NTSB National Transportation Safety Board

Office of Aviation Safety

Operations

Zoë Keliher

Carson Helicopters

Carson Helicopters S-61N
Operated by U.S. Forest Service
Weaverville, CA

August 5, 2008

Topics

- Helicopter weight was excessive
  - Altered weight records
- Performance planning
  - Safety margin
  - Determination of payload
- Erosion of safety margin to HOGE
  - Altered performance charts and weight records
  - Incorrect procedure
  - Inadvertent error
- Indications of operating near the helicopter's maximum capability

Weight

- Helicopter weight was excessive
- Actual empty weight: 13,845 lb.
- Carson-provided weight: 12,408 lb.

= 1,437 lb.

NTSB

Weight

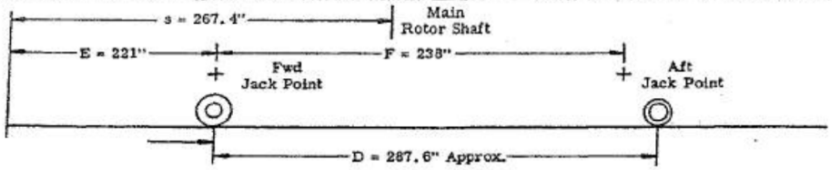
Correct & Altered

AIRCRAFT ACTUAL WEIGHT AND HORIZONTAL BALANCE
FOR S-61N MODEL HELICOPTER

1-4-08

Serial No. 61297

			TARE	SCALE ERROR	SYMBOL	NET WEIGHT
LE					W_L	5015
RIGHT MAIN POINT		5132			W_R	5132
POINT TAIL		2181			W_T	2181
TOTAL WEIGHT		12328			W	12328



CENTER OF GRAVITY TO FORWARD DATUM (HORIZ. DIST. - AS WEIGHED)

Weighing on Wheels $E + \frac{W_T \times D}{W}$

Weighing on Jack Points $E + \frac{W_T \times F}{W}$ $221 + \frac{2181 \times 238}{12328} = 263.1$

CORRECTED WEIGHT AND HORIZONTAL BALANCE

ITEMS ADDED & SUBTRACTED	WEIGHT (LB)	HORIZONTAL DIST (in) C.G. TO FWD DATUM	MOMENT (lb in.)
Aircraft as Weighed	12328	263.1	3243496.8
Plus -			
Minus -			
TOTAL EMPTY WEIGHT	12328	263.1	3243496.8
BALANCE 263.1 (Correcte		Main Rotor Centroid	

5654 (R2)

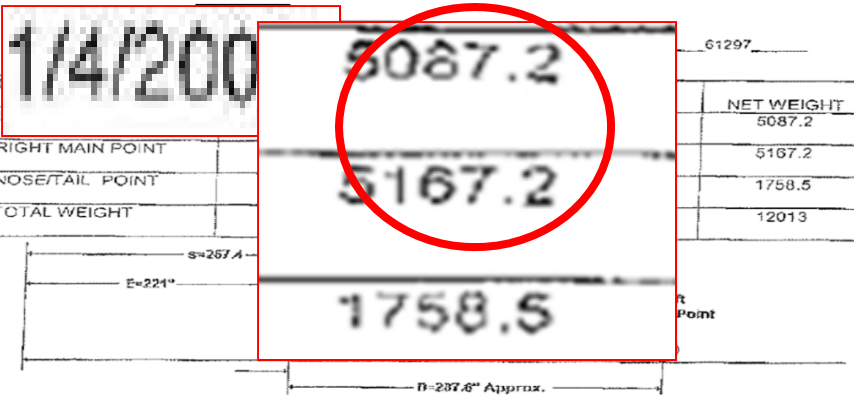
Witnessed By [redacted]

AIRCRAFT ACTUAL WEIGHT AND HORIZONTAL BALANCE, CHART B
S-61N MODEL HELICOPTER (Form 80-287)

1/4/200

61297

		NET WEIGHT
RIGHT MAIN POINT		5087.2
NOSE/TAIL POINT		5167.2
TOTAL WEIGHT		1758.5
		12013



CENTER OF GRAVITY TO FORWARD DATUM (HORIZ. DIST. - AS WEIGHED)

Weighing on Wheels $E = \frac{Wt \times D}{W}$

Weighing on Jack Points $E = \frac{Wt \times F}{W}$ $221 + \frac{1758.5 \times 267.6}{12013} = 263.1$

