
# Task Title: Finding and Calculating Working Load Limits

## OALCF Cover Sheet – Practitioner Copy

**Learner Name:** _____

**Date Started:** _____

**Date Completed:** _____

**Successful Completion:** Yes ☐ No ☐

**Goal Path:** Employment ☐ Apprenticeship ☐

Secondary School ☐ Post Secondary ☐ Independence ☐

**Task Description:** The learner will calculate Working Load Limits (WLL) using formulas for rope strength.

**Main Competency/Task Group/Level Indicator:**

- Find and Use Information/Interpret documents/A2.2
- Understand and Use Numbers/Use measures/C3.3

**Materials Required:**

- Pen/pencil and paper and/or digital device
- Calculator or digital device with calculator function

## Learner Information

Millwrights and other tradespeople calculate Working Load Limits (WLL) for different materials to determine the maximum load weight they can safely handle.

Scan “Working Load Limit Information and Formulas for Fibre Rope”.

## Working Load Limit Information and Formulas for Fibre Rope

The Working Load Limit (WLL) is the maximum load (or upper limit of weight or force) that a piece of lifting or rigging equipment (such as the eyebolt, shackle, sling or rope) can safely handle under intended operating conditions. It's a safety measure determined by the manufacturer that comes in significantly lower than the breaking strength and is crucial for ensuring safe lifting operations.

A Working Load Limit is determined by dividing the breaking strength of a piece of lifting or rigging equipment by a safety/design factor, which is usually between 3:1 and 6:1 according to lifting equipment companies. A safety factor of 5:1 is commonly used for ropes and slings. This safety factor provides a margin of safety to account for potential unforeseen stresses or variations in load conditions.

| **Formula for Working Load Limit of Fibre Rope** |
|---|
| WLL = Breaking Strength ÷ Safety/Design Factor<br><br>For example: A rope rated at 1500 lbs. breaking strength that has a safety factor of 5:1 has a working load limit of 300 lbs.<br><br>1500 lbs ÷ 5 = 300 lbs [1,500 lbs ÷ 5 (5:1)] |

Fibre ropes include both natural and synthetic options, however synthetic options such as nylon, polypropylene, polyester and polyethylene ropes are the most popular. As each rope type uses a different calculation, you must be sure to use the correct formula to ensure the safety of the lift.

To calculate the safe working load of specific rope types and sizes use the following formulas:

**Nylon Rope**

Step 1 – Convert the rope diameter to eighths of an inch, e.g. ¾" = 6/8"

Step 2 – Calculate the WLL using the following formula

**WLL = (Numerator of Rope Diameter)$^2$ x 60 lbs**

WLL of a ¾-inch Nylon Rope will be $6^2$ x 60 = 36 x 60 = 2,160 lbs

Therefore, a ¾-inch nylon rope can be used on loads of 2,160 lbs or less.

**Polypropylene Rope**

Step 1 – Convert the rope diameter to eighths of an inch, e.g. ½" = 4/8"

Step 2 – Calculate the WLL using the following formula

**WLL = (Numerator of Rope Diameter)$^2$ x 40 lbs**

WLL of a ¾-inch Polypropylene Rope will be $4^2$ x 40 = 16 x 40 = 640 lbs

Therefore, a 1/2-inch polypropylene rope can be used on loads of 640 lbs or less.

**Polyester Rope**

Step 1 - Convert the rope diameter to eighths of an inch, e.g. ½" = 4/8"

Step 2 – Calculate the WLL using the following formula

**WLL = (Numerator of Rope Diameter)$^2$ x 60 lbs**

WLL of a 1/2-inch Polyester Rope will be $4^2$ x 60 = 16 x 60 = 960 lbs

Therefore, a 1/2-inch polyester rope can be used on loads of 960 lbs or less.

**Polyethylene Rope**

Step 1 - Convert the rope diameter to eighths of an inch, e.g. 1" = 8/8"

Step 2 – Calculate the WLL using the following formula

**WLL = (Numerator of Rope Diameter)$^2$ x 35 lbs**

WLL of a 1-inch Polyethylene Rope will be $8^2$ x 35 = 64 x 35 = 2,240 lbs

Therefore, a 1-inch polyethylene rope can be used on loads of 2,240 lbs or less.

