ROYAL CANADIAN ARMY CADETS

GREEN STAR

INSTRUCTIONAL GUIDE

SECTION 3

EO M121.03 – TIE KNOTS AND LASHINGS

Total Time:	90 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-701/PG-001, *Green Star Qualification Standard and Plan*, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

PRE-LESSON ASSIGNMENT

Nil.

APPROACH

An interactive lecture was chosen for TPs 1 and 2 to introduce the cadets to the types and the care and maintenance of ropes.

A demonstration and performance was chosen for TP 3 as it allows the instructor to explain and demonstrate how to tie various knots, while providing an opportunity for the cadets to practice under supervision.

INTRODUCTION

REVIEW

Nil.

OBJECTIVES

By the end of this lesson the cadet shall be expected to tie various knots and lashings, to include:

- Thumb (overhand);
- Reef (Square);
- Figure of eight;
- Double figure of eight (figure of eight loop, follow through / rewoven, and figure of eight on a bight);
- Clove hitch; and
- Half hitch.

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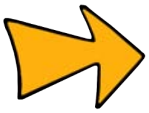
IMPORTANCE

Knots and lashings are all used for binding, building or securing. Cadets will need to use knots when erecting a shelter and building a tent site. As such, it is important to know how to tie knots properly and when and where they should be used.

Teaching point 1 **Explain types of ropes and their common uses.**

Time: 10 min Method: Interactive Lecture



All specialized terms used in this instructional guide are found in the glossary (Attachment A). This handout could be given to the cadets at the end of the lesson.

TYPES OF ROPE

Ropes are made with natural or synthetic fibres. Hemp and manila are the most common natural fibre ropes, although sisal, coir and cotton are also used. Natural fibres are often used in larger sizes for rope bridging because they have limited stretch and are easy to grip when wet.

Natural fibres

Hemp is obtained from the stem of the plant *Cannabis sativa*. This natural fibre makes one of the strongest natural-fibre ropes though it has a tendency to rot if left wet for long periods of time. Hemp ropes need to be frequently tarred – covered with tar, to help prevent rotting.

Manila is the fibre obtained from the wild banana plant, *Musa textiles*. This material is as strong as hemp and more resistant to rot, so it rarely needs to be tarred.

Sisal is a rope-making fibre derived from *Agave sisalana*, a cactus-type plant from Central America. It is weaker than manila or hemp and requires treating with chemicals to make it waterproof and rot-resistant.

Cotton is mainly used to make small ropes and twines. Cotton rots easily; therefore, it needs to be tarred.

Coir is a natural fibre derived from the outer part of the coconut. It is not a very strong material but it is light and has a high degree of stretch. It is the only natural-fibre rope that floats.

Synthetic fibres

Synthetic ropes are usually made from nylon, polyester or polypropylene. Synthetic ropes are generally stronger and lighter than natural ropes.

Nylon ropes are very strong (more than two and a half times the strength of hemp). This rope is mostly used when sudden shock loads may be applied, such as mooring ropes and climbing ropes. It is used for most fishing line when it is spun into a heavy monofilament yarn. Nylon ropes lose about 5 -10 % of their strength when wet. It wears very well, and is resistant to chafe, mildew and rot. Nylon is the strongest of the synthetic ropes.

Polyester, also known as Dracon or Terylene, is weaker than nylon but holds its strength when wet. It resists rot and chafe.

Polypropylene is not as strong as nylon and polyester, but is considerably cheaper. It is light so it will float, making it useful for rescue ropes and short mooring ropes. However, polypropylene does not resist abrasion well.

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Over the last few years, additional rope materials have been developed. They are lighter, stronger and have less stretch than most natural and synthetic fibres. These ropes are made of chemicals. Some of these rope materials are Kevlar, Tawron, Technora, Spectra, Dynema, Vectran and Zylon.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS:

Q1. What are two types of ropes?

Q2. What are some types of natural ropes?

Q3. How much strength does a nylon rope lose when wet?

ANTICIPATED ANSWERS:

A1. Natural and synthetic.

A2. Hemp, manila, sisal.

A3. 5 -10%.

Teaching point 2 **Explain the care and maintenance of ropes.**

Time: 5 min Method: Interactive Lecture

CARE AND MAINTENANCE OF ROPES

Ropes, like other pieces of equipment, require care and maintenance to ensure they are in good condition when needed. The following are some general guidelines for rope care:

Sunlight exposure: All ropes experience deterioration from exposure to ultraviolet sunlight. Ropes are to be stored in cool, dry, and dark locations.

Chemical or fume contamination: If a rope comes into contact with such a substance it may begin to deteriorate. If contaminated, wash with cold running water. Remove oil and grease with mild soap solution.

Storage: Ropes must be stored in bins, on raised surfaces, or hung where air can circulate freely. Ropes must be stored in cool, dry, dark locations to avoid sunlight and excessive heating. Excessive cold will make rope brittle.

Natural wear is unavoidable and, if not excessive, is harmless. Replace lines if approximately 20% wear is evident. Look for chafed areas, rot and fatigue. Serious damage can be seen when the strands are distorted and bear unequal strain.

Cleaning and drying: Depending on frequency of use, ropes should be cleaned according to current condition; a rope that is covered in mud and clay should be washed before its next use. To clean, wash in a sudsy tub of liquid detergent (detergent must be suitable for rope cleaning). Rinse, coil and hang to dry.

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General tips on rope care:

- Whip, melt (hot knife) or bind the rope ends to keep the rope from unravelling;
- Avoid snagging on, or dragging across, sharp rocks;
- Inspect the rope before and after use for damage;
- Do not step on a rope; and
- Distribute wear on the rope.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS:

Q1. What effect does sunlight have on ropes?

