# SUSTAINABLE ESSENTIAL SKILLS

## Trades Worksheets Book One

BUILDFORCE CANADA

SKILLPLAN

# Introduction

## What is the purpose of this collection of worksheets?

These worksheets are part of a project to encourage integrating Essential Skills into technical training. The worksheets address competencies that are outlined in the National Occupational Analysis and are part of every trades training curriculum, regardless of region or level. The content originated in trades training curricula but is enhanced with features that make Reading, Document Use and Numeracy tasks transparent.

The purpose of this collection of worksheets is to

- provide ready-made materials for instructors to use
- model an Essential Skills approach that integrates Essential Skills strategies into technical training topics
- provide a means to assist apprentices who find technical training difficult

## Who should use these worksheets?

Technical instructors can decide which worksheets are appropriate for individual apprentices, study groups and classes. Educators in settings that prepare students for apprenticeship or who have an interest in work-related applications may find some worksheets appropriate.

## Why use these worksheets?

Each worksheet activity was suggested and reviewed by an experienced trades instructor. The trades topics are useful for more than one trade. For example, several trades use fan laws; however, this topic is only discussed in one of the workbooks under one trade.

The worksheets provide practice and strategies to reinforce concepts instructors present in class. Instructors can use them with apprentices to review and to teach using a clear process that can become a transferable strategy. The activities have been carefully selected to identify technical training topics that are problematic for apprentices.

Integrating Essential Skills into worksheets helps apprentices develop transferable skills including:

- locating and integrating information from complex text and information displays that use technical terms, abbreviations and symbols
- translating problems into mathematical operations using several steps of calculation and a combination of formulae

## How can the worksheets be used?

The worksheets are arranged in three workbooks ordered alphabetically by trade. A complete listing of the topics in all three workbooks is on the back inside cover.

Instructors can choose worksheets as they fit into their curriculum or to supplement existing study materials or as a class learning activity. Worksheets can also be used with apprentices who need extra practice.

Instructors can also look beyond the topic and examine the layout and concepts addressed. They can develop their own content using these ideas to integrate the Essential Skills appropriate for their apprentices and trade application.

## How can instructors participate in this project?

These workbooks and accompanying instructor's guide are part of a project to integrate Essential Skills into technical training. You are invited to join the growing community of technical training instructors who are learning more about Essential Skills and how this approach can facilitate effective trades training and increase success for more apprentices.

Here is how you can participate now and in the future:

- Download copies of these workbooks and other related publications at www.buildforce.ca.
- Use these materials with your apprentices
- Design your own materials using the same Essential Skills features

The completed project envisions a virtual community of technical training instructors who will post their own worksheets and other materials to share with instructors across Canada. There will be opportunities for networking online, a 1-800 information service, and instructor training courses. The goal of these initiatives is to inspire instructors to add to their credentials by meeting the requirements of a formal Essential Skills endorsement program.

# Table of Contents

# Boilermakers

Boilermakers construct, install, maintain and repair boilers, tanks, and pressurized vessels that contain liquids, gases, and dry products. They often have to attach rigging and work with cranes to lift components into place. They use both hot and cold working methods to shape steel components to form boilers, tanks and vessels. Boilermakers are employed in industries such as metal fabrication, construction, shipbuilding, petroleum, and power generation.

## Activities

This activity provides practice with the calculations required to safely rig a lift.

- Calculating Sling Stress, Lead Line Pull, Holdback, and Wire Rope Diameter

## National Occupational Analysis (NOA)

The NOA has identified the following tasks as being required for a fully competent tradesperson in this trade:

- Determines load
  - Knowledge of rigging formulas and working load limit (WLL)
  - Ability to calculate weights of loads using required formulas
- Performs pre-lift analysis
  - Ability to interpret engineered lift drawings
  - Ability to interpret load charts and perform load calculations
- Selects rigging and hoisting equipment
  - Knowledge of hoisting equipment such as cranes, blocks, Tirfors, tuggers and chain falls
  - Knowledge of types of ropes used in rigging such as wire, natural and synthetic
  - Ability to ensure rigging meets parameters of WLL

## Essential Skills Highlights

This activity combines Document Use and Numeracy skills at Level 3.

Document Use

- Locate and integrate information on diagrams and tables
- Use specialized knowledge such as trade terms and abbreviations

Numeracy

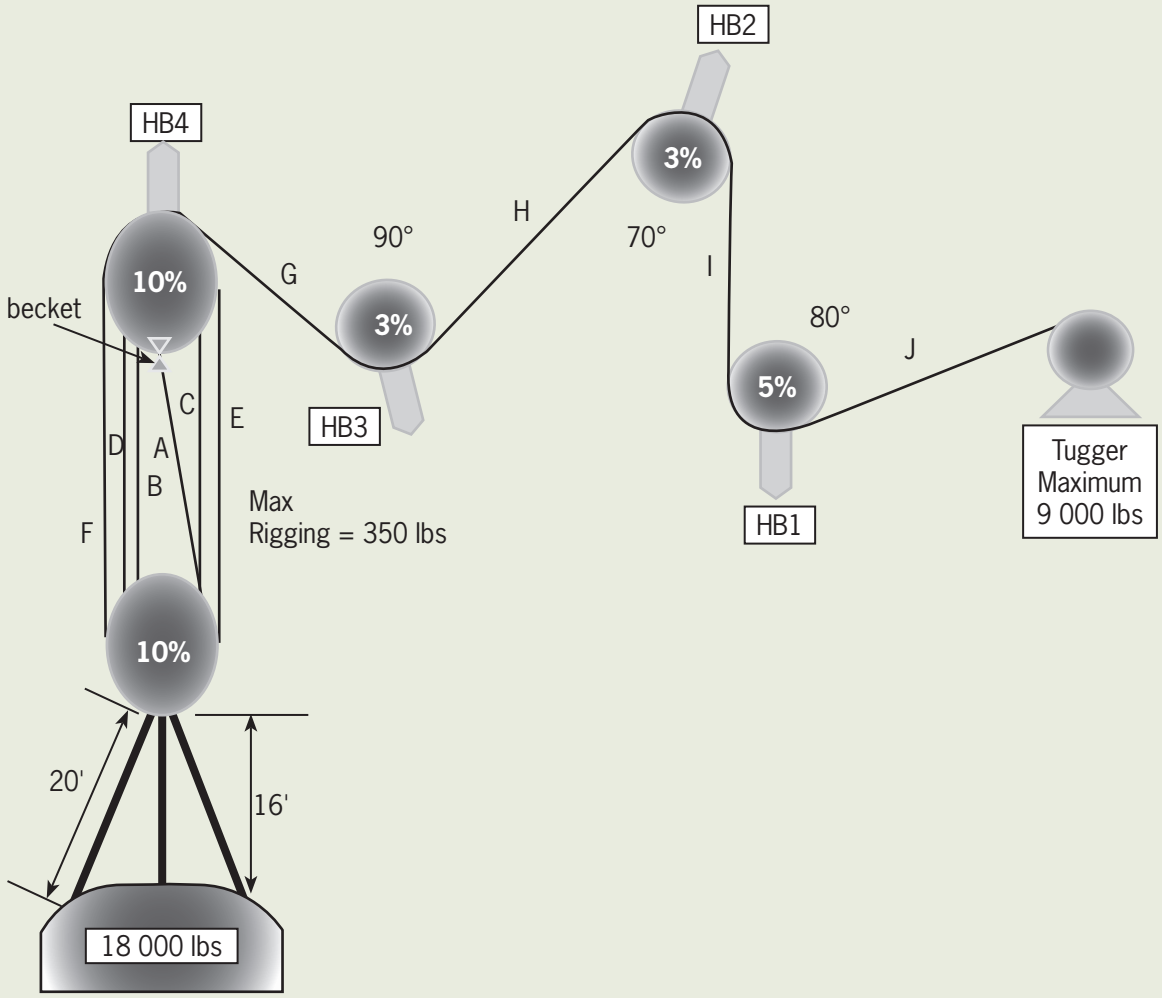
- Make multiple steps of calculations
- Translate problem into a set of mathematical operations using several steps of calculations and combinations of formulae.

# Calculating Sling Stress, Lead Line Pull, Holdback, and Wire Rope Diameter

Boilermakers must determine the forces on rigging hardware before performing lifts in order to select the correct components and ensure safety.

**Example:**

Calculate the sling stress, mechanical advantage, lead line pull, holdbacks, and determine the minimum wire rope diameter for the following rigging system. Round answers to four decimal places.




**Step 1:** Calculate the sling stress at the load.

$$\text{Sling Stress} = \frac{\text{Weight}}{\text{\# of legs}} \times \frac{\text{length of sling}}{\text{vertical}} = \frac{18\,000}{2} \times \frac{20}{16}$$

$$= 9\,000 \times 1.25$$

$$= \mathbf{11\,250\ lbs}$$

*Note: Always calculate based on two legs, regardless of the actual number of legs.*

**Step 2:** Determine the mechanical advantage (MA).
Count the number of lines supporting the load.
**MA = 6**

**Step 3:** Calculate the lead line pull (LLP).
Part of the lifting force is lost due to friction. The blocks have a 10% efficiency loss.
Always start calculation from the becket and work out to the lead line.

Load on each line in the block supporting the load = 18 000 ÷ MA
= 18 000 ÷ 6 = 3 000 lbs

*Note: In this example, both sheaves of the reeved system have a 10 % loss to friction. However, the sheaves may vary in reeved systems so be sure to use the correct percentage of friction for each sheave.*

Line A = 3 000 lbs
Line B = 3 000 lbs × 1.1 = 3 300 lbs
Line C = 3 300 lbs × 1.1 = 3 630 lbs
Line D = 3 630 lbs × 1.1 = 3 993 lbs
Line E = 3 993 lbs × 1.1 = 4 392.3 lbs
Line F = 4 392.3 lbs × 1.1 = 4 831.53 lbs
Line G = 4 831.53 lbs × 1.1 = 5 314.683 lbs

The snatch block used to calculate H and I has a 3% efficiency loss.
Line H = 5 314.683 lbs × 1.03 = 5 474.1235 lbs
Line I = 5 474.12349 lbs × 1.03 = 5 638.3472 lbs

The snatch block used to calculate J has a 5% efficiency loss.
Line J = 5 638.3472 lbs × 1.05 = 5 920.2646 lbs

**The lead line pull (LLP) is 5 920.2646 lbs.**

**Step 4:** Calculate the holdback (HB).
The stress on the snatch block varies with the angle between the lead and load lines.
Always start calculation from the tugger and work toward the becket.
Use the table titled Multiplication Factors for Snatch Block Loads.

