



# 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

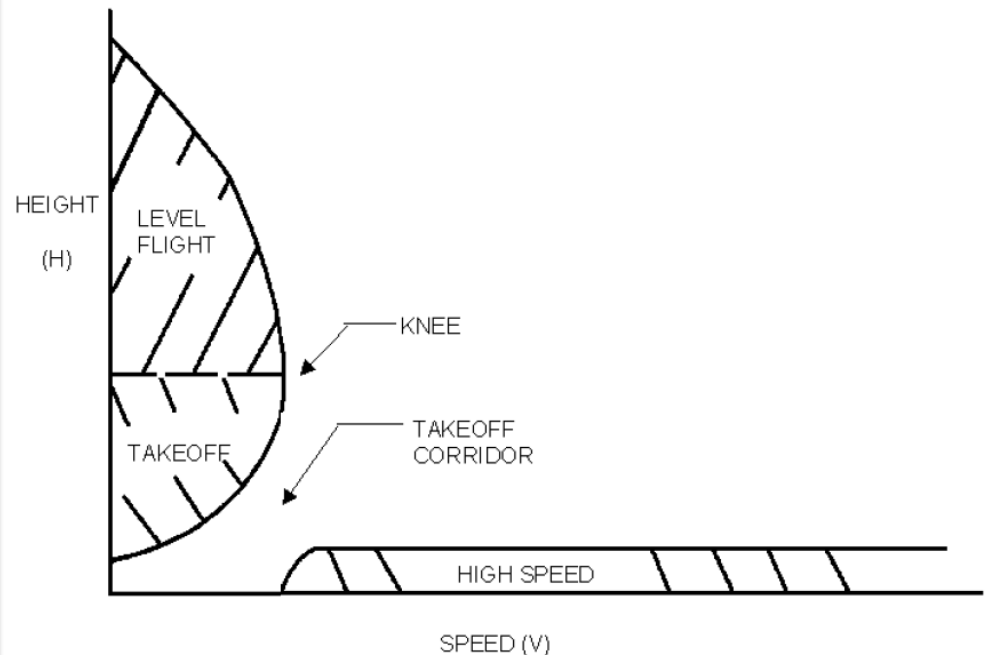
- (a) If there is any combination of height and forward velocity (including hover) under which a safe landing cannot be made after failure of the critical engine and with the remaining engines (where applicable) operating within approved limits, a height velocity envelope must be established for:

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

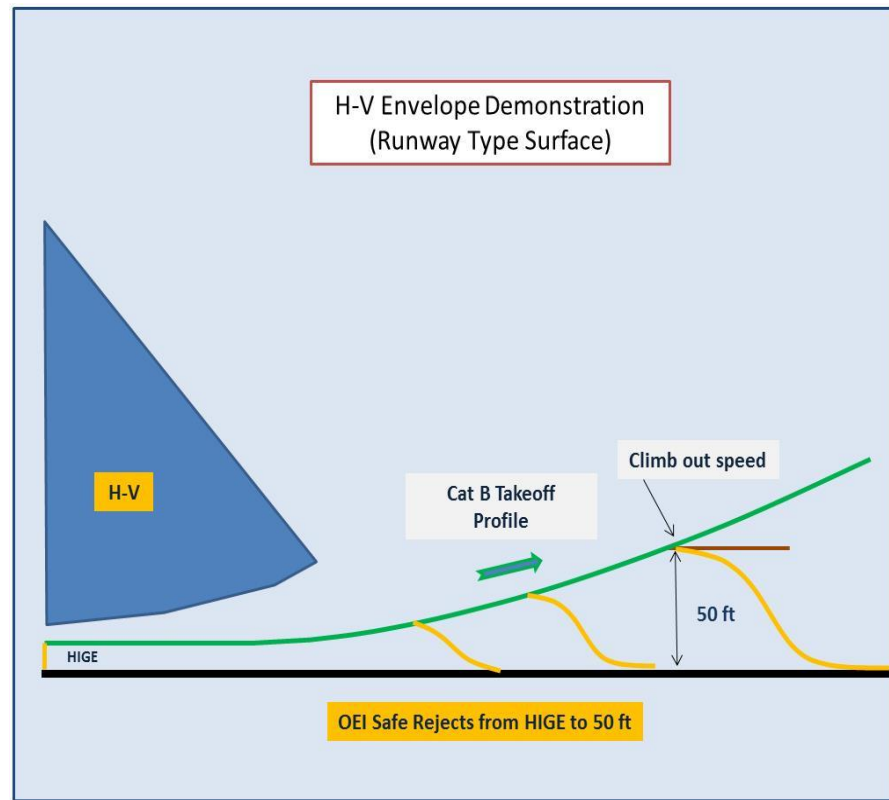
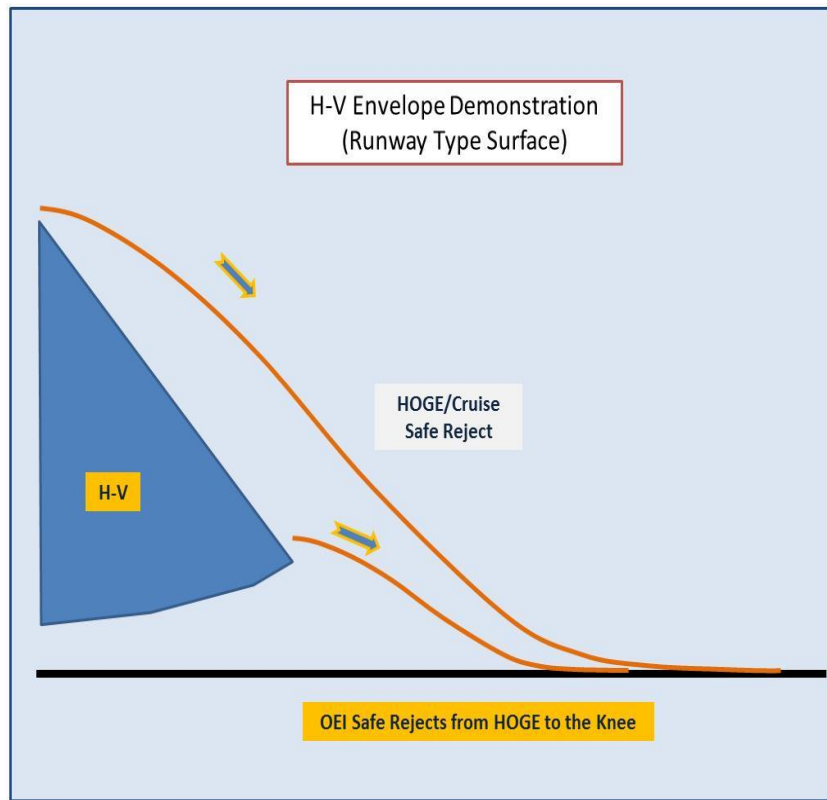
# Height-Speed Envelope