Q2. Where should ropes be stored?

Q3. When should a rope be discarded?

ANTICIPATED ANSWERS:

A1. All ropes experience deterioration from exposure to ultraviolet sunlight.

A2. Ropes must be stored in bins, on raised surfaces, or hung where air can circulate freely. Ropes must be stored in cool, dry, dark locations.

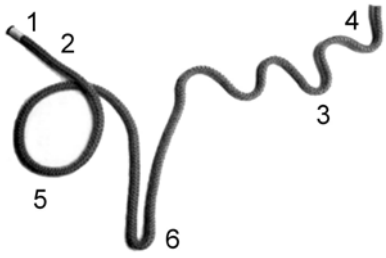
A3. When 20% wear is evident. Look for chafed areas, rot and fatigue.

Teaching point 3 **Explain and demonstrate how to tie knots.**

Time: 65 min Method: Demonstration and Performance

TYING KNOTS

Before teaching how to tie knots, the following terms shall be clarified, as they will be used to explain how to make the different knots.



Pocket Guide to Knots and Splices, by Des Pawson, 1991

Figure 1 Parts of a Rope

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1. **Working end** (running end) – The end of the rope that is used during the tying of the knot.

2. **Working part** (running part) – The short length of rope that is manipulated to make the knot.

3. **Standing part** – Part of the rope usually ‘stands still’ during the knot tying process. Often it is the longer end that leads away from the loop, bight or knot.

4. **Standing end** – The end of the rope that not immediately being used in the tying of a knot.

5. **Loop** (crossing turn) – A circle created in the process of tying a knot.

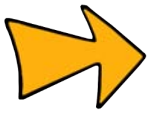
6. **Bight** – Middle part of a length of rope. This term also refers to a loop of rope that does not cross over itself.



These web pages have some excellent animated knots:

http://www.mistral.co.uk/42brghtn/knots/42ktmenu.html

http://www.korpegard.se



Cadets should be given two short ropes and two small poles in order to tie knots, hitches and lashings along with the instructor.

THUMB KNOT

- **Other names:** Overhand knot, Simple knot.
- **Uses:** Keep the end of a rope from unravelling or to stop a rope from passing through an eye.
- **Qualities:** Easy to make, stays in place.
- **Faults:** It is difficult to untie. An overhand knot in the middle of a length of rope will reduce the strength of the rope by about half.



The instructor shall provide an EXPLANATION and DEMONSTRATION of the complete skill.

The instructor shall also provide an EXPLANATION and DEMONSTRATION of each step required to effectively complete the skill.

Procedure:

1. Form a loop with the working end passing under the standing part of the rope (Diagram 2, Figure 1).

2. Tuck the working end down through the middle of the loop formed by the crossing turn and out of the loop (Diagram 2, Figure 2).

3. Pull both ends to tighten the knot.

4. As it is being tightened, the position of the knot can be moved nearer the end if so required (Diagram 2, Figure 3).

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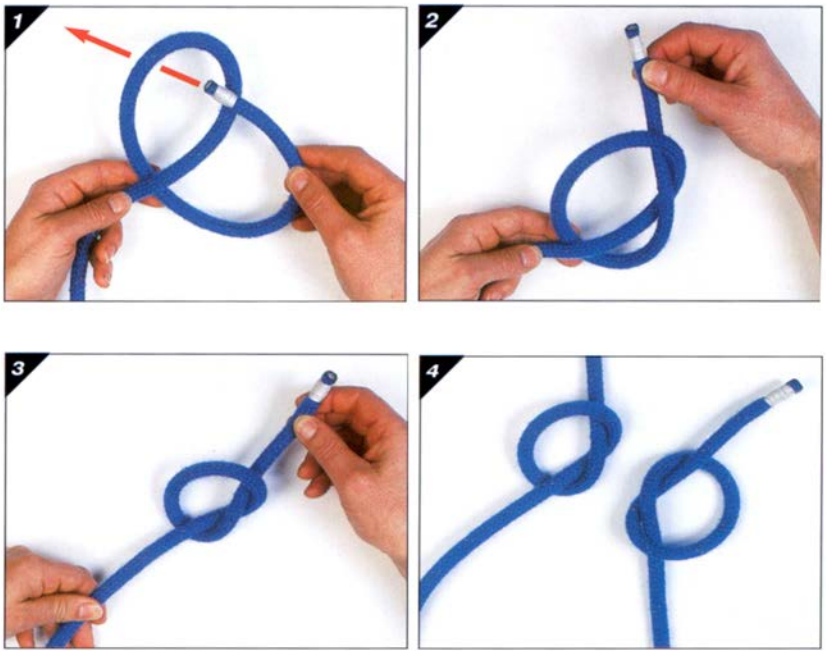

Pocket Guide to Knots and Splices, by Des Pawson, 1991

Figure 2 Thumb Knot

Cadets will IMITATE the demonstration provided by the instructor for each step within the skill. The instructor(s) will SUPERVISE the cadets during this imitation.

REEF KNOT

- **Other names:** Square knot, opposite knot.
- **Uses:** Joining two ropes of equal thickness. Also used in first aid for tying bandages.
- **Qualities:** Lies flat, holds well, and is easily untied.

The instructor shall provide an EXPLANATION and DEMONSTRATION of the complete skill. The instructor shall also provide an EXPLANATION and DEMONSTRATION of each step required to effectively complete the skill.

Procedure:

1. Take the running ends of two different ropes and place the left-hand working end across the right working end (Diagram 3, Figure 1).