Load on the block
= LLP leading into the snatch block from the direction of the tugger × Multiplication factor for the angle between the lead and load lines

At 80° the load on HB 1 = J × 1.53
= 5 920.2646 lbs × 1.53 = **9 058.0048 lbs**

At 70° the load on HB 2 = I × 1.64
= 5 638.3472 lbs × 1.64 = **9 246.8894 lbs**

At 90° the load on HB 3 = H × 1.41
= 5 474.1235 lbs × 1.41 = **7 718.5141 lbs**

For the block supporting the load, the holdback is calculated differently than for the snatch blocks.

Load on HB 4
= load weight + LLP at G + weight of the rigging
= 18 000 lbs + 5 314.683 lbs + 350 lbs = **23 664.683 lbs**

**Step 5:** Determine the minimum wire rope diameter required.
Use the table titled *WIRE ROPE SLINGS* and the column for Single Vertical Hitch because it is a single line at the tugger.

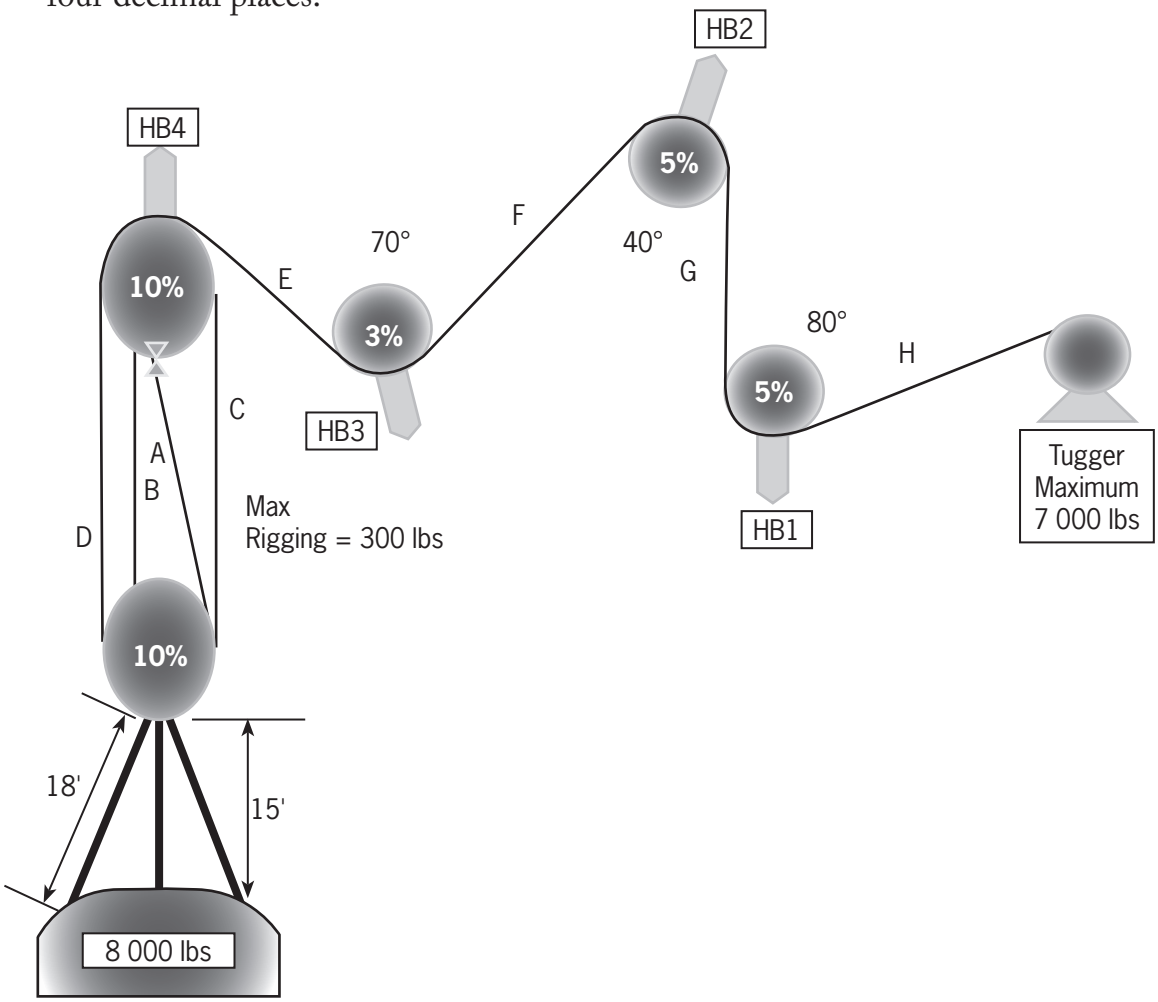
Use the LLP at the tugger or the Tugger maximum, whichever is smaller.

5 920.2646 lbs (LLP at the tugger) is less than 9 000 lbs (Tugger Maximum). Therefore, use the LLP at the tugger.

**The minimum wire rope diameter to use is $\frac{5}{8}$".**

## Practice:

1) Calculate the sling stress, mechanical advantage, lead line pull, holdbacks, and the minimum wire rope diameter for the following rigging system. Round answers to four decimal places.



# Bricklayers

Bricklayers build and repair floors, walls, arches, pavings, chimneys and fireplaces. They work with bricks, concrete blocks, natural and manufactured stone, precast masonry panels, membranes and insulation. Bricklayers work in industrial, commercial, residential and institutional settings. They may specialize in stonework, ornamental or restoration work, or may install and maintain refractory brick in high-temperature boilers or furnaces.

