fly-away
- H-V envelope is applicable to all operational environments





Height-Speed Envelope (Multi-engine Cat B)

Takeoffs from helidecks respecting H-V envelopes (defined over different type of surface) are equally unsafe of takeoffs intruding H-V



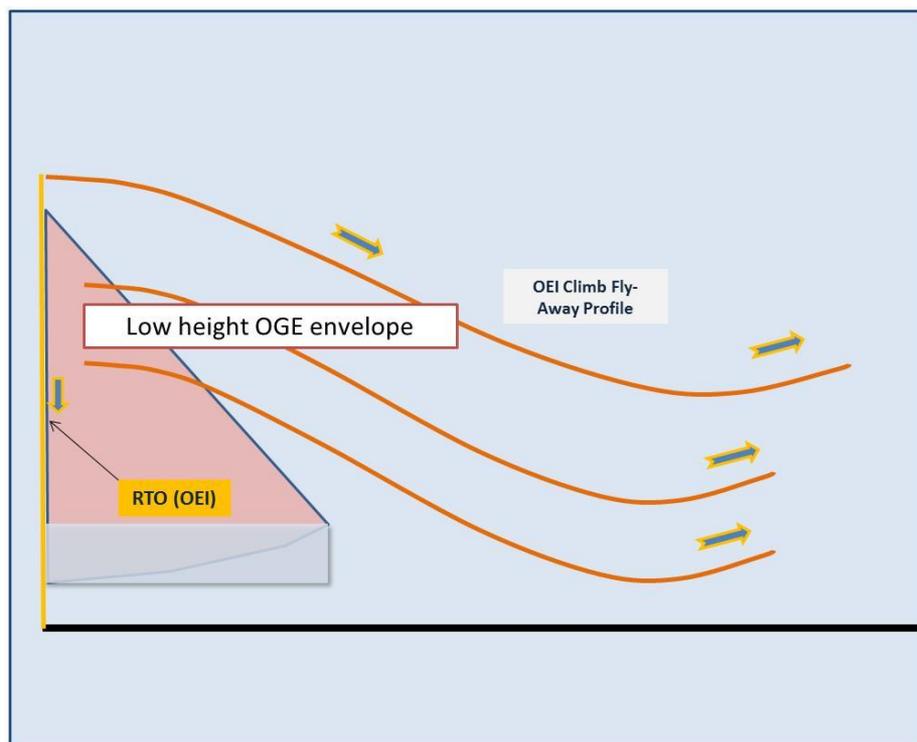
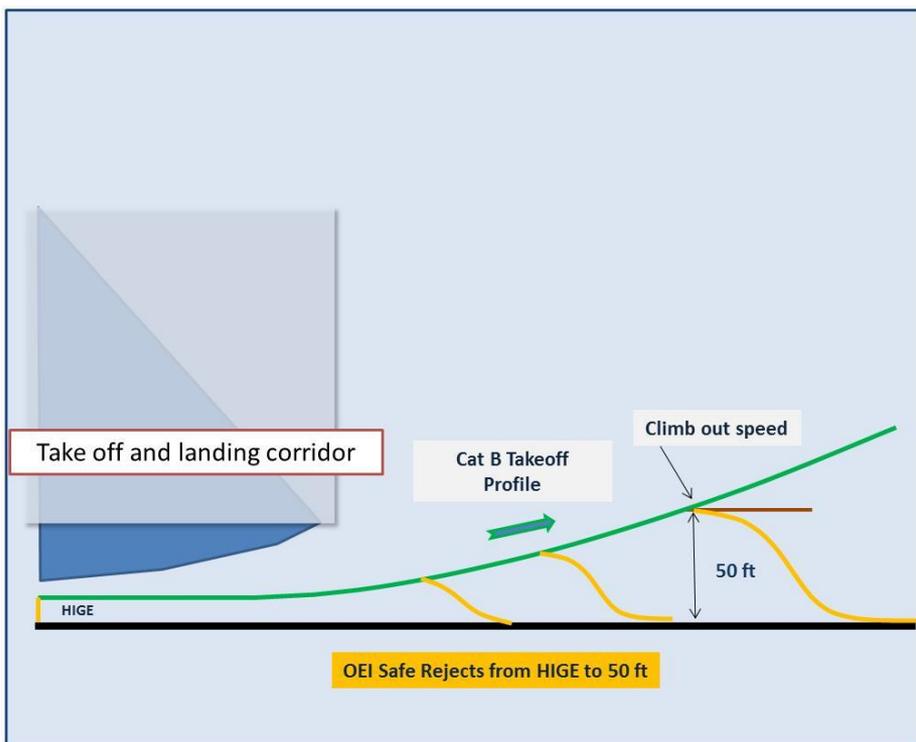