2. Tuck the left-hand end under, and back up over the right end (Diagram 3, Figure 2).

3. Bring the two ends together again and place the right-hand end over the left-hand one (Diagram 3, Figure 3).

4. Tuck the right-hand end under and back up over the left-hand end (Diagram 3, Figure 4).

5. Dress the knot by pulling on both ends (Diagram 3, Figure 5).

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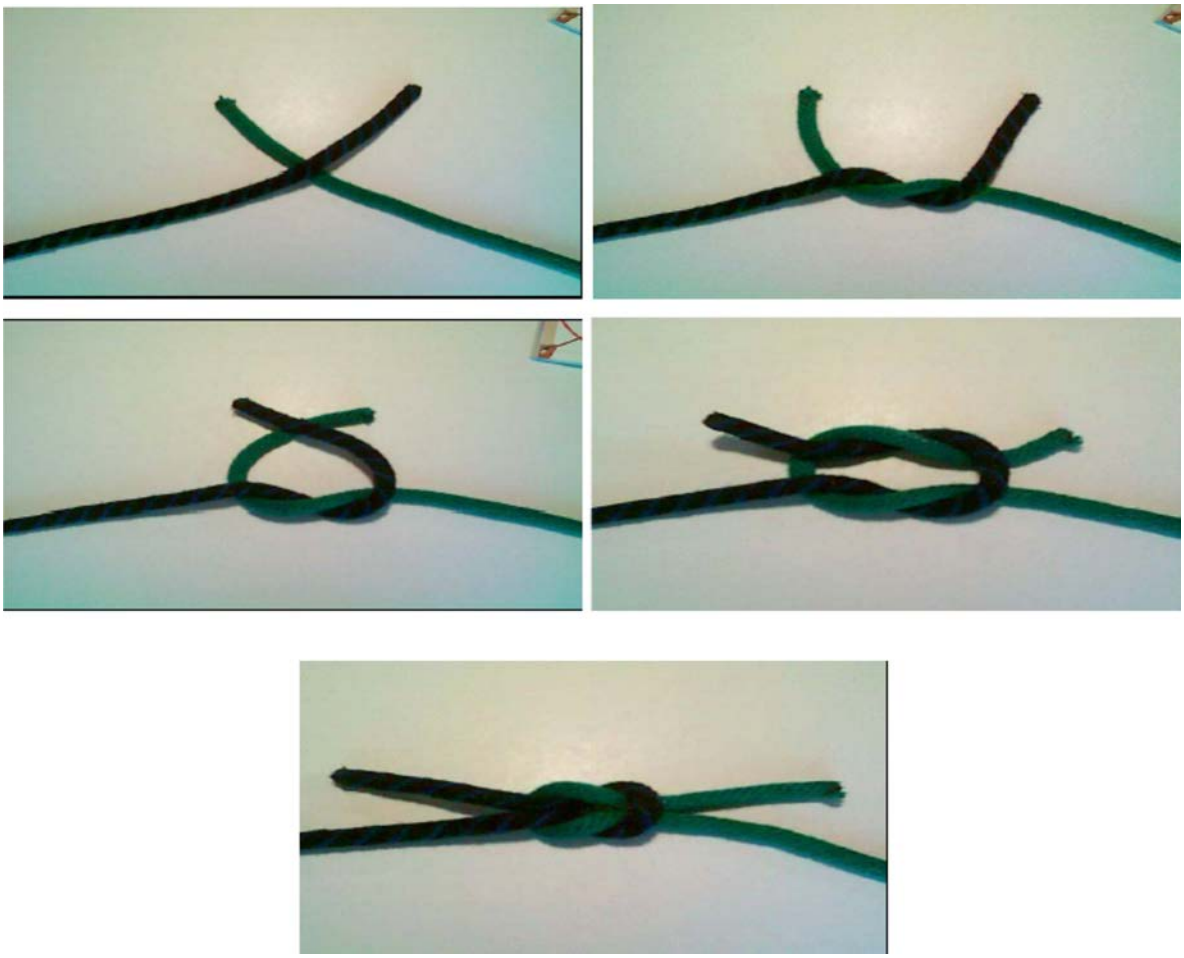

Figure 3 Reef Knot

When done correctly, the running end and the standing end of one rope are on the same side of the bight formed by the other rope. To tie this knot, a good trick is to say “left over right and right over left.”

Cadets will IMITATE the demonstration provided by the instructor for each step within the skill. The instructor(s) will SUPERVISE the cadets during this imitation.

FIGURE OF EIGHT KNOT

- **Uses:** Keep the end of a rope from unravelling or to stop a rope from passing through an eye.
- **Qualities:** Same uses as the thumb knot but bulkier and easier to undo.

The instructor shall provide an EXPLANATION and DEMONSTRATION of the complete skill.

The instructor shall also provide an EXPLANATION and DEMONSTRATION of each step required to effectively complete the skill.

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Procedure:

1. Start by forming a loop with the running end passing under the standing end, and then make a bight in the running end (Diagram 1, Figure 4).

2. Pass the running end in front of the standing end then thread it through the loop from the back (Diagram 2, Figure 4).

3. The knot should now have the figure eight, which gives it its name (Diagram 3, Figure 4).

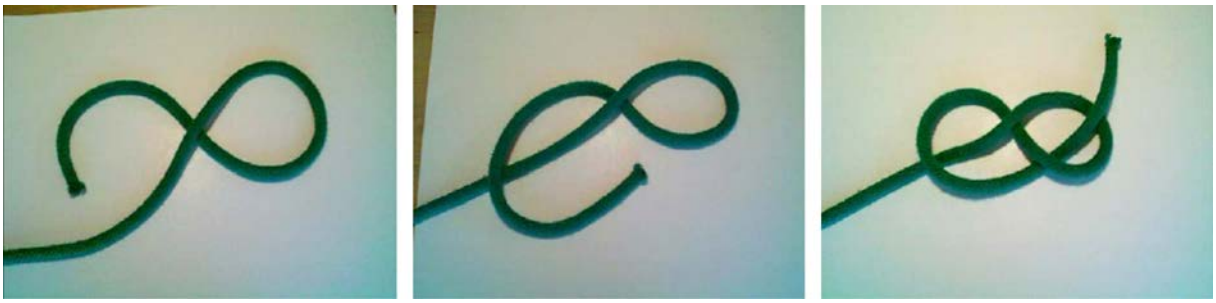

Figure 4 Figure of Eight Knot

Cadets will IMITATE the demonstration provided by the instructor for each step within the skill. The instructor(s) will SUPERVISE the cadets during this imitation.