## (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

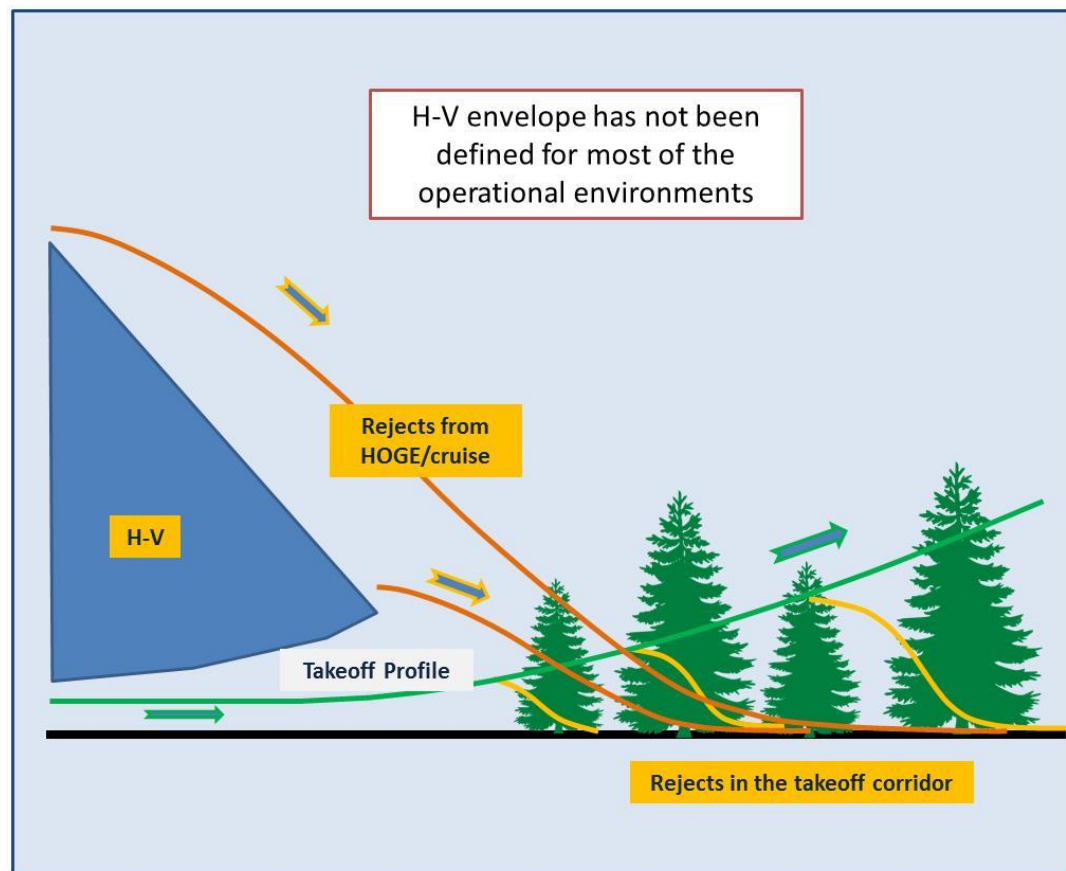
## CS 29.1 Applicability

- **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)

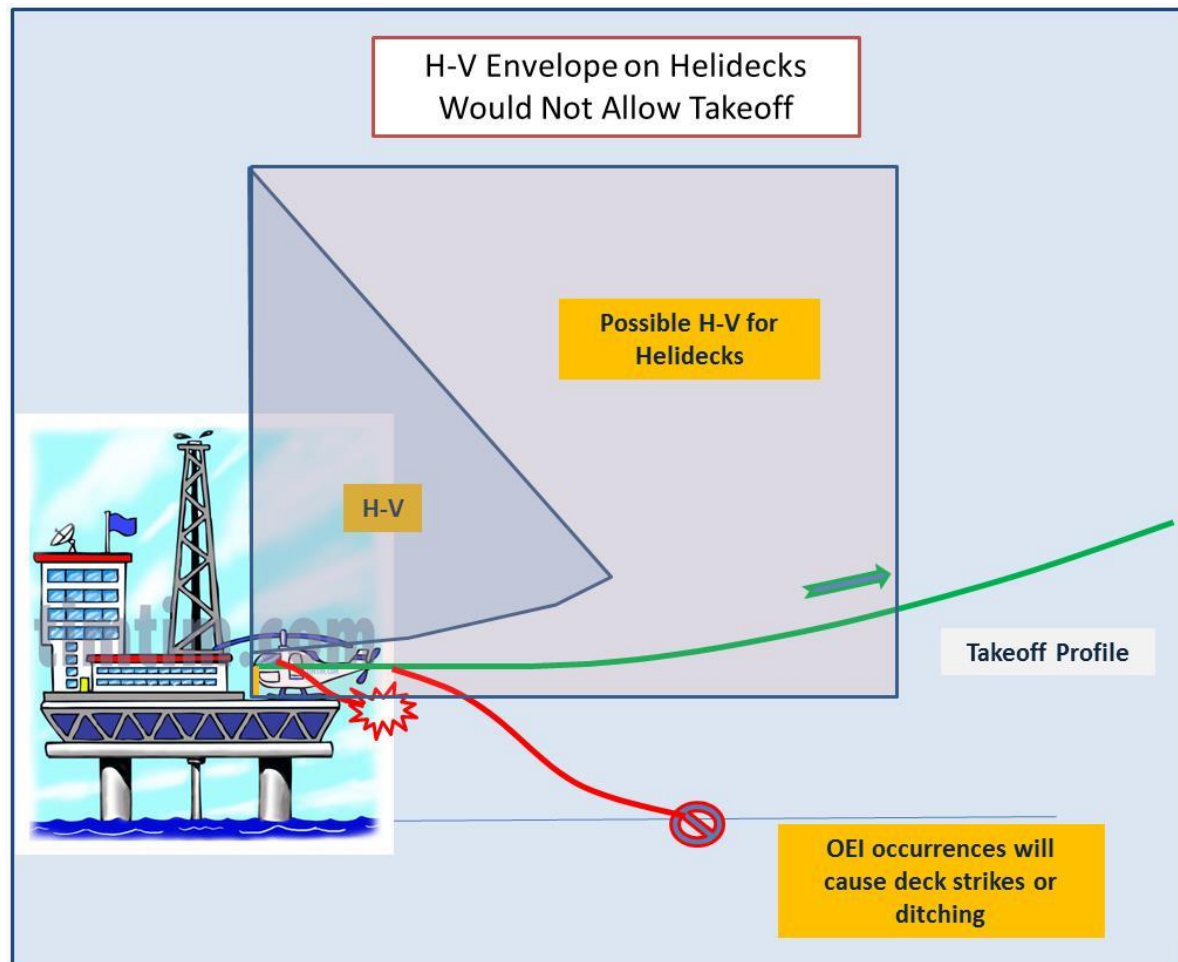
## COMMON MISCONCEPTIONS:

- 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**



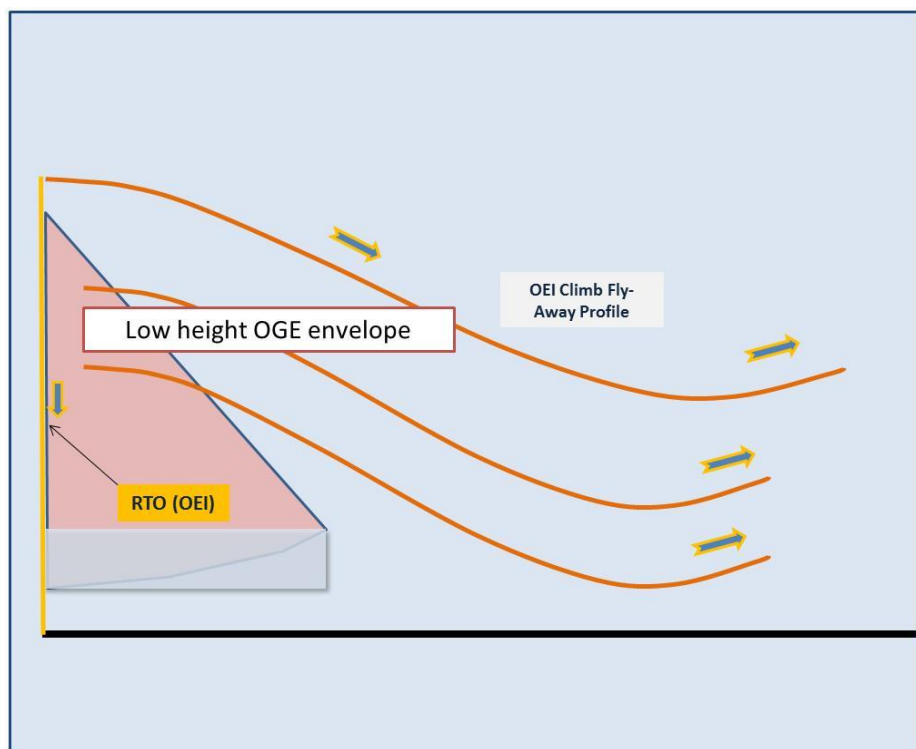
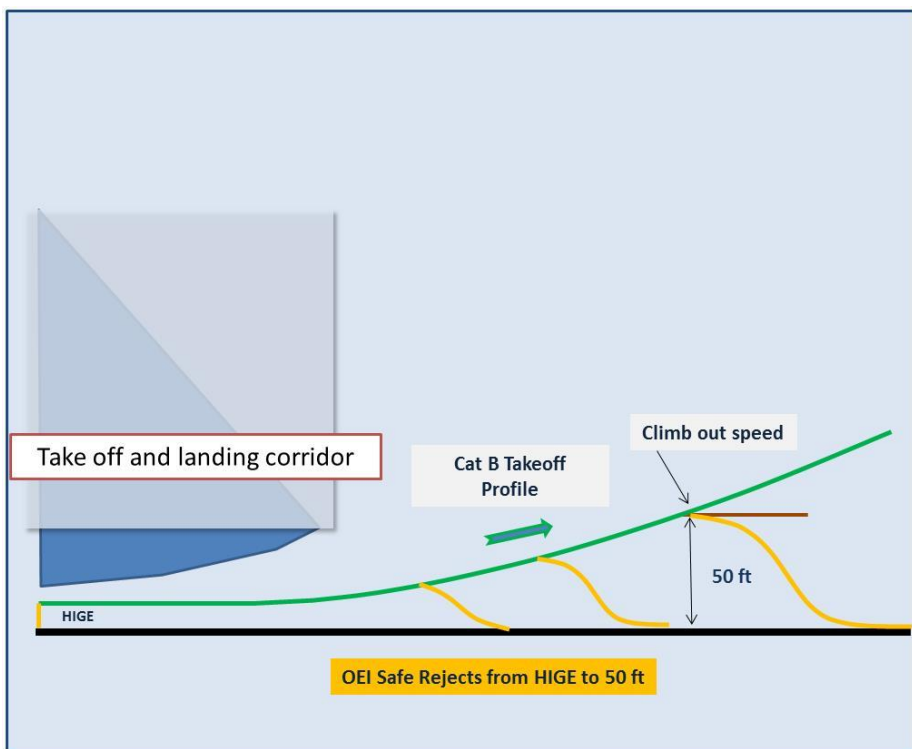


