CHAPTER III
BLOCK AND TACKLE

Block and tackle is used in rescue work as a lifting device to raise, lower, or move persons being rescued, heavy weights, beams, sections of floor, and heavy timbers. This device provides a mechanical advantage, enabling rescue workers to overcome otherwise immovable obstructions.

A tackle is formed by the reeving of blocks with rope. Rescue workers should be thoroughly familiar with the use, capabilities, terminology, and maintenance of block and tackle.

A. TERMINOLOGY

1. Block - A grooved pulley or sheave in a frame or shell provided with a hook or strap by which it may be attached to another object. (See Fig. 21)

2. Tackle - An assemblage of ropes and pulleys arranged for lifting, lowering, or pulling.

3. Pulley or Sheave - A grooved wheel over which a rope passes.

4. Snatch Block - A single block with an opening or gate in one side of the shell, through which a rope can be engaged or "snatched" into the sheave without threading the end through. (See Fig. 22) This opening is closed by a hinged or pivoted portion of the strap.
5. Shell - The part of the block which holds the sheave, and to which the strap, hook, or ring is attached.
6. Strap - The part to which a hook is attached.
7. Standing Block - The block fastened to a support or to a holdfast.
8. Running Block - The block attached to the object being moved.
9. Leading Block - Blocks used in the tackle to change the direction of the pull without affecting the mechanical advantage. Ordinarily a snatch block is used as a leading block.
10. Overhauling the Blocks - The process of separating two blocks a desired distance before attaching the running block to the load (at least the distance the load is to be moved).
11. Chock-a-block (or two-block) - When two blocks have been run in as far as they can possibly go.
12. Reeding the Tackle - The process of passing rope over sheaves of a block in proper order.
13. Twisting of the Tackle - A motion of the tackle during pulling, usually caused by a peculiar lay in the rope. (See Fig. 23 for preventing twists)

Method Of Preventing Tackle From Twisting
Figure 23

15. Mechanical Advantage - Increase in lifting or moving capacity gained by using the block and tackle.
16. Heave or Haul - Signal for rescue persons to exert pull on the rope - also the act of pulling.
17. Paying Out or Easing Off - Give slack to a rope.
18. Fall Line - The rope that is pulled on for lifting or moving an object.

B. KINDS OF BLOCKS

Blocks normally used in rescue work are:

1. Three-sheave block
2. Two-sheave block
3. Two single-sheave blocks
4. Prusik minding pulleys
   Four-inch or two-inch blocks are suitable for rescue work. The size of the block is determined by measuring the length of the shell.

C. KINDS OF TACKLE

1. Reeving Tackle
   a. Triple sheave and double sheave - To reeve, lay blocks about three feet apart with the three-sheave block in a vertical position and the two-sheave block in the horizontal position. Start the running end through the top of the center sheave of the three-sheave block. Then pass the rope through the bottom of the two-sheave block (going in the same side as the rope came out the other block); go back to the top sheave of the two-sheave block (on the same side). Then go back to the top of the remaining sheave of the three-sheave block; take the free end back to the becket of the two-sheave block, making fast with two half hitches. (See Figure 24) Note: If a locking clove hitch is used on the becket, it is not necessary to seize the running end to the standing part.
b. Triple Sheave and Triple Sheave - To reeve, lay blocks out the same as for reewing a triple and double. For sequence of steps, follow number in Figure 25.

![Triple And Double Reewing](image)

**Figure 24**

![Triple And Triple Reewing](image)

**Figure 25**

c. Double Sheave and Double Sheave - Lay blocks in vertical and horizontal positions and follow the sequence of steps, follow number in Figure 26.

![Double And Double Reewing](image)

**Figure 26**

2. Lifting Tackle
   A lifting tackle has the weight attached to the moving block (the lower block) and the running end of the fall line coming off the standing block (upper block).

3. Hauling Tackle
   A hauling tackle is one in which the running end of the fall line comes off the moving block to which the weight being hauled is attached. The standing block is made fast to a holdfast.

D. COMPUTING THE STRENGTH OF TACKLE

1. Lifting Tackle
   When figuring the capabilities of a lifting tackle, only the returns between the blocks are lifting. The fall line is moving in an opposite direction from the weight being lifted; therefore, it does not assist in the lifting.
Factors to be considered in calculating the strength of a lifting tackle are:

a. The safe working load of rope being used.
b. The number of returns at the moving block (including the standing part if it is attached to the moving block).
c. Loss of efficiency of the tackle owing to friction one-third reduction allowed.

Example:
Using a three and two tackle reeved with 1/2" kernmantle rope.
Formula: (SWL) x (The number of returns at moving block) x (friction loss)
Example with SWL of 600 pounds: 600 x 5 x 2/3 = 2,000

2. Hauling Tackle
When calculating the strength of a hauling tackle, the fall line is pulled in the same direction as the weight to be moved and assists the returns to move the weight. Therefore, it must be included in the returns. All other considerations in figuring strength are the same as lifting tackle.

Example:
Using a three and two tackle reeved with 1/2" kernmantle rope.
Formula: (SWL) x (The number of returns plus the fall line) x (friction loss)
Example with SWL of 600 pounds: 600 x 6 x 2/3 = 2,400

E. COMPUTING LENGTH OF ROPE REQUIRED FOR A TACKLE

It is necessary for rescue personnel to know how to figure the length of rope required to lift or lower a person or weight a given distance. Factors to be considered are:

1. Number of sheaves plus fall line.
2. Distance the weight has to be moved.
3. Overall length of a tackle when chock-a-block. A standard of four feet will be used for chock-a-block.

Example:
To move a weight 26 feet, using a three and two tackle
Formula: (number of returns + 1) x (distance + chock-a-block)
(5 + 1) x (26 + 4) = 180’

F. MECHANICAL ADVANTAGE

In order to move heavy loads, a machine must be used to multiply the force exerted by man. The machine used can be a lever, a screw, or a block and tackle. To determine the mechanical advantage of a tackle, count the number of sheaves or the number of returns in the tackle. This will give you the theoretical advantage. Friction loss of the ropes passing over the sheaves would have to be considered to get the actual advantage.

Example: Using a three-sheave and two-sheave block, you have a total of five sheaves or five returns. Your theoretical advantage would be five to one. Each pound of pull would exert five pounds of force or lift. (See Fig. 27 on page 33)

G. POINTS TO BE OBSERVED WHEN USING TACKLE

1. The fall line must be free from kinks and twists.
2. All hooks must be moused.
3. Tackle should be carried, not dragged.
4. Suspended weights should be eased off uniformly, not by jerks.
5. Rescue personnel should be trained to pull and ease-off together.
6. Not more than one tackle should be hooked in the same sling.
7. Blocks should be well cared for.
8. Use snatch blocks to change direction of pull. Remember, more rescue personnel can be used on the line pulling at ground level than from the vertical.

32
### Mechanical Advantage

**Figure 27**

#### LIFTING TACKLE

<table>
<thead>
<tr>
<th>LIGHT GIN</th>
<th>HEAVY GIN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEORETICAL ADVANTAGE</strong></td>
<td>5 to 1</td>
</tr>
<tr>
<td><strong>ACTUAL ADVANTAGE</strong></td>
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#### RUNNER TACKLE

<table>
<thead>
<tr>
<th><strong>LUFF TACKLE</strong></th>
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<tbody>
<tr>
<td><strong>THEORETICAL ADVANTAGE</strong></td>
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<td><strong>ACTUAL ADVANTAGE</strong></td>
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<table>
<thead>
<tr>
<th><strong>TWO SINGLE</strong></th>
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<tbody>
<tr>
<td><strong>THEORETICAL ADVANTAGE</strong></td>
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<tr>
<td><strong>ACTUAL ADVANTAGE</strong></td>
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Pulleys shown - left to right:
Prusik minding, 2" single, 2" double with becket, 4" single, 4" double with becket, triple sheave

**Figure 28**