Session II. Hazard Characterization

Wind Shear Hazard Determination

Mike Lewis, NASA Langley Research Center

WIND SHEAR AIRBORNE SENSORS PROGRAM

WIND SHEAR

HAZARD DETERMINATION

MICHAEL S. LEWIS

DEPUTY MANAGER

NASA/FAA WIND SHEAR
AIRBORNE SENSORS PROGRAM

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F-FACTOR RELATIONSHIP WITH AIRCRAFT PERFORMANCE

$$\gamma_p = \frac{T-D}{W} - F$$

- F = LOSS OF POTENTIAL GAMMA DUE TO WIND SHEAR

  (RADIANS; 0.10 RAD = ~6 DEG.)

- F IS ADDITIVE WITH (T-D)/W

  TYPICAL INSTALLED (T-D)/W 0.17 (2 ENGINE)
  0.13 (3 ENGINE)
  0.11 (4 ENGINE)

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F-FACTOR FORMULATIONS

$$F = \frac{\dot{W}_I \circ \hat{e}_a}{g} - \frac{W_h}{V_a} \qquad \text{(3-D)}$$

$$\cong \frac{1}{g}\frac{\partial W_x}{\partial t} - \frac{W_h}{V_a} \qquad \text{(2-D, SMALL GAMMA)}$$

$$\cong \frac{V_g}{g}\frac{\partial W_x}{\partial x} - \frac{W_h}{V_a} \qquad \text{(DOPPLER)}$$

- ALL OF THESE EQUATIONS DETERMINE SHEAR MAGNITUDE
- ***NONE*** OF THESE EQUATIONS DETERMINE SHEAR HAZARD

(• TURBULENCE PRODUCES LARGE F - FACTOR VALUES:
  - THEY ARE OF SHORT DURATION
  - THEY ARE TYPICALLY FOLLOWED BY EQUALLY LARGE NEGATIVE VALUES)

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WIND SHEAR HAZARD

IS A FUNCTION OF F-FACTOR

MAGNITUDE **AND** ***DURATION***

- **WHAT MAGNITUDE?**
- **HOW LONG?**

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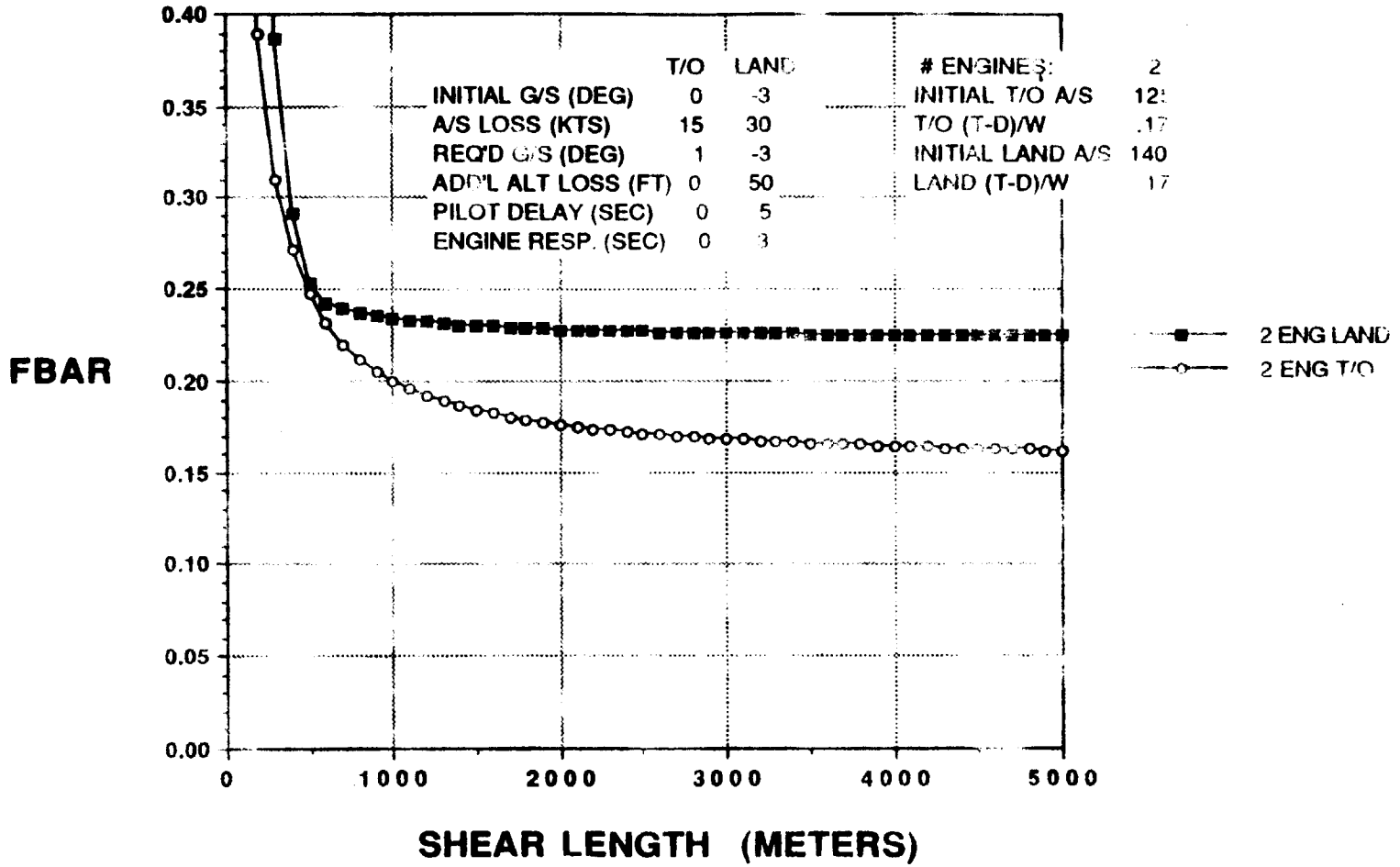
THE FBAR INDEX