DOUBLE FIGURE OF EIGHT

- **Other name:** Figure-of-eight loop.
- **Uses:** To anchor a rope around a tree trunk, pole or such item.
- **Qualities:** Will not slip and is easy to undo.

The instructor shall provide an EXPLAINATION and DEMONSTARTION of the complete skill.

The instructor shall also provide an EXPLINATION and DEMONSTARTION of each step required to effectively complete the skill.

Procedure: There are two methods to do this knot. However, the first one is the one to use to anchor the rope to a tall tree or wide pole or trunk (Diagram 5).

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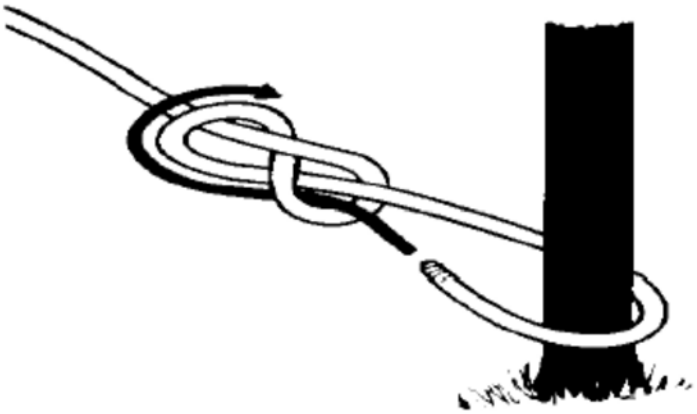

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Figure 5 Double Figure of Eight Knot

The steps for method #1 are:

1. Begin with a loose figure of eight knot (Diagram 6, Figure 1).
2. Guide the running end back up through the loop it just came down through (Diagram 6, Figure 2).
3. Have the running end trace alongside the rope in the original figure of eight under the standing end.
4. Have the running end follow the original figure of eight under the double rope (Diagram 6, Figure 3).
5. The running end follows the original figure of eight (Diagram 6, Figure 4).
6. Pull tight and dress knot by flattening it and making sure the ropes are side by side.

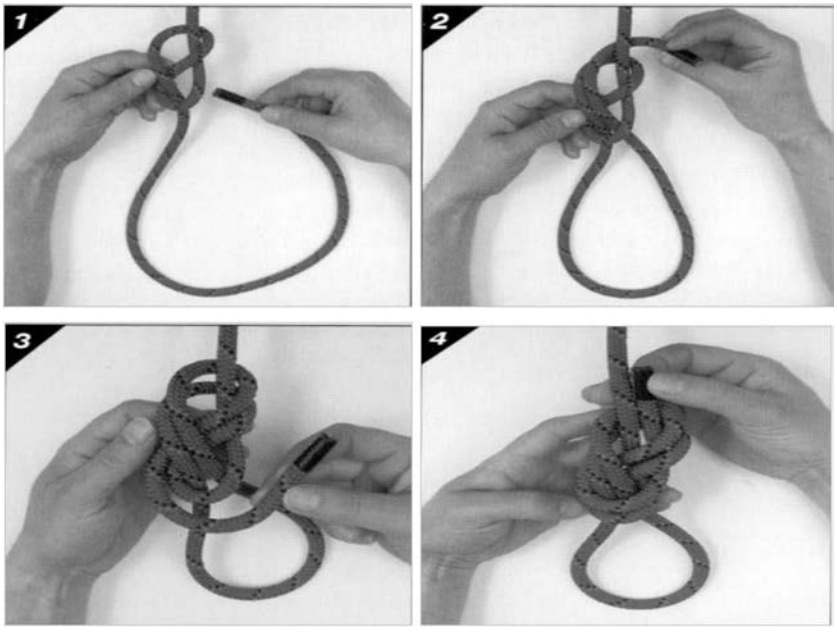

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Figure 6 Double Figure of Eight Knot, Method #1

The steps for method #2 are: double the rope and follow the steps to make a figure of eight knot. (See Diagram 7.)

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Figure 7 Double Figure of Eight Knot, Method #2

Cadets will IMITATE the demonstration provided by the instructor for each step within the skill. The instructor(s) will SUPERVISE the cadets during this imitation.

CLOVE HITCH

- **Uses:** To finish off knots like the round turn and two half hitches and the various types of lashings. To secure a rope to a spar, rail or similar fitting.
- **Qualities:** Quick and easy to tie. Can be made with the end or with the bight of the rope.



The instructor shall provide an EXPLANATION and DEMONSTRATION of the complete skill.

The instructor shall also provide an EXPLANATION and DEMONSTRATION of each step required to effectively complete the skill.

Procedure: There are two methods to tie a clove hitch; one using the end and the other using the bight.

The steps for tying a clove hitch using the end of the rope are:

1. Pass the running end of the rope over the rail from front towards the back.
2. Bring the running end under the rail and over the standing end towards the left.
3. Bring the running end over the spar to the left.
4. Bring the running end out under the rail and thread it up under the rope on the rail by the crossover.
5. Work the hitch tight with the running end and the standing end snug against each other.
6. Be sure to leave enough rope on the end so that it does not unravel.

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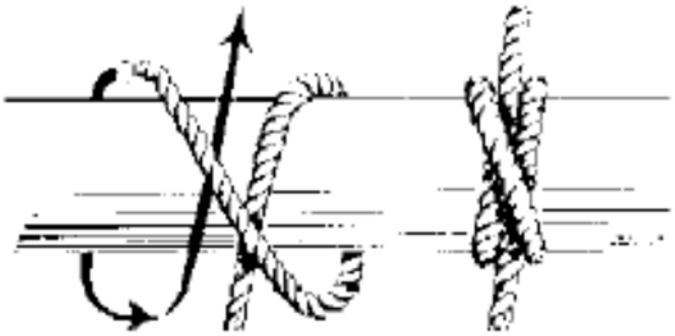

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Figure 8 Clove Hitch

The steps for tying a clove hitch using the bight are:

1. In the middle of the rope, make a crossing turn or half hitch, with the rope that comes from the left being on top.

2. To the right of the first crossing turn, make a half hitch with exactly the same configuration (Diagram 9, Figure 1).

3. Put the right-hand half hitch on top of the left-hand half hitch (Diagram 9, Figure 2).

4. The pair of hitches are now slipped over the top of the post (Diagram 9, Figure 3).

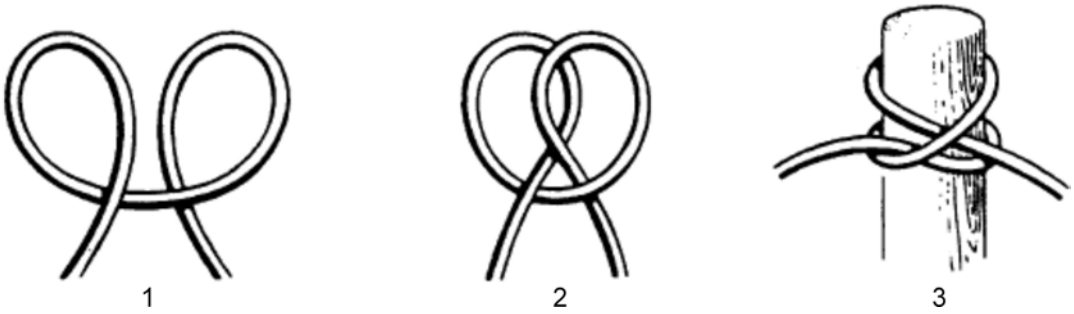

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Figure 9 Clove Hitch

Cadets will IMITATE the demonstration provided by the instructor for each step within the skill. The instructor(s) will SUPERVISE the cadets during this imitation.

HALF HITCH

- **Uses:** Make other knots stronger. Hang, tie or hook objects.
- **Quality:** Easy to make.
- **Fault:** Cannot support a lot of strain.

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The instructor shall provide an EXPLANATION and DEMONSTRATION of the complete skill.

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Procedure: Pass the rope around the pole and then behind the standing part and into the eye of the loop.



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Figure 10 Half Hitch

Cadets will IMITATE the demonstration provided by the instructor for each step within the skill. The instructor(s) will SUPERVISE the cadets during this imitation.

Give cadets handout B on knots, hitches, and lashings.

CONFIRMATION OF TEACHING POINT 3

QUESTION:

Q1. What is the fault of the half hitch?

Q2. Which knot will be used to anchor a rope to a tree trunk?

Q3. What are the two types of fibre that can be used to make ropes?

ANTICIPATED ANSWERS:

A1. Cannot support a lot of strain.

A2. Double figure of eight knot.

A3. Natural and synthetic fibres.

END OF LESSON CONFIRMATION

Cadets are to tie all knots, hitches and lashings learned in this EO.

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CONCLUSION

HOMEWORK/READING/PRACTICE

Nil.

METHOD OF EVALUATION

Nil.

CLOSING STATEMENT

Knots, hitches and lashings have many uses in the field and will prove necessary in various situations, such as erecting a shelter, building a bivouac site or constructing a rope bridge. It is therefore important to know how to tie the knots properly, as well as when and where they should be used.

INSTRUCTOR NOTES/REMARKS

Where possible, the instructor should demonstrate a variety of natural and synthetic types of ropes.

Cadets should be given the opportunity to tie knots during the bivouac FTX

REFERENCES

A0-004 B-GN-181-105/FP-E00 DMPPD 9-4. (1997). *CFCD 105 fleet seamanship rigging and procedures manual*. Ottawa ON: The Department of National Defence.

C2-007 0-7858-1446-9 Pawson, D. (2001). *Pocket guide to knots and splices*. Edison, NJ: Chartwell Books, Inc.

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Bight	Middle part of a length of rope. This term also refers to a loop of rope that does not cross over itself.
Chafe	Wear caused by abrasion.
Coil	Rope made up in neat series of circles usually for storage purposes.
Cordage	General term to cover all sorts and sizes of rope.
Crossing turn	A circle of rope made with the rope crossing over itself.
Eye	The hole inside a circle of rope; a permanent loop made at the end of a rope.
Mildew	Any fungus that attacks ropes when exposed to damp, resulting in a thin, furry, whitish coating or discoloration.
Standing end	The end of the rope not immediately being used in the tying of a knot.
Standing part	Part of the rope that usually “stands still” during the knot tying process. Often it is the longer end that leads away from the loop, bight or knot.
To tar	To cover a rope with a thick, sticky, brown to black liquid with a pungent odor, obtained by the destructive distillation of wood, coal, peat, shale, etc., to extend its life.
Working end	The very end of the rope that is used during the tying of the knot. Also called “running end.”
Working part	The short length of rope that is manipulated to make the knot. Also called “running part.”

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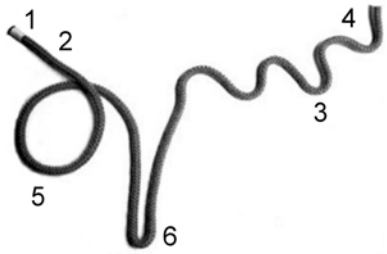

Pocket Guide to Knots and Splices, by Des Pawson, 1991

Figure B-1 Parts of a Rope

1. Working end (running end) – The end of the rope that is used during the tying of the knot.

2. Working part (running part) – The short length of rope that is manipulated to make the knot.

3. Standing part – Part of the rope that usually “stands still” during the knot tying process. Often it is the longer end that leads away from the loop, bight or knot.

4. Standing end – The end of the rope not immediately being used in the tying of a knot.

5. Loop (crossing turn) – A circle created in the process of tying a knot.

6. Bight – Middle part of a length of rope. This term also refers to a loop of rope that does not cross over itself.



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THUMB KNOT

- **Other names:** Overhand knot, Simple knot.
- **Uses:** Keep the end of a rope from unravelling or to stop a rope from passing through an eye.
- **Qualities:** Easy to make, stays in place.
- **Faults:** It is difficult to untie. An overhand knot in the middle of a length of rope will reduce the strength of the rope by about half.
- **Procedure:**

(1) Form a loop with the working end passing under the standing part of the rope (Figure B-2, image 1).
(2) Tuck the working end down through the middle of the loop formed by the crossing turn and out of the loop (Figure B-2, image 2).
(3) Pull both ends to tighten the knot. As it is being tightened the position of the knot can be moved nearer the end if so required (Figure B-2, image 3).

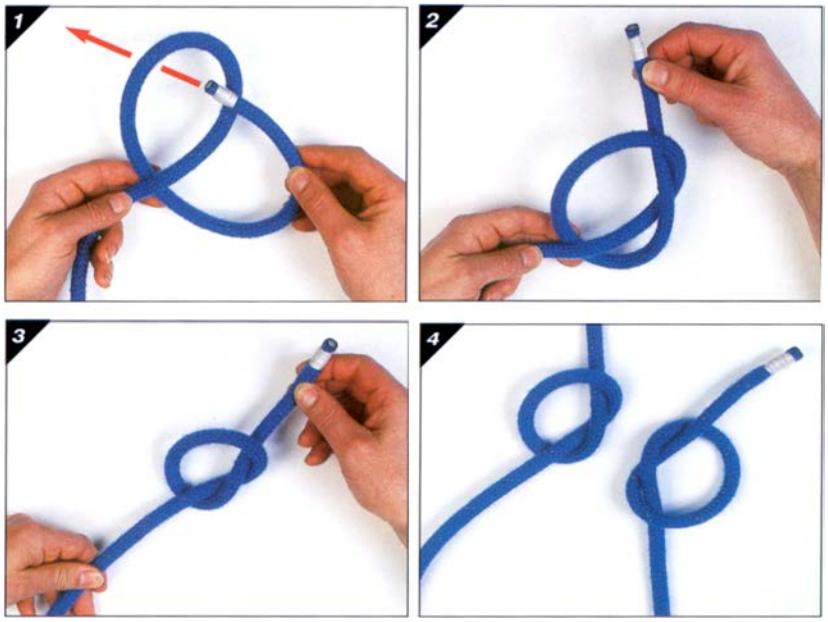

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Figure B-2 Thumb Knot

REEF KNOT

- **Other names:** Square knot, Opposite knot.
- **Uses:** Joining two ropes of equal thickness. Also used in first aid for tying bandages.
- **Qualities:** Lies flat, holds well and is easily untied.
- **Procedure:**

(1) Take the running ends of two different ropes and place the left-hand working end across the right working end (Diagram 3, Figure 1).
(2) Tuck the left-hand end under, and back up over the right end (Diagram 3, Figure 2).
(3) Bring the two ends together again and place the right-hand end over the left-hand end (Diagram 3, Figure 3).
(4) Tuck the right-hand end under and back up over the left-hand end (Diagram 3, Figure 4).

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(5) Dress the knot by pulling on both ends (Diagram 3, Figure 5).

