WINCH DRIVE CALCULATIONS

The following section explains how to calculate the output torque and speed required from a hydraulic motor to drive a winch.

Before proceeding to the motor torque and speed calculations the following variables need to be determined:

Bare drum line pull	F_{max}
Bare drum line speed	v_{min}
Bare drum radius	R_{min}
Gearbox ratio (if any)	¡

Drum torque

The drum torque required to achieve the desired line pull increases as the number of rope layers on the drum increases. Therefore, when drum torque is fixed, maximum line pull is achieved with a 'bare-drum' (less than one complete layer of rope on the drum). The drum torque required to achieve a desired bare-drum line pull can be calculated using the following formula:

$$T_d = F_{max} \times R_{min}$$

Where

T_d	=	drum torque in inch-pounds (in-lb)
F_{max}	=	bare-drum line pull in pounds (lb)
R_{min}	=	bare-drum radius in inches (in.)

In metric units

$$T_d = F_{max} \times R_{min}$$

Where

T_d	=	drum torque in deca Newton metres (daNm)
F_{max}	=	bare-drum line pull in kilograms (kg)
R_{min}	=	bare-drum radius in metres (m)

Note that the figure calculated here is the required drum torque. If no gearing is used between the drum and hydraulic motor, the shaft torque required from the hydraulic motor (T_m) equals drum torque (T_d). If a reduction gearbox is used, the torque multiplication of the gear ratio must be considered.

Motor torque

If a reduction gearbox is used, the gearbox input torque required from the hydraulic motor will be less than the required drum torque and can be calculated as follows:

$$T_m = \frac{T_d}{i}$$

Where

T_m = motor shaft torque in inch-pounds (in-lb)
T_d = drum torque in inch-pounds (in-lb)
i = gear ratio of reduction box

In metric units

$$T_m = \frac{T_d}{i}$$

Where

T_m = motor shaft torque in deca Newton metres (daNm)
T_d = drum torque in deca Newton metres (daNm)
i = gear ratio of reduction box

Drum speed

The drum speed required to achieve the desired line speed decreases as the number of rope layers on the drum increases. Therefore, when drum speed is fixed, minimum line speed is achieved with a 'bare-drum' (less than one complete layer of rope on the drum).

Motor speed

Motor shaft speed required to achieve a desired bare-drum line speed can be calculated using the following formula:

$$n_m = \frac{114.6 \times v_{min} \times i}{R_{min}}$$

Where

n_m = motor speed in rpm
v_{min} = bare-drum line speed in feet per second (ft-sec)
i = gear ratio of reduction box
R_{min} = bare-drum radius in inches (in.)

In metric units

$$n_m = \frac{9.5 \times v_{min} \times ¡}{R_{min}}$$

Where

n_m	=	motor speed in rpm
v_{min}	=	bare-drum line speed in metres per second (m/s)
¡	=	gear ratio of reduction box
R_{min}	=	bare-drum radius in metres (m)

At this point, the torque and shaft speed required from the hydraulic motor to drive the winch have been determined. For detailed information on motor and pump sizing and selection refer to our Technical Library document titled Pumps and Motors.