## Height-Speed Envelope – Possible Improvements

- **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

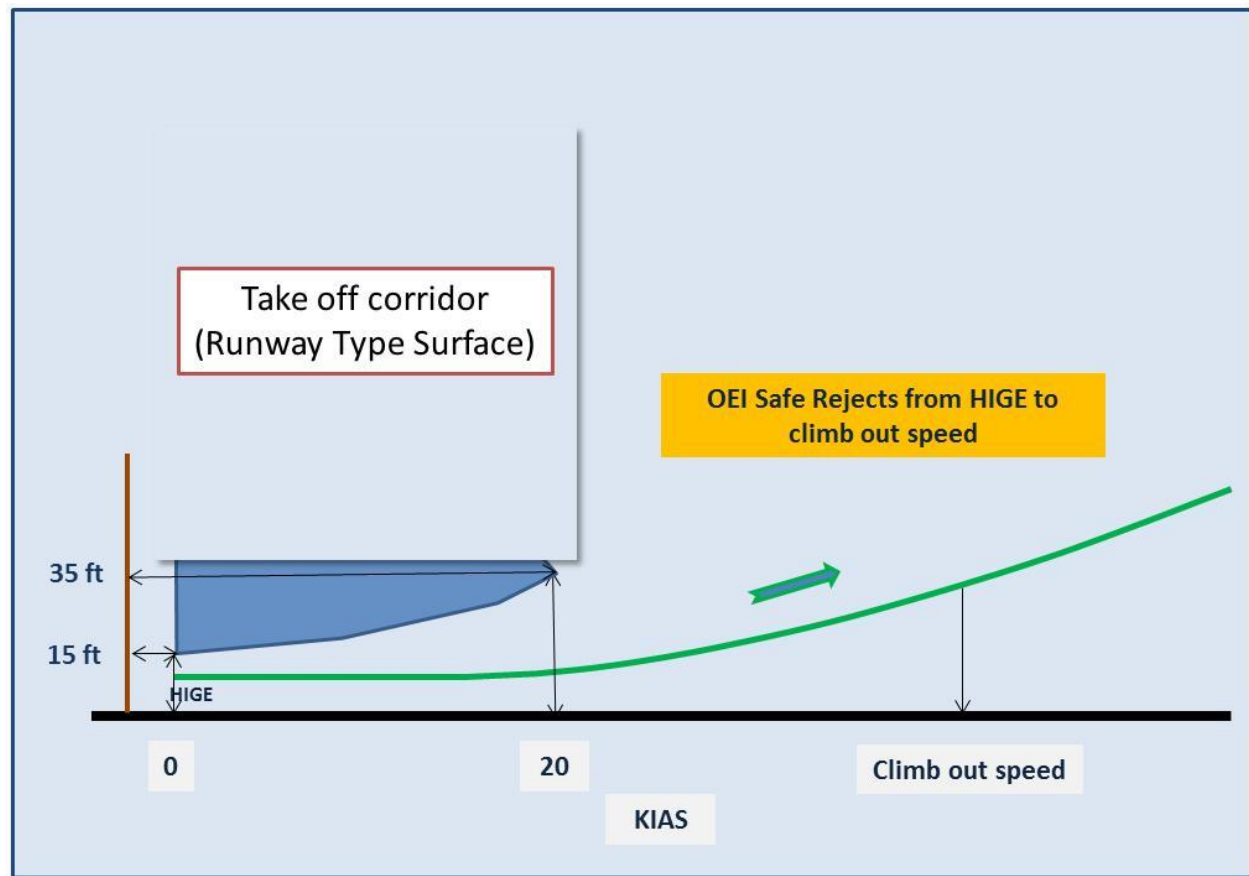
## **Twin Engines – Take off/Landing Corridor**