DEFINE $$\bar{F}=\frac{1}{L}\int_0^L F\,dx$$

THEN, $$\bar{F}=\frac{1}{L}\int_0^L \left(\frac{T-D}{W}\right) dx-\frac{\Delta(V_a^2)}{2gL}-\frac{\Delta h}{L}$$

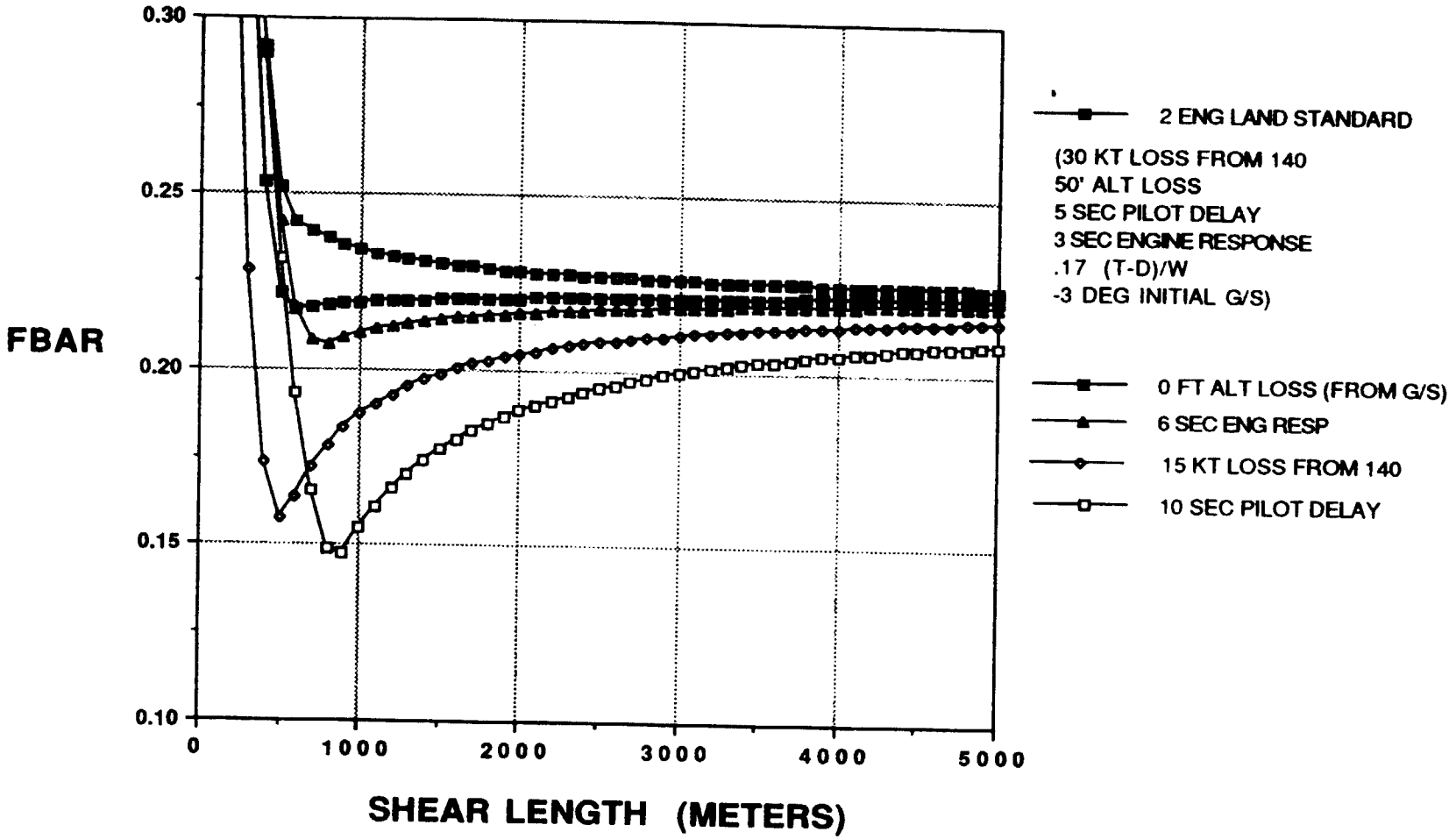
ASSUME:	TAKEOFF	LANDING
INITIAL GAMMA ((T-D)/W): (MAX GAMMA 0.17, 0.13, 0.11)	0 DEG	-3 DEG
PILOT DELAY:	0 SEC	5 SEC
ENGINE RESPONSE TIME:	0 SEC	3 SEC
INITIAL A/S		
2 ENGINE:	125 KTS	140 KTS
3 ENGINE:	135 KTS	150 KTS
4 ENGINE:	145 KTS	160 KTS
AIRSPEED LOSS:	15 KTS	30 KTS
REQUIRED GAMMA:	1 DEG	-3 DEG
ACCEPTABLE DEVIATION FROM REQ'D GAMMA:	0 FT	50 FT

