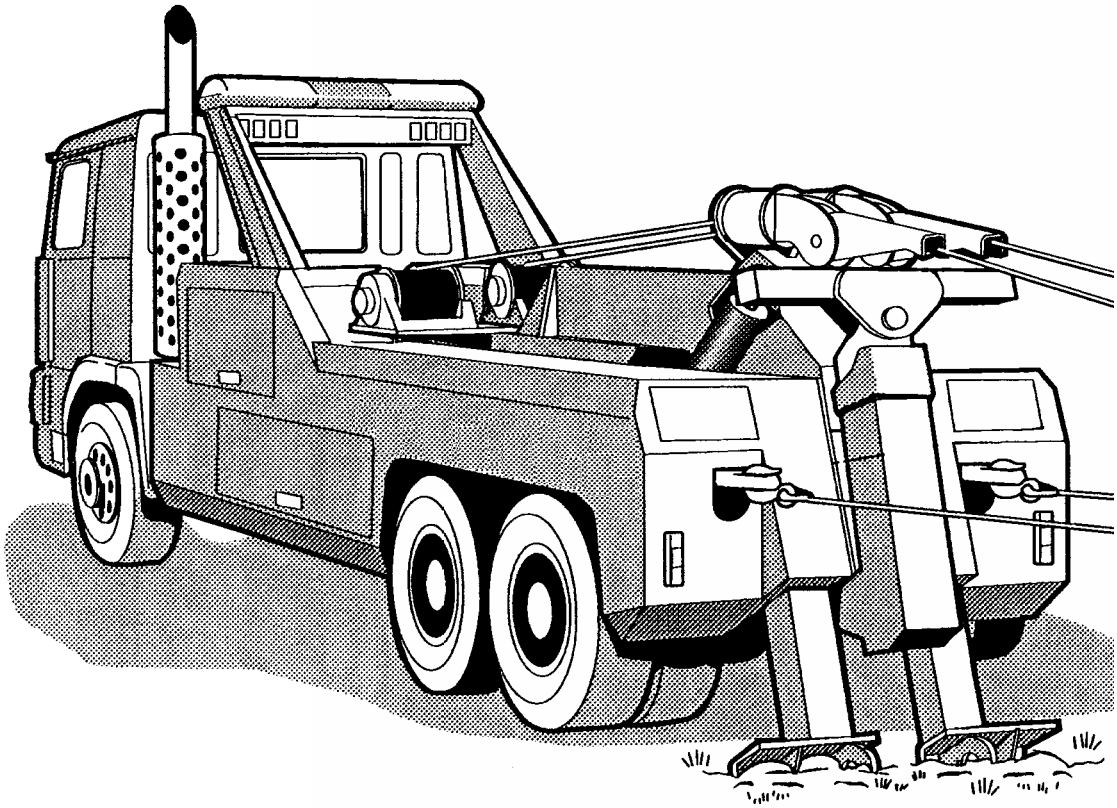
# Handbook of Winching Techniques for Vehicle Recovery



SUPERWINCH®

# Handbook of Winching Techniques




**Superwinch Ltd.**,
Abbey Rise, Whitchurch Road, Tavistock, Devon.
Great Britain.
PL19 9DR
Tel: +44 (0)1822 614101
Fax: +44 (0)1822 615204

**Superwinch Inc.**,
Winch Drive, Putnam, Connecticut 06260
U.S.A.
Tel: (860) 928 7787
Fax: (860) 928 1143


SUPERWINCH®

## INTRODUCTION

Please read and understand this handbook before using your Superwinch and it's accessories. It has been supplied with your winch to encourage safe operation - if used unsafely or improperly, there is a possibility that property damage or personal injury can result, since your safety ultimately depends on your caution when using these products. Pay particular attention to the RULES FOR SAFE OPERATION in this handbook.

Vehicle recovery is a particularly hazardous practice. Full professional training should be undertaken before engaging in professional vehicle recovery, contact the Association of Vehicle Recovery Operators, the Institute of Vehicle Recovery or Road, Rescue and Recovery for further details.

**PLEASE RETAIN THIS HANDBOOK WITH THE WINCH AT ALL TIMES**
**(PREFERABLY KEEP WITH THE WINCH OWNER'S MANUAL)**

## WARNINGS, CAUTIONS AND NOTES

These are given through these instructions in the following form :

**WARNING : Procedures which must be followed precisely in order to avoid the possibility of personal injury.**

**CAUTION : This calls attention to procedures which must be followed to avoid damage to components.**

**NOTE : This calls attention to methods which make a job easier or gives helpful information.**

SUPERWINCH winches are not to be used to lift, support or otherwise transport personnel. Any such use shall be considered to invalidate the warranty and Superwinch shall not be responsible for any claims arising from such use.

## REFERENCES

References to the left and right hand side in the instructions are made when viewing the vehicle from the rear.

## THE THEORY OF WINCHING

To get the best from your Superwinch and auxiliary equipment requires some understanding of the mechanics involved in winching. For winching purposes the resistance to motion of a vehicle is dependent on five main factors.

(i) The inherent resistance to movement of the vehicle to be recovered.
(ii) The total weight of the vehicle to be recovered.
(iii) The nature of the surface to be transited by the vehicle to be recovered.
(iv) The gradient up which the vehicle to be recovered is required to be moved.
(v) Any damage sustained by the vehicle.

(i) The *inherent resistance* of a vehicle depends on whether the vehicle has sustained any damage to it's rolling gear, e.g. whether all or some of the wheels are missing or not, the state of the tyres on any remaining wheels (a flat tyre will cause considerable drag, it may be advisable to change a tyre that is deflated before commencing recovery operations), friction in the drive-train (which will cause drag), and the weight of the vehicle.

(ii) The *weight of the vehicle*, includes all equipment, luggage, fuel, passengers and stores, etc. aboard the vehicle.

(iii) The *nature of the surface to be traversed* is the second largest variable in the winching equation. A vehicle in good running order on a metalled surface will only require a force of about 4% of its total weight to induce motion, whereas a vehicle to be recovered from a bog will require a pull equivalent to about 50% of the total weight of the vehicle. The table below shows that different surfaces require proportionate efforts to produce vehicle movement.

| Type of Surface | Effort required to move vehicle as a fraction of total weight |
|---|---|
| Hard metalled road | 1/25 total weight |
| Grass | 1/7 total weight |
| Sand (hard wet) | 1/6 total weight |
| Gravel | 1/5 total weight |
| Sand (soft wet) | 1/5 total weight |
| Sand (soft/dry/loose) | 1/4 total weight |
| Shallow mud | 1/3 total weight |
| Bog | 1/2 total weight |
| Marsh | 1/2 total weight |
| Clay (clinging) | 1/2 total weight |

A simple calculation will show that approximate rolling resistance of an undamaged vehicle on a flat surface can be predicted e.g. the pull required to move a vehicle weighing about 2041 kgs along a flat sandy beach of hard wet sand.

$$\frac{\text{Weight of vehicle (kgs)}}{\text{co-efficient of resistance of hard wet sand}} = \frac{2041 \text{ kgs}}{6} = 340\text{kgs}$$

However, as all surfaces are not flat, the calculation must therefore include the gradient resistance co-efficient.

(iv) *Gradient Resistance*. The gradient up which a vehicle is to be moved may only cover a short distance, over the total distance of the pull, e.g. a ditch or rock, or it may cover a long climb up a hill. Even for a relatively short upward pull, gradient resistance must be taken into account. For practical winching purposes, gradient resistance can be taken as a 1/60th weight of the vehicle for each degree of the slope, up to 45 degree incline.

$$\frac{\text{Gradient x weight of vehicle}}{60}$$

e.g. for a 15 degree slope, gradient resistance will be 15/60 of the weight of the vehicle, which is 1/4 the vehicle weight. For an incline of 45 degrees the gradient resistance will be equal to 3/4 of the total weight of the vehicle. That the slope to be negotiated to all intents and purposes is only 1ft high will make no difference to the calculations, and should be kept in mind when pulling vehicles up or over ridges.

(v) The *damage* sustained by the vehicle is the largest variable in the winching equation. The damage resistance of the vehicle to be recovered can be expressed as:

$$\text{Weight of Vehicle} \times \frac{\text{No. of damaged wheels}}{\text{No. of wheels}}$$

## THE THEORY OF WINCHING

Note that twin wheels count as one.

So, if no wheels are damaged on a four wheeled vehicle then there is no *damage resistance* to be added to the final equation. However, if all four wheels are damaged on a four wheeled vehicle, then we must add the entire weight of the vehicle to the equation as the damage resistance.

If we combine the weight of the vehicle, the type of surface to be transited, the gradient to be overcome and the damage to the vehicle we get the calculation:

$$\left(\frac{\text{Weight of Vehicle}}{\text{Surface to be transited}}\right) + \left(\frac{\text{Gradient}}{60} \times \text{Weight of Vehicle}\right) + \left(\frac{\text{Damaged Wheels}}{\text{Total Wheels}} \times \text{Weight of Vehicle}\right)$$

Therefore the winching formulae is

$$\frac{W}{S} + \frac{(G \times W)}{60} + \frac{(DW \times W)}{TW} = \text{effort required}$$

Where
- W = Weight of vehicle
- S = Surface to be transited
- G = Angle of gradient (in degrees)
- TW = Total No. of Wheels on vehicle
- DW = No. of damaged wheels on vehicle

i.e. A vehicle weighing 2041 kgs, with two non operative wheels out of four is to be recovered up a grass bank with a slope of 45 degrees.

Using the winching formula above.

Where
- W = 2041 kgs (vehicle weight)
- S = 1/7 (co-efficient for grass)
- G = 45 (slope in degrees)
- DW = 2
- TW = 4

We have

$$\frac{2041}{7} + \frac{(45 \times 2041)}{60} + \frac{(2 \times 2041)}{4} = 292 + \frac{(91845)}{60} + \frac{4082}{4}$$

$$= 292 + 1531 + 1020$$

$$= 2843 \text{ kgs effort required to recover vehicle.}$$

If we substitute shallow mud for the surface (co-efficient of 1/3) in the above equation we get:

$$\frac{2041}{30} + \frac{(45 \times 2041)}{60} + \frac{(2 \times 2041)}{4} = 680 + \frac{(91845)}{60} + \frac{4082}{4} = 3231 \text{ kgs effort}$$

The effort required may be outside the capacity of the winch, (the rating of a winch usually refers to the first layer of wire rope on the drum). In this case, one solution may be to run out most of the winch cable to enable the winch to be used at or near its rated capacity, or introduce a pulley block in the winch line to create a mechanical advantage, thus reducing the effort required by the winch.

## USE OF A PULLEY BLOCK

The most important aid to successful winching (after the winch) is the pulley block, which can be used to increase the pulling power of the winch or for indirect pulls. Pulley blocks can be used in two modes:

(a) attached to the vehicle to be recovered, and,
(b) secured to an anchor point.

The anchor point, when used, must be secured and able to withstand the load necessary to recover the vehicle, e.g. using a tree, another vehicle or any firm structure to which a pulley block can be securely attached. Fig. 1 - show typical examples where a pulley block can be used to advantage, based on a winch line pull of 2040 kgf (20kN).