# Work Sheet

**Task 1: Calculate the Working Load Limits for the following fibre rope diameters:**

**a) ¼" diameter polypropylene rope**

Answer:

**b) 1-5/8" diameter polypropylene rope**

Answer:

**c) 3/8" diameter nylon rope**

Answer:

**d) 1½" diameter nylon rope**

Answer:

**e) 5/16” diameter polyethylene rope**

Answer:

**f) ¾” diameter polyethylene rope**

Answer:

**g) 7/8” diameter polyester rope**

Answer:

**h) 1” diameter polyester rope**

Answer:

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# Answers

**Task 1: Calculate the Working Load Limits for the following fibre rope diameters:**

**a) ¼" diameter polypropylene rope**

Answer:

1/4 inch = 2/8 inch
WLL = $2^2$ x 40 = 4 x 40 = 160 lbs
WLL for 1/4-inch diameter polypropylene rope is 160 lbs

**b) 1-5/8" diameter polypropylene rope**

Answer:

1 5/8 inch = 13/8 inch
WLL = $13^2$ x 40 = 169 x 40 = 6,760 lbs
WLL for 1 5/8-inch diameter polypropylene rope is 6,760 lbs

**c) 3/8" diameter nylon rope**

Answer:

WLL = $3^2$ x 60 = 9 x 60 = 540 lbs
WLL for 3/8-inch diameter nylon rope is 540 lbs

**d) 1½" diameter nylon rope**

Answer:

1 ½ inch = 3/2 inch = 12/8 inch
WLL = $12^2$ x 60 = 144 x 60 = 8,640 lbs
WLL of 1 ½ inch diameter nylon rope is 8,640 lbs

**e) 5/16” diameter polyethylene rope**

Answer:

5/16-inch = 2.5/8 inch
WLL – $2.5^2$ x 35 = 6.25 x 35 = 218.75 lbs
WLL of a 5/16” diameter polyethylene rope is 218.75 lbs

**f) ¾” diameter polyethylene rope**

Answer:
3/4 -inch = 6/8 inch
$6^2$ x 35 = 36 x 35 = 1,260 lbs
WLL of ¾ inch diameter polyethylene rope is 1,260 lbs

**g) 7/8” diameter polyester rope**

Answer:
$7^2$ x 60 = 49 x 60 = 2,940 lbs
WLL of a 7/8-inch diameter polyester rope is 2,940 lbs

**h) 1” diameter polyester rope**

Answer:

1 inch = 8/8 inch
$8^2$ x 60 = 64 x 60 = 3,840 lbs
WLL for 1 inch diameter polyester rope is 3,840 lbs

## Performance Descriptors

| Levels | Performance Descriptors | Needs Work | Completes task with support from practitioner | Completes task independently |
|---|---|---|---|---|
| A2.2 | performs limited searches using one or two search criteria | | | |
| | extracts information from tables and forms | | | |
| | uses layout to locate information | | | |
| | makes connections between parts of documents | | | |
| C3.3 | calculates using numbers expressed as whole numbers, fractions, decimals, percentages and integers | | | |
| | manages unfamiliar elements (e.g. context, content) to complete tasks | | | |
| | chooses and performs required operations; makes inferences to identify required operations | | | |
| | selects appropriate steps to solutions from among options | | | |
| | interprets, represents and converts measures using whole numbers, decimals, percentages, ratios and fractions | | | |
| | organizes and displays numerical information (e.g. graphs, tables) | | | |

| Levels | Performance Descriptors | Needs Work | Completes task with support from practitioner | Completes task independently |
|---|---|---|---|---|
| | uses strategies to check accuracy (e.g. estimating, using a calculator, repeating a calculation, using the reverse operation) | | | |

This task: Was successfully completed ☐ Needs to be tried again ☐

Learner Comments:

Instructor (print): _____

Learner (print): _____