

Practical Exercise Statement – Simple Haul Systems – 4:1

Time Allotted: 2 Hours

Purpose: The purpose of this exercise is to review and perform the construction of a 4:1 mechanical advantage system suitable for confined space or other environments.

Terminal Learning Objective: The students shall properly construct and operate mechanical advantage systems in raising operations using a 4:1 mechanical advantage system.

Enabling Learning Objectives: Given an equipment cache, and following a period of instruction, the student shall:

- Construct a 4:1 mechanical advantage systems
- Haul a load a given distance with the system
- Transfer the load and safely lower the load
- Transfer the load and haul the load

Equipment Needed:

- 1 - ½" rescue rope of suitable length for the mainline
- 1 - ½" rescue rope for belay (may be omitted if no live load is used)
- 1 – Tripod (may be omitted if training is in horizontal environment)
- 1 – Belay or belay device
- Anchor straps as necessary for Belay anchor
- 'G' rated carabiners for all anchor connections
- Pulleys for change of directions as needed
- 2 – Double pulleys or complete CSR kit
- 2 – 8 mm prusiks for progress capture
- Edge protection as needed
- A load to be hauled. (this may be a rescue dummy in an appropriate packaging device)

Instructor's Notes:

This exercise is designed for 4 or more students. The environment that is selected will determine the rigging that is used. Ideally, use a vertical confined space simulator that a tripod may be used in a vertical access configuration. The 4:1 mechanical advantage system also has applications in low angle scenarios, so customize the training to your organizations intended application.

Discuss with the students the applications for a 4:1 system. If a CSR kit is used, highlight the features of the device, making special note of the descent control device.

Demonstrate the rigging of the 4:1, and have the students count the units of tension. Have the students disassemble and re-rig the system until each student is comfortable with the rigging.

Install the 4:1 onto the tripod, (or other selected anchor). If using a tripod, review and discuss the concept of resultant force, and highlight the importance of pulling down during hauling operations and not out to the side. (Refer to the tripod videos as needed)

If a live load is to be lowered and raised, utilize a belay system and appropriate edge protection.

Utilize the 4:1 system to haul a load. Transition to lowering operations, using either the 4:1 itself with the integrated DCD (or progress capture prusiks in place), or re-direct the haul line through a change of direction to a remote anchor and rig the line through a decent control device such as a break bar rack. Be sure to rig the change of direction within the footprint of the tripod so the resultant force does not make the tripod unstable.

Conduct hauling and lowering operations until each student has performed the functions and is comfortable with the system.