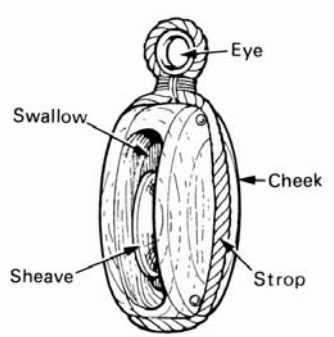
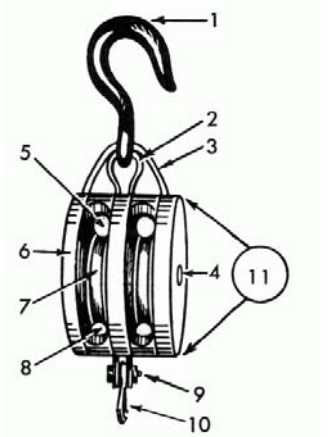
Blocks, Tackles, Cordage, Sailcloth

Toronto Brigantine
Grade III

Parts of a Block



Oxford Companion to Ships and the Sea

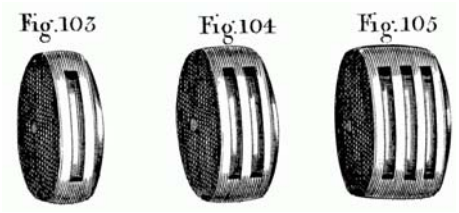


1. Hook
2. Inner Strap
3. Outer Strap
4. Pin
5. Swallows
6. Cheeks
7. Sheaves – either plain, roller, or self-lubricating
8. Breech
9. Becket
10. Thimble
11. Shell

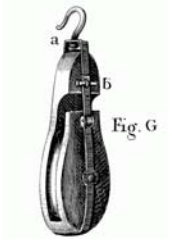
Piloting, Seamanship and Small boat handling: Chapman 1972

Types of Blocks

- Single block
- Double block
- Triple block
- Fiddle block
- Snatch block

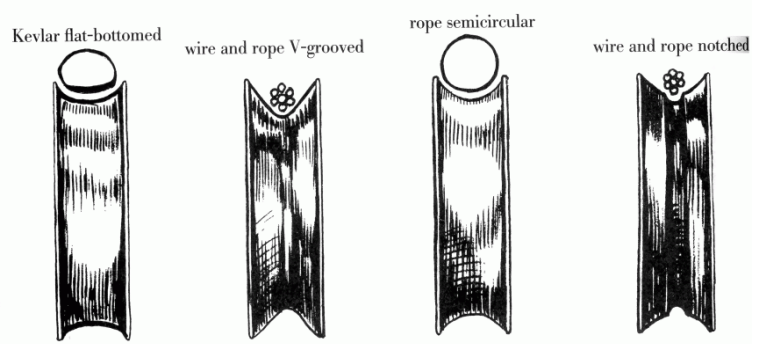


The complete Rigger's Apprentice, Brion Toss 1998



The Young Sea Officer's Sheet Anchor: Lever 1858

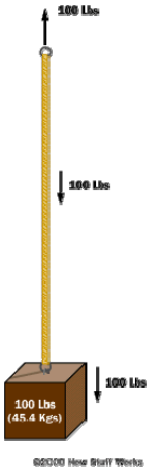
Types of Sheaves



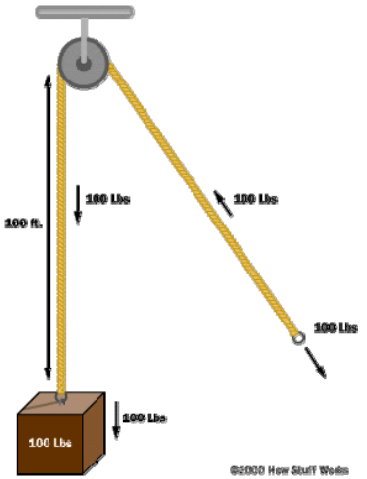
The complete Rigger's Apprentice, Brion Toss 1998

How do Blocks and Tackles Work?