## Activities

This activity provides practice reading a section of text with the intent to answer review questions.

- Checking for Understanding: Textbook Section Review Questions

## National Occupational Analysis (NOA)

The NOA has identified the following tasks as being required for a fully competent tradesperson in this trade:

- Builds hearth and firebox
  - Knowledge of how fireplaces operate
  - Knowledge of flues
  - Ability to calculate size of firebox
- Builds chimney, damper and flue lining
  - Knowledge of types and sizes of flues and fireboxes
  - Ability to calculate size of firebox

## Essential Skills Highlights

This activity combines Reading, Document Use and Numeracy skills at Levels 3 and 4.

Reading and Document Use

- Locate and integrate multiple pieces of information from dense text and diagrams
- Identify relevant and irrelevant information
- Read the whole text to understand and to learn

Numeracy

- Make multiple steps of calculations
- Use simple operations and formulae with some translation to turn a problem into a mathematical operation

## Checking for Understanding: Textbook section review questions

Use the *Textbook of Canadian Masonry*, pages 204 - 209 to answer the following questions.

1) List three things that are needed to start and maintain a successful fire.

2) What two parts of a fireplace are lined with firebrick?

3) What two parts support the chimney?

4) There is a note at the end of the section on the FRESH AIR INLET. Where do you think you would find the information for this note?

5) The LINTEL supports the masonry above the fireplace opening. What supports the ends of the lintel?

6) The THROAT and DAMPER are sometimes called the CONNECTION. What does the THROAT connect in a fireplace and chimney?

7) Why should the DAMPER be closed when a fireplace is not being used?

8) What is the purpose of the FLASHING?

9) Draw the direction of downdrafts redirected by the smoke shelf in the diagram of a fireplace and chimney.

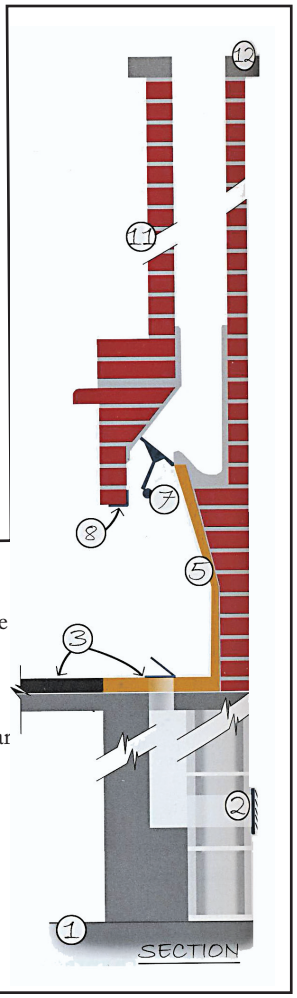



FIGURE 12-3
Section of a standard fireplace and chimney.

1. Footing
2. Fresh air intake vent
3. Outer hearth and inner hear
5. Firebox
7. Damper
8. Lintel
9. Smoke chamber
10. Flue
11. Solid masonry
12. Chimney cap

# Carpenters - Scaffolders

*(Training is also delivered by other trades)*

Scaffolders lay out, assemble, erect, use, maintain and dismantle scaffolding including access scaffold, shoring, falsework, bleachers and stages.

## Activities

This activity provides practice locating and using information in health and safety regulations.

- Using Occupational Health and Safety Regulations

## Jurisdictional Requirements

Jurisdictional requirements include:

- Applies codes, regulations and standards
  - Knowledge of the Occupational Health and Safety (OH&S) Act and Regulations
  - Ability to comply with codes, regulations and standards
- Erects access structures
  - Knowledge of types of access scaffolds such as wooden, welded frame, tube and clamp, system, and rolling

## Essential Skills Highlights

This activity uses Reading and Document Use at Level 3.

Reading and Document Use

- Read more complex text with legal language to locate multiple pieces of information
- Identify relevant and irrelevant information

## Using Occupational Health and Safety Regulations

Use the Occupational Health and Safety regulations to answer the following questions.

1) When is an employer or contractor required to provide a scaffold?

2) List three types of scaffold that are only used as light-duty scaffolds.

3) List four types of scaffolds that may be used as other than light duty if designed by an engineer.

4) Which clause gives the minimum working load for light-duty scaffolds?

5) What is the minimum working load required for every heavy-duty scaffold?

6) How are freestanding scaffolds restrained from overturning?

7) How must scaffolds built from the ground be supported against lateral movement?

8) List the two pieces of information employers must provide workers who work on a scaffold.

9) A scaffold is 8 metres high. What must the employer install for hoisting materials?

10) What is the topic of Clause 174?

11) What is the maximum span between vertical supports on a light-duty scaffold for a wooden plank?

12) What is the minimum width of a scaffold platform on a heavy-duty scaffold?

13) What is the minimum structural grade spruce lumber required to construct a wooden scaffold?

14) What information is provided in Table 15?

15) What is a gusset?

16) What are the minimum dimensions for the uprights for a double pole wood scaffold that is less than 6 metres in height?

(z) **"temporary supporting structure"** means a falsework, form, flyform deck panel, shoring, brace or cable that is used to support a structure temporarily or to stabilize materials or earthworks until the materials or earthworks are self-supporting or the instability is otherwise overcome, and includes metal scaffold components;

(aa) **"tube and clamp scaffold"** means a platform that is supported by steel or aluminum tubes with wedge or bolt clamp connectors and accessories;

(bb) **"tubular frame scaffold"** means a platform that is supported by welded tubular frames, cross-braces and accessories;

(cc) **"upright"** means a vertical scaffold member that transmits the load to the ground, and includes posts, verticals and standards;

(dd) **"working load"** means the total of the loads from workers, materials, equipment and work processes.