CORRECTED WEIGHT AND HORIZONTAL BALANCE

ITEMS ADDED & SUBTRACTED	WEIGHT (lbs)	HORIZONTAL DIST (in) C.G. TO FWD DATUM	MOMENT (lb. in.)
Aircraft as Weighed	12013	263.1	3160620.3
Plus -			
Minus -			
TOTAL EMPTY/GRO WEIGHT	12013	1	3160620.3
BALANCE H (corrected)		ain Rotor Centroid	

Form # 80-287

Witnessed By:

NTSB

Weight

Correct & Altered

CHART A - EMPTY WEIGHT CHECK LIST

AIRCRAFT MODEL S-61N SERIAL NO. 61297 ENTER DATE 1-4-08

ITEM NUMBER	ITEMS AND LOCATION GROUPED BY COMPARTMENT	WEIGHT	ARM	MOMENT/100	DELIVERY EQUIPMENT	CHECK 1 IN AIRCRAFT	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRCRAFT	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRCRAFT	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRCRAFT	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRCRAFT	CHECK 5 CHART C ENTRY
E	TAIL CONE & PYLON (493-705)														
E-1	BLOWER, FRESH AIR (M4941A)	7	497	34.8		O		O							
E-2	BLOWER, FRESH AIR (M5862X)	12	497	59.6		O		O							
E-3	FLUX VALVE & COMPENSATOR - C4A	2	543	10.9		✓		✓							
E-4	CATWALK	4	543	21.7		✓		✓							
E-5	OIL, INTERMED, & TAIL GEAR BOXES	5	687	34.4		✓		✓							
E-6	RECEIVER (R-836/ARC-21A)	7	517	36.2		O		O							
E-7	DYNAMOTOR (DY-150/ARC-21A)	5	524	26.2											
	Aerial liquid tank														
F-9	Goodrich AC Rescue Hoist	135	156.4	211						✓	✓				
F-10										✓	✓				
F-1	MAIN TIRES 6.50 x 10 (4)	50	221	110.5		✓		✓							
F-2	TAIL TIRE 6.00 x 6	9	505	45.5		✓		✓							
F-3	WIRE ANTENNA (ARC-21A)	3	540	16.2		O		O							
F-4	LOOP ANTENNA L-11	5	595	29.8		O		O							
	ENGINE AIR INLET ICE DE-FLECTOR	33	154	50.8		O		O							
F-5	Fixed gear installation	357	177	631.9		O		✓							
F-6	Sponson installation	971	171	1660.4		✓		O							
F-7	Hoist	129	211	272.2		O		O							

*MANDATORY FLIGHT EQUIPMENT.

CHART A - EMPTY WEIGHT CHECK LIST

AIRCRAFT MODEL S-61N SERIAL NO. 61297 ENTER DATE 1-4-08

ITEM NUMBER	ITEMS AND LOCATION GROUPED BY COMPARTMENT	WEIGHT	ARM	MOMENT/100	DELIVERY EQUIPMENT	CHECK 1 IN AIRCRAFT	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRCRAFT	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRCRAFT	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRCRAFT	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRCRAFT	CHECK 5 CHART C ENTRY
E	TAIL CONE & PYLON (493-705)														
E-1	BLOWER, FRESH AIR (M4941A)	7	497	34.8		O		O							
E-2	BLOWER, FRESH AIR (M5862X)	12	497	59.6		O		O							
E-3	FLUX VALVE & COMPENSATOR - C4A	2	543	10.9		✓		✓							
E-4	CATWALK	4	543	21.7		✓		✓							
E-5	OIL, INTERMED, & TAIL GEAR BOXES	5	687	34.4		✓		✓							
E-6	RECEIVER (R-836/ARC-21A)	7	517	36.2		O		O							
E-7	DYNAMOTOR (DY-150/ARC-21A)	5	524	26.2		O									
	Aerial liquid tank														
F-9	Goodrich AC Rescue Hoist	135	156.4	211		O									
F-10															
F-1	MAIN TIRES 6.50 x 10 (4)	50	221	110.5		✓		✓							
F-2	TAIL TIRE 6.00 x 6	9	505	45.5		✓		✓							
F-3	WIRE ANTENNA (ARC-21A)	3	540	16.2		O		O							
F-4	LOOP ANTENNA L-11	5	595	29.8		O		O							
	ENGINE AIR INLET ICE DE-FLECTOR	33	154	50.8		O		O							
F-5	Fixed gear installation	357	177	631.9		O		✓							
F-6	Sponson installation	971	171	1660.4		✓		O							
F-7	Hoist	129	211	272.2		O		O							

*MANDATORY FLIGHT EQUIPMENT.