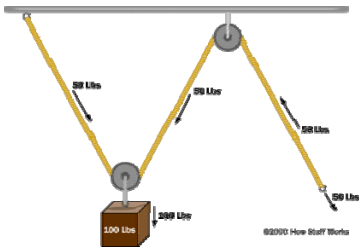
- To lift this 100 lb weight 100 ft you will need to pull 100ft of line
- There is no mechanical advantage to this



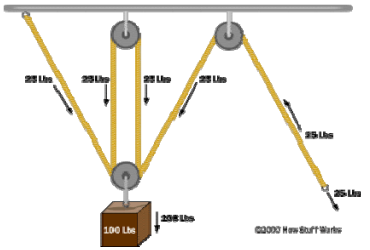
- We have added a pulley
- But we are still lifting 100lbs and pulling 100 ft of line
- No mechanical advantage and we have only changed the direction



- We have now added another pulley
- The ring in the ceiling is holding 50lbs, and the pulley in the ceiling is holding 50lbs
- So now the weight we are lifting is half, but we have to pull twice as much line to raise it the same amount
- This a 2:1 advantage



- We have now added another pulley
- The person pulling is now only has to pull 25 lbs, but they must pull 400 ft of line to raise the object 100 ft
- This a 4:1 advantage

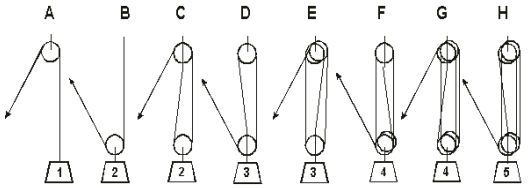


How do you calculate your mechanical advantage?

- In a block and tackle there will be a stationary block that is attached to part of the vessel, and a block attached to a moving object (sail, dory, yard, boom etc).
- When calculating mechanical advantage focus on the moving block
- Count the number of lines entering or exiting a sheave, or attached to a becket

Mechanical Advantage

- Notice A and B are the same block and line arrangement just reversed, but B has a 2:1 advantage and A only has a 1:1. This is the same for C and D with a 3:1 vs 2:1
- When the line you are pulling on is leading from the moving block it is **rove to advantage**, when it leads from the stationary block it is **rove to disadvantage**



A. Single Whip
B. Runner
C. Single Purchase
D. Gun Tackle
E. Luff Tackle
F. Reversed Luff Tackle
G. Double Purchase
H. Double Tackle

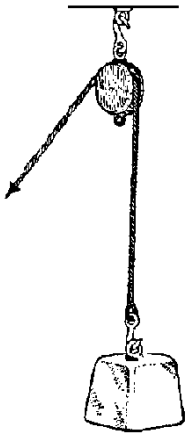
Classicmarine.co.uk

Types of Purchases

- Single Whip
- Double Whip
- Double Purchase
- Gun Tackle
- Spanish Burton

Single Whip

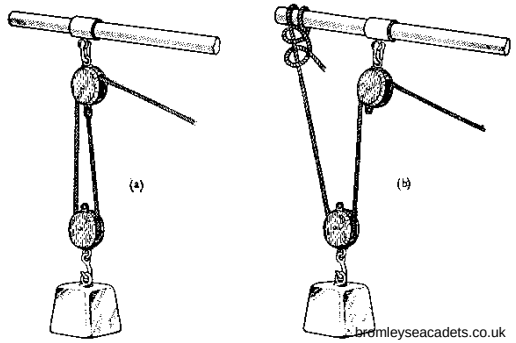
- Rove to disadvantage
- 1:1



bromleyseacadets.co.uk

Double Whip

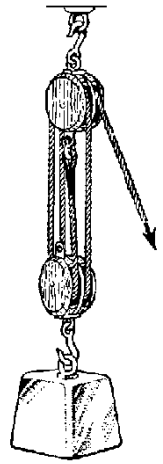
- Rove to disadvantage
- 2:1



bromleyseacadets.co.uk

Double Purchase

- Rove to disadvantage
- 4:1



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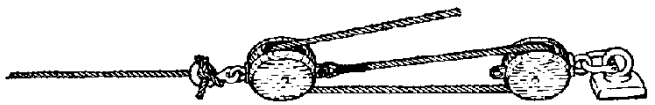
Gun Tackle

