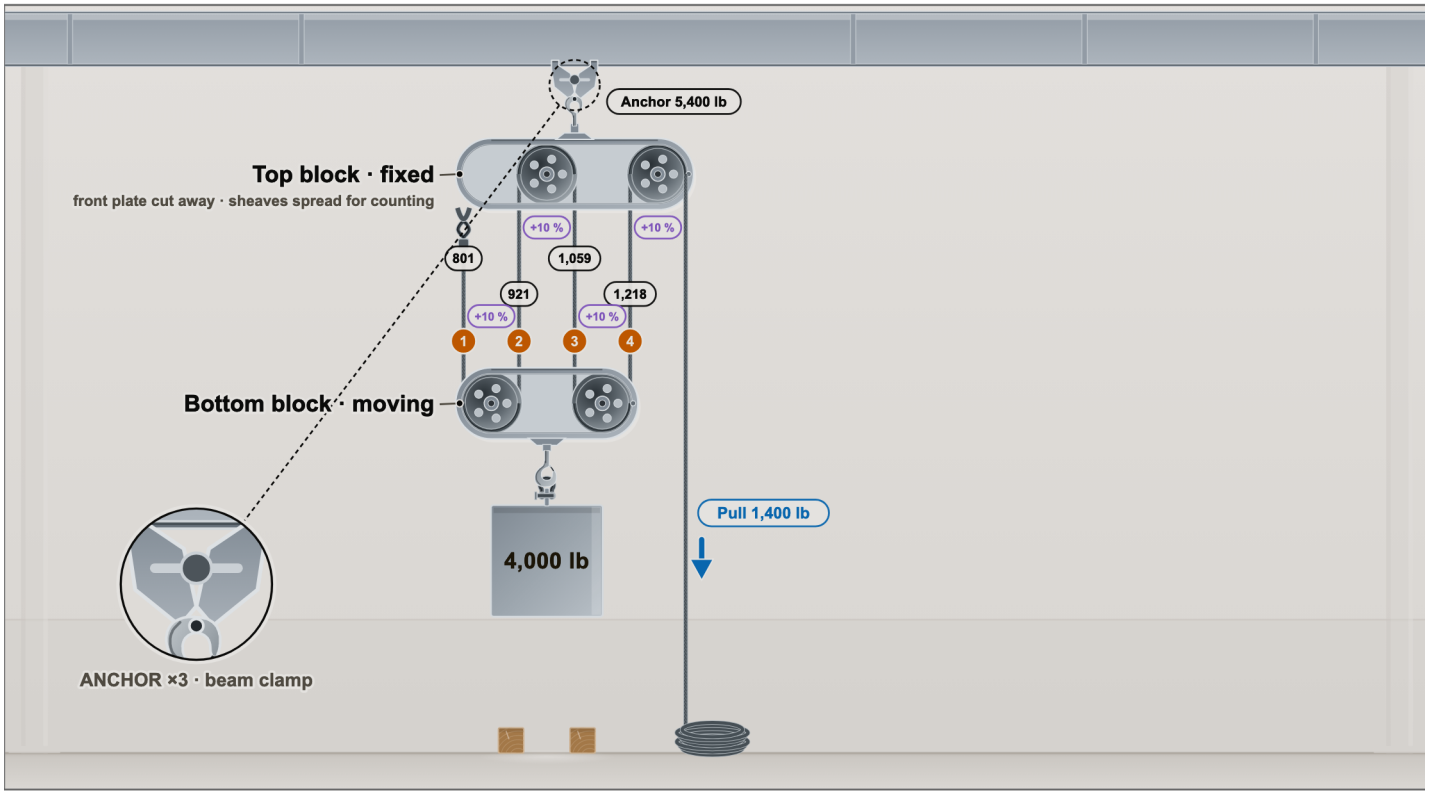
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# Block and tackle

Red Seal Industrial Mechanic (Millwright) RSOS task B-10. Exam preparation, not a procedure.




## The rules

- **Parts of line, n:** count the parts that hold the **moving** block. The lead line counts only when it leaves the moving block.
- **Ideal pull:** P = W ÷ n. **Lead line travel** = n × load rise (velocity ratio VR = n).
- **10 % rule:** P = W × (1 + 0.10 × S) ÷ n. S = sheaves the rope runs over: S = n (lead off the fixed block), n − 1 (off the moving block).
- **Maker's table (Crosby):** P = W ÷ ratio. Ratio A bronze bushed, ratio B anti-friction bearing.
- **Efficiency** = (W ÷ P) ÷ VR. Friction adds force, never distance.