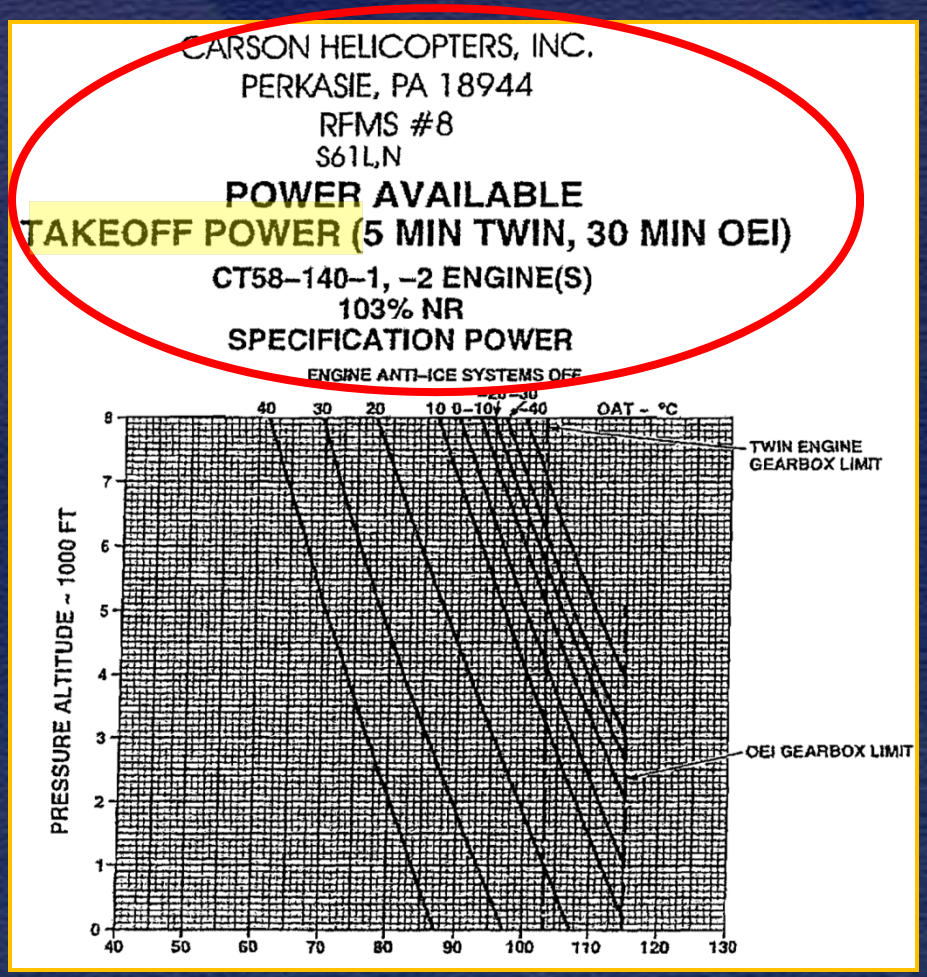
Performance Charts

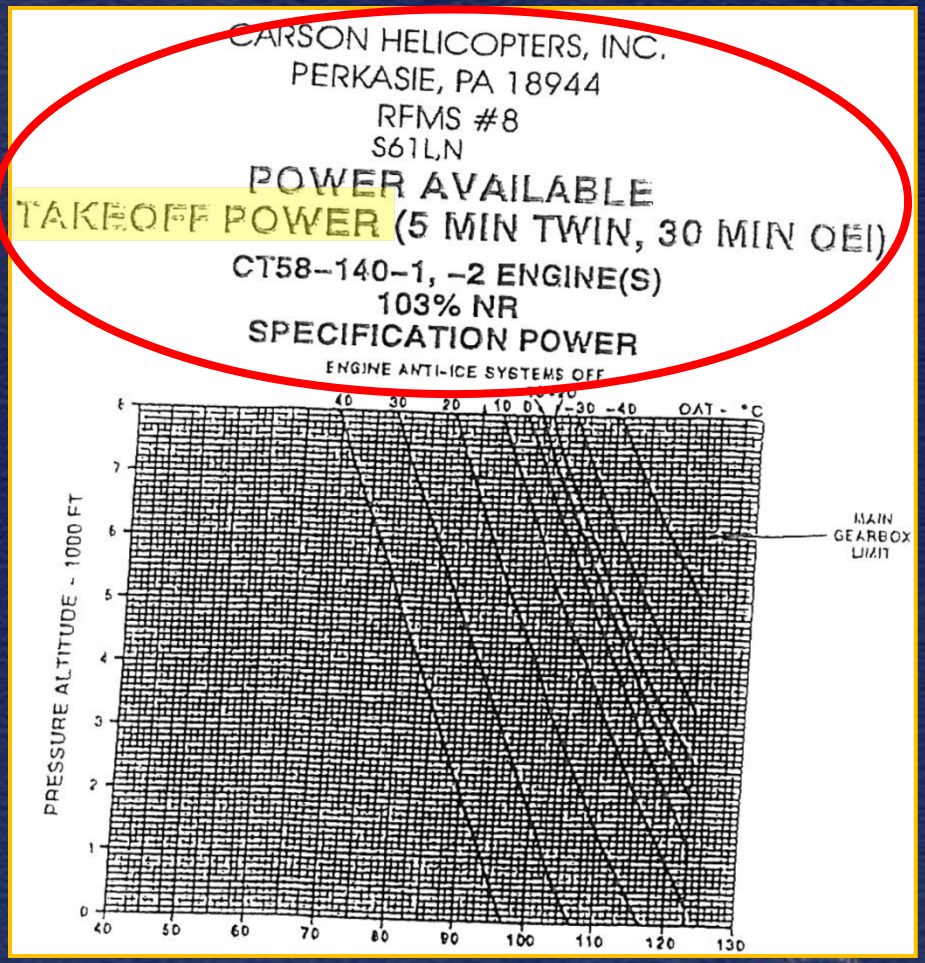
- Emergency power performance substituted for normal takeoff performance
- Emergency power HOGE: 17,600 lb.
- Normal power HOGE: 16,400 lb.

= 1,200 lb.

Performance Charts

Correct & Altered





Procedural Error

- PIC used above minimum specification (min spec) engine torque in planning
- HOGE using PIC-derived power: 18,400 lb.
- HOGE using min spec power: 17,600 lb.

= 800 lb.

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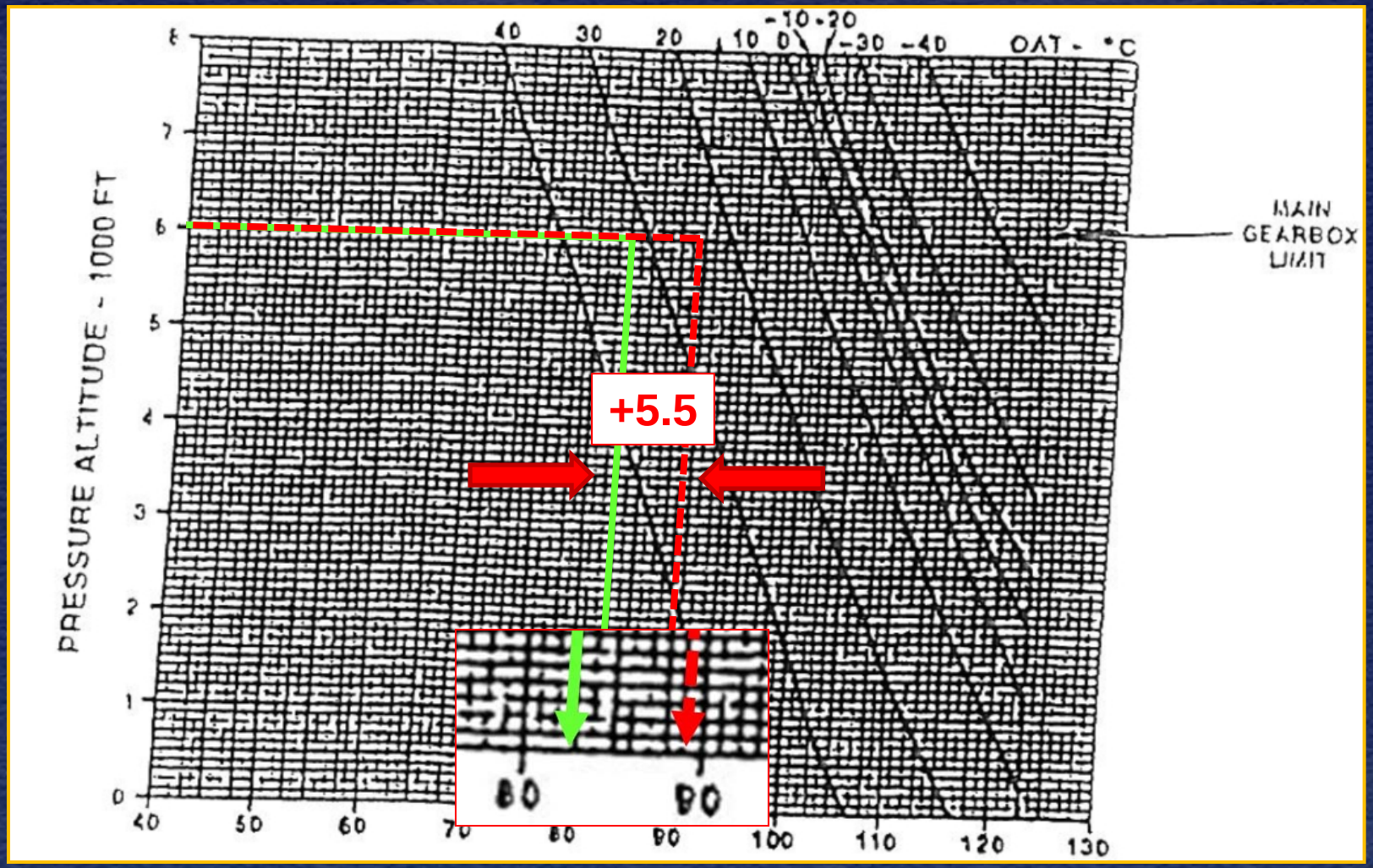
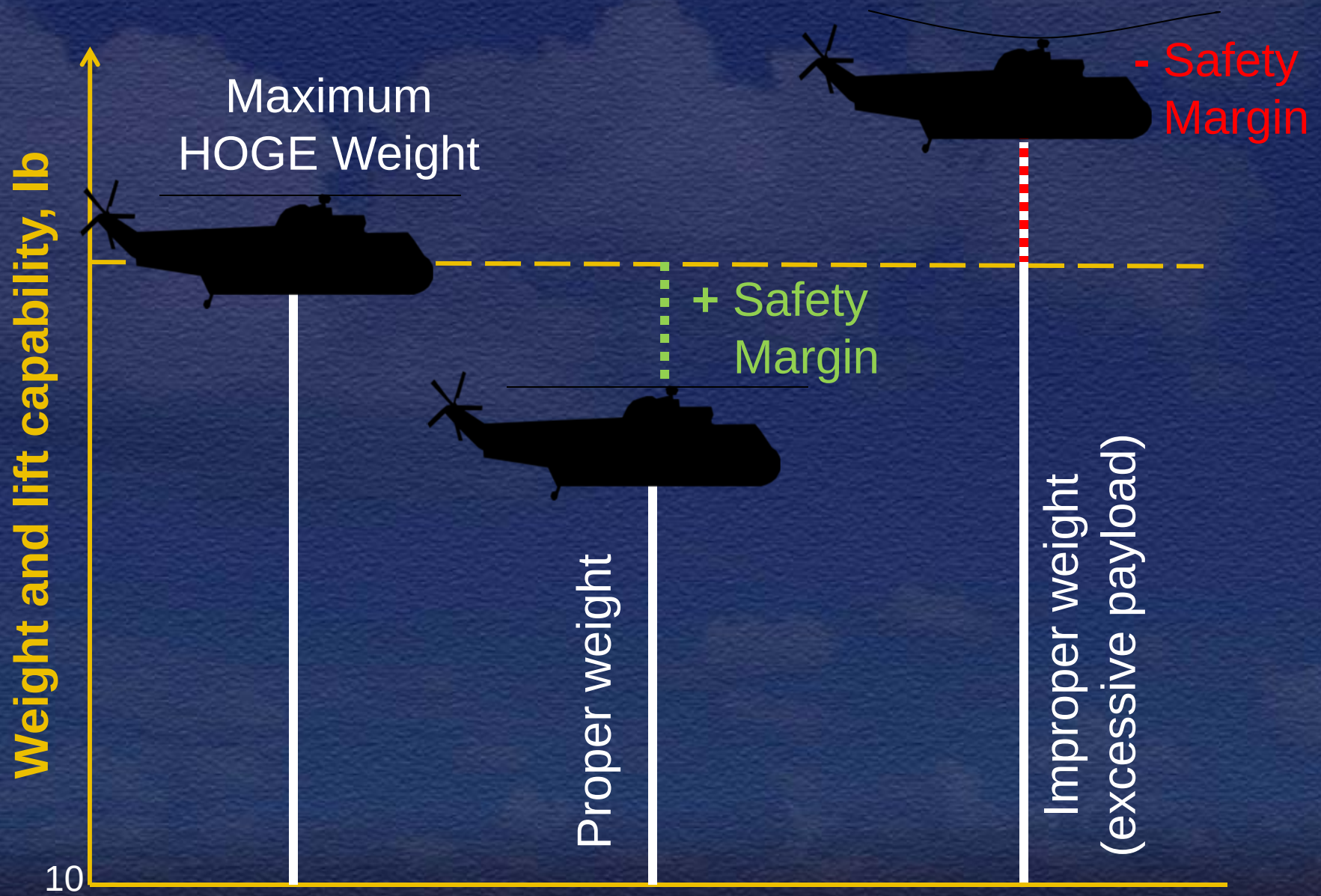
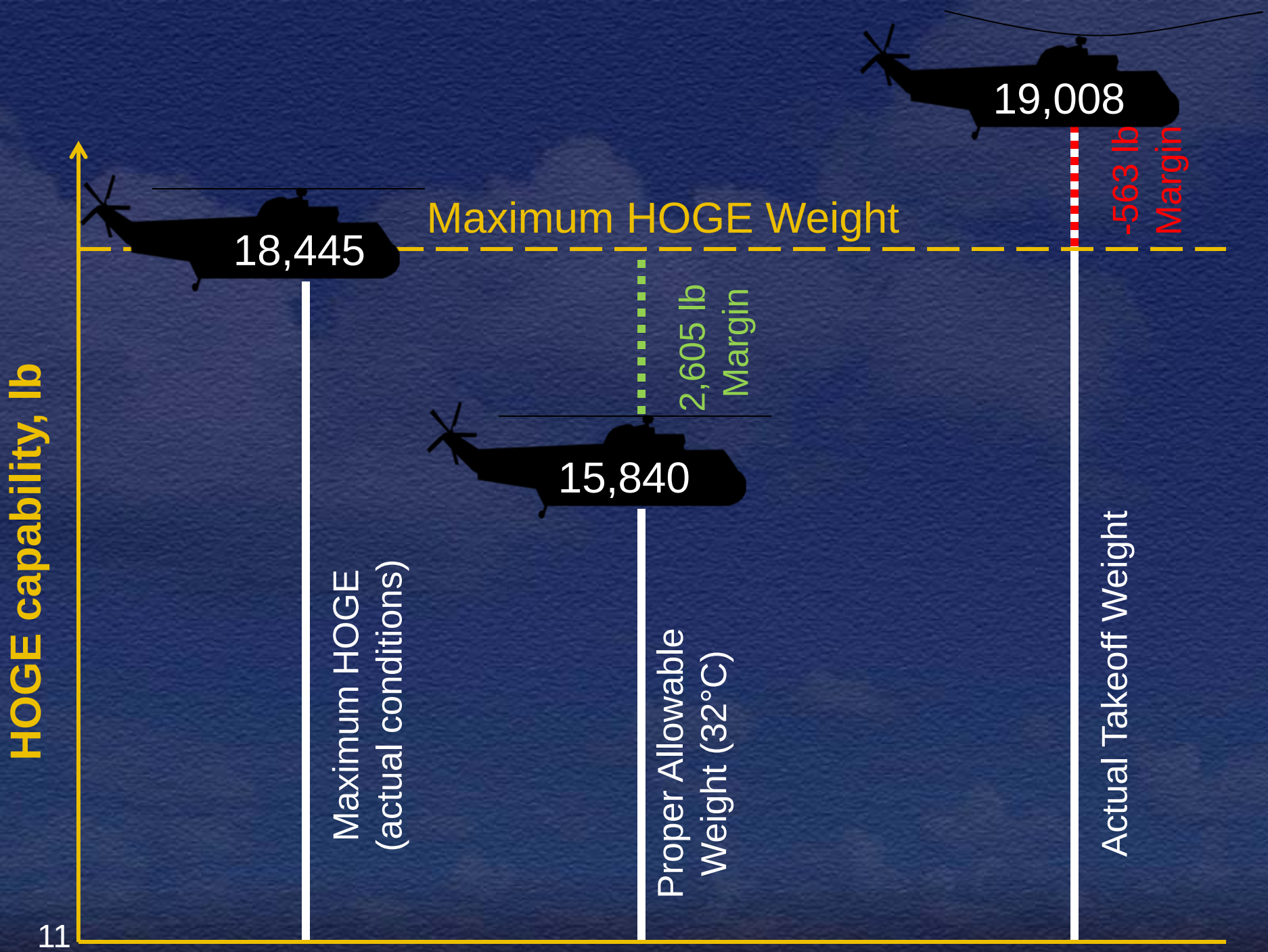
Procedural Error



