

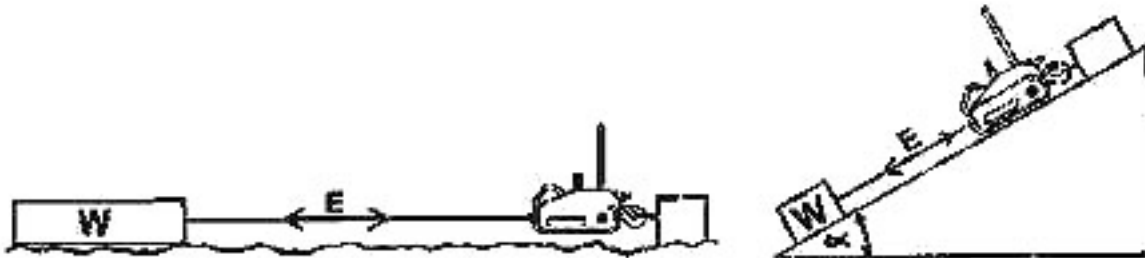
How to use the TIRFOR machine: calculation of pulling effort.

The rated capacity of a TIRFOR is not equal to the weight of the load to be moved. It is the maximum available pulling effort. In fact, the necessary pulling effort is generally only a small proportion of the weight of the load. It depends on the coefficient of friction between the load and the ground, and on the angle of the slope, if any. It is important to know the approximate pulling effort which will be required to choose the most suitable TIRFOR model.

1- Mathematical method of calculating the effort required to move a given load.

Horizontally: $E = \mu W$

On a slope: $E = W (\mu \cos \alpha + \sin \alpha)$



Where **E** is the effort required to pull a load lying on the ground,

W is the weight of the load

μ is the friction between load and ground which depends upon the area of contact of the load with the ground and the nature of the ground (presence of wheels, rollers, sand, mud, concrete, etc...)

α is the angle of the slope

The value of μ , the coefficient of friction, must be known or estimated.

We give hereafter some general values of this coefficient μ :

- steel on steel	0,4 - 0,6	- iron on stone	0,3 - 0,7
- leather on metal	0,6	- continuously lubricated surfaces	0,15
- wood on stone	0,4	- load on wheels	0,02 - 0,05

Here are two examples for calculation purposes, using the above formula:

Case 1: W = vehicle on wheels +/- 3000 kg; Coefficient of friction = 0.05; Angle = 5° . Formula: $E = W$
(Coefficient of friction $\times \cos 5^\circ + \sin 5^\circ$)

$$\cos 5^\circ = 0.99619$$

$$\sin 5^\circ = 0.087155$$

$$E = 3000 \text{ kg} (0.05 \times 0.99619 + 0.087155)$$

$$E = 414 \text{ kg}$$

This means that to move the vehicle up the 5° slope, 414 kg is required in terms of effort. For this task a TIRFOR TU8 or T508 would be suitable, with a capacity of 800 kg.

Case 2: W = vehicle on wheels +/- 3000 kg; Coefficient of friction = 0.05; Angle = 45° .

Formula: $E = W(\text{Coefficient of friction} \times \cos 45^\circ + \sin 45^\circ)$

$$\cos 45^\circ = 0.70711$$

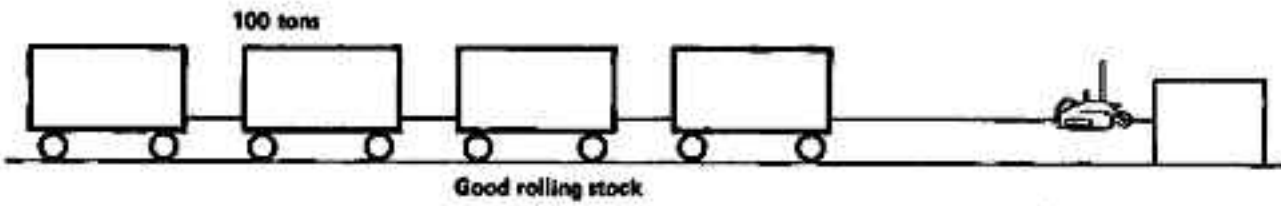
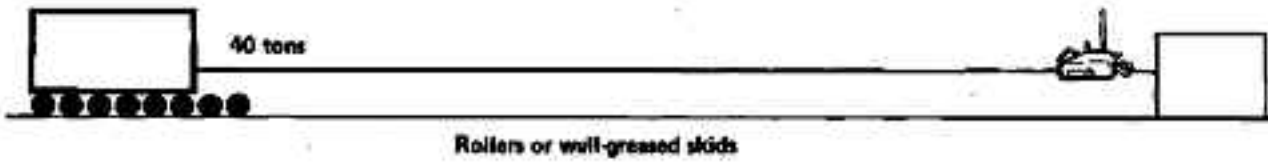
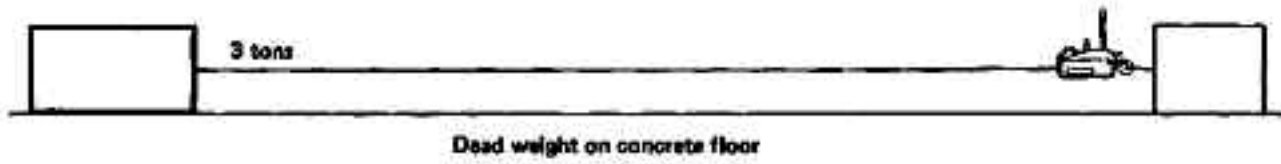
$$\sin 45^\circ = 0.707106$$

$$E = 3000 \text{ kg} (0.05 \times 0.70711 + 0.707106)$$

$$E = 2227 \text{ kg}$$

This means that to move the vehicle up the 45° slope, 2227 kg is required in terms of effort. This time, a TIRFOR TU32 or T532 would be required, with a capacity of 3200 kg, on a single line pull or a TIRFOR TU16 or T516, with a capacity of 1600 kg, but used in conjunction with a pulley block to increase the capacity, operating on a two line pull.

2 – Approximate loads which have been moved during by a $1\frac{1}{2}$ ton TIRFOR under tests.



3 – Graphical method of calculating effort required to move a given load.