F-FACTOR HAZARD LIMIT

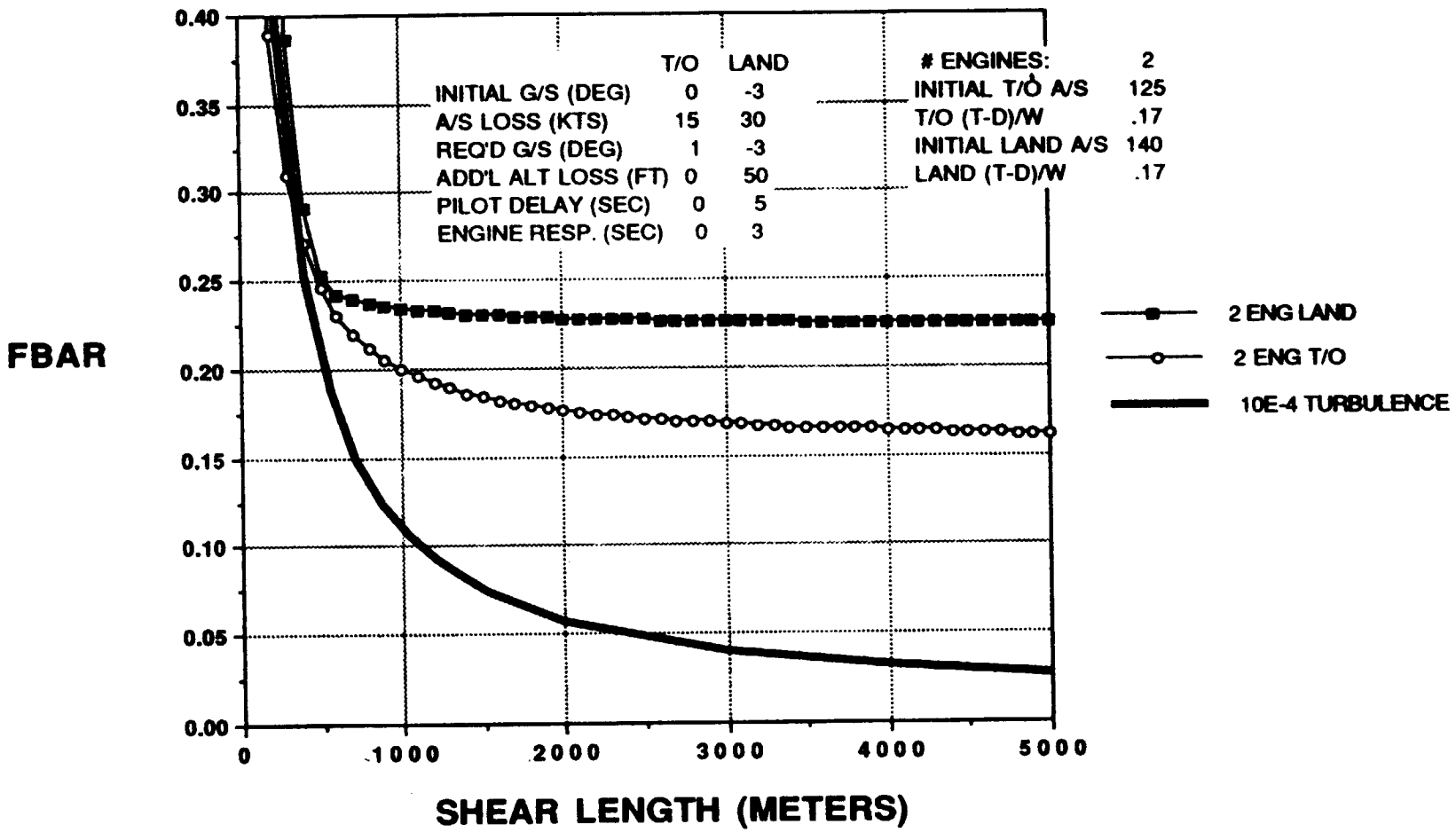


F-FACTOR HAZARD LIMIT

PARAMETER SENSITIVITY



F-FACTOR HAZARD LIMIT



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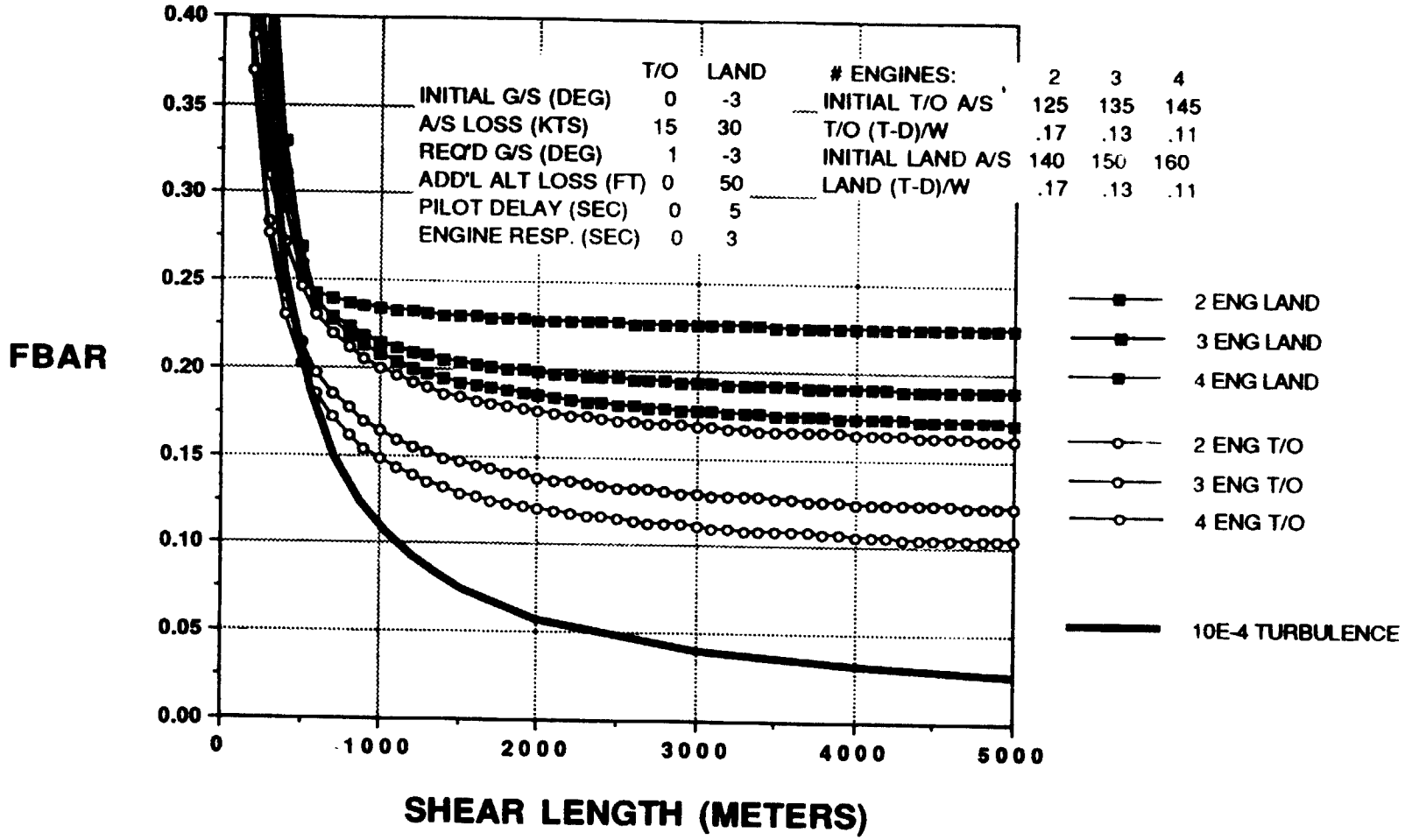