- Rove to advantage
- 3:1



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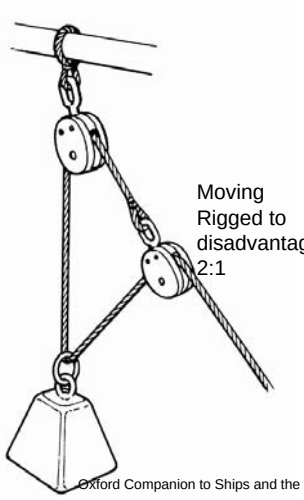
Spanish Burton

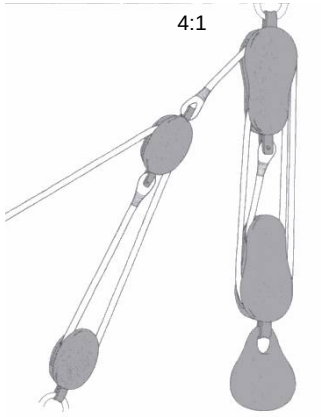
- Used to move cargo
- 4:1 advantage combined



Oxford Companion to Ships and the Sea

Combined tackles

- Combined 12:1

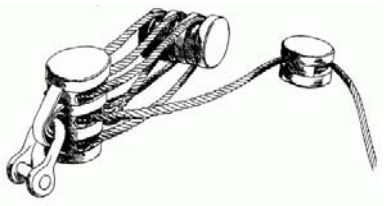


Friction

- Friction increases as the number of sheaves increases
- There is roughly a 10% increase in the “weight” of an object per sheave
- If you are lifting the 250lb AP with a double purchase (two double blocks) you would have 4 sheaves, and the extra 10% due to friction would be 25lb per sheave = 100lbs, for a rough total “weight” of 250lb + 100lb = 350lb
- With a 4:1 purchase the weight that the person would have to pull would be roughly 350/4 = 87.5lb

Reeving methods

- Lacing: when blocks are facing the same direction and line is passed from one sheave to the next. Lots of friction produced when chock-a-block, wear on cheeks and line.
- Right-angle reeving: blocks are at right angles, less friction when chock-a-block
- Triple blocks should always have the fall leading from the middle sheave, this prevents the block from tipping with the force of hauling



The complete Rigger’s Apprentice, Brion Toss 1998

Types of Rope Fibres

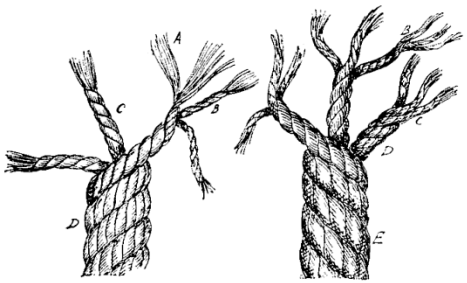
- Traditionally made from manila, hemp, linen, cotton, coir, jute, and sisal.
- Most rope is now made from synthetic fibers such as polypropylene, nylon and dacron.

Types of Rope fibres

- Polypropylene:
  - Stiff, hard to work with, hard on the hands, very little stretch, easily damaged by UV and heat, Floats
- Nylon:
  - Easy to work with, looses shape, easy on the hands, doesn't float, can stretch up to 40% of its length, weak when wet
- Dacron:
  - Easy to work with, maintains shape, easy on hands, doesn't float, not as stretchy as nylon
- Roblon:
  - Synthetic material (from Denmark) that looks like natural fiber, used on replica vessels

Rope Making

- Many fibres (A) are twisted together to form yarn (B)
- Many yarns are twisted together to form strands (C)
- Strands are twisted together to form rope (D)
- Rope is twisted together to form cable (E)



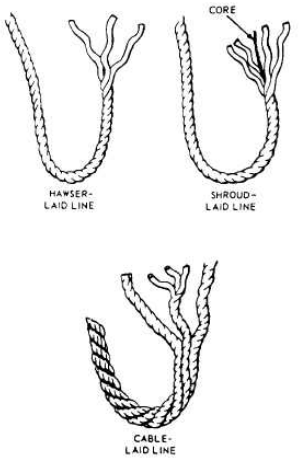
Knots, Splices and Ropework. A. Hyatt Verrill http://www.gutenberg.org/files/13510/13510-h/13510-h.htm

Traditional Rope Making

- Rope was made in a rope walk or ropery
- A traditional operational ropery remains in Chatham England. It is 346m (1135 ft) long, and when constructed was the longest brick built building in Europe capable of laying a 1,000 ft (300 m) rope

Laid Line

- Hawser
- Shroud
- Cable



http://www.tpub.com/content/construction/14043/css/14043_106.htm

Hawser Laid Line

- Hawser laid line generally consists of three strands twisted together, usually in a right-hand direction.
- Most of the lines used at TBI are Hawser laid

Shroud Laid

- Ordinarily, a shroud-hid line is composed of four strands twisted together in a right-hand direction around a center strand or core.
- This core is usually of the same material but smaller in diameter than the four strands.
- Shroud-laid line is more pliable and stronger than hawser-laid line.
- Shroud-laid line has a strong tendency to kink.

Cable Laid Line

- Consists of three hawser laid lines twisted together

Braided Line

- Inner core: prevents stretch and provides strength
- Outer braid: prevents damage from abrasion, UV, chemicals
- Made from synthetic materials like nylon, polyester and spectra

http://redpointropes.com/rope.html

http://www.urbanhart.com/shopsite/rope_polyesterind.html

Types of Braided line

- Hollow Braid: has no core, is very flexible but can flatten during use. It is only found in small sized rope.
- Parallel Core: has a braided sheath over a core of straight or lightly twisted yarns – it is very strong.
- Braid on Braid: has a braided core inside a braided sheath - will stretch less and has less flexibility than a hollow braid.

Braided vs Laid

- Compared to braided line, laid line is generally:
  - Not as strong
  - Stretches more (better for mooring lines or anchor lines)
  - Easier to splice
  - Less expensive
  - More traditional look

Rope Strength

	Nylon		Polypropylene		Manila		Sisal	
Diameter inches	Working load lbs	Breaking strength lbs	Working load lbs	Breaking strength lbs	Working load lbs	Breaking strength lbs	Working load lbs	Breaking strength lbs
1/4"	124	1,485	113	1,130	54	540	48	480
5/16"	192	2,250	171	1,710	90	900	80	800
3/8"	278	3,330	244	2,440	122	1,220	108	1,080
1/2"	525	5,760	420	3,780	264	2,380	236	2,120
5/8"	935	9,360	700	5,600	496	3,960	440	3,520
3/4"	1,420	12,750	1,090	7,650	695	4,860	617	4,320
1"	2,520	22,500	1,800	12,600	1,160	8,100		
1.1/2"	5,320	47,700	3,820	26,800	2,380	16,700		
2"	9,200	82,800	6,700	46,800	4,000	28,000		