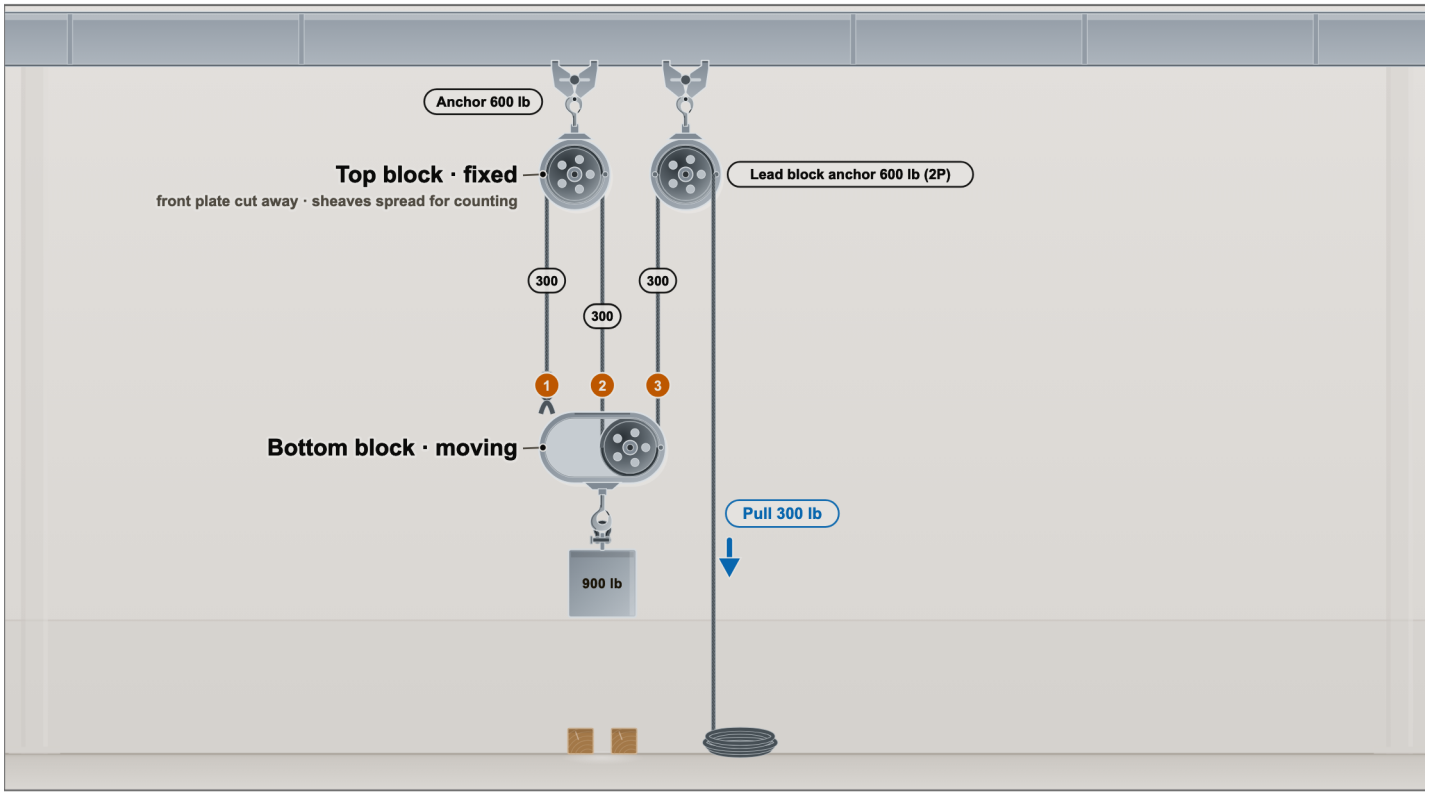
## Key numbers

| Parts n | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 10 % rule factor (lead off fixed block) | 1.10 | 0.60 | 0.433 | 0.35 | 0.30 | 0.267 | 0.243 | 0.225 |
| Crosby ratio A (bronze) | .96 | 1.87 | 2.75 | 3.59 | 4.39 | 5.16 | 5.90 | 6.60 |
| Crosby ratio B (anti-friction) | .98 | 1.94 | 2.88 | 3.81 | 4.71 | 5.60 | 6.47 | 7.32 |

10 % rule factor × W = pull. Example: 4 parts, 4,000 lb: 0.35 × 4,000 = 1,400 lb.

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# The anchor and chain falls




## Load on the anchor

- Lead pulled straight down off the top block: top block, hook and anchor carry **W + P**. One fixed sheave: **2 × W**.
- Lead off the moving block: the main anchor carries **W − P**; a lead block that turns the line straight back carries **2 × P**.
- At other angles the block load is line pull × an angle factor from the maker's chart (Crosby: 0° = 2.00, 90° = 1.41, 120° = 1.00).
- Never exceed the working load limit (BC OHS Reg. 15.4(2)). The WLL is marked on the gear (BC 15.5; Alberta OHS Code s. 293; Ontario O. Reg. 213/91 s. 174 for hook blocks). The design factor (beam clamp 5:1, blocks about 4:1) is not extra capacity.

## Chain falls

- **Geared hoist:** VR = the maker's overhaul ratio. Pull at a part load = rated pull × W ÷ rated load (Harrington 2 t: 72 lb, 70 : 1).
- **Differential block:** VR = 2D ÷ (D − d). Under 50 % efficient, it holds the load by itself.
- Much more pull than the maker lists? Stop: the load may be heavier, or something is caught.

**Where people lose marks:** counting the lead off the fixed block; missing it off the moving block; adding 10 % once instead of per sheave; mixing up VR and actual MA; rating the anchor for W instead of W + P.

## Sources

Red Seal Occupational Standard, Industrial Mechanic (Millwright), task B-10
The Crosby Group, How to Figure Line Parts, p. 443 (ratio A bronze bushed, ratio B anti-friction bearing)

US Navy Steelworker rigging chapter, Allowance for friction (10 % of the load per sheave): https://tpub.com/steelworker2/60.htm
The Crosby Group, Loads on Blocks, pp. 440-441
Harrington CB hand chain hoist specifications; Harrington UBC beam clamp (design factor 5:1)
WorkSafeBC OHS Regulation Part 15 (15.4, 15.5, 15.6); Alberta OHS Code Part 21 (s. 293, 302); Ontario O. Reg. 213/91 s. 174, O. Reg. 851 s. 51