4 Oct 96 cO-1.1 Reg 1 s168.

**Scaffold required**

**169** Where work cannot be safely done from the ground or from a permanent structure, an employer or contractor shall provide a scaffold or other safe working platform or a ladder that meets the requirements of Part XVI for the use of workers.

4 Oct 96 cO-1.1 Reg 1 s169.

**Prohibition**

**170** No employer or contractor shall require or permit a worker to use a needle-beam scaffold or a suspended outrigger scaffold as a work platform.

4 Oct 96 cO-1.1 Reg 1 s170.

**Limited use of certain scaffolds**

**171**(1) An employer or contractor shall ensure that the following types of scaffolds are used only as light-duty scaffolds:

(a) half-horse scaffolds;

(b) ladderjack scaffolds;

(c) single-pole scaffolds.

(2) An employer or contractor shall ensure that the following types of scaffolds are used only as light-duty scaffolds unless the scaffold is designed by a professional engineer and constructed, erected, used, maintained and dismantled in accordance with that design:

(a) bracket scaffolds;

(b) outrigger scaffolds;

(c) suspended scaffolds;

(d) suspended powered scaffolds.

4 Oct 96 cO-1.1 Reg 1 s171.

# Crane Operators

Crane Operators perform lifts and hoists, place and secure loads, set up and take down cranes, and plan lifts and crane procedures.

## Activities

All three activities in this section provide strategies and practice using load charts. The information in each of the load charts is displayed differently.

- Lifting Capacities RT522
  Use a load chart to calculate net capacity
- Elliot 1881 Load Specifications
  Use a load chart to calculate net capacity
- Folding Boom Crane
  Use a load chart to calculate net capacity

## National Occupational Analysis (NOA)

The NOA has identified the following tasks as being required for a fully competent tradesperson in this trade:

- Interpret load charts and load study drawings to configure crane for workplace operation

## Essential Skills Highlights

These activities combine Document Use and Numeracy skills at Level 4.

Document Use

- Locate and integrate information from complex information displays including multiple tables, legends and notes
- Match between given and required information is not always exact and requires specialized information and inference

Numeracy

- Data Analysis: make comparisons to determine which radius, boom length or angle to use to locate the required information
- Measurement and Calculation: use simple operations (adding and subtracting) with some translation to turn a problem into a mathematical operation

# Lifting Capacities RT522

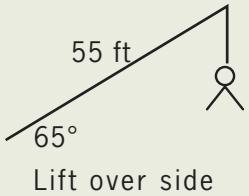
Use Lifting Capacities from the RT522 Load Chart to answer the following questions.

## Example:

**What is the net capacity based on the configuration below?**

- on fully extended outriggers
- lift over the side
- 55 ft of boom extended
- boom angle 65 degrees
- 23 ft jib stowed
- 22 ton 3 sheave block
- Rigging: 90 lbs

**Step 1: Draw a diagram. Label diagram with given information.**




**Step 2: Calculate the total deductions.**

All load handling devices and boom attachments are considered part of the load. There are three deductions:

- 23 ft jib stowed: 381 lbs
- 22 ton 3 sheave block: 490 lbs
- Rigging: 90 lbs

Locate in tables titled 23 ft. JIB with 28 - 70 ft. BOOM and HOOK BLOCKS

Given information

Total deductions = 381 + 490 + 90
= 961 lbs

WEIGHT REDUCTIONS FOR LOAD HANDLING DEVICES

| 23 ft. JIB with 26-70 ft. Boom |
|---|
| * Stowed — 381 lbs.<br>* Erected — 1,950 lbs. |

| 23-38 ft. TELE JIB with 28-70 ft. Boom |
|---|
| * Stowed — 604 lbs.<br>* Erected (Retracted) — 3,659 lbs.<br>* Erected (Extended) — 4,583 lbs. |

* Reduction of boom capacities.

| HOOK BLOCKS | |
|---|---|
| 22 Ton, 3 Sheave | 490 lbs. |
| 15 Ton, 2 Sheave | 300 lbs. |
| 12 Ton, 1 Sheave (15 7/8" OD) | 400 lbs. |
| 12 Ton, 1 Sheave (12 1/8" OD) | 285 lbs. |
| Auxiliary Boom Head | 100 lbs. |
| 5 Ton Headache Ball | 150 lbs. |

Note: All Load Handling Devices and Boom Attachments are Considered Part of the Load and Suitable Allowances MUST BE MADE for Their Combined Weights. Weights are for Grove furnished equipment.