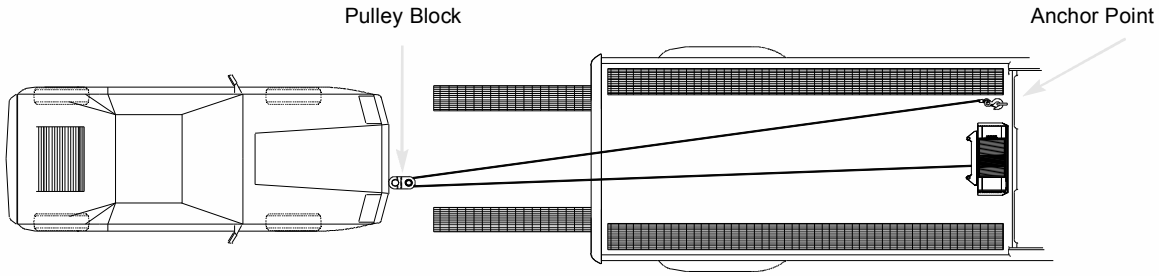



Fig. 1

Fig. 1: Vehicle recovery using the pulley block attached to the vehicle to be recovered for direct pull. The actual pulling power on the vehicle will be 4080 kgf (40kN) at half winch rope speed (See next section).

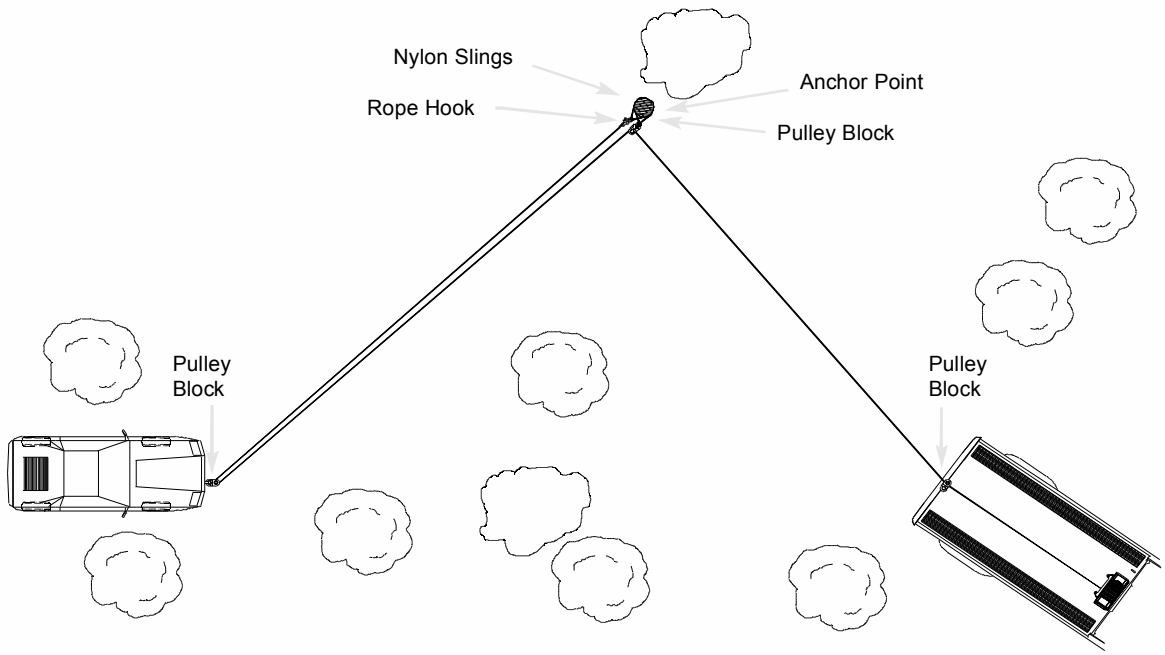



Fig. 2

Fig. 2: Indirect pull necessitated by obstructions or soft ground with a pulley block attached to vehicle to be recovered and using a suitable anchor point. Note how the angle of rope feed onto the winch drum is kept as close as possible to 90° by use of a pulley block at the back of the bed of the recovery vehicle. The actual pulling power on the vehicle will be 4080 kgf (40kN) at half winch rope speed (See next section).

