SECTION 4

RIGGING

To a large extent a diver is an underwater rigger. Rigging enters every aspect of diving, more so on the construction barges. Every effort should be made to enhance your rigging skills and knowledge. A diver that is a good rigger will accomplish tasks seemingly easily, whereas others fail.

There are many good rigging books on the market. From which you can learn an array of knots and splices. I am just listing here some quick reference hard facts.

FIBRE ROPES

Every 1/8" = 4mm (Rounded off)

ie. Every 1" = 25.4mm
Every 1/2" = 12.7mm

IDENTITY YARN IN FIBRE ROPES

Sisal	-	Light Blue
Manilla	-	Black
Polyethelene	-	Grey (Staple)
Takilon (Silver Rope)	-	Purple (Mono)
Vinylon - Kuralon	-	Orange
Polyhpropylene	-	Yellow
Polyester (Dacron, Terylene)	-	Green
Polymide (Nylon)	-	Red

SAFE WORKING LOAD OF FIBRE ROPES

Diam. in mm2 = Kg (Kilograms)

General fibre rope sizes in mm.
3, 4, 5, 6, 7, 8, 9, 10, 12, 16, 20, 24, 28, 32, 36, 40 mm.

To find S.W.L. of a given weight:

ie. 100KG = $\sqrt{100}$ = 10 mm. rope

To find the load in a lead rope as it leaves the Blocks. One must find the "Beckett load" = Lead rope = the rope you are pulling on.

$$\text{B.L.} = \frac{\text{Load}}{\text{no. of rope parts at "moving" block (not static block)}}$$

ie. $\frac{\text{Load}}{\text{No. of parts}}$ say $\frac{600\text{ kg}}{4\text{ parts}}$ = 150 kg B.L.

Rope required is $\sqrt{150}$ KG = 12.2 mm = 16 mm
(This is a hand power formula only)
Handling ropes by hand, the minimum diameter of any sheaves used should be 6 x rope diam.

Power handling ie. on a winch, minimum diam. of any sheaves should be 12 x rope diam.

Minimum depth of sheave groove should be 1/2 diam. of rope.

Minimum diameter of fiber rope worked comfortably in the hand is 16 mm.

FIBRE ROPE CONSTRUCTION

Fibres into yarns, yarns to strands, strands to rope.

Hawser Laid

Fibres turned R.H. into yarn
Yarn turned L.H. into strand
Strand turned R.H. into rope
(or vice versa)

Cable Laid

3 Hawser laid rope layed together in opposite lay.

Shroud Laid

Four strand rope laid around a central heart.

STEEL WIRE ROPES

ROPE CONSTRUCTION

Lang Lay

Strands and wire in the strands all laid one way. (Mostly used for fixed standing ropes).

Ordinary Lay

Wires in strands in one direction and strands in rope the other.
Most common make up 6/19, 6/24, 6/37.
ie. Six strands each of 19 wires, etc.

General SWR sizes in MM.

8, 9, 10, 11, 12, 13, 14, 16, 18, 20, 22, 24, 26,
28, 32, 36, 40, 44, 48, 52, 56, 60 mm.

Minimum Sheave Diameter

SWR		POWER	HAND
6 x 37 } diam. of rope	x	17	10
8 x 25 }			
6 x 26 } diam. of rope	x	18	10
8 x 19 }			
7 x 34 non-rotating } diam. of rope	x	18	10
6 x 24 diam. of rope	x	19	10
6 x 19 extra flexible } diam. of rope	x	23	10
7 x 17 non-rotating }			
7 x 18 non-rotating }			
6 x 19 scale } diam. of rope	x	28	10

Depth of sheave groove minimum $1^1/_2$ diam. of rope. Groove not less than 42^0 not more than 52^0.

S.W.L. SAFE WORKING LOAD

DIAM.^{2}mm x 8 S.F. = KG S.W.L.

ie. safe working load of 10 Ton

$$10 \text{ Ton} = \frac{10{,}000 \text{ Kg}}{8 \text{ S.F.}} = \sqrt{1250} = 35.3 \text{ mm} = 36 \text{ mm rope}$$

BREAKING STRAIN

CIRCUMFERENCE $MM^2 \times 5.8 = KG$

PULL IN LEAD ROPE (USING POWER)

The greatest load on any rope is in the lead rope from winch to 1st sheave. To calculate load and thus calculate size of rope needed, we must first find the beckett load. ie, load in each part of the rope.

$$\text{B.L.} = \frac{\text{Total load on lower block}}{\text{No. of parts supporting load}}$$

ie. Load = 10 Ton and 5 parts of rope supporting lower block $\frac{10}{5}$ = 2 Ton B.L.

Load in lead rope

$$= \text{BL} + (\text{BL} \times \text{no. of sheaves} \times 3\%)\ 3\% = \frac{3}{100} = .33$$

$$= \text{BL} + \frac{(\text{BL} \times \text{no. of sheaves})}{33} = 2 + \frac{(2 \times 5)}{33}$$

$$= 2.3 \text{ Ton} = \frac{2300 \text{ KG}}{8 \text{ SF}} = \sqrt{287.5} = 16.9 \text{ mm}$$

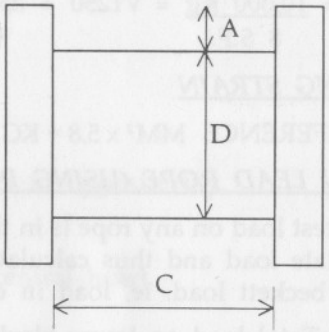
= 18 mm rope required.

LENGTH OF ROPE THAT CAN BE STORED ON A DRUM REEL = IN METRES

$$\text{Length in Meters} = \frac{(A + D) \times A \times c}{1000 \times K}$$

A = Depth of Reel Flange in MM.
D = Diameter of Reel in MM.
C = Distance between Flanges in MM.
K = Multiplying Factor

K	6 mm	-	11.2
	10 mm	-	31
	12 mm	-	45
	16 mm	-	80
	20 mm	-	125
	24 mm	-	180
	28 mm	-	240
	32 mm	-	315
	36 mm	-	400
	40 mm	-	500
	44 mm	-	600
	48 mm	-	720
	52 mm	-	840
	56 mm	-	980
	60 mm	-	1120



FLEET ANGLE

Fleet angle is the minimum angle from the centre of a winch that a rope can veer or lead off to reach the lead block.

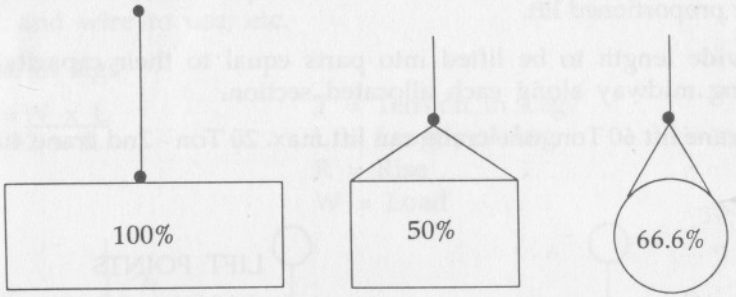
Grooved Drums 5^0 or 1 - 12
Ungrooved Drums 3^0 or 1 - 20

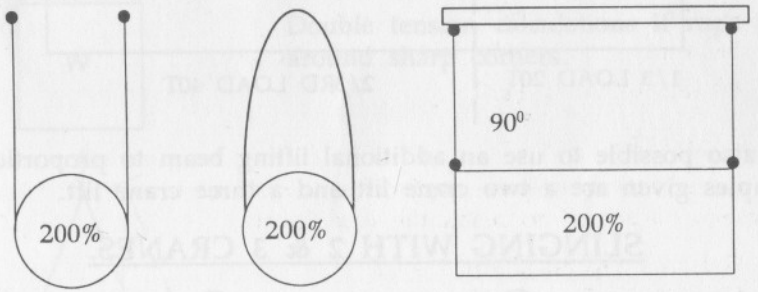
GENERAL SAFETY FACTORS FOR ROPE USAGE

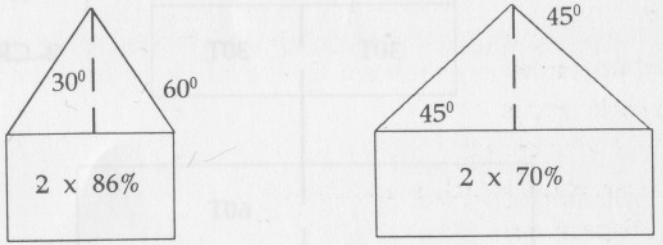
USE	S.F.
Mobile cranes	6
Derrick cranes	6
Hot Metal cranes	7
Construction Winches and Slings	5
Haulage ropes	6
Shovels Excavating ropes	5 - 6
Guy Ropes	4
People Suspended Power	10
People Suspended Hand	7

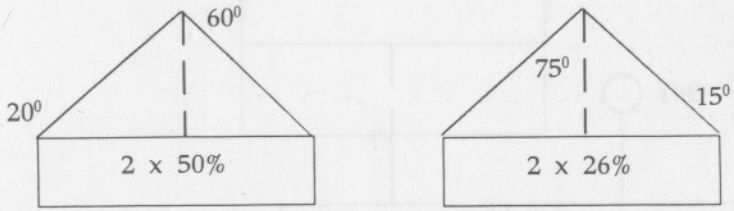
Maximum wear allowed 35% Max. loss by test 20%

SLINGING AND ROPE STRENGTH







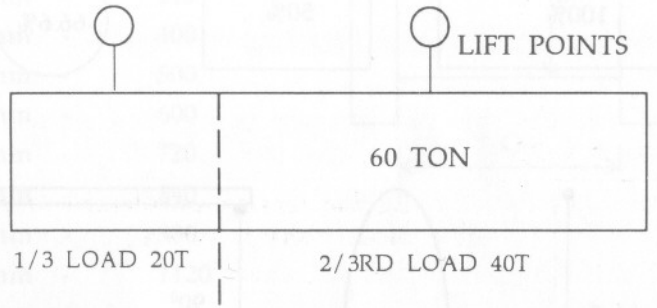


SLINGING WITH TWO OR MORE CRANES FOR ONE LIFT

When using cranes they must always have a safe work load of 25% more than their proportioned lift.

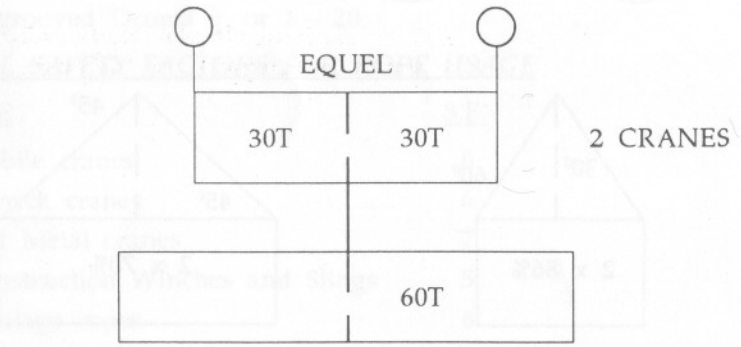
1) Divide length to be lifted into parts equal to their capacity.
2) Sling midway along each allocated section.

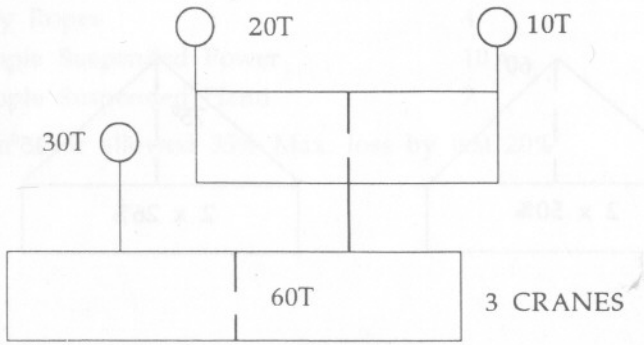
ie. Two crane lift 60 Ton. one crane can lift max. 20 Ton - 2nd crane 40 Ton.



It is also possible to use an additional lifting beam to proportion lifts. Examples given are a two crane lift and a three crane lift.

SLINGING WITH 2 & 3 CRANES.





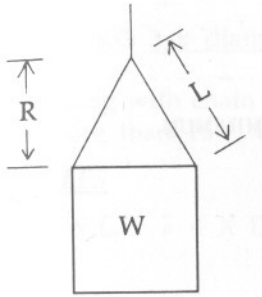
FINDING TENSION IN S.W.R. WHEN SLINGING

After you have calculated your tension under load, you can work out your S.W.L. and wire to use, etc.

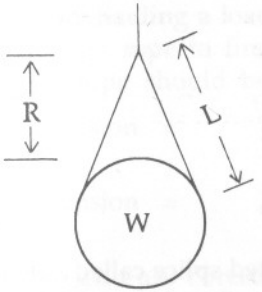
Tension in legs

$$T = \frac{W \times L}{2 \times R}$$

T = Tension in Leg
L = Length of Leg
R = Rise
W = Load

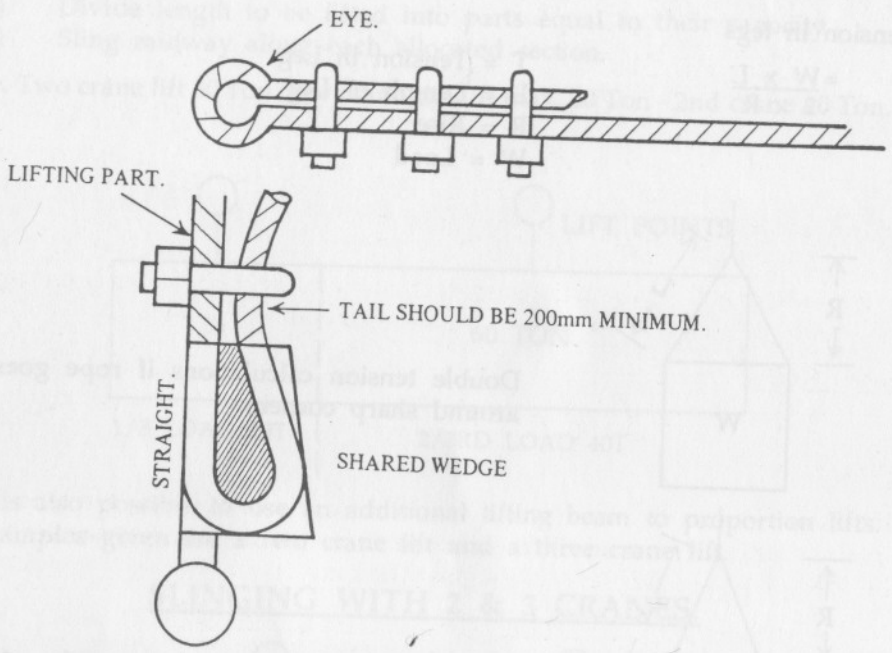


Double tension calculations if rope goes around sharp corners.



T x 1 1/2 for circular loads more than 10 times the diameter of the wire.

BULLDOG GRIPS



On wire made into an eye. Possibly done in a twisted splice called a flemish eye - liverpool splice or whatever. On the tail there shoud be the following amount of grips.

3 - Below 26 mm rope
4 - 26 mm to 36 mm
5 - 40 mm and over

It gives 80% of rope strength.

CHAIN

Chain comes in the following links.

Short Link

Link length no more than 5 x diam. of link material, or 3 1/2 x diam. of link material wide.

Stud Link

Has a strengthening stud across the centre.

Calibrated Link

Calibrated to fit FOC'SLE GYPSYS. Sides made parallel.

Length max. 6 x diam. of link material
Width max. 3 1/4 x diam. of link material

CHAIN CONSTRUCTION

TKUPLEX	-	HERCALLOY	-	FRAM
FRAM	+	HERCALLOY	=	GRADE 80
T	+	KITO-SV	=	GRADE 100

S.W.L. in KG $\frac{3 \times \text{diam. mm2} \times \text{GRADE}}{10}$

When lifting with chain make sure the maximum angle between both legs is no more than 150^0, or 75^0 to centre, from lifting point.

SHACKLES

S.W.L. = 4 X D2 mm = KG

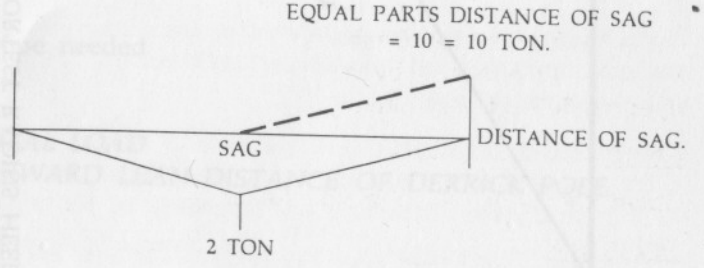
SPANS

If you are hauling a load across a span you will need to know the tension in the span rope to find SWL and rope to use. Minimum allowable sag in span rope should be 1/20 of span length.

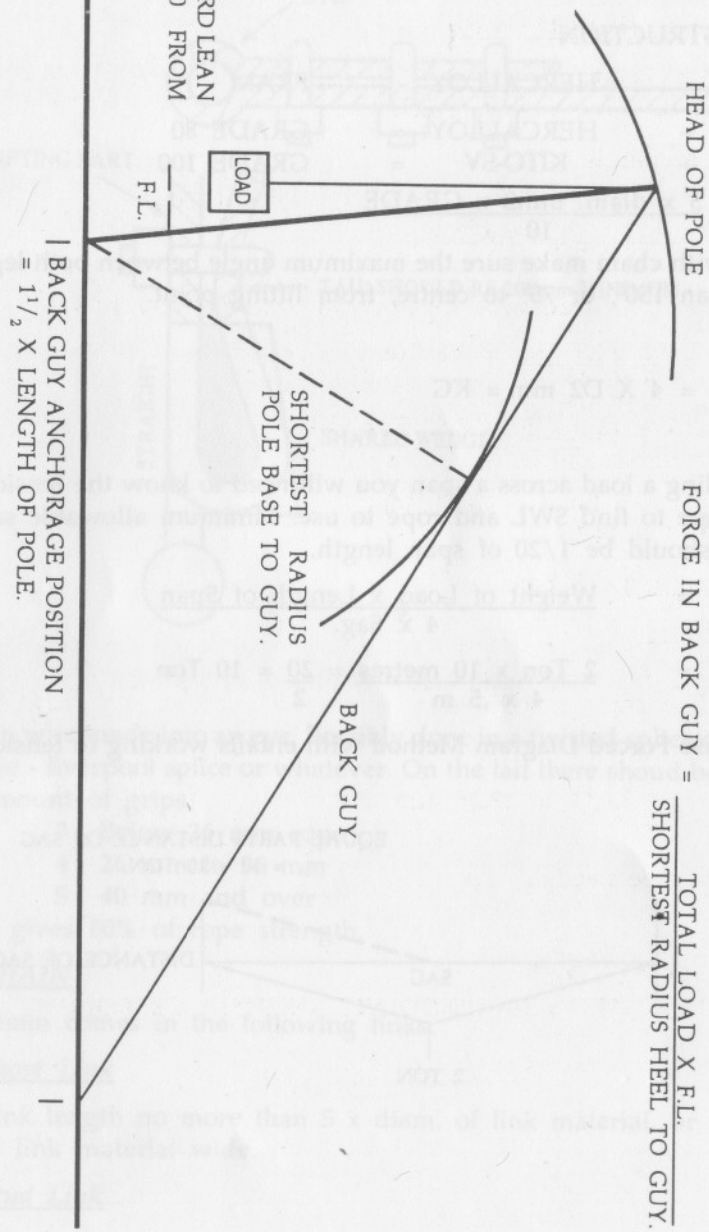
$$\text{Tension} = \frac{\text{Weight of Load} \times \text{Length of Span}}{4 \times \text{Sag.}}$$

ie. $$\text{Tension} = \frac{2 \text{ Ton} \times 10 \text{ metres}}{4 \times .5 \text{ m}} = \frac{20}{2} = 10 \text{ Ton}$$

You can also use Forced Diagram Method with entails working to tension by angles.
ie.



DERRICK POLES



TO FIND SIZE OF ROPE NEEDED FOR BACK GUY ONE NEEDS TO CALCULATE FORCE IN BACK GUY.

FORCE IN BACK GUY = $\frac{\text{TOTAL LOAD X F.L.}}{\text{SHORTEST RADIUS HEEL TO GUY.}}$

DERRICK POLES

Calculating Guy Stress or load.

TOTAL LOAD

(1st) Calculate B.L. (Beckett Load)

$$= \frac{\text{Total block Load}}{\text{No. of parts of rope at lower block}}$$

(2nd) = Then load in lead rope.

= BL + (BL x No. of sheaves x 5%) (5/100 = .20)

$$= BL + \frac{(BL \times \text{No. of sheaves})}{20}$$

Add load and load in lead rope together and multiply by 1.08.

ie. (1) $\frac{\text{Load 10.5 Ton}}{\text{5 parts}} = 2.1 \text{ Ton}$

(2) $2.1 + \frac{(2.1 \times 5)}{20} = 2.63 \text{ Ton}$

2.63 Ton + 10.5 Load = 13.13 Ton

13.13 x 1.08 = 14.18 Ton

Total Load = 14.18 Ton

BACK GUY LOAD

$$= \frac{\text{T.L. x F.L.}}{\text{Short Radius}} = \frac{14.18 \times 1000}{7{,}900 \text{ mm}}$$

= 1.79 = 2 Ton

$$\frac{2000 \text{ KG}}{6 \text{ S.F.}} = \sqrt{333.33} = 18.25 \text{ mm}$$

= 20 mm rope needed

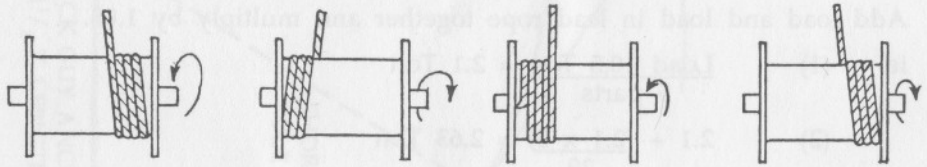
NOTE: *T.L. = TOTAL LOAD*
F.L. = FORWARD LEAN DISTANCE OF DERRICK POLE.

SPOOLING ROPE ON A DRUM

OBSERVER STANDING BEHIND DRUM AND LOOKING TOWARDS THE DIRECTION OF ROPE TRAVEL.

Correct Spooling of ropes on a drum

The method described below may be used to determine the proper direction of a rope lay for spooling or winding on a flat or smooth face drum.



Using Left Lay Rope
OVERWIND
Right to Left

Using Left Lay Rope
UNDERWIND
Left to Right

OVERWIND
Left to Right
Using Right Lay Rope

UNDERWIND
Right to Left
Using Right Lay Rope

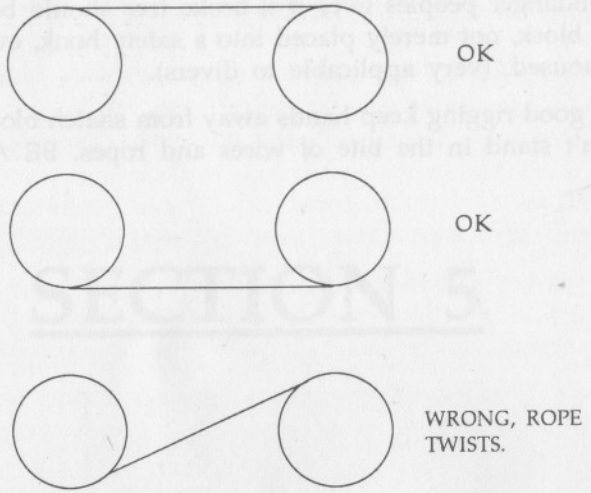
When rope is wound onto a drum any tendency of the rope to twist when tension is released will be in a direction which would untwist the rope at the free end.

The advantage in applying rope of proper direction of lay is that when the load is slashed off, the several coils on the drum will hug together and maintain an even layer.

When rope of improper lay the coils will spread apart at each removal of the load and when winding is resumed the rope may cross and overlap on the drum with flattening and crushing of the rope, as a result.

The proper direction of rope lay to give the best results is shown in the sketch. This applies to either regular or lang lay rope.

FROM DRUM TO DRUM.



RIGGING PACKAGE

The following is a guide to a rigging package to take out on the job:

1)	Snatch Blocks 2 - 3 Ton	4
2)	Tirfors 1.5 Ton	2
3)	Tirfors 3 Ton	2
4)	Comealongs 3 Ton	4
5)	Bow Shackle (safety 8 - 10 Ton	20
6)	Bow Shackle (safety 20 Ton	10
7)	Large Spikes	3
8)	4 lb Mallet	3
9)	Air Lift Bags 5T - 2T - 1T	5
10)	Air Tuggers 1.5T and 3T with min. 150 M wire	2
11)	Slings 1.5 - 4 M assorted	12 (wire and soft rope)
12)	Flogging Spanners to fit bolts	
13)	Assorted Ropes and Buoys	
14)	Crowbars large and small	4
15)	Assorted Bulldog Grips	20
16)	Assorted diam. soft rope	

SAFETY NOTES

1) All lifts by a crane entailing personnel or equipment that could possibly endanger peoples lives if it broke free should be shackled onto the lifting block, not merely placed into a safety hook, even if the safety hook is moused. (very applicable to divers).

2) Use good rigging keep hands away from snatch blocks and tuggers wires, don't stand in the bite of wires and ropes. BE AWARE.

SECTION 5

WORKING TIPS