Safety Margins




HOGE capability, lb
Maximum HOGE Weight
18,445
15,840
19,008
2,605 lb Margin
-563 lb Margin
Maximum HOGE (actual conditions)
Proper Allowable Weight (32°C)
Actual Takeoff Weight

Safety Margin

- Preflight planning ensures safety margin by:
  - Total weight below HOGE weight
  - Reserve HOGE capability

Allowable Weight

Empty Weight
Fuel
Crew

Operating Weight

Firefighters
Cargo

Payload

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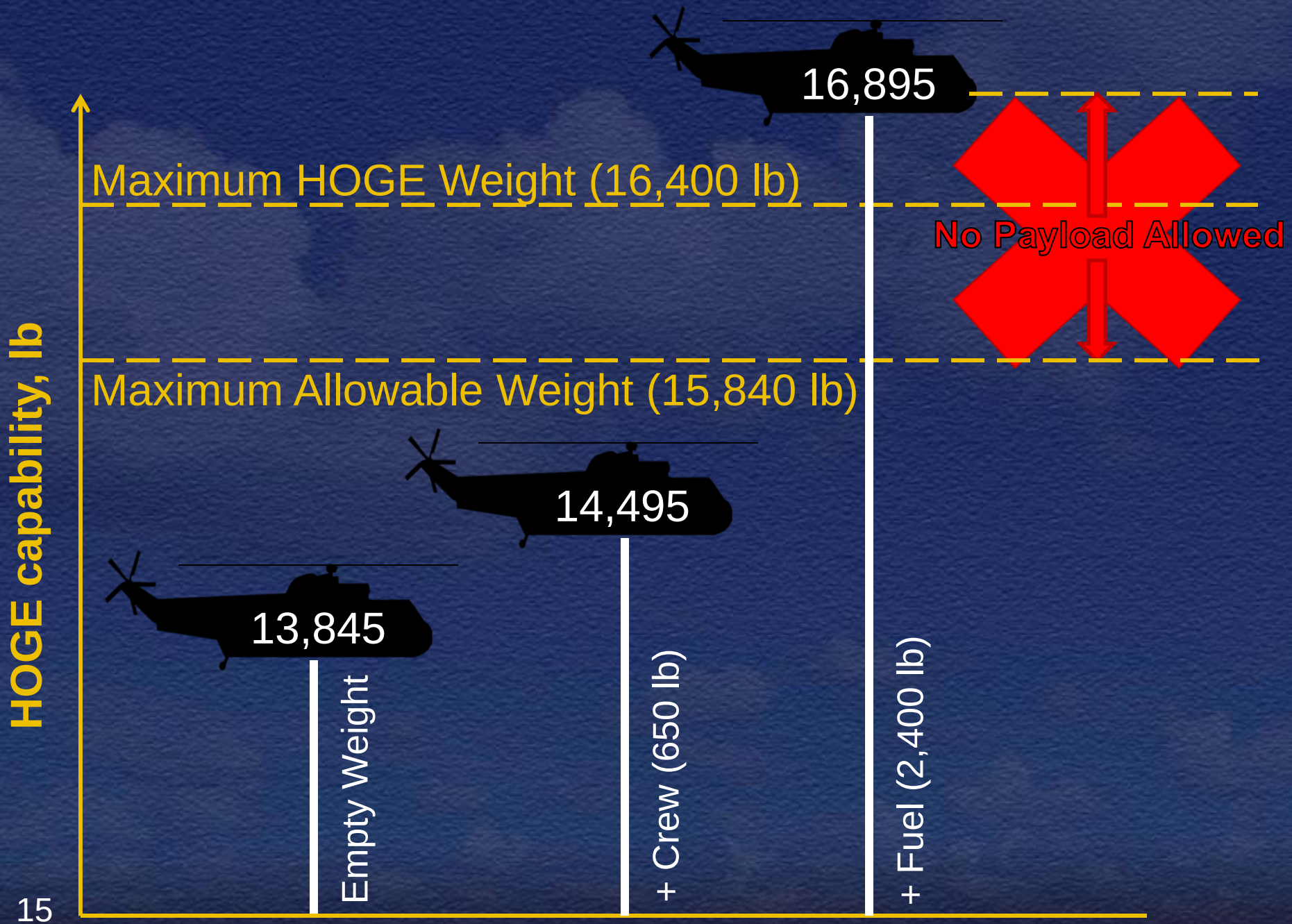
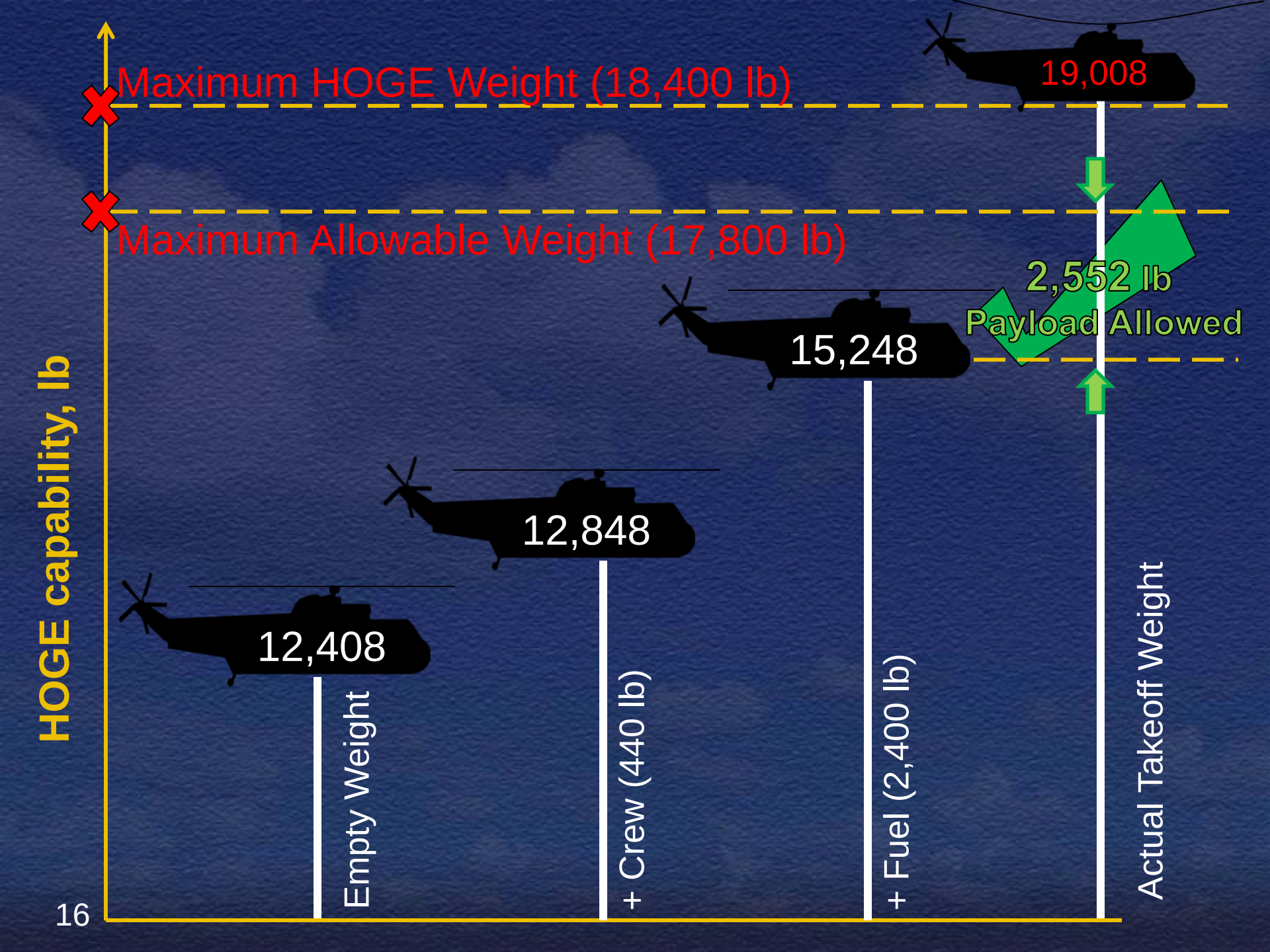
Determining Allowable Weight