## USE OF A PULLEY BLOCK

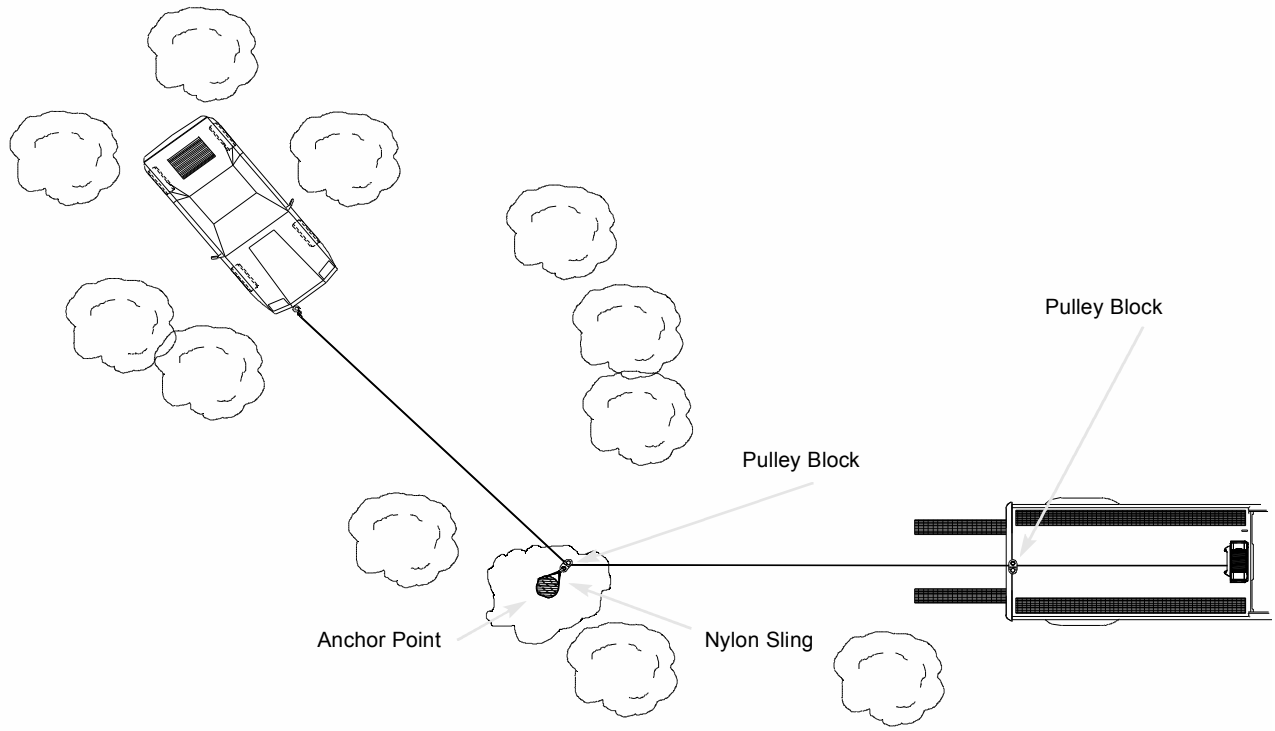



Fig. 3

Fig. 3: Indirect pull where vehicle access is limited due to unsuitable ground or obstructions, using a pulley block attached to suitable anchor point. Actual pulling power on load will be 20kN (2040 kgf) at winch rope speed.

## MECHANICAL ADVANTAGE

As well as changing the direction of the pull, the pulley block can also be used to give a mechanical advantage. This means that the use of pulleys can exert a force on an object greater than the force being delivered by the winch. Consider Fig. 4 below, if the winch is exerting a force of say, 20kN (2040 kgf), then that force is constant throughout the rope. This means that if we count the number of times the rope is connected to an object and multiply that by the force the winch is exerting, we have the total force acting on that object. So, for Fig. 4, below, the vehicle being recovered is subject to a force of 2040 kgf x 2 = 4080 lgf (40kN). For the anchor point there are three falls of rope so it is subject to a force of 6120 kgf (60kN).