- **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

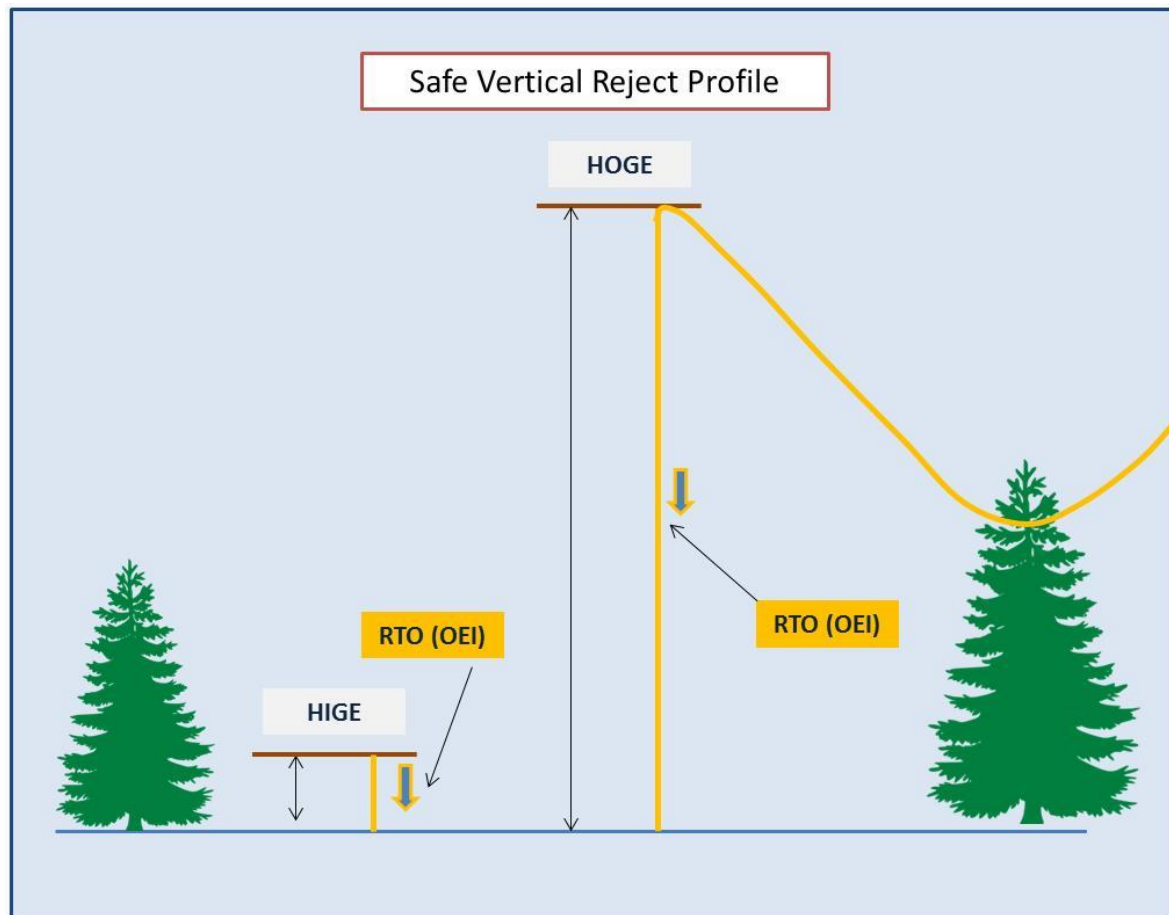
- **Safety and operations requirements need to be combined.**
- **An envelope where a vertical safe reject is possible should be part of the performance requirements (both IGE and OGE)**
- **An envelope where a safe fly-away capability exists that defines the amount of height loss with wind/speed effect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



# Height-Speed Envelope – Possible Improvements

## Multi Engine – Low height HOGE Conditions (cont.)

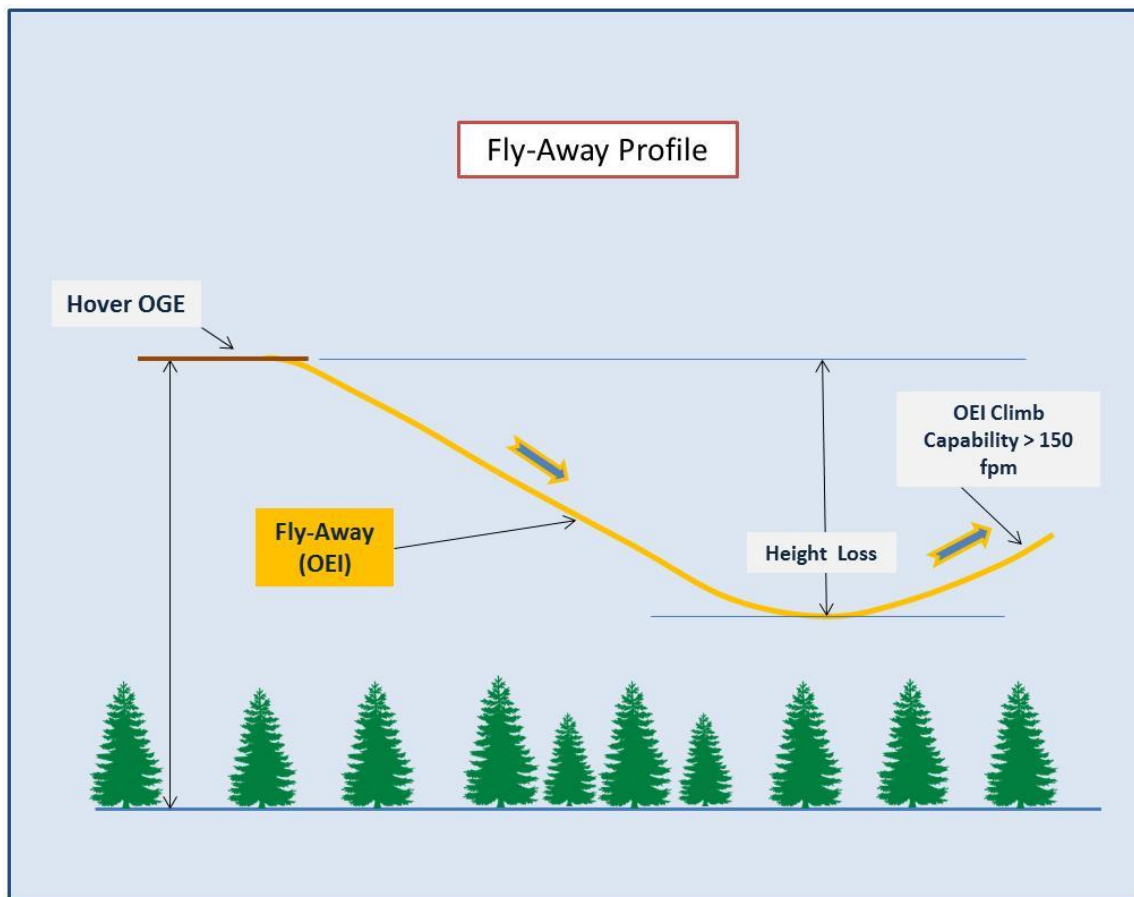
- Safe Vertical Rejects envelope provides a possible safe escape when a fly-away could not be achieved