Feeney Wire rope and rigging

For comparison a 5/16 wire rope (6x19) has a 10540 lb breaking strength

If unsure, figure the working load is 1/10th of the breaking strength

Comparison of Rope materials

	Manila	Nylon	Dacron	Polyprop
Relative Strength	1	4	3	2
Relative weight	3	2	4	1
Elongation	1	4	2	3
Relative resistance to impact or shock	1	4	2	3
Mildew and Rot resistance	Poor	Excellent	Excellent	Excellent
Acid resistance	Poor	Fair	Fair	Excellent
Alkali resistance	Poor	Excellent	Excellent	Excellent
Sunlight resistance	Fair	Fair	Good	Fair
Organic solvent resistance	Good	Good	Good	Fair
Melting Point (Degrees F)	380	410	410	300
Floatability	Only new	None	None	Yes
Relative Abrasion Resistance	2	3	4	1

1=lowest, 4=highest

Piloting, Seamanship and Small boat handling

Roblon (Spunflex)

- 3 laid line
- Made of fibrillated polypropylene film yarns
- UV stabilized and resistant to acids, alkalis and sunlight
- Colour of hemp, so it has that traditional look
- Used on many traditionally rigged ships and STVs

Knots and Splices and Strength of Rope

- Knot is the weakest part of a line
- Knots with sharp curves like an overhand knot are the weakest knots
- Knots with broad curves are generally stronger

	% Efficiency
Normal Rope	100%
Anchor or Fisherman's bend	76
Timber hitch	70-65
Round turn	70-65
Two half-hitches	70-65
Bowline	60
Clove hitch	60
Sheet bend	55
Reef knot	45
Eye Splice	95-90
Long Splice	87
Short Spice	85

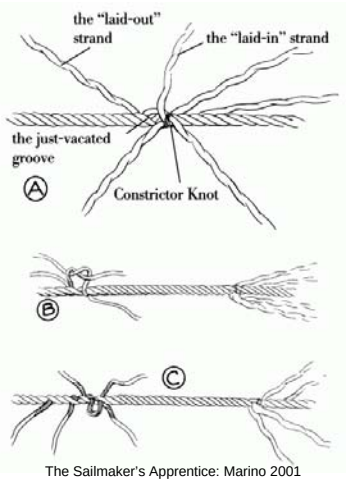
Piloting, Seamanship and Small boat handling

Splices

- You should already know how to do the following:
  - Eye splice
  - Back splice
  - Short spice

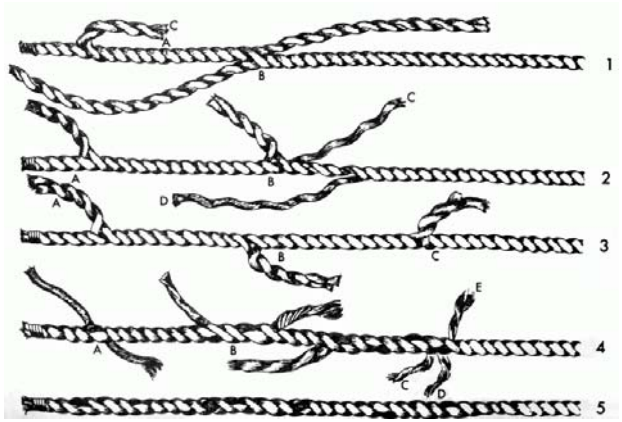
Long Splice

- Used to join together two lines
- Repair a broken or damaged line
- The diameter of the line does not increase, unlike with a short splice



The Sailmaker's Apprentice: Marino 2001

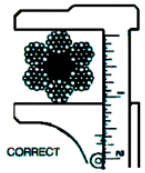
Long Splice



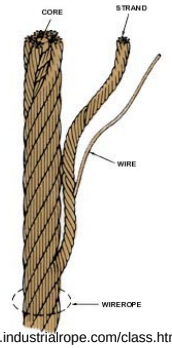
Piloting, Seamanship and Small boat handling: Chapman 1972