**STEP 3: Locate the gross capacity (GC).**
Use the table titled ON OUTRIGGERS FULLY EXTENDED - 360°.

ON OUTRIGGERS FULLY EXTENDED - 360°

| Radius in Feet | Boom Length in Feet | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 28 | 34 | 40 | 46 | 52 | 58 | 64 | 70 |
| 10 | 44,000 (64) | 36,000 (69) | 36,000 (73) | | | | | |
| 12 | 40,000 (59.5) | 36,000 (65.5) | 36,000 (70) | 35,000 (73) | | | | |
| 15 | 31,000 (51.5) | 31,000 (59.5) | 30,700 (65) | 29,850 (69) | 29,150 (72) | 28,600 (74.5) | | |
| 20 | 23,200 (36.5) | 23,200 (49) | 23,200 (57) | 23,200 (62) | 23,000 (66) | 22,600 (69.5) | 22,150 (72) | 20,500 (74) |
| 25 | 17,950 (6) | 17,950 (36) | 17,950 (47.5) | 17,950 (54.5) | 17,950 (60) | 17,950 (64) | 17,950 (67) | 17,650 (69.5) |
| 30 | | 13,470 (15.5) | 13,470 (36.5) | 13,470 (46.5) | 13,470 (53) | 13,470 (58) | 13,470 (62) | 13,470 (65) |
| 35 | | | 10,220 (20) | 10,220 (36.5) | 10,220 (45.5) | 10,220 (51.5) | 10,220 (56.5) | 10,220 (60) |
| 40 | | | | 8,010 (23) | 8,010 (36.5) | 8,010 (45) | 8,010 (50.5) | 8,010 (55) |
| 45 | | | | | 6,530 (25) | 6,530 (37) | 6,530 (44.5) | 6,530 (49.5) |
| 50 | | | | | | 5,430 (26.5) | 5,430 (37) | 5,430 (43.5) |
| 55 | | | | | | 4,440 (3.5) | 4,440 (28) | 4,440 (37) |
| 60 | | | | | | | 3,620 (13) | 3,620 (28.5) |
| 65 | | | | | | | | 2,980 (15.5) |
| Min. boom angle (deg.) for indicated length [No Load] | | | | | | | | 0 |
| Max. boom length (ft.) at 0 degree boom angle [No Load] | | | | | | | | 70.0 |

NOTE: Boom Angles are in degrees. A6-829-003710 & -003716G

55 ft is between columns so go to the next longer boom length

65 degrees does not match the load chart. Go to the next lowest angle.

*Note: When either boom length or radius or both are between values listed, use the smallest load shown at either the next larger radius or boom length. When the angle is between the values listed, use the next lower angle.*

The gross capacity at a boom angle of 65° and 55 ft of boom is 17 950 lbs.

**STEP 4: Calculate the net capacity.**
Net Capacity = Gross Capacity – Deductions
= 17 950 lbs – 961 lbs
= **16 989 lbs**

## Practice:

1) What is the weight deduction for the 23-38 ft tele. jib with 28 – 70 ft boom when it is stowed?

2) How much does a 5 ton headache ball weigh?

3) Which load chart should be used for loads lifted over the side?

4) What is the gross capacity at a 30 ft radius and 62 ft boom length with outriggers fully extended and lifting over the side?

5) What is the maximum radius a gross load of 17 000 lbs can be placed over the side with a 52 ft boom length at an angle of 60°?

6) What is the maximum radius a gross load of 14 000 lbs can be placed over the front with a 59 ft boom length at an angle of 65°?

7) What is the net capacity of the crane based on the configuration below?

- outriggers fully extended
- lift over the side
- 58 ft of boom extended
- 35 ft radius
- 3 sheave 22 ton block
- 23 ft jib stowed
- rigging: 90 lbs

8) What is the net capacity of the crane based on the configuration below?

- outriggers fully extended
- over the front
- 60 ft of boom extended
- 20 ft radius
- 3 sheave 22 ton block
- 23 ft jib stowed
- rigging: 75 lbs

# Floorcovering Installers

Floorcovering Installers install, repair and replace finishing surfaces such as carpet, hardwood, laminate and cork flooring, linoleum, vinyl and other types of floor coverings in residential, commercial, industrial and institutional buildings. They also inspect, measure and clean the surfaces to be covered before installing the floor covering.

## Activities

The activity in this section provides practice determining the order to install cuts of carpet so that it is easier to match patterns and seams.

- Determing Cut Order

## National Occupational Analysis (NOA)

The NOA has identified the following tasks as being required for a fully competent tradesperson in this trade:

- Ability to position carpet widths with respect to pile direction and pattern
- Knowledge of carpet layout considerations such as dye lot sequence, direction of pile lay and locations of seams, fills and cross seams
- Knowledge of carpet pattern repeats

## Essential Skills Highlights

This activity combines Reading, Document Use and Numeracy at Level 2.

Reading and Document Use

- Locate information in text and diagrams

Numeracy

- use simple operations with some translation to turn a problem into a mathematical operation

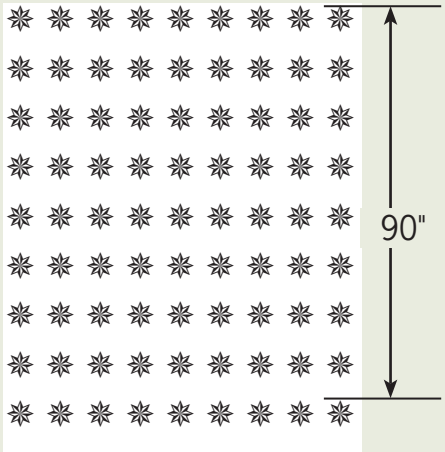
## Determining Cut Order

Floor covering installers match patterns and seams in carpets to determine the order cuts will be installed. Carpets with patterns contain a design that repeats at regular intervals in both the width and the length of the carpet. They measure the distance from one point of the design to the next identical point in the length of carpet. This measurement is called the repeat. This exercise shows how to measure repeat variations and determine the order to install the cuts of carpet.