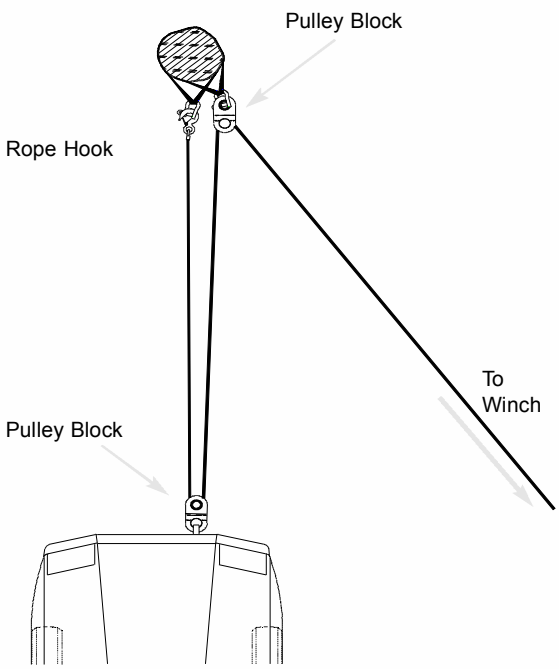



Fig. 4

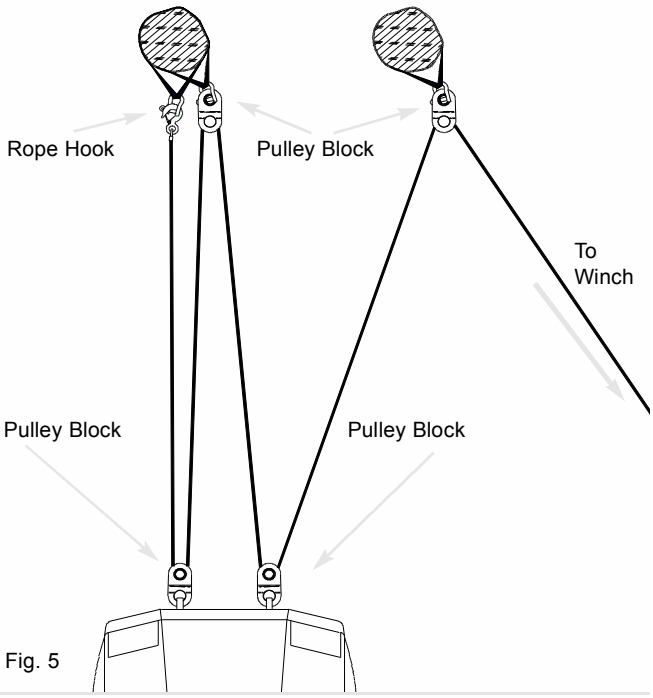



Fig. 5

## MECHANICAL ADVANTAGE

The disadvantage of using this system, however, is the effective reduction in winch speed apparent at the recovered vehicle. This equates to the winch speed divided by the number of rope falls. In the system shown in Fig. 4, the speed of the recovered vehicle will be halved. In Fig. 5, a greater mechanical advantage is being exerted. If we again assume a winch force of 2040 kgf, then the vehicle is subject to a force of 8160 kgf (80kN) but at 1/4 winch speed. The tree on the left is subject to 6120 kgf (60kN) and the tree on the right 4080 kgf (40kN).

## USE OF A NYLON SLING & SHACKLE

2.1A shackle should always be used when attaching winch hooks to nylon slings. See Fig. 6.

NOTE: The shackle must pass through both eyes of the sling. The safe working load of the nylon sling is based on the use of both eye ends.

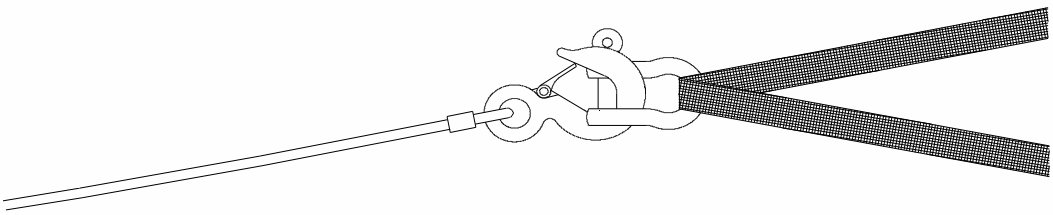


Fig. 6

## USE OF GLOVES

3.1 Use of gloves when handling or rewinding cable to eliminate the possibility of cuts caused by burrs, broken strands and trapped foreign material.

