

TRACE EVIDENCE SYMPOSIUM

- ▶ Sheraton Sand Key Resort
- ▶ Clearwater Beach, Florida
 - ▶ August 3 – 7, 2009





SINCE 1920

**CORDAGE
INSTITUTE**

SUPPORTING QUALITY
PRODUCTS

EXECUTIVE COMMITTEE

BOARD of DIRECTORS

TECHNICAL COMMITTEE

DIRECTOR

TECHNICAL COMMITTEE CHAIRPERSON

VARIOUS SUB-COMMITTEES

WORK GROUPS

ALL VOLUNTEER CONSENSUS ORGANIZATION



TECHNICAL COMMITTEE
MEETS THREE TIMES A YEAR

PURPOSE

- **PROMOTE QUALITY PRODUCTS**

- **GENERATE STANDARDS FOR INDUSTRY USE**

- **GENERATE GUIDELINES**

- **GENERATE TEST METHODS**



WHAT DO WE DO?

STANDARDS, GUIDELINES & PUBLICATIONS

- 29 STANDARDS MOST APPROVED - OTHERS WORK IN PROGRESS
- 7 GUIDELINES, ONE WORK IN PROGRESS
- 2 PUBLICATIONS
- PROVIDE INFORMATION AND SUPPORT

ALL STANDARDS HAVE A 5 YEAR REVIEW

IN THE PROCESS OF REVISING THE **TECHNICAL INFORMATION &
APPLICATION MANUAL**



VISIT US AT OUR WEB SITE

www.ropecord.com

**IF YOU ARE INTERESTED YOU MAY REQUEST OUR
QUARTERLY NEWSLETTER “ ropecordNEWS”**

QUESTIONS OR COMMENTS

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- **THE CORDAGE INSTITUTE WAS FOUNDED IN 1920 TO CONTROL THE IMPORT AND PRICING OF MANILA FIBER.**
- **IN THE 1970'S IT CHANGED FROM A LOBBYING GROUP TO A MORE TECHNICAL ORIENTED ORGANIZATION. THIS WAS DUE TO THE EFFORTS OF MR. GALE FOSTER.**
- **WE ARE NOW RECONIZED AS AN INTERNATIONAL STANDARDS ORGANIZATION.**
- **EUROCORD IS A SIMILAR ORGANIZATION IN EUROPE.**
- **EACH COUNTRY HAD A STANDARDS ORGANIZATION.**
- **EUROCORD IS NOW ALMOST ALL ISO (INTERNATIONAL STANDARDS ORGANIZATION)**



WHAT IS ROPE ?

- ❖ THE PRODUCT FORMED BY TWISTING OR BRAIDING YARNS TOGETHER INTO AND ESSENTIALLY CIRCULAR CROSS SECTION, WHICH IS CAPABLE OF SUSTAINING LOAD.
- ❖ TRADITIONAL AND BY SOME US GOVERNMENT REGULATIONS, UNDER $2/32$ " INCH DIAMETER = TWINE, $2/32$ " – $3/16$ " INCH DIAMETER = CORDAGE, $3/16$ " INCH DIAMETER AND UP = ROPE.
- ❖ THE COLLECTIVE TERM FOR ROPE, LINE, AND CORD.
- ❖ WHEN WAS ROPE INVENTED?
- ❖ WHO WERE THE FIRST ROPE MANUFACTURERS?



COILS OF ANCIENT EGYPTIAN ROPE FOUND IN CAVE - 2005

THE ANCIENT EGYPTIAN'S SECRET TO MAKING THE STRONGEST OF ALL RIGGING ROPES LIES IN A TANGLE OF CORD COILS IN A CAVE AT THE RED SEA COAST.

DISCOVERED 3 YEARS AGO BY ARCHAEOLOGISTS RODOLFO FATTOVICH OF THE ORIENTAL STUDIES UNIVERSITY OF NAPLES AND KATHRYN BARD OF BOSTON UNIVERSITY, THE ROPES OFFER AN UNPRECEDENTED LOOK AT SEAFARING ACTIVITIES IN ANCIENT EYGP.

CAREFULLY WRAPPED IN COILS BY ANCIENT EGYPTIAN SAILORS ALMOST 4,000 YEARS AGO, THE ROPES WERE FOUND IN A HAND-HEWN CAVE AT THE ANCIENT RED SEA PORT OF MARSА GAWASIS.

RESEARCERS ARE STILL PUZZLING OVER THE MATERIAL THE ANCIENT EGYPTIANS USED TO MAKE SUCH A STRONG CORDAGE.





CLOSER TO HOME

NATIVE AMERICANS HAVE ALWAYS POSSESSED A VAST KNOWLEDGE OF CORDAGE.

IN NEW ENGLAND IN THE 1600's. THE CORDAGE MADE BY NATIVE AMERICANS FOR THEIR FISHING LINES AND NETS WERE SUPERIOR TO THAT OF THE EUROPEANS' BY THEIR OWN ACCOUNTS

NOT ONLY WAS THIS HAND-MADE ROPE AND STRING PERFECTLY MADE, THE TENSILE STRENGTH OF MANY OF THE INDIGENOUS FIBERS WAS GREAT ENOUGH TO CATCH THE LARGEST STURGEON AND SALMON, AND EVEN FOR HARPOON LINES TO RETRIEVE WHALES AND OTHER SEA MAMMALS.

GO TO WWW.NATIVETECH.ORG FOR COMPLETE STORY



TERMINOLOGY FOR FIBER ROPE CI 1202-03

Used in Standards and Guidelines February 2003

Terminology and definitions are important to assure clear

communication and understanding among industry members, engineers, re-sellers and consumer/users.

This standard defines the terms that are used in the Cordage Institute standards and in many cases may differ

from the same terms used in other areas of the textile industry or other industries.




An attempt has been made to list all terms by the key noun. Thus 'Twill Braid' will be found under 'Braid, twill'. However, other terms are more easily understood if listed with an adjective first; for instance, 'Linear Density', will be found under 'Linear Density' instead of 'Density, Linear'. If a term is defined at another location in the standard an attempt has been made to show it in bold format. Terms may be used as a noun (n.) or a verb (v.) and when multiple uses are possible the abbreviation indicates the way in which the term is used.



SYNTHETIC

FIBERS USED IN ROPE CONSTRUCTIONS

- MATERIALS OF CONVIENENCE – NATURAL FIBERS
 - NYLON (POLYAMIDE)
 - POLYESTER
 - POLYPROPYLENE (MONOFILAMENT * MULTI-FILAMENT * SLIT FILM)
 - BI-COMPONENT POLYOLEFIN
 - ULTRA HIGH MOLECULAR WEIGHT POLYETHELYENE (UHMWPE) TRADE NAMES DYNEEMA AND SPECTRA
 - ARAMIDS AND PARA-ARAMIDS TRADE NAMES KEVLAR, TEJIN, TWARON, TECHNORA.
 - LIQUID CRYSTAL POLYESTER (LCP) VECTRAN
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**FIBERS
For
Cable,
Cordage,
Rope and
Twine
CI 2003**

November 2004

Comparative Reference

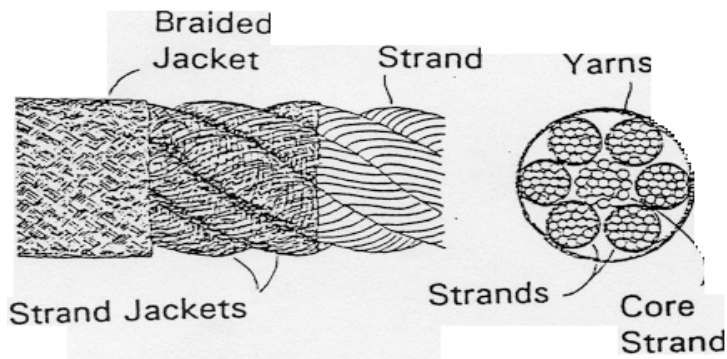


ROPE CONSTRUCTIONS

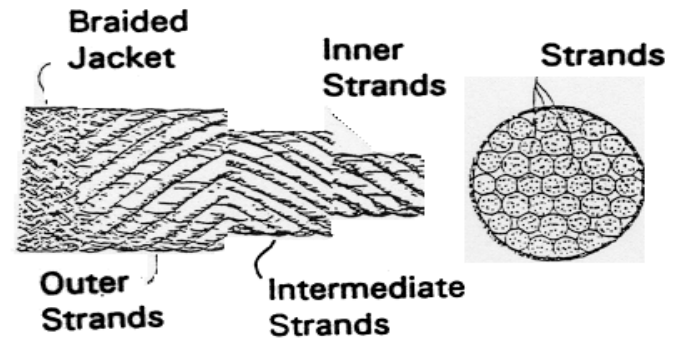
Basic Principles

In order for cordage to be used effectively it must be made with closely packed fiber structures which retain dimensions and form over a reasonable service life. Compactness is attained by successive twisting operations; the fibers being compacted by twisting into yarns; the yarns by twisting into strands or cords; the strands by twisting into ropes - either stranded, plaited, or braided. The degree and effectiveness of compacting is determined by factors such as (a) the amount of twist, (b) the tension in the component units as they are being twisted together, and (c) the compression and confinement by applied restrictions such as tubes and dies.

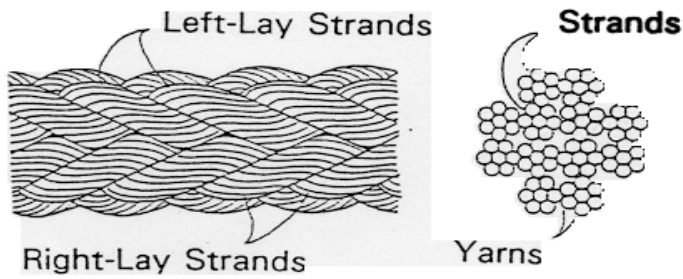




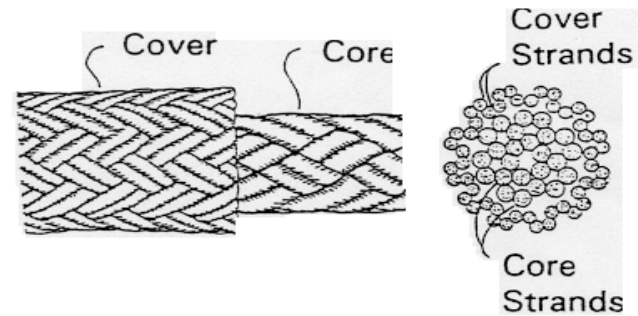
7 Strand Laid Rope



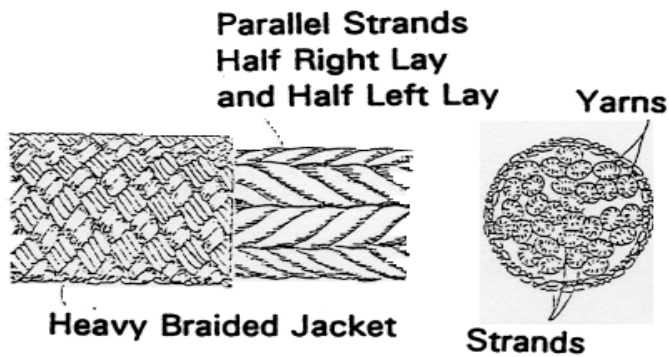
36 Strand Laid Rope



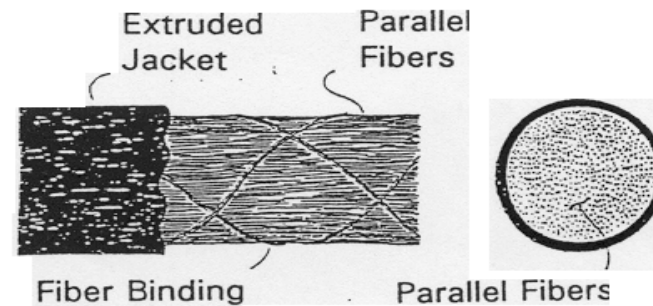
12 Strand Braided Rope



Double Braid Rope



Parallel Strand Rope



Parallel Fiber Rope

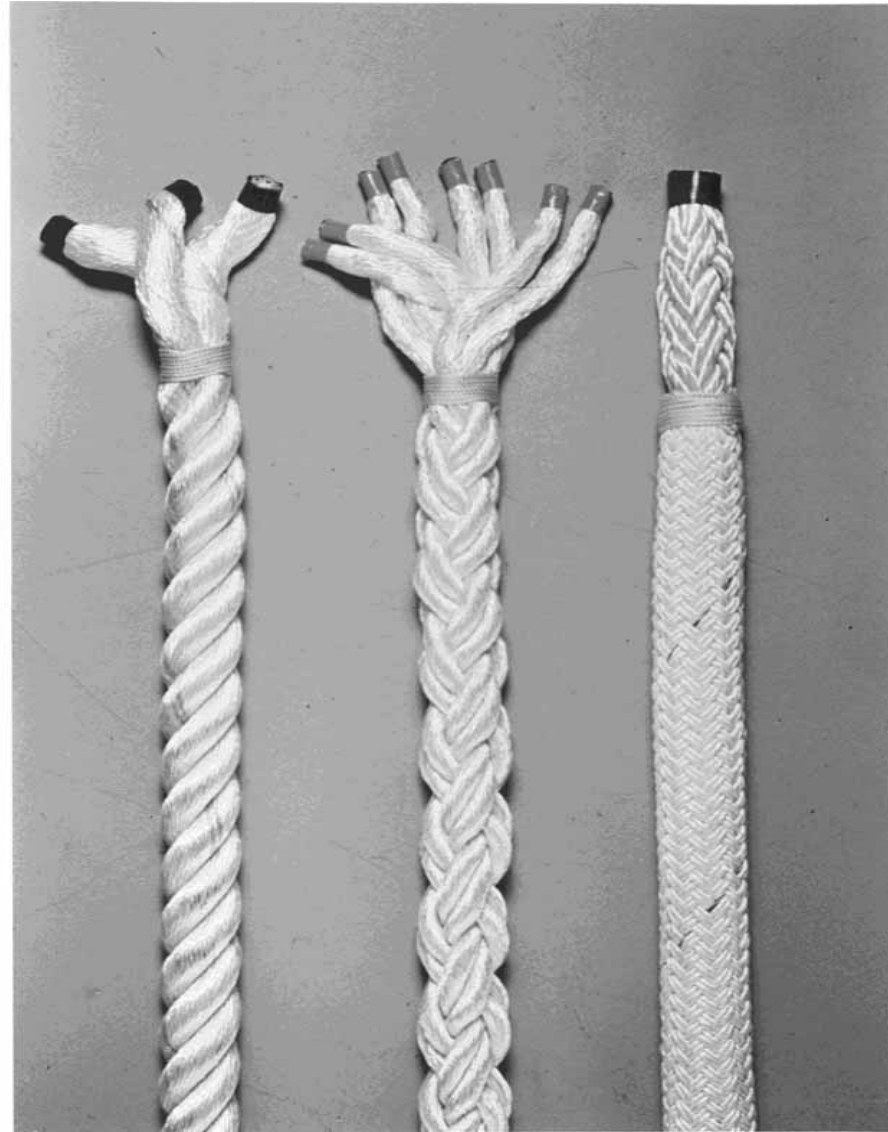
COMMON ROPE CONSTRUCTIONS

3-STRAND

4-STRAND

8-STRAND

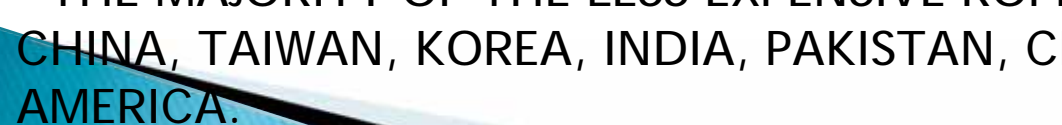
DOUBLEBRAID



3-STRAND – 4-STRAND

- NYLON, POLYPROPYLENE, POLYPROPYLENE/POLYESTER, POLYESTER, MANILA, COTTON.
- SIZE RANGE FROM 3/16" TO 3/4" DIAMETER COMMON IN GENERAL HARDWARE STORES SUCH AS WALMART, HOME DEPOT, LOWES ETC.
- GENERAL USAGE ROPE IN A LOT OF INDUSTRIES.
- ANTIQUE ROPE EQUIPMENT – A LOT OF CRAFT SHOWS HAVE COLLECTORS AND SELLERS OF HAND POWERED ROPE MAKING EQUIPMENT THAT USE BALER TWINE NATURAL AND MAN-MADE FIBERS.

DIAMOND , SOLID BRAIDS AND KERNMANTLE

- RELATIVELY INEXPENSIVE 1/4" TO 3/4" DIAMETER ROPES SOLD IN GENERAL HARWARE STORES.
 - USUALLY IN PACKAGED LENGTHS A LOT IN BRIGHT COLORS.
 - THE SOLID BRAIDS WERE THE FIRST BRAIDED ROPES USED FOR CLOTHSLINES, AND SASH CORDS. AT ONE TIME THEY WERE 100% COTTON OR FLAX. NOW ARE A COMBINATION OF NATURAL AND MAN-MADE FIBERS. SOMETIMES IT IS POSSIBLE TO DETERMINE MANUFACTURER BY IDENTIFYING THE FILLER FIBERS.
 - THE MAJORITY OF THE LESS EXPENSIVE ROPE PRODUCTS ARE MADE IN CHINA, TAIWAN, KOREA, INDIA, PAKISTAN, CENTRAL AND SOUTH AMERICA.
- 

- THERE ARE SEVERAL SMALL MANUFACTURERS THAT ARE MAKING SOLID BRAID POLYESTER ROPES WITH ARAMID, HMPE OR LCP CORES. THESE GIVE A RELATIVELY HIGH STRENGTH FOR A LOWER COST.
- THESE ARE EASY TO IDENTIFY AND DETERMINE THE MANUFACTURER AS WELL AS THE END USER.



KERNMANTLE

- IS A VERY SPECIALIZED ROPE USED FOR MOUNTAIN CLIMBING, LIFESAFETY, RESCUE AND ROPE ACCESS WORK.
- ALL HAVE A BRIGHT COLORS EXCEPT FOR MILITARY AND SWAT TEAMS. CAN BE BLACK, OLIVE DRAB OR SAND COLOR.
- THERE ARE 3 TYPES; STATIC, DYNAMIC, AND ACCESSORY CORDS. IN 7, 10.5 AND 12 mm.
- VERY SPECIFIC REQUIREMENTS AND SPECIFICATIONS.
- CI 1801, CI 1803, CI 2005 ARE SOME OF THE REQUIREMENTS FOR KERNMANTLE CONSTRUCTIONS.
- A LOT OF THE CHEAP MPORTED ROPES HAVE A GENERAL APPEARANCE OF KERNMANTLE, BUT HAVE A MUCH LESS QUALITY AND BREAK STRENGTH.
- THERE ARE SEVERAL U.S. MANUFACTURERS AS WELL AS CANADA AND EUROPEAN.
- THIS IS A PRODUCT THAT IS USED PRIMARILY WITH KNOTS.



SINGLE BRAID (HOLLOW BRAID)

- POLYOLEFIN (POLYPROPYLENE OR POLYETHYLENE) POLYESTER, POLYESTER/POLYPROPYLENE, NYLON, HMPE, ARAMIDS AND LCP.
- IN A VARIETY NUMBER OF STRANDS. USUALLY 4, 8, 12, AND 16 STRANDS OR PAIRS OF STRANDS.
- COLORS VARY WITH A MAJORITY OF YELLOWS WITH SOME HAVING MORE THAN ONE COLOR.
- MOST ARE IMPORTS WITH ONLY A COUPLE OF U.S. COMPANIES COMPETING.
- AVAILABLE IN MOST GENERAL HARDWARE STORES IN PACKAGED LENGTHS. SIZES ARE FROM 1/4" TO 5/8" DIAMETER.
- ALMOST ALWAYS SIGNIFICANTLY UNDERSIZED.



POLYESTER AND POLYESTER/POLYPROPYLENE

- USUALLY 12-STRAND IN SIZES 1/4" TO 2" DIAMETER.
- AVAILABLE FROM DISTRIBUTORS AND MANUFACTURERS USED BY THE UTILITY, INDUSTRIAL, ABORIST AND LIMITED MARINE APPLICATION.
- SOME ARE COATED WITH BRIGHT COLORS FOR THE UTILITY INDUSTRY STRINGING LINES. THESE ARE USUALLY IN LONG LENGTHS 8,000 TO 12,000 FEET IN LENGTH. THE MANUFACTURER AND END USER ARE EASY TO IDENTIFY.
- THE COMBO POLYESTER/POLYPROPYLENE ARE THE MOST COMMON ABORIST ROPES AND USED AS HANDLINES IN THE UTILITY INDUSTRY. SOME OF THE ABORIST ROPE ARE BRIGHT COLORS AND VERY TIGHT BRAID REQUIRING KNOTS INSTEAD OF SPLICES.



12-STRAND POLYESTER LARGER SIZES

2" TO 6" DIAMETER USUALLY USED IN THE OFFSHORE INDUSTRY FOR MOORING AND SHIP HANDLING.

12-STRAND NYLON LARGER SIZES

2" TO 6" DIAMETER USUALLY USED IN THE MARINE INDUSTRY FOR MOORING LINES AND TOW PENDANTS AND SURGE LINES.

3 AND 8-STRAND NYLON LARGER SIZES

2" TO 6" DIAMETER USUALLY USED FOR MOORING LINES, MOORING TAILS, TOW PENDANTS AND SURGE LINES.

3 AND 8-STRAND POLYPROPYLENE AND HIGH POLYPROPYLENE

2" TO 6" DIAMETER USUALLY USED FOR MOORING LINES.



12-STRAND HMPE

- SMALLER SIZES 3/16" TO 1-5/8" DIAMETER USED FOR A MULTITUDE OF APPLICATIONS FROM SLINGS TO TOW LINES. REPLACING WIRE ROPE SLINGS IN A LOT OF APPLICATIONS. REPLACING WIRE ROPE FOR WINCH LINES ON ATV'S AND UTILITY TRUCKS. USED IN THE UTILITY INDUSTRY TO PROVIDE HIGH STRENGTH LIGHT WEIGHT STRINGING LINES FOR LONG DISTANCE PULLS.
- LARGER SIZES 1-1/2" TO 4" DIAMETER USED IN SLINGS AND LIFTING LINES. MOORING LINES ON TANKERS AND CARGO VESSELS. TOW LINES AND SHIP HANDLING LINES FOR LARGER VESSELS.



DOUBLE BRAID NYLON

- SMALLER SIZES 1/4" TO 1-1/4" DIAMETER USED IN THE INDUSTRIAL AND MARINE INDUSTRY. MOORING AND ANCHOR LINES FOR SMALL VESSELS. SLINGS FOR THE ARMY, NAVY AND MARINE CORP HELICOPTER OPERATIONS. TOWLINES FOR SMALL CRAFT. MOORING LINES FOR USCG VESSELS. AVAILABLE FROM DISTRIBUTORS, MANUFACTURERS, BOATING SUPPLIERS AND GOVERNMENT AGENCIES.
- USUALLY WHITE SOMETIMES WITH A COLORED MARKER. GOVERNMENT USUALLY REQUIRES A MARKER TAPE BETWEEN COVER AND CORE WITH MANUFACTURERS NAME, FIBER AND YEAR OF MANUFACTURE.



DOUBLE BRAID POLYESTER

- SMALLER SIZES 1/4" TO 1" DIAMETER IN GREAT ABUNDANCE IN THE PLEASURE MARINE SAILING INDUSTRY. THERE ARE MANY APPLICATIONS ON SAILING VESSELS FOR SHEETS, HALYARDS ETC.
- MANY COLRS AND COMBINATION COLORS AVAILABLE TO IDENTIFY APPLICATION. AT ONE TIME THE U.S. MANUFACTURERS HAD SPECIFIC MARKERS COLORS TO IDENTIFY THE MANUFACTURER. THIS IS NO LONGER THE CASE BECAUSE THE OFFSHORE MANUFACTURERS DO NOT RESPECT OUR TRADEMARKS.
- ALSO USED IN THE UTILITY INDUSTRY FOR SLINGS AND STRINGING LINES.
- AVAILABLE FROM MANUFACTURERS, DISTRIBUTORS, BOATNG SUPPLIERS AND MAILORDER.



TO MAKE THIS MORE CONFUSING

- EACH CONSTRUCTION CAN BE ADJUSTED TO MEET CERTAIN CRITERIA.
- THERE ARE CONSTRUCTIONS AND PRODUCTS THAT ARE FOR A VERY LIMITED APPLICATION THEREFORE NOT READILY KNOWN.
- FOR INSTANCE OAKUM WAS USED FOR YEARS TO FILL IN THE GAPS OF WOODEN VESSELS AND PACK PLUMBING JOINTS.
- IT NO LONGER EXISTS BUT AT PRESENT THERE ARE 25,000 LAWSUITS AGAINST ANYBODY THEY CAN LOCATE.
- THE MAJORITY OF CASES THAT I HAVE BEEN CALLED HAVE THE TYPICAL ROPE PURCHASED FROM ANY WALMART, LOWES, HOME DEPOT ETC.



KNOTS BENDS & HITCHES

THERE HAS ALWAYS BEEN A NEED FOR ROPE, SINCE ROPE COULD HAVE SERVED FEW USEFUL PURPOSES UNLESS IT COULD HAVE BEEN ATTACHED TO SOMETHING. MAN, AT THE TIME OF HIS FIRST CONCEPTION OF THE USE OF ROPE, MUST HAVE CONCEIVED OF SOME MEANS OF TYING KNOTS.

FIRST SOURCE – ENCYCLOPEDIA OF KNOTS AND FANCY ROPE WORK – RAUL GRAUMONT AND JOHN HENSEL – CORNELL MARITIME PRESS, INC. – CAMBRIDGE, MARYLAND

ANOTHER SOURCE – ASHLEY'S BOOK OF KNOTS

ALSO – THE ULTIMATE ENCYCLOPEDIA OF KNOTS & ROPEWORK GEOFFREY BUDWORTH – BARNES & NOBLE BOOKS – NEW YORK

THERE IS A LOT OF KNOT INFORMATION ON THE WEB
THE BEST IS "ANIMATED KNOTS by GROG"
www.animatedknots.com



QUESTIONS OR COMMENTS

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