Wire Rope

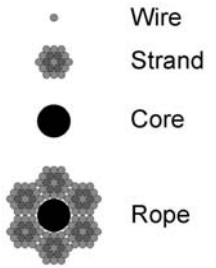
- Consists of wires twisted into strands which are twisted into rope
- May contain a core made of fibre or wire rope



http://www.globalsecurity.org/military/library/policy/army/fm/55-17/ch6.htm



http://www.industrialrope.com/class.html



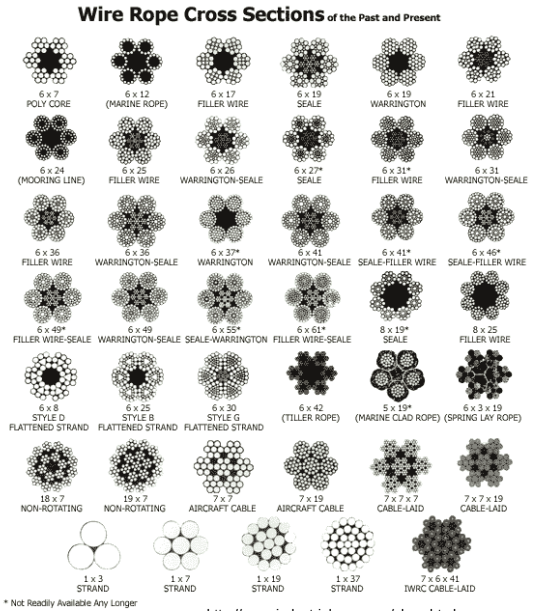
Types of Wire Rope

- Classified by the Lay
  - Regular: strands laid in the opposite direction of the rope, better resistance to crushing, less rotation when ends are not fixed

  - Lang: strands laid in the same direction as the rope, more flexible, better resistance to fatigue and wear

- Both Lang and regular lay have the same breaking strength
- Classified by the number of strands (eg 6) and wires (eg 19) in each strand 6x19,

- Wire rope with more small wires is more flexible, but is less resistant to abrasion and corrosion



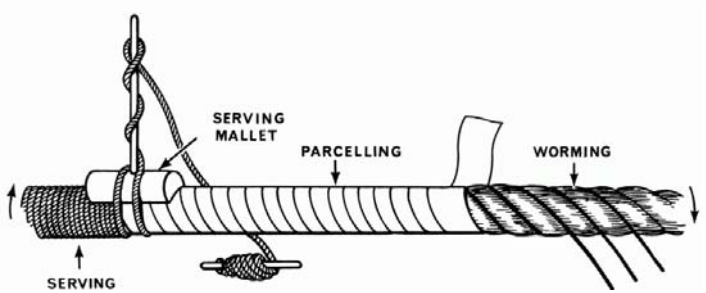
http://www.industrialrope.com/class.html

Splices and Swages

- Advantage of splices is that they can easily be inspected for wear and corrosion
- Swages are the commercial alternative to splices
- If you want a splice you have to do it yourself

Serving

- Protects wire rope and line from wear and chafe
- Protects wire rope from corrosion



Piloting, Seamanship and Small boat handling; Chapman 1972

Worming and Parceling

- “Worm and parcel with the lay, turn and serve the other way”
- Worming is done with linseed oil soaked marlin
- The worming material is placed between the strands of the wire rope
- Parceling was traditionally done using sailcloth. Now it is often done with cloth tape (hockey tape)
- Worming and parceling provides an even surface for serving

Sail Theory – How a sail works

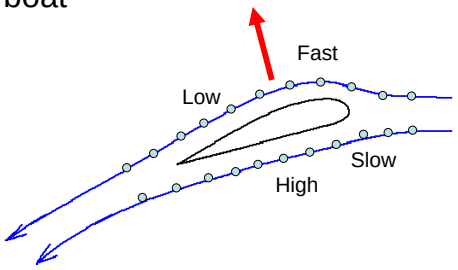
- Downwind:

  -sail merely traps the wind

  -boat is being pushed forward

Sail Theory – How a sail works

- Upwind: Bernoulli's Principle
  -Windward side = high pressure
  -Leeward side = low pressure
- Sail is sucked towards the low pressure, pulling the boat forward



TBI Sails

	Pathfinder	**Playfair**
Main	Topgun	Topgun
Main Stays'l	Topgun	Topgun
Jib	Topgun	Topgun
Course	Topgun	Oceanus
Tops'l	Topgun	Oceanus
Jibtop	Topgun	Topgun
Fisherman	Dacron	Dacron
Gaff Tops'l	Destiny	Destiny

Topgun

- Topgun is a Polyester based cloth, originally intended for use as a tarpaulin/sailcover.
- Andy has found it works quite well for what we need.
- Cheaper than the sailcloths actually designed to replicate older materials.
- Although not designed as a sailcloth it possess many of the qualities that TBI requires such as strength and UV resistance.

Oceanus

- Polyester based cloth
- Designed for use as a sailcloth.
- Andy is not a big fan, but feels it works alright for squares
- More expensive than Topgun.

Dacron

- Dacron is also polyester based
- Andy does not use it for making many of our sails anymore
- Commonly used in more modern rigs

Destiny

- Destiny is a Duradon derivative (another polyester)
- Andy felt would give flatter setting, and it has

Sail Cloth Comparison

Sail Cloth	Shape Retention	Strength to Weight	Aesthetic Appeal (colour, feel, smell)	Durability	Ease of Handling
Cotton	Poor	Low	Excellent	Good	Good (poor when wet)
Flax	Poor	Low	Excellent	Good	Good
Duradon	Fair	Med-Low	Excellent	Excellent	Excellent
Soft Dacron	Good	Med	Good	Good	Good/Excellent
Firm Dacron	Excellent	Med-High	Poor	Fair	Poor
Cruising Laminates	Excellent	High	Poor	Fair	Fair
Racing Laminates	Excellent	Very High	Poor	Poor	Fair

Characteristics to look for in Sailcloth

- Strength
- Amount of stretch
- Resistance to UV damage
- Feel of the fabric
- Cost
- Easy to work with

Sail Damage

- Torn sails:
  - Straight tear: sail caught on rigging
  - L- tear: sail caught on rigging
  - Jagged tear: excessive stress
- Worn sails
  - UV damage: becomes brittle
  - Sail becomes thin from chafing

Sail Repair

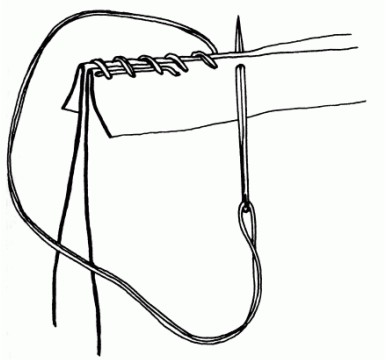
- Short straight tears can often be repaired by stitching up the hole (or using Sail tape if you are on a Yachty boat)
- Longer tears, jagged tears and L-shaped tears can be stitched but often require a patch over the area to reinforce the sail
- Worn places in a sail can sometimes be repaired with a patch, but if it is extensive then the sail may have to be replaced