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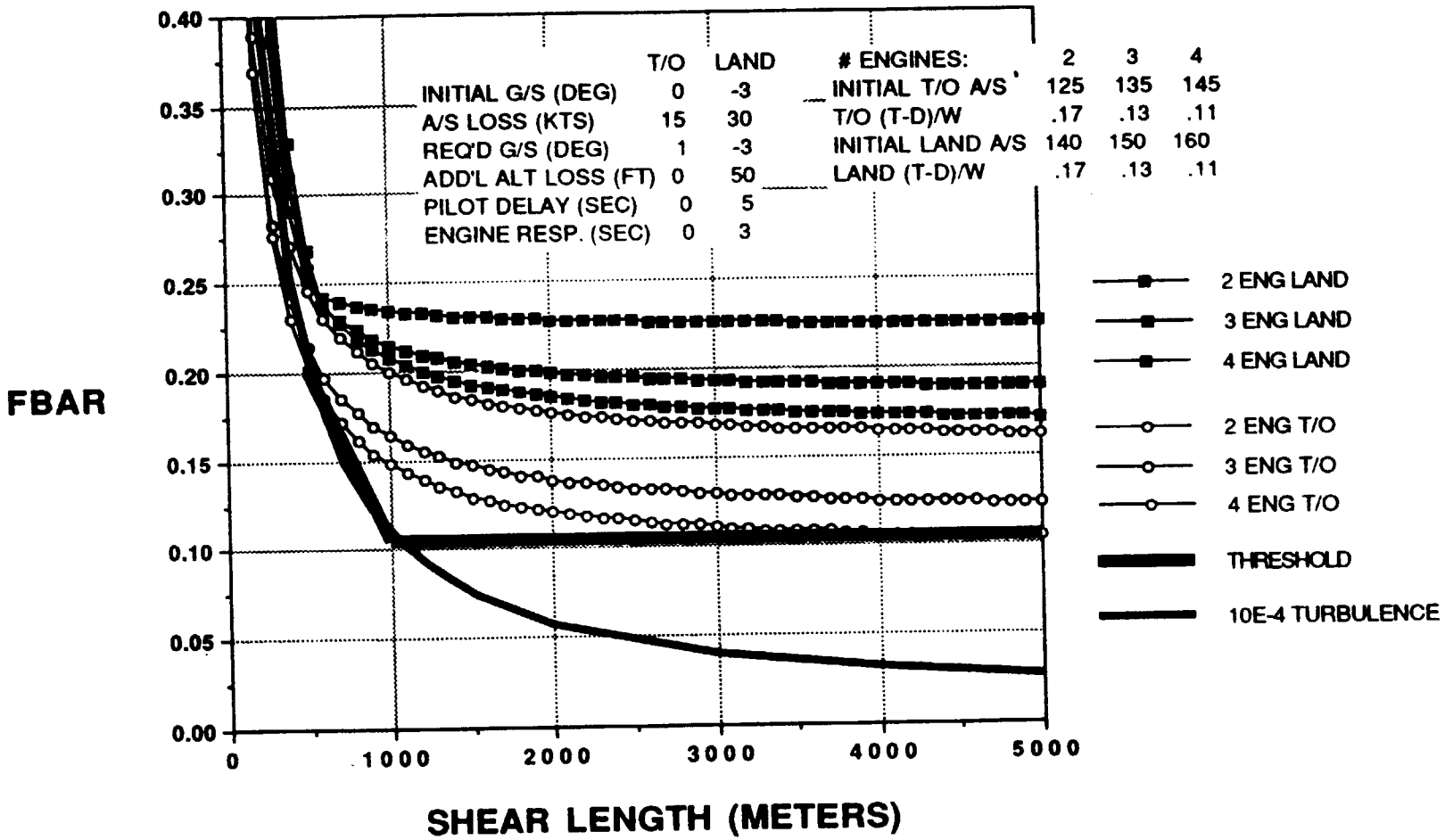

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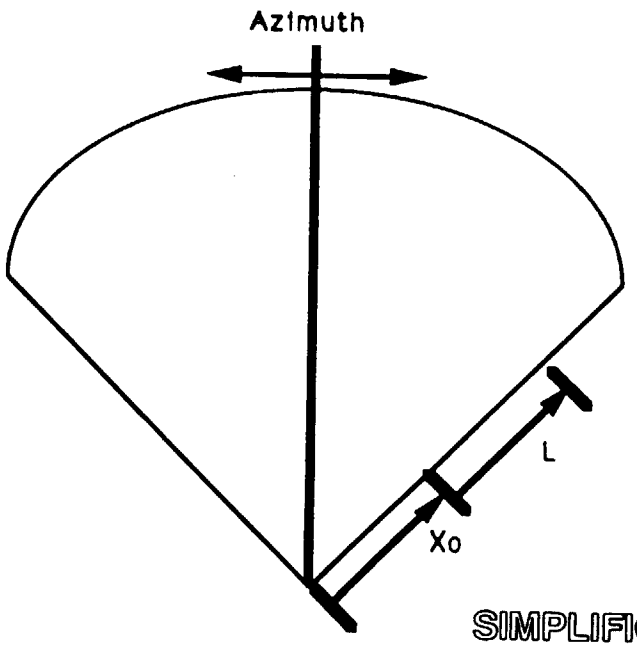
FBAR WITH DOPPLER SENSORS



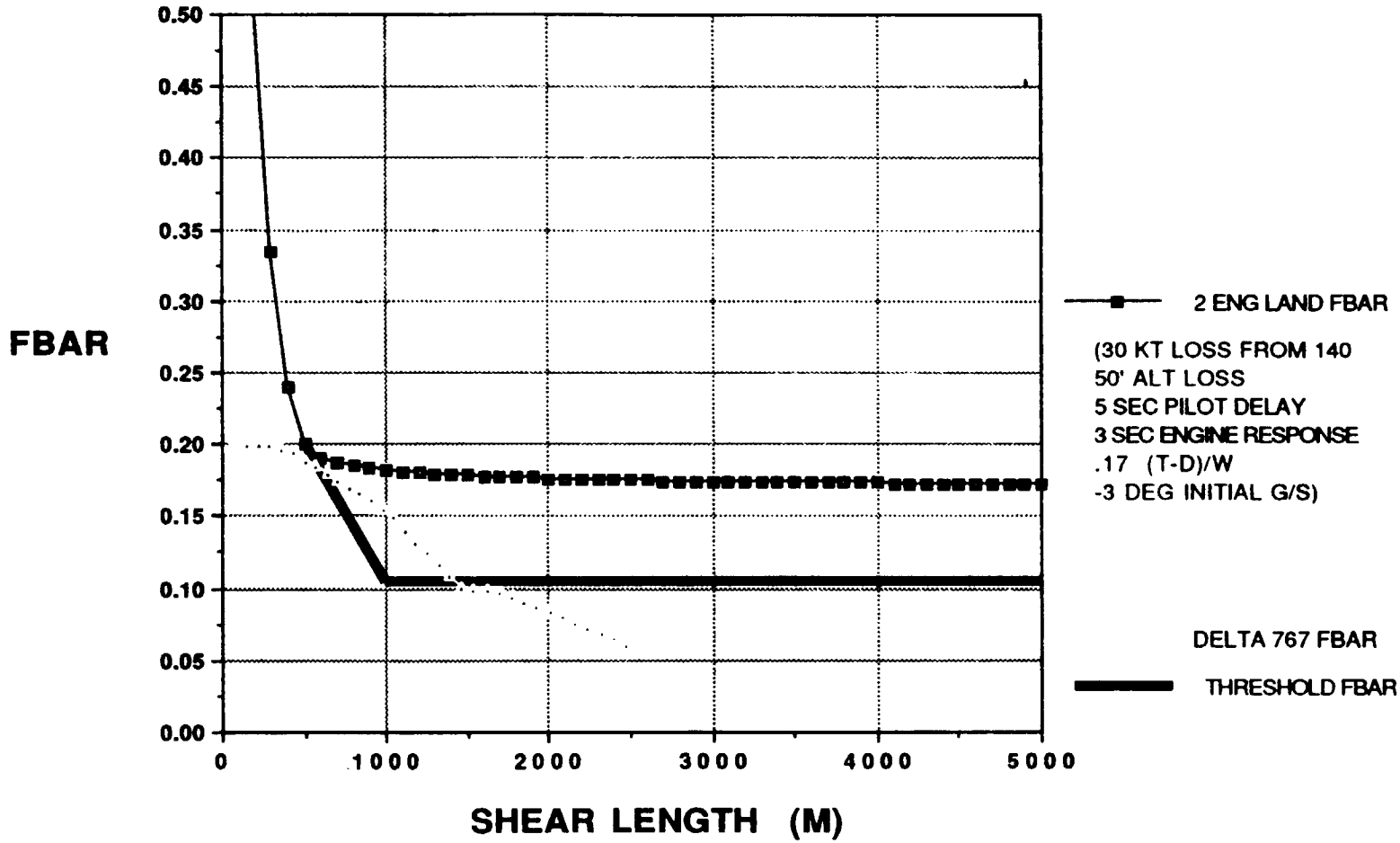
$$\bar{F}=\frac{1}{L}\int_{x_o}^{x_o+L} F\ dx$$

EVALUATE EVERY SCAN:
- AT EVERY AZIMUTH,
- FOR EVERY X_0,
- AND EVERY L

SIMPLIFICATIONS/PRACTICAL CONSIDERATIONS:

- TEST ONLY L = 1000 M
- REQUIRE MINIMUM CONTIGUOUS AZIMUTH EXCEED.
- REQUIRE MULTIPLE SCAN EXCEEDANCES
- OTHERS

FBAR PROFILE COMPOSITE



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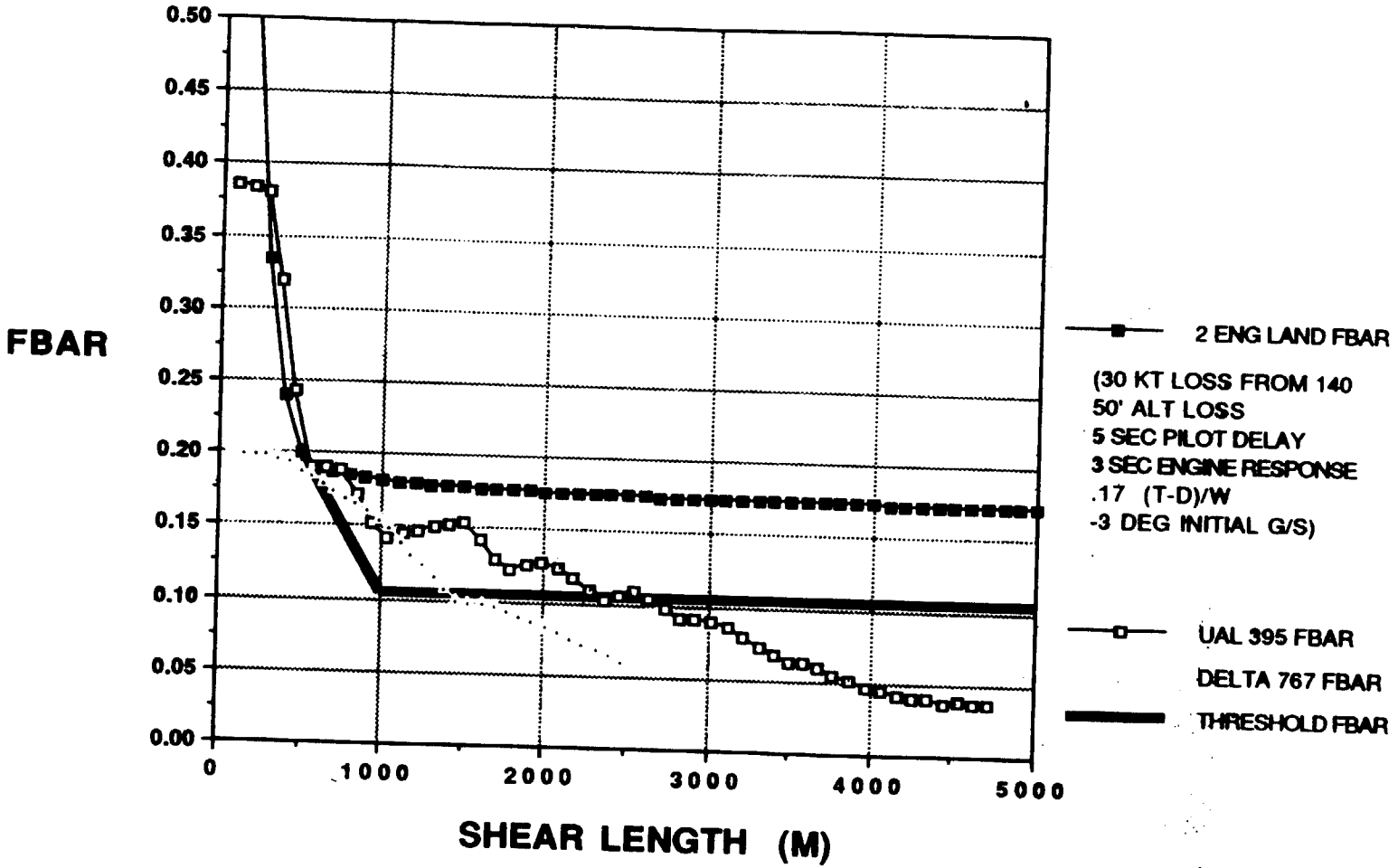

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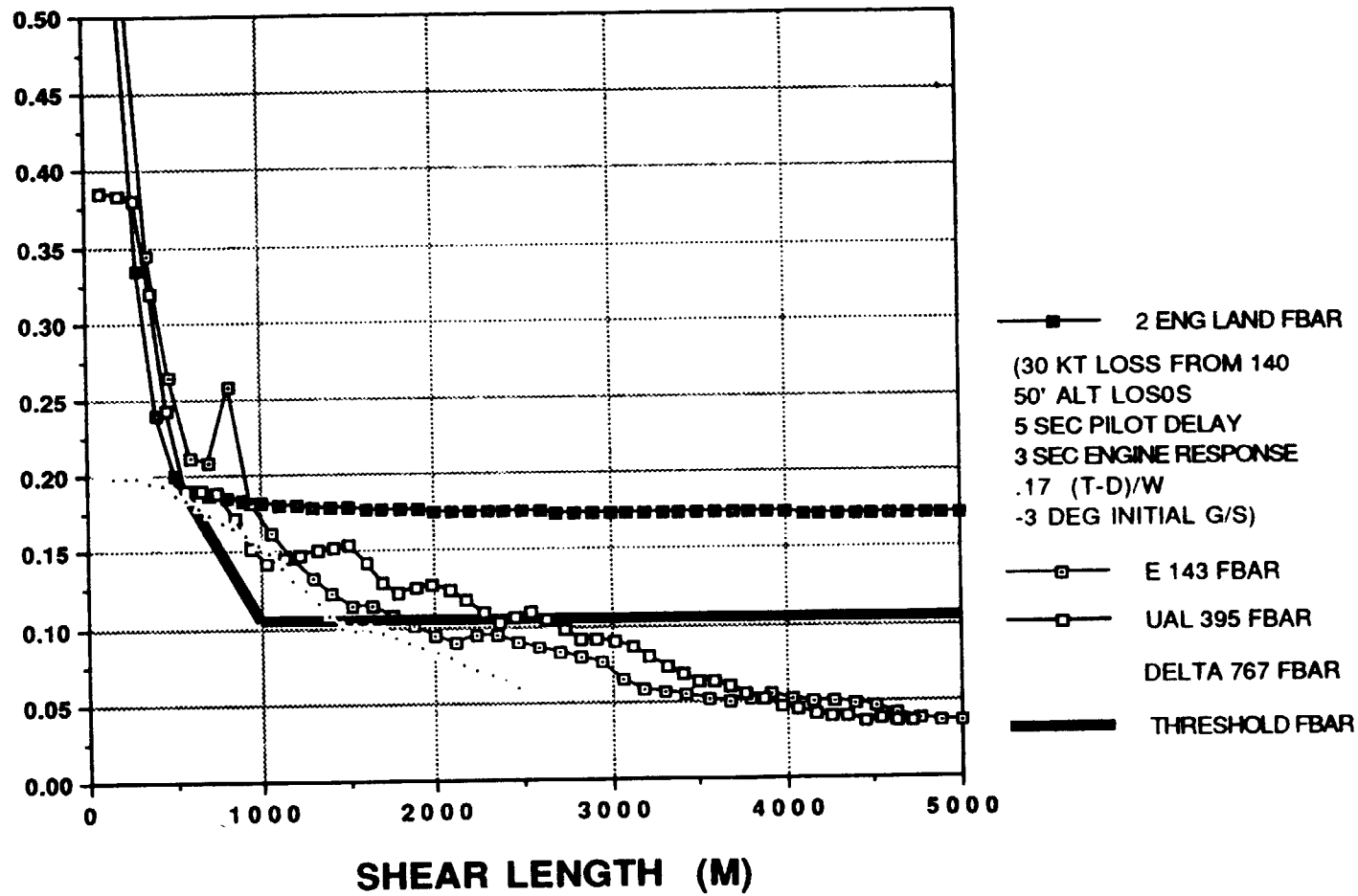

