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Fitting Fibre Rope to the Towing Winch – a Guideline

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SYNOPSIS

Most harbour tugs are fitted with a powerful hydraulic/electric winch to not only store the main tow rope, but also to hold that rope in such a manner that the full power of the tug can be transferred from the propulsion units of the tug to the vessel being assisted via this rope. How can we ensure that the rope is secured and packed on to the winch so that the tugmaster can be confident that the rope will not slip, will not bury and can be relied upon to ensure that all towing operations can be confidently undertaken in a safe and speedy manner?

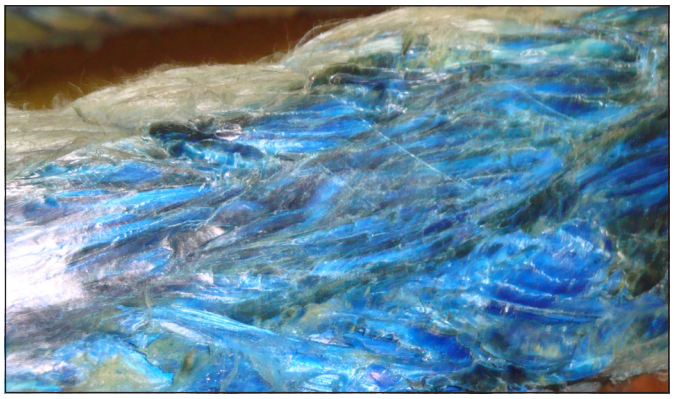
In this paper I will present some concepts that can be built upon to provide a guideline for not only fitting fibre tow rope to tug winches, but how to maximise the life of those towlines by pre-tensioning ropes before use.

LOADING A TOWLINE ON TO A WINCH DRUM

This paper is being written with the objective of gathering information so that a guideline can be devised to help tugmasters and crews fit soft ropes correctly to their winches so as to maximize the life of these tow ropes. In the Australian tug market most tug winches are adapted from winches that were generally designed for wire rope usage and modified for use with soft rope. It is fair to say that we have a reasonable body of knowledge on working with wire rope winches, but this does not appear to be the case in regard to soft ropes.

With wire rope, the bitter end of the wire is fitted through a slot in the side of the drum and clamped with wire rope clamps. The wire is then heaved onto the winch drum, generally with some form of resistance being applied by a shore-mounted or portable reeling device. Because wire is inflexible to the degree that each successive turn on the drum will pack down firmly, this generally means that the formation layers of wires on the drum can be relatively easily fitted. In some cases, the drum has ridges formed in it to make sure that the wire does not have a riding turn. In the more sophisticated wire winches, there is a level winder to assist in guiding the rope into place; otherwise this is done manually.

Using soft rope creates a couple of challenges for the crew to deal with: the rope is soft and pliable and its diameter is generally somewhat larger than the wