Lifting Equipment

When using a plant machinery to conduct lifting operations there are several considerations than need to be made before the lifting operation can begin.

1 What hazards are in the area? Including the ground conditions, and their weight bearing capability.
2 What piece of plant equipment is going to be uses?
3 Does the piece of plant equipment have a **MANUFACTURES APPROVED LIFTING LUG?**
4 What is the load rating (SWL) of the piece of plant equipment? And at what distance?
5 How much does the load weight?
6 How far away from the machine is the load?
7 Where is the loads centre of gravity?
8 Where are the lifting point/s for the load?
9 What type of lifting equipment is required to lift the load?
10 What is the lifting capability of each piece of the lifting equipment?
11 What is the condition of the lifting equipment?

Only after answering these questions are you able to safely lift and shift the load.
Plant equipment can only be used for lifting as a crane for work connected directly with the excavation.

Lifting Chain

The Strength or how much the lifting sling can lift is determined by the grade (G) of the chain.
Do not use a lifting sling to lift if it does not have a manufactures tag that gives details of the SWL. Return the sling to the manufacture for SWL assessment and re-tagging.

Lifting formulas

There are 3 formulas too remember to work out the capability of different grades of lifting chains or for Flexible Steel Wire Rope (FSWR). Although through these formulas the SWL of the lifting equipment can be worked out the law states that each piece of lifting equipment must have a Safe Working Load (SWL) tag, or the SWL stamped on it. Without the SWL tag or SWL stamp the lifting equipment can not be used for lifting.

The 3 formulas are for lifting are

1. Grade (G) 80 Lifting Chain
   D^2x32=SWL
2. Grade (G) 30 to 75 Lifting Chain
   D^2xGx0.3=SWL
3. Flexible Steel Wire Rope
   D^2x8=SWL

D = Diameter of the chain or FSWR
² = Means Multiplying the factor by itself. For example the diameter (D) is the factor.
The Diameter is 10mm (D = 10) $D^2 = 10^2$ $10^2 = 10x10$ 10x10 = 100
So 10^2 is the same as 10x10 and both = 100, it is just a shorter way to write it
G = Grade of the chain (The strength of the chain)
32, 0.3, and 8 = are the factors required for each of the 3 different formula to calculate the SWL
It is easier to keep the = in the same position throughout the calculation when using the formula see the answer at the back for examples.

To calculate the SWL of lifting chains there are 2 formulas depending on the grade of the chain. The base units for all lifting formulas are kilograms (kg) for the weight or the (SWL) and millimetres for the diameter of the sling.

Lifting Equipment

Formula 1 for Grade 80 lifting Slings

$D^2x32=SWL$ Grade 80

D^2(mm)x32=SWL(KG)

This formula calculates the safe working load that can be lifted by the diameter of the grade 80 lifting chain.

Chain diameter 10mm, grade 80 (T)

Formula for grade 80	$D^2x32 = SWL$
Add the diameter	$\mathbf{10}^2x32 = SWL$
Simplify the equation & do the calculation	**10x10**x32 = 3200kg SWL

10mm grade 80 chain has a SWL of 3.2 tonnes

When the weight (SWL) is given the formula can be converted so that the minimum required diameter of the lifting chain can be calculated.

The load to be lifted weighs 3.2 tonnes and is classed as the SWL, the chain is grade 80 (T)

To convert the formula

Formula for Grade 80 chain	$D^2x32 = SWL$
√ (square root) instead of ² (squaring)	Dx32 = **√**SWL
÷ (Divide) instead of x (Multiplying)	D32 = √SWL**÷**
Shift the 32 to the other side of the Equation	D = √SWL÷**32**

Formula is now converted to calculate the diameter **D = √SWL÷32**

Converted formula	D = √SWL÷32
Insert the weight to be lifted as the SWL	D = √**3200**÷32
Divide 3200 by 32	D = √**100**
√100	D = **10**mm

To lift 3.2 tonnes a 10mm diameter grade 80 lifting chain is required

Lifting Equipment

Formula for Grade 30 -70 Lifting Slings

$D^2xGx0.3=SWL$

D^2(mm)x Grade of the chain x0.3=SWL(kg)

This formula calculates the safe working load that can be lifted from grade 30 lifting chains through to grade 75 lifting chains.

Chain diameter 10mm, grade 60

Formula for grade 30- 75 lifting chain	$D^2xGx0.3 = SWL$
Add the diameter & the grade	**10^2x60**x0.3 = SWL
Simplify the equation & do the calculation	**10x10**x60x0.3 = 1800 kg SWL

10mm grade 60 chain has a SWL of 1.8 tonnes

When the weight (SWL) is given the formula can be converted so that the minimum required diameter of the lifting chain can be calculated

The load to be lifted weighs 1.8 tonnes and is classed as the SWL, the chain is grade 60

To convert the formula

Formula for Grade 30 - 75 chain	$D^2xGx0.3 = SWL$
√ (square root) instead of ² (squaring)	DxGx0.3 = **√**SWL
÷ (Divide) instead of x (Multiplying)	DGx0.3 = √SWL**÷**
Shift the G to the other side of the equation	Dx0.3 = √SWL**÷G**
÷ (Divide) instead of x (Multiplying)	D0.3 = √SWL÷G**÷**
Shift the 0.3 to the other side of the equation	D = √SWL÷G÷**0.3**

Formula is now converted to calculate the diameter **D = √SWL÷G÷0.3**

Converted formula	D = √SWL÷G÷0.3
Insert the weight to be lifted as the SWL	D = √**1800**÷**60**÷0.3
Divide 1800 by 60 divided by 0.3	D = √**100**
√100	D = **10**mm

To lift 1.8 tonnes a 10mm diameter grade 60 lifting chain is required

Lifting Equipment

Formula 3 for Flexable steel wire rope (FSWR)

$D^2x8=SWL$ FSWR

D^2(mm)x8=SWL(KG)

This formula calculates the safe working load that can be lifted by the diameter of the **F**lexible **S**teel **W**ire **R**ope (**FSWR**).

FSWR diameter 10mm

Formula for grade 80	$D^2x8 = SWL$
Add the diameter	$\mathbf{10}^2x8 = SWL$
Simplify the equation & do the calculation	**10x10**x8 = 800kg

10mm FSWR has a SWL of 0.8 tonnes

When the weight (SWL) is given the formula can be converted so that the minimum required diameter of the lifting chain can be calculated.

The load to be lifted weighs 0.8 tonnes and is classed as the SWL, with FSWR

To convert the formula

Formula for Grade 80 chain	$D^2x8 = SWL$
√ (square root) instead of ² (squaring)	Dx8 = **√**SWL
÷ (Divide) instead of x (Multiplying)	D8 = √SWL**÷**
Shift the 8 to the other side of the Equation	D = √SWL÷**8**

Formula is now converted to calculate the diameter **D = √SWL÷8**

Converted formula	D = √SWL÷8
Insert the weight to be lifted as the SWL	D = √**800**÷8
Divide 800 by 8	D = √**100**
Square root 100	D = **10**mm

To lift 0.8 tonnes a 10mm diameter FSWR is required

Lifting Equipment

Grade 80 (T) Lifting Sling

$D^2x32=SWL$ Grade 80 Lifting sling

Q 1

12mm can lift what SWL?

Q 2

18mm can lift what SWL

Q 3

28mm can lift what SWL?

$D = \sqrt{SWL} \div 32$ SWL Grade 80 Lifting sling

Q 4

What diameter is required to lift 1.8T?

Q 5

What diameter is required to lift 3.75T?

Q 6

What diameter is required to lift 18.26?

Lifting Equipment

Grade 30 -75 Lifting Sling

$D^2xGx0.3=SWL$ **Grade 30 -75 Lifting Sling**

Q 7

12mm Grade 70 lifting chain can lift what SWL?

Q 8

18mm Grade 50 lifting chain can lift what SWL

Q 9

28mm Grade 35 lifting chain can lift what SWL?

$D = \sqrt{SWL \div G \div 0.3}$ **Grade 30 -75 Lifting Sling**

Q 10

What diameter Grade 70 lifting chain is required to lift 1.8T?

Q 11

What diameter Grade 50 lifting chain is required to lift 3.75T?

Q 12

What diameter Grade 35 lifting chain is required to lift 18.26?

Lifting Equipment

FSWR Lifting Sling

$D^2x8=SWL$ FSWR **$D = \sqrt{SWL} \div 8$**

Q 13

12mm FSWR can lift what SWL?

Q 14

18mm FSWR can lift what SWL

Q 15

28mm FSWR can lift what SWL?

Q 16

What diameter FSWR is required to lift 1.8T?

Q 17

What diameter FSWR is required to lift 3.75T?

Q 18

What diameter FSWR is required to lift 18.26?

Lifting Equipment

Grade 80 (T) Lifting Sling

Q 1

12mm can lift what SWL?

D^2x32=SWL

12^{2}x32=SWL

12 x **12**x32=4,608kg SWL

12mm diameter lifting sling can lift 4.608kg

Q 2

18mm can lift what SWL

D^2x32=SWL

18^{2}x32=SWL

18 x **18**x32=10,368kg SWL

18mm diameter lifting sling can lift 10,368kg

Q 3

28mm can lift what SWL?

D^2x32=SWL

28^{2}x32=SWL

28 x **28**x32=25,088kg SWL

28mm diameter lifting sling can lift 25,088kg

Q 4

What diameter is required to lift 1.8T?

D^2x32=SWL

Dx32 = **√**SWL

D32 = √SWL**÷**

D = √SWL÷**32**

D = √SWL÷32

D = √**1800**÷32

D = √**56.25**

D = **7.5**mm

8mm diameter lifting sling required to lift 1.8T

Q 5

What diameter is required to lift 3.75T?

D^2x32=SWL

Dx32 = **√**SWL

D32 = √SWL**÷**

D = √SWL÷**32**

D = √SWL÷32

D = √**3750**÷32

D = √**117.1875**

D = **10.825**mm

11mm diameter lifting sling required to lift 3.75T

Q6

What diameter is required to lift 18.26T?

D^2x32=SWL

Dx32 = **√**SWL

D32 = √SWL**÷**

D = √SWL÷**32**

D = √SWL÷32

D = √**18260**÷32

D = √**570.625**

D **23.888**mm

24mm diameter lifting sling required to lift 18.26T

Lifting Equipment

Grade 30 -75 Lifting Sling

Q 7

12mm Grade 70 lifting chain can lift what SWL?

$D^2xGx0.3 = SWL$

$\mathbf{12}^2x\mathbf{70}x0.3 = SWL$

$\mathbf{12}x\mathbf{12}x70x0.3 = 3{,}024kg\ SWL$

12mm diameter Grade 70 lifting sling can lift 3.024T

Q 8

18mm Grade 50 lifting chain can lift what SWL

$D^2xGx0.3 = SWL$

$\mathbf{18}^2x\mathbf{50}x0.3 = SWL$

$\mathbf{18}x\mathbf{18}x50x0.3 = 4{,}860\ SWL$

18mm diameter Grade 50 lifting sling can lift 4.86T

Q 9

28mm Grade 35 lifting chain can lift what SWL?

$D^2xGx0.3 = SWL$

$\mathbf{28}^2x\mathbf{35}x0.3 = SWL$

$\mathbf{28}x\mathbf{28}x35x0.3 = 8{,}232\ SWL$

28mm diameter Grade 35 lifting sling can lift 8.232T

Q 10

What diameter Grade 70 lifting chain is required to lift 1.8T?

$D^2xGx0.3 = SWL$

$DxGx0.3 = \mathbf{\surd}SWL$

$DGx0.3 = \surd SWL\div$

$Dx0.3 = \surd SWL\div\mathbf{G}$

$D0.3 = \surd SWL\div G\div$

$D = \surd SWL\div G\div\mathbf{0.3}$

$D = \surd SWL\div G\div 0.3$

$D = \surd\mathbf{1800}\div\mathbf{70}\div 0.3$

$D = \surd\mathbf{185.71}$

$\mathbf{D = 9.26mm}$

10mm diameter grade 70 lifting chain required to lift 1.8T

Q 11

What diameter Grade 50 lifting chain is required to lift 3.75T?

$D^2xGx0.3 = SWL$

$DxGx0.3 = \mathbf{\surd}SWL$

$DGx0.3 = \surd SWL\div$

$Dx0.3 = \surd SWL\div\mathbf{G}$

$D0.3 = \surd SWL\div G\div$

$D = \surd SWL\div G\div\mathbf{0.3}$

$D = \surd SWL\div G\div 0.3$

$D = \surd\mathbf{3750}\div\mathbf{50}\div 0.3$

$D = \surd\mathbf{250}$

$D = \mathbf{15.81}mm$

16mm diameter grade 50 lifting chain required

Q 12

What diameter Grade 35 lifting chain is required to lift 18.26?

$D^2xGx0.3 = SWL$

$DxGx0.3 = \mathbf{\surd}SWL$

$DGx0.3 = \surd SWL\div$

$Dx0.3 = \surd SWL\div\mathbf{G}$

$D0.3 = \surd SWL\div G\div$

$D = \surd SWL\div G\div\mathbf{0.3}$

$D = \surd SWL\div G\div 0.3$

$D = \surd\mathbf{18260}\div\mathbf{35}\div 0.3$

$D = \surd\mathbf{1739.05}$

$D = \mathbf{41.70}mm$

42mm diameter grade 35 lifting chain required

Lifting Equipment

FSWR Lifting Sling

Q 13

12mm FSWR can lift what SWL?

$D^2x8=SWL$

$\mathbf{12}^2x8=SWL$

12 x**12**x8=1,153kg SWL

12mm diameter FSWR lifting sling can lift 1,153T

Q 14

18mm FSWR can lift what SWL

$D^2x8=SWL$

$\mathbf{18}^2x8=SWL$

18 x**18** x8=2,592kg SWL

18mm diameter FSWR lifting sling can lift 2.593T

Q15

28mm FSWR can lift what SWL?

$D^2x8=SWL$

$\mathbf{28}^2x8=SWL$

28 x**28**x8=6,272kg SWL

28mm diameter FSWR lifting sling can lift 6,272

Q 16

What diameter FSWR is required to lift 1.8T?

$D^2x8 =SWL$

$Dx8 = \sqrt{}SWL$

$D8 = \sqrt{SWL}\div$

$D = \sqrt{SWL}\div\mathbf{8}$

$D = \sqrt{SWL}\div 8$

$D = \sqrt{\mathbf{1,800}}\div 8$

$D = \sqrt{\mathbf{225}}$

D = **15**mm

15mm diameter FSWR lifting sling required to lift1.8T

Q 17

What diameter FSWR is required to lift 3.75T?

$D^2x8 = SWL$

$Dx8 = \sqrt{}SWL$

$D8 = \sqrt{SWL}\div$

$D = \sqrt{SWL}\div\mathbf{8}$

$D = \sqrt{SWL}\div 8$

$D = \sqrt{\mathbf{3,750}}\div 8$

$D = \sqrt{\mathbf{468.75}}$

D = **21.65**mm

22mm diameter FSWR lifting sling required to lift 3.75T

Q18

What diameter FSWR is required to lift 18.26T?

$D^2x8 = SWL$ Grade 80

$D \times 8 = \sqrt{}SWL$

$D8 = \sqrt{SWL}\div$

$D = \sqrt{SWL}\div\mathbf{8}$

$D = \sqrt{SWL}\div 8$

$D = \sqrt{\mathbf{18,260}}\div 8$

$D = \sqrt{\mathbf{2,282.5}}$

D = **47.78**mm

48mm diameter FSWR lifting sling required to lift 18.26T

Lifting Equipment

Always maintain a safe distance from electrical wires when travelling with the boom raised.

To prevent electrocution

- Keep at least 6.4 meters from distribution line on **power poles**
- Keep at least 10 meters transmission lines on **towers**

SEE PAGE 16A FOR DIAGRAM OF OPERATING DISTANCES FROM POWER

If your machine makes contact with power electrical wires:

- Stay calm
- Stay in your seat if safe
- Warn others to keep away from the area
- Try to untangle the machine from the electrical wires
- If you have to leave the machine ensure that
    - Jump from the machine ensuring that you don't touch the machine and the ground at the same time
    - Hop away from the machine, do not walk
- Contact the power authority