## RULES FOR SAFE OPERATION

Your Superwinch is a very powerful machine. Treat it with respect, use it with caution, and always follow these safety guidelines. Your Superwinch is specifically designed for the recovery of vehicles. In an emergency situation where the lives of people are endangered take every precaution including those listed below.

**1. GENERAL** - applicable in all instances.

**2. HAULING** - the recovery of a vehicle.

## GENERAL SAFETY

1.1 **LEARN TO USE YOUR SUPERWINCH.** After installing it, take some time and practice using it so you will be familiar with it when the need arises. Periodically, check the winch installation to ensure that all bolts are tight.

1.2 **KEEP WINCHING AREA CLEAR.** Do not allow people to remain in the area during winching operations. Do not step over a taut wire rope or allow anyone else to do so.

1.3 **INSPECT WIRE ROPE AND EQUIPMENT FREQUENTLY.** The wire rope should be inspected for damage that could reduce it's breaking strength. A frayed rope with broken strands should be replaced immediately. Always replace the rope with a Superwinch recommended replacement part. Any substitution must be **IDENTICAL** in strength, quality, lay and stranding.

1.4 **USE THE GLOVES** when handling or rewinding wire rope to eliminate the possibility of cuts caused by burrs and slivers from broken strands.

1.5 **ALWAYS MAKE SURE** that there are at least 5 complete turns of rope left on the drum before winching since the rope fastener will not support a heavy load.

1.6 **KEEP HANDS AND FINGERS CLEAR OF WINCH ROPE AND HOOK WHEN OPERATING WINCH.** Never put your finger through the hook when reeling in the last few feet. If your finger should become trapped in the hook or rope, you could lose your finger. Use the **HAND SAVER BAR** (Fig 7) to guide the hook for the last few feet. Never guide a wire rope under tension onto the drum with your hand.

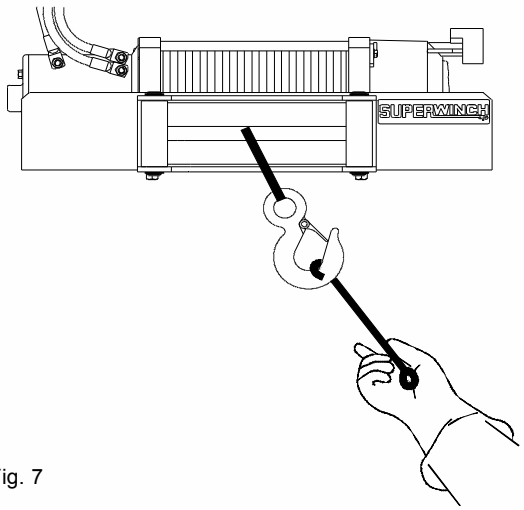



Fig. 7

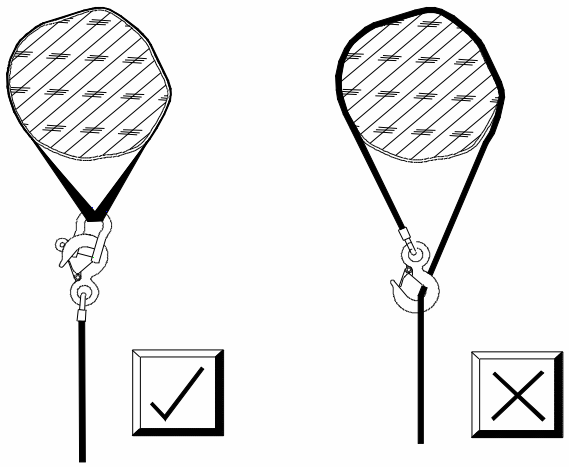


Fig. 8

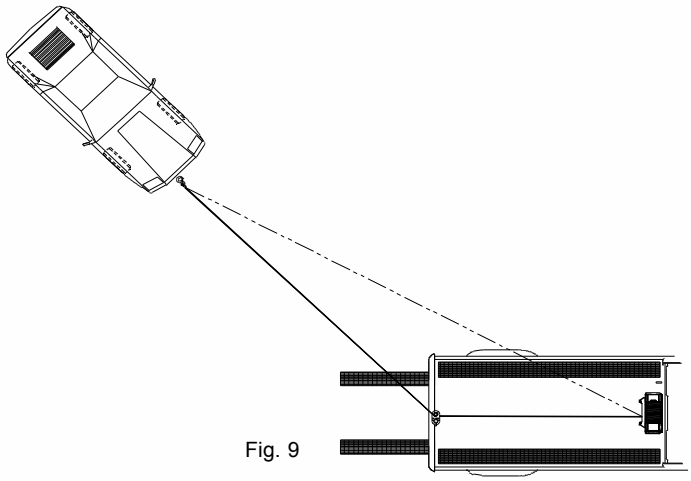


Fig. 9

## GENERAL SAFETY

1.7 **NEVER HOOK THE ROPE BACK ONTO ITSELF.** Hooking the rope back onto itself creates an unacceptable strain, breaking individual strands which in turn weakens the entire wire rope. Use the sling as shown in Fig. 8.

1.8 **AVOID CONTINUOUS PULLS FROM EXTREME ANGLES** as this will cause the rope to pile up at one end of the drum (Fig 9). Always aim to get the rope as straight as possible to the direction of the vehicle.

1.9 **NEVER OPERATE THE WINCH WITHOUT THE ROPE FAIRLEAD FITTED.** Operator injury or winch damage can result if a fairlead is not installed.

1.10 **NEVER ATTEMPT TO ENGAGE OR DISENGAGE WINCH CLUTCH WHEN THERE IS A LOAD ON THE WINCH.**

1.11 **STORE THE REMOTE CONTROL CORD IN A SAFE PLACE** when not in use to prevent use by children or other unauthorized persons who could injure themselves, others or damage the controls.

1.12 **DO NOT OPERATE WINCH WHEN UNDER THE INFLUENCE OF DRUGS, ALCOHOL OR MEDICATION.**

1.13 **ISOLATE WINCH BEFORE PUTTING YOUR HANDS IN OR AROUND THE FAIRLEAD OR WIRE ROPE DRUM (THE DANGER ZONE)**

1.14 **DO NOT OVERLOAD YOUR WINCH.** Do not maintain power to the winch if the motor stalls. Overloads can damage the vehicle, winch and / or the wire rope and create unstable operating conditions.

1.15 **ELECTRIC WINCHES:** If the vehicle is powered from the vehicle battery, take care that this is not discharged to the point whereby the engine cannot be started and you could be stranded. It is recommended to keep the engine running whilst winching to provide charging current to the battery.

1.16 It is recommended to lay a heavy blanket or jacket over the rope about halfway along to the hook attachment. If a rope failure should occur, the weight of the cloth will act as a damper and help prevent the broken rope from whipping. Remember to move the blanket or coat as winching proceeds, but halt winching when doing so.

## HAULING

2.1 When using your Superwinch to recover a vehicle, ensure the recovery vehicle is held securely to the ground, preferably with a ground anchor. Application of the vehicles footbrake by you or your assistant may be sufficient, depending on the load and the ground surface. Never leave an automatic transmission in the ‘park’ position.

2.2 **DO NOT** ‘move’ your vehicle in reverse to assist the winch. The combination of the winch and vehicle pulling together could cause catastrophic damage with the high risk of personal injury.



This Manual's Part No. is:
**5-001-031**

Issue No.
**3**

**Superwinch Ltd.**,
Abbey Rise, Whitchurch Road, Tavistock, Devon.
Great Britain.
PL19 9DR
Tel: +44 (0)1822 614101
Fax: +44 (0)1822 615204

**Superwinch Inc.**,
Winch Drive, Putnam, Connecticut 06260
U.S.A.
Tel: (860) 928 7787
Fax: (860) 928 1143