Stitches

- Round Stitch: sewing seams
- Herringbone Stitch: repairing tears

Round Stitch

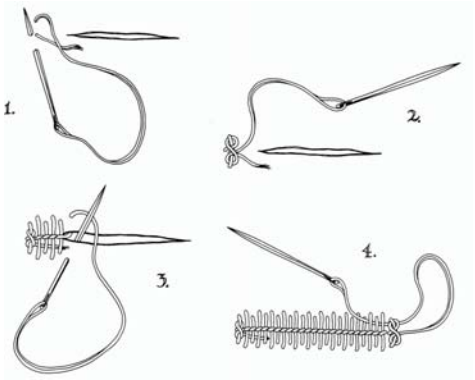
- Used for sewing seams and patches



The Sailmaker's Apprentice: Marino 2001

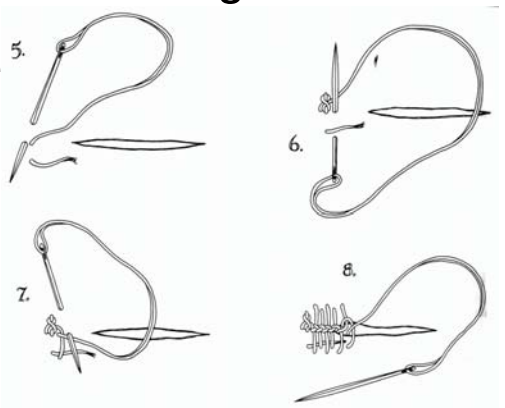
Herringbone

- Stitch is started before the rip
- Stitches are not all at the same distance from the tear

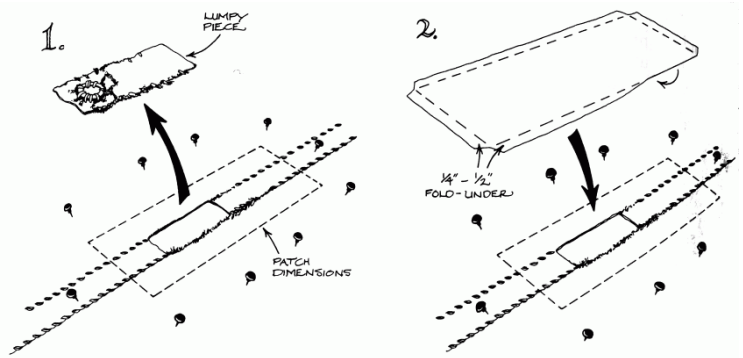


Sailmaker's Herringbone

- Very similar to the basic herringbone, but with an extra locking stitch
- Stronger and fills the hole better than regular herringbone

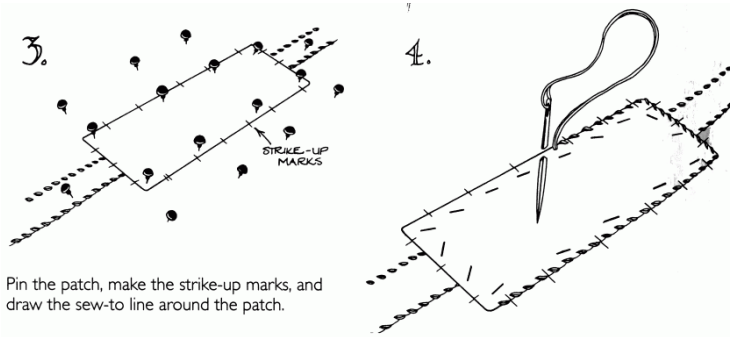


Sewing Patches



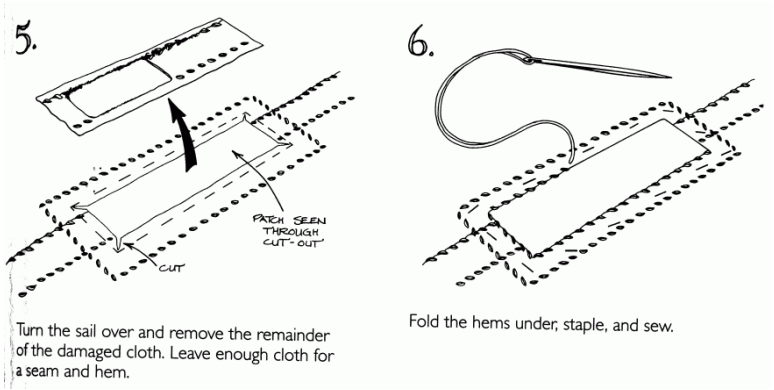
Cut out the lumpy portion of the damaged area, pin out the sail, and measure the patch dimensions.

Cut the patch, fold its hems under, and place it over the damaged area.



Pin the patch, make the strike-up marks, and draw the sew-to line around the patch.

Staple the patch, pull the pins, and flat stitch the outer edge of the patch to the sail, maintaining alignment of strike-up marks.



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