- Conservative HOGE weight:
  - Use of normal takeoff power
  - Use of min-spec engine torque
  - Accident: neither were used
- 560 lb. USFS additional margin
- These determine maximum allowable weight

Erosion of Safety Margin

- Operating weight higher than believed
- Payload capability overestimated
- Total weight higher than allowed


16,895
Maximum HOGE Weight (16,400 lb)
No Payload Allowed
Maximum Allowable Weight (15,840 lb)
14,495
13,845
HOGE capability, lb
Empty Weight
+ Crew (650 lb)
+ Fuel (2,400 lb)


Maximum HOGE Weight (18,400 lb)
Maximum Allowable Weight (17,800 lb)
19,008
2,552 lb
Payload Allowed
15,248
12,848
12,408
HOGE capability, lb
Empty Weight
+ Crew (440 lb)
+ Fuel (2,400 lb)
Actual Takeoff Weight

Topping

- On all takeoffs from H-44 the engines went to topping
- Topping indicates marginal performance
- Indications to flight crew
  - Exceeded 100% N_G redline limit
  - Flight crew did not comment on CVR
- Normalization of exceedances
  - Logging and water operations have jettisonable loads
  - Operating near maximum capability accepted

Summary

- The helicopter was too heavy to takeoff successfully from H-44
- Excess weight primarily a result of
  - Altered performance charts
  - Altered empty weight
  - Use of above min spec torque
- Marginal performance not addressed by flight crew
  - N_G redline exceedances

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