Cuts taken from the same roll of carpet may have different elongation measurements. That is, there may be differences in the length of the pattern repeat. Positioning sections with similar elongation makes it easier to match the pattern repeat. When installing the carpet it is possible to stretch carpet to match the pattern. It is much more difficult to shrink the carpet to match the pattern.

### Example:

**Step 1:** Determine the length of the repeat.




**Step 2:** Measure the repeat for each cut.

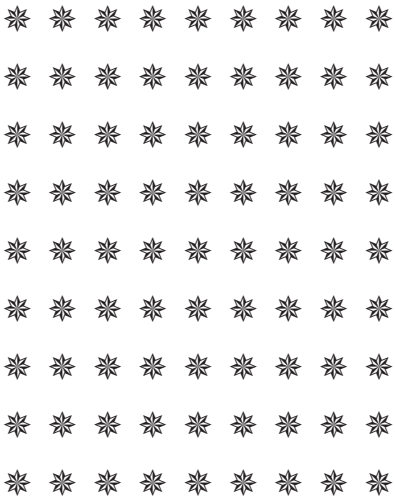
| | | | |
|---|---|---|---|
| Cut 1 = $90\frac{3}{4}$" | Cut 2 = $90\frac{1}{4}$" | Cut 3 = 90" | Cut 4 = $90\frac{1}{2}$" |

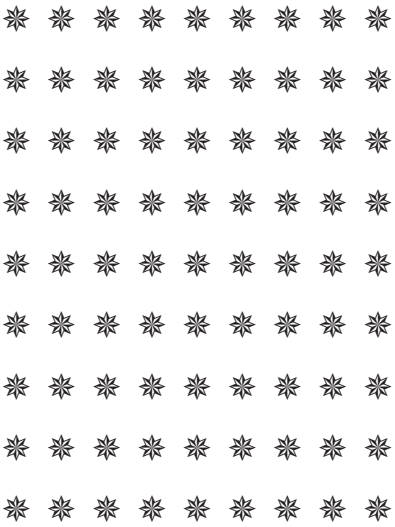
**Step 3:** Sequence the cuts. Manufacturers often recommend installing the cut with the largest pattern repeat first, then the next largest repeat and so on.

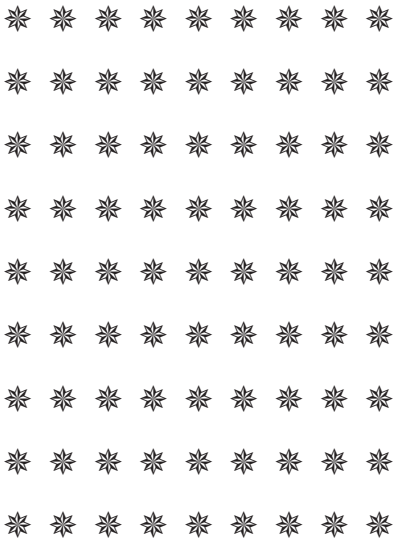
| Cut 1 = $90\frac{3}{4}$" | Cut 4 = $90\frac{1}{2}$" | Cut 2 = $90\frac{1}{4}$" | Cut 3 = 90" |
|---|---|---|---|
| Installed first | Installed second | Installed third | Installed last |

## Practice:

1) Each group of patterns represents a cut of carpet. Measure the pattern repeat on each of the cuts. Then sequence the cuts for ease of installation.



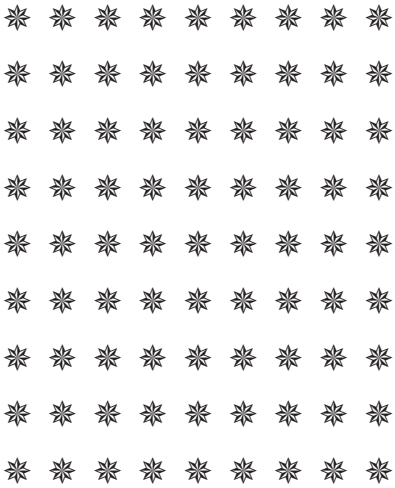


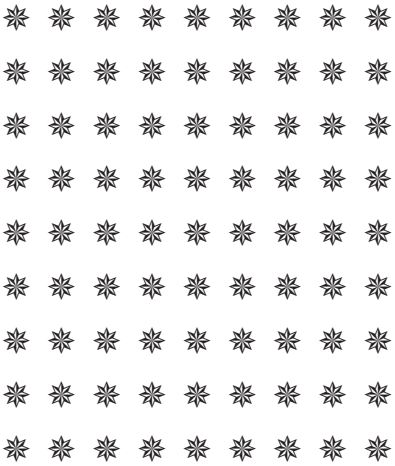


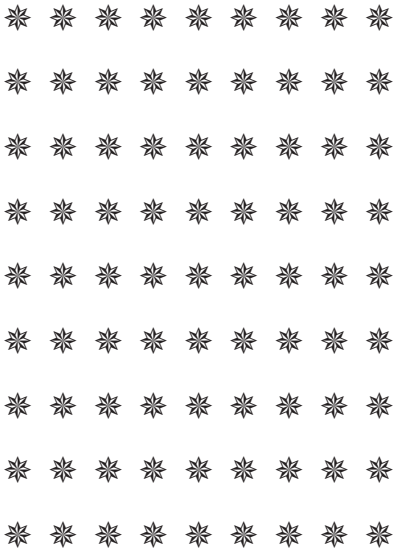
Cut #1 = _____mm

Cut #2 = _____mm

Cut #3 = _____mm







Cut #4 = _____mm

Cut #5 = _____mm

Cut #6 = _____mm

| Cut #_____ | Cut #_____ | Cut #_____ | Cut #_____ | Cut #_____ | Cut #_____ |
|---|---|---|---|---|---|
| | | | | | |

# Glaziers

Glaziers prepare, install, and repair glass and glass substitutes in commercial, residential, and transportation applications. This includes such installations as doors, windows, curtain wall framing, skylights, shower enclosures and glass railings. They fabricate architectural metal components in entranceways, windows, skylights and curtain walls. Glaziers are employed by construction glass installation contractors, fabrication shops, retail service and repair shops, or can be self-employed.