Height-Speed Envelope – Possible Improvements

- **H-V as originally constructed should now be revisited**
- **H-V should only be considered as a performance information regardless of the type or Category of rotorcraft.**
- **The traditional shape should be replaced by a set of performance information regarding the take off/landing corridor and a set for the low height Out of Ground Effect area.**



Height-Speed Envelope – Possible Improvements





Height-Speed Envelope – Possible Improvements

Twin Engines – Take off/Landing Corridor

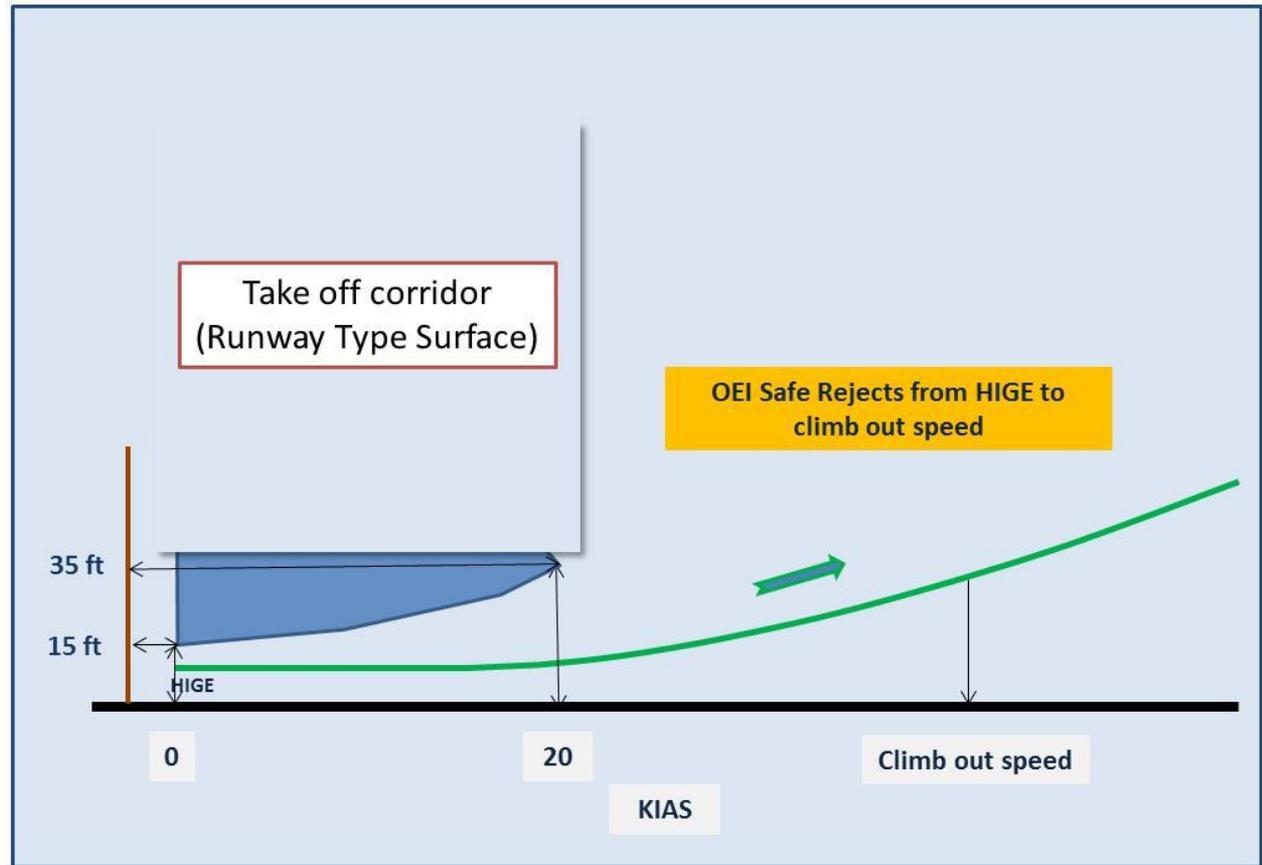
- **Safety and operations requirements need to be combined.**
- **The take off /landing corridor should be defined in the approved Normal Procedures (the type of surface where this has been demonstrated should be reported in the performance section)**
- **Take off/landing corridor is defined as Height vs KIAS, this takes into account the wind that would provide benefit reducing take off distance**



Height-Speed Envelope – Possible Improvements

Twin Engines – Take off corridor

- Climb out speed should be redefined as V_{TOSS}
- Minimum ROC of 100 fpm at V_{TOSS} with capability to reach V_Y





Height-Speed Envelope – Possible Improvements

Multi Engine – Low level HOGE Conditions

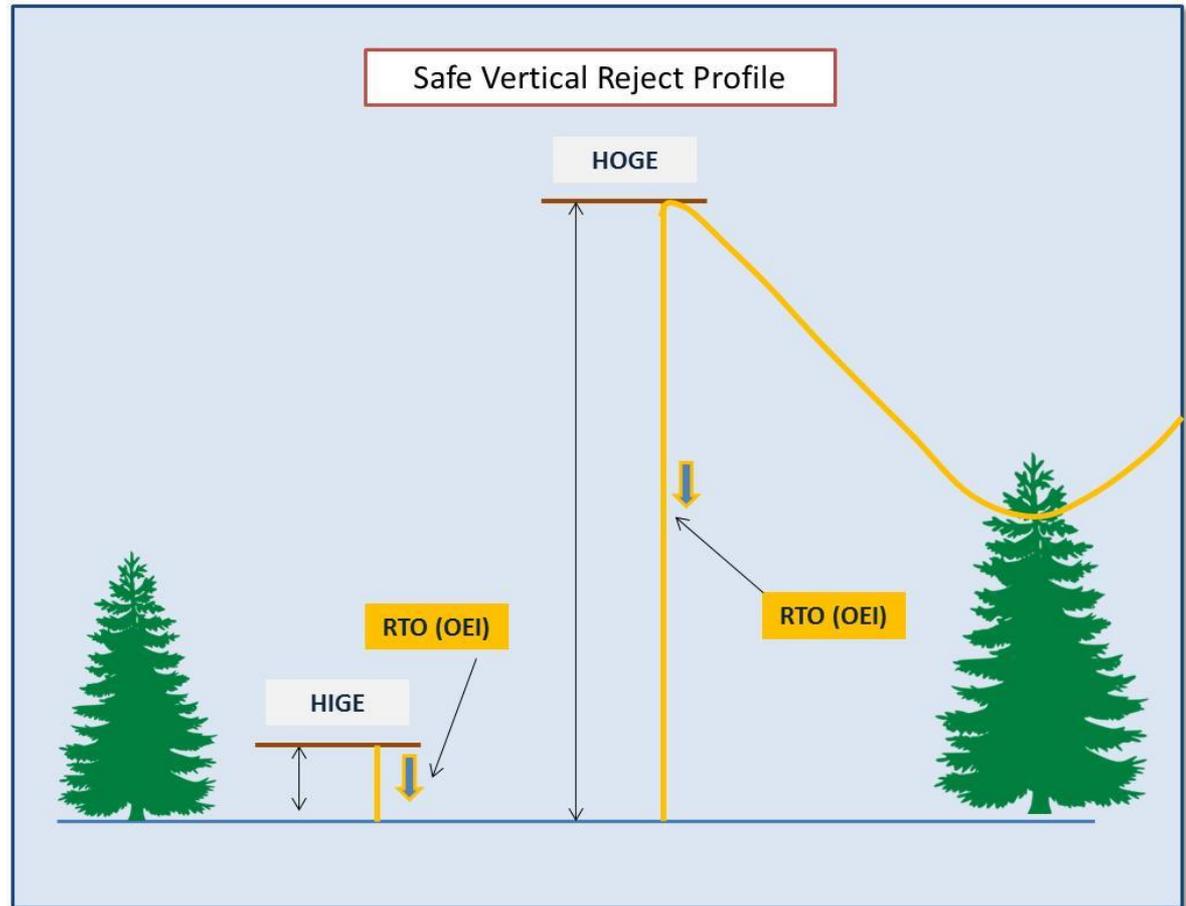
- **Safety and operations requirements need to be combined.**
- **An envelope where a vertical safe reject is possible should be part of the performance requirements (both IGE and OGE)**
- **An envelope where a safe fly-away capability exists that defines the amount of height loss with wind/speed effect should be also included**



Height-Speed Envelope – Possible Improvements

Multi Engine – Low height HOGE Conditions (cont.)