# 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

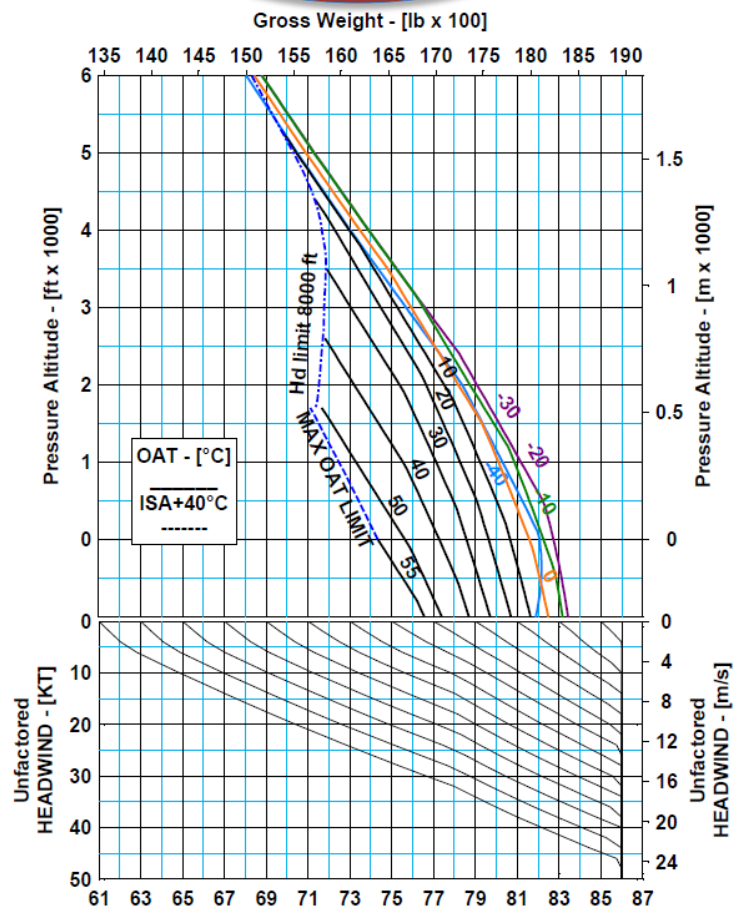
- **Take off/landing corridor:**
  - **The applicability of this performance is still limited by the demonstrated rejected take offs type of surface (usually runways). Operations over different types are not covered by certification evidence – EXPOSURE**
  - **Introduction of the  $V_{TOSS}$  concept 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

		OAT [°C]											Speed correction	
Hp [ft]		-40	-30	-20	-10	0	10	20	30	40	50	55	IAS [kt]	H [ft]
7100 kg	-1000	0	0	0	0	0	0	0	11	31	47	58	20	-43
	-500	0	0	0	0	0	0	0	22	40	58	68	30	-73
	0	0	0	0	0	0	0	13	33	49	68	79	40	-105
	500	0	0	0	0	0	1	24	42	60	78		50	-137
	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										

THANK **YOU** FOR YOUR ATTENTION

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