## Activities

The four activities in this section provide strategies and practice using trigonometry to calculate segmented window openings.

- Trigonometry for Radius Frames 3
  Uses trigonometry to calculate half a segment of a segmented window opening, given the inner radius
- Trigonometry for Radius Frames 4
  Uses trigonometry to calculate the length of the outer sill of a segmented window opening, given the outer radius
- Trigonometry for Radius Frames 5
  Uses trigonometry to calculate the length of the outer sill, given the outer radius when the opening of the radius frame is not 90°
- Trigonometry for Radius Frames 8
  Uses trigonometry to calculate the lengths of the sill segment and glass lite

## National Occupational Analysis (NOA)

The NOA has identified the following tasks as being required for a fully competent tradesperson in this trade:

- Interpret plans, drawings and specifications
  - ability to perform mathematical calculations
- Use documentation and reference material
  - ability to complete work-related documents such as cut lists, work orders, log books, and time sheets

## Essential Skills Highlights

These activities combine Document Use and Numeracy at Level 4.

Document Use

- Locate and integrate information on diagrams
- Refer to complex assembly drawings integrating text and drawings

Numeracy

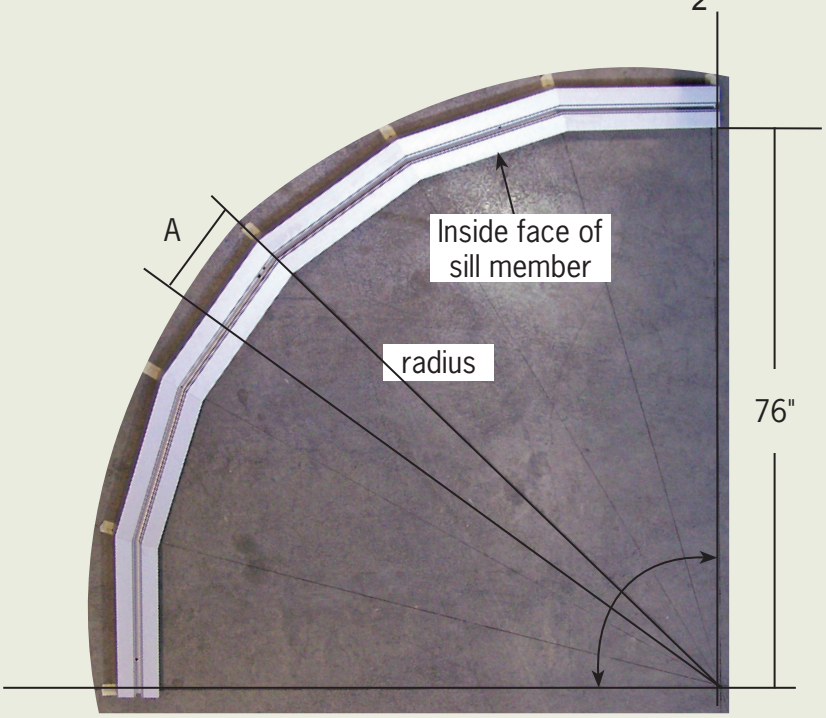
- Make multiple steps of calculations
- Translate problems into a set of mathematical operations using several steps of calculations and a combination of formulae

# Trigonometry for Radius Frames 3

This worksheet gives you practice calculating half a segment of a segmented window opening, given the inner radius.

**Example:**

Calculate the length of dimension A to the nearest 16th of an inch. The inner radius of the segmented window is 76 inches. The sill is $4\frac{1}{2}$" wide.




**Step 1:** Calculate the outer radius, including the width of the sill.

$76" + 4\frac{1}{2}" = 80\frac{1}{2}" = 80.5"$

*Note: The radius is the hypotenuse of the right triangle you work with using trigonometry.*

**Step 2:** Calculate the angle of the segment. There are six window segments in the 90° opening.

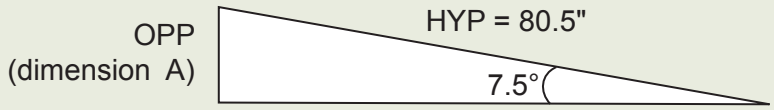
*Note: The number of segments in an opening may vary.*

$90° \div 6 = 15°$

The segment is bisected into two right angle triangles.

$15° \div 2 = 7.5°$

**Step 3:** Calculate the length of Dimension A, which is the OPPOSITE side.




know HYP = 80.5"
angle = 7.5°

need: OPP

Therefore, use sine function.

OPP = Sin × HYP

= (sin 7.5) × 80.5 = 10.50735847 = $10\frac{1}{2}$"

**Dimension A measures $10\frac{1}{2}$"**

1) Calculate the length of dimension A (to the nearest 16th of an inch) if the inner radius is 68 inches. The sill is $4\frac{1}{2}$" wide.