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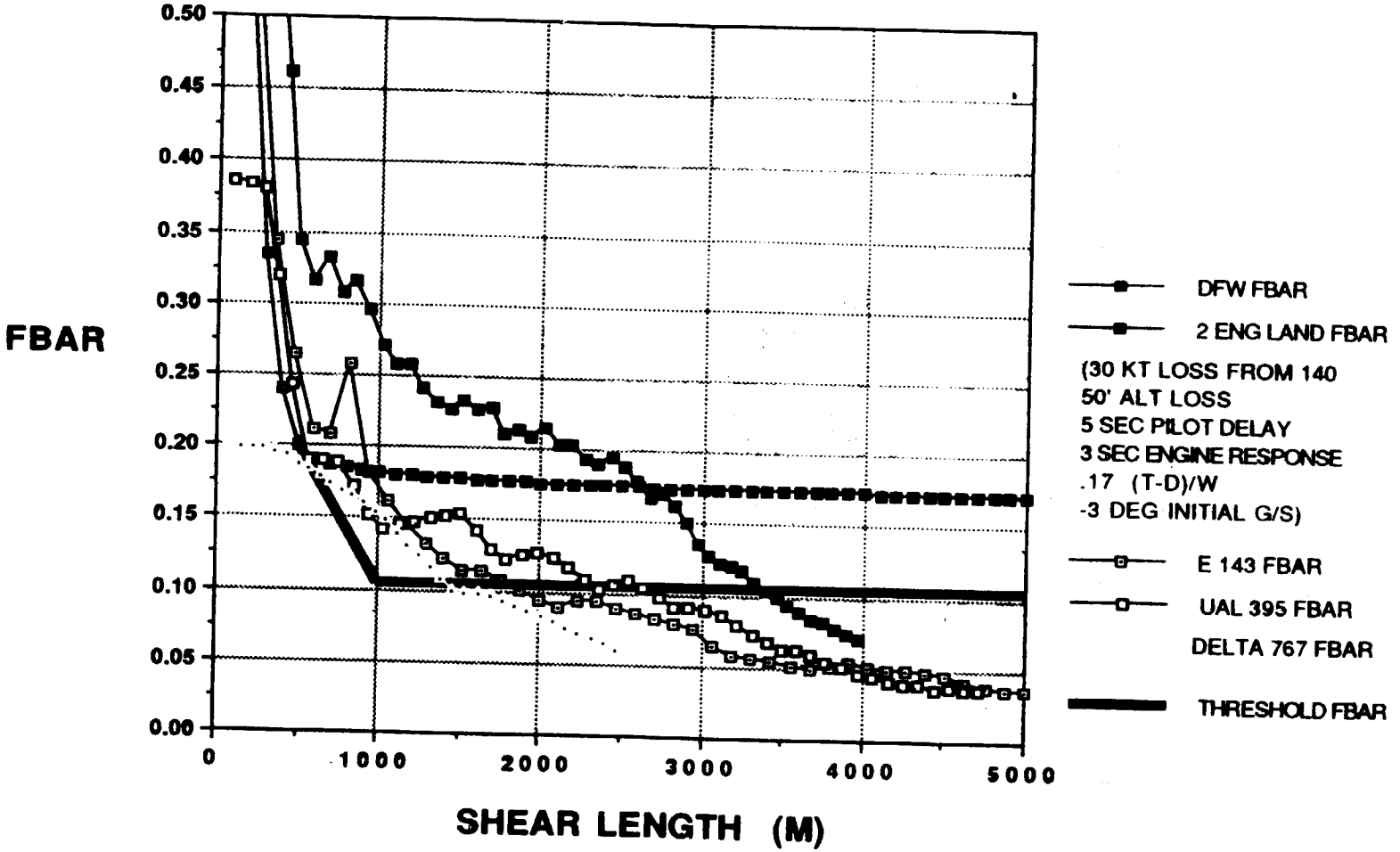

FBAR PROFILE COMPOSITE