- Safe Vertical Rejects envelope provides a possible safe escape when a fly-away could not be achieved

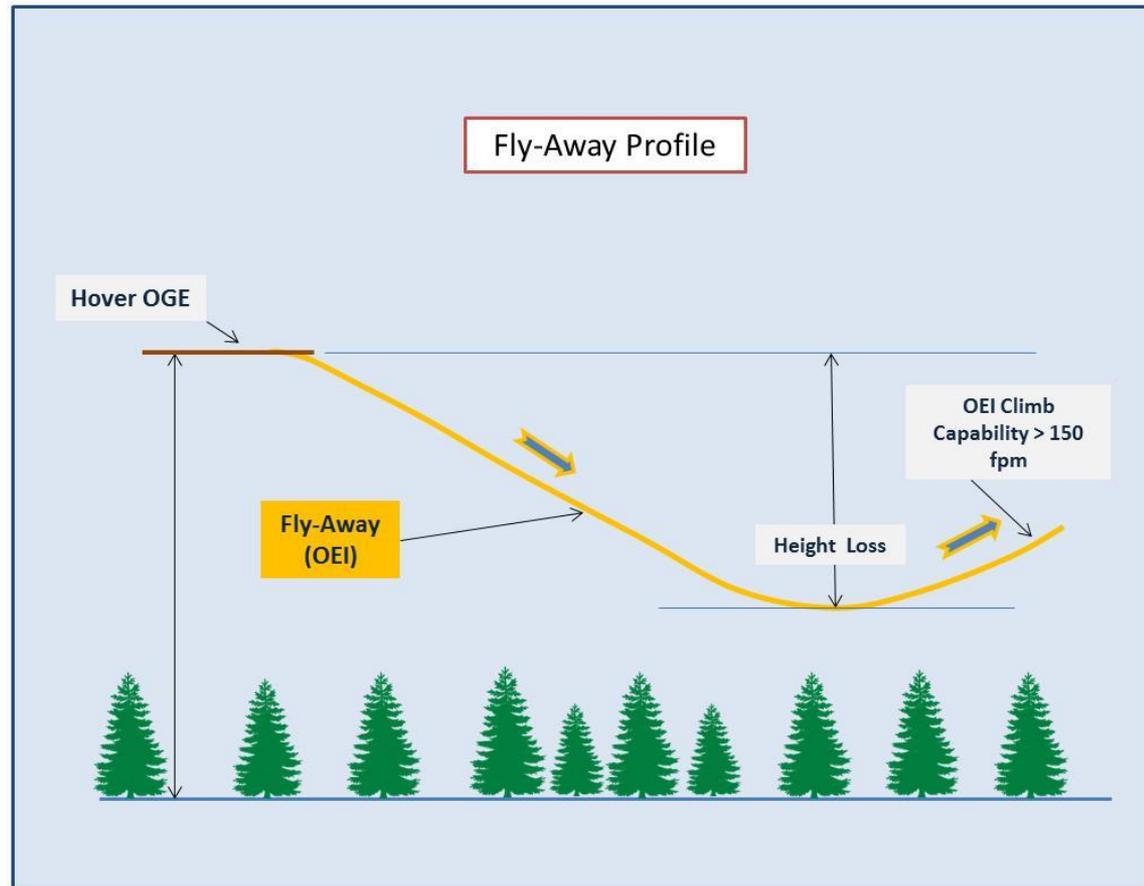




Height-Speed Envelope – Possible Improvements

Multi Engine – Low height HOGE Conditions (cont.)

- The fly-away data should include the Cat A second segment performance requirement (>150 ft/min climb at OEI Continuous Power). This provides a true survival capability if operated at the correct height above obstacles





Height-Speed Envelope – CS 29 Multi-engine Cat B

CS 29.1 Proposed Applicability

- **The proposed reshape of the H-V envelope should be applicable to all multi-engine rotorcrafts regardless of weight and number of passenger seats**
- **This envelope should be included in the Performance information (approved) for Category B certification**



Height-Speed Envelope – CS 29 Multi-engine Cat A

CS 29.1 Proposed Applicability

- **Category A certification should not require H-V to be a limitation since safe rejects are always required**



Height-Speed Envelope – Conclusions

TODAY

- **Regulation does not provide enough information for the different operational scenarios**
- **H-V envelopes (limitations or performance) are only demonstrated on one type of surface (usually runway) and cannot be applied to all surfaces where helicopters can be operated**
- **Operations outside of the H-V area could not be safe**
- **No information is required to safely operate over congested/hostile environments or areas unsuitable for safe landings**



Height-Speed Envelope – Conclusions

PROPOSAL

- **A separation of the low height OGE envelope from the Take Off corridor envelope should be considered**
- **The take off corridor should be defined in Normal procedures with the applicable weights included in the Limitations**
- **V_{TOSS} concept should replace Climb Out speed with the aim to guarantee actual OEI capability**



Height-Speed Envelope – Conclusions

PROPOSAL

- **The regulation should clearly require a statement of applicability where this performance can be achieved (type of surface as demonstrated) e.g. “This performance can only be achieved over such surface”**
- **Safe Vertical Rejects HIGE/HOGE and HOGE Fly-Away performance provide a safer and operational oriented envelope rather than the existing “NO Fly Zone”**



Height-Speed Envelope – Conclusions

PROPOSAL

- **Take off/landing corridor:**
 - **The applicability of this performance is still limited by the demonstrated rejected take offs type of surface (usually runways). Operations over different types are not covered by certification evidence – EXPOSURE**
 - **Introduction of the V_{TOSS} concept also for Cat B limits the exposure to the first part of the take off profile (if not carried out over the type of surface demonstrated)**
- **Safe Vertical Rejects HIGE/HOGE and HOGE Fly-Away performance would meet certification requirements for all type of environments**

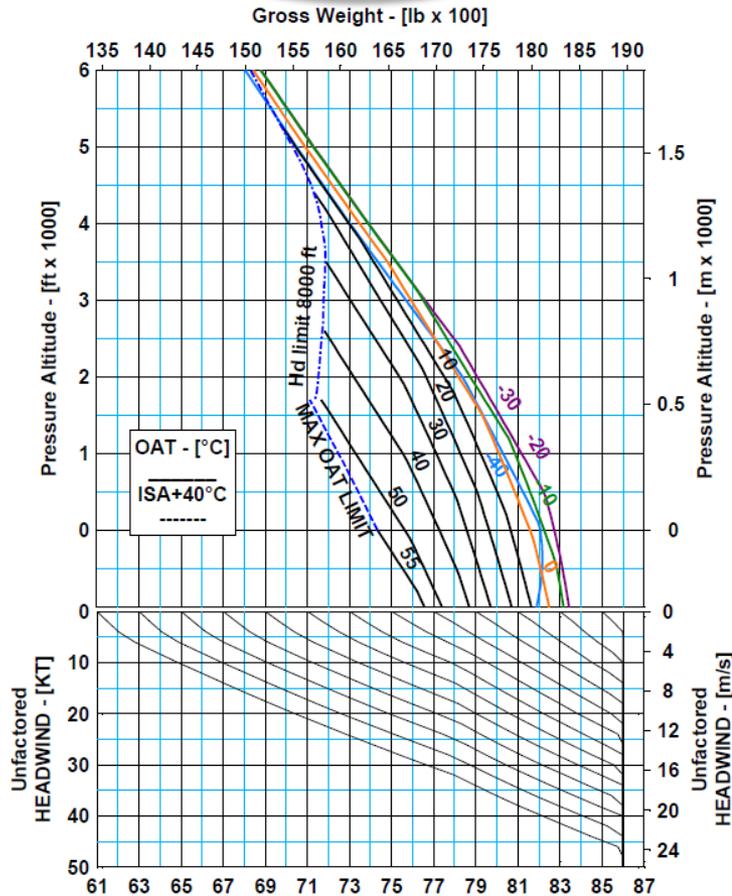


Height-Speed Envelope

**WEIGHT-ALTITUDE-TEMPERATURE
SAFE VERTICAL REJECT
NO TAILWIND**

Max Hover Height: 2000 ft ALS

Eng. AI: OFF
Heater: OFF/ON



NO TAILWIND

FLY AWAY HEIGHT LOSS

HEATER OFF/ON

Hp [ft]	OAT [°C]										
	-40	-30	-20	-10	0	10	20	30	40	50	55
-1000	0	0	0	0	0	0	0	11	31	47	58
-500	0	0	0	0	0	0	0	22	40	58	68
0	0	0	0	0	0	0	13	33	49	68	79
500	0	0	0	0	0	1	24	42	60	78	
1000	0	0	0	0	0	15	34	51	70	90	
1500	0	0	0	0	8	29	46	62	79	101	
2000	0	0	0	0	23	42	57	72	91	111	
2500	0	0	0	23	40	54	67	81	102	121	
3000	0	0	0	42	57	68	78	92	112	131	
3500	0	0	43	59	71	81	89	103	121		
4000	0	41	64	75	85	93	100	113	131		
4500	50	76	82	91	98	104	109	122			
5000	89	89	99	106	111	115	118	132			
5500	120	106	113	119	123	125	128				
6000	114	121	126	130	133	134	137				
6500	129	134	138	144	149	152					
7000	158	164	170	176	180						
7500	209	200	202	206	211						
8000	242	230	231	236							

Speed correction	
IAS [kt]	H [ft]
20	-43
30	-73
40	-105
50	-137

THANK YOU FOR YOUR ATTENTION

A New Approach to the H-V Envelope Definition