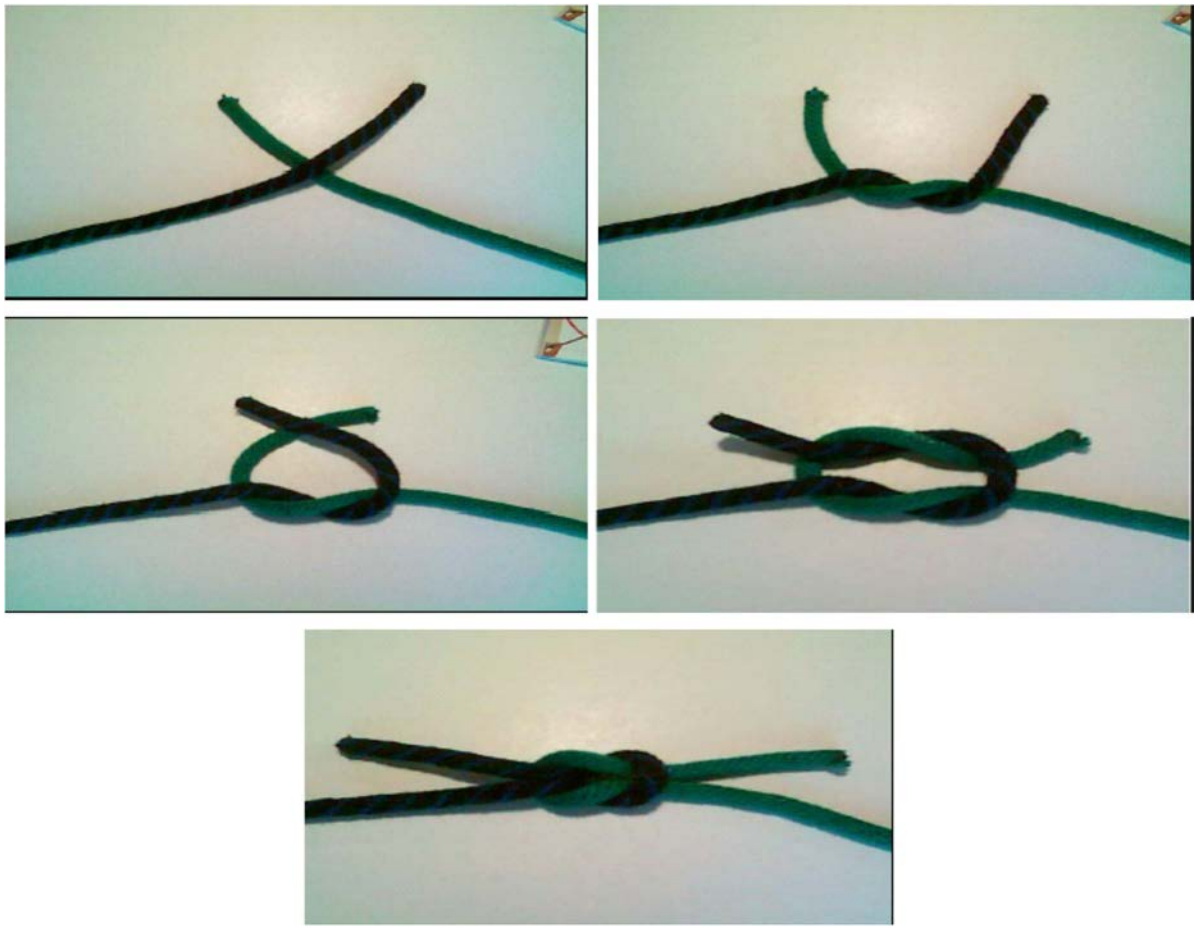

Figure B-3 Thumb Knot

When done right, the running end and the standing end of one rope come out on the same side of the bight formed by the other rope. To tie this knot, a good trick is to say “left over right and right over left.”

FIGURE OF EIGHT KNOT

- **Uses:** Keep the end of a rope from unravelling or to stop a rope from passing through an eye.
- **Qualities:** Same uses as the thumb knot but bulkier and easier to undo.
- **Procedure:**

(1) Start by forming a loop with the running end passing under the standing end, and then make a bight in the running end (Diagram 4, Figure 1).
(2) Pass the running end in front of the standing end then thread it through the loop from the back (Diagram 4, Figure 2).
(3) The knot should now have the figure eight, which gives it its name (Diagram 4, Figure 3).

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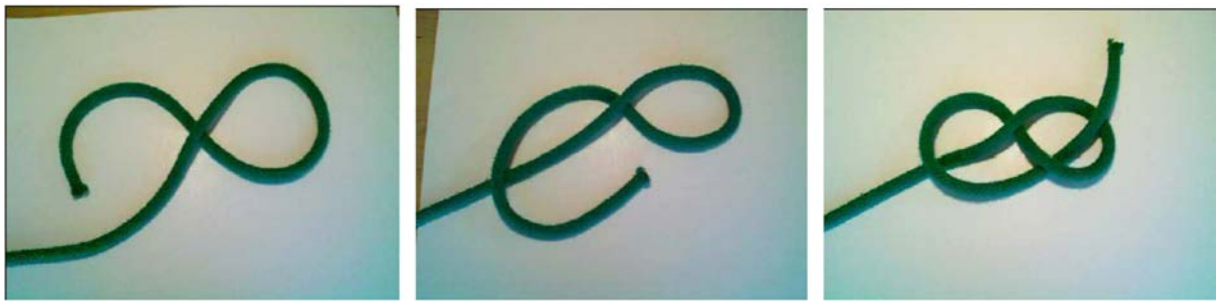

Figure B-4 Figure of Eight Knot

DOUBLE FIGURE OF EIGHT

- **Other name:** Figure-of-eight loop.
- **Uses:** To anchor a rope around a tree trunk, pole or such item.
- **Qualities:** Will not slip and is easy to undo.
- **Procedure:** There are two methods to do this knot. However, the first one is the one to use to anchor the rope to a tall or wide pole or trunk (Diagram 5).

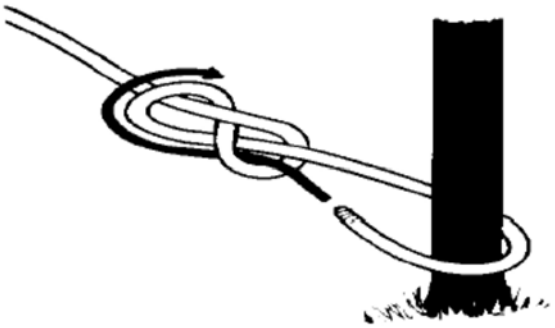

Figure B-5 Double Figure of Eight Knot

The steps for method #1 are:

1. Begin with a loose figure of eight knot (Diagram 6, Figure 1).

2. Guide the running end back up through the loop it just came down through (Diagram 6, Figure 2).

3. Have the running end trace alongside the rope in the original figure of eight under the standing end. Have the running end follow the original figure of eight under the double rope (Diagram 6, Figure 3).

4. The running end follows the original figure of eight (Diagram 6, Figure 4).

5. Pull tight, dress knot by flattening it and making sure the ropes are side by side.

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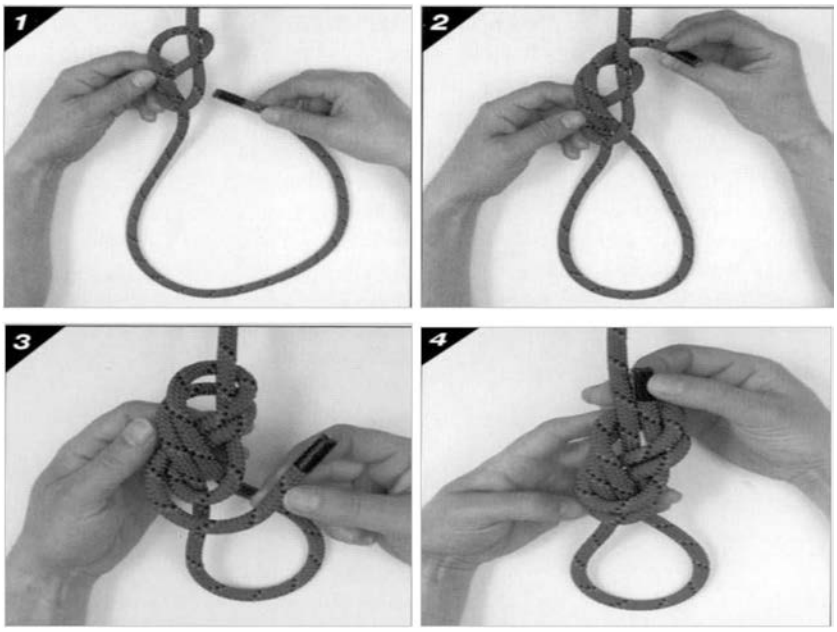

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Figure B-6 Double Figure of Eight Knot, Method #1

The steps for method #2 are double the rope and follow the steps to make a figure of eight knot. (See Figure B-7.)



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Figure B-7 Double Figure of Eight Knot, Method #2

HALF HITCH

- **Uses:** Make other knots stronger. Hang, tie or hook objects.
- **Quality:** Easy to make.
- **Fault:** Cannot support a lot of strain.
- **Procedure:** Pass the rope around the pole and then behind the standing part and into the eye of the loop.

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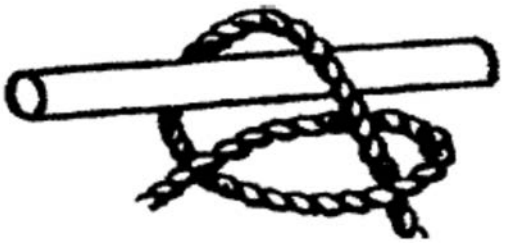

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Figure B-8 Half Hitch

CLOVE HITCH

- **Uses:** To finish off knots like the round turn and two half hitches and the various types of lashings. To secure a rope to a spar, rail or similar fitting.
- **Qualities:** Quick and easy to tie. Can be made with the end or with the bight of the rope.
- **Procedure:** There are two methods to tie a clove hitch; one using the end and the other using the bight.

The steps for tying a clove hitch using the end of the rope are:

1. Pass the running end of rope over the rail from front towards the back.
2. Bring the running end under the rail and over the standing end towards the left.
3. Bring the running end over spar to the left.
4. Bring the running end out under the rail and thread it up under the rope on the rail by the crossover.
5. Work the hitch tight with the running end and the standing end sung against each other.
6. Be sure to leave enough rope on the end so that it does not unravel.

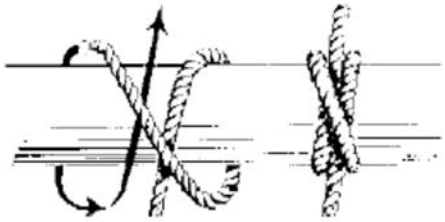

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Figure B-9 Clove Hitch

The steps for tying a clove hitch using the bight are:

1. In the middle of the rope, make a crossing turn or half hitch, with the rope that comes from the left being on top (Diagram 14, Figure 1).

2. To the right of the first crossing turn, make a half hitch with exactly the same configuration (Diagram 14, Figure 2).

3. Put the right-hand half hitch on top of the left-hand half hitch (Diagram 14, Figure 3).

4. The pair of hitches are now slipped over the top of the post (Diagram 14, Figure 4).

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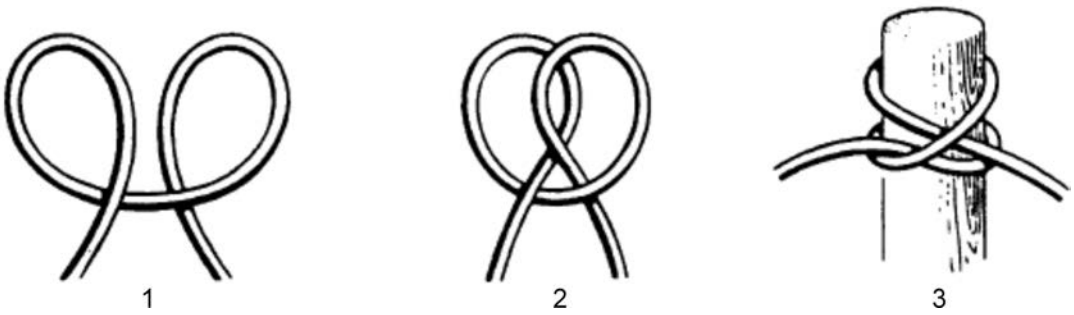

Figure B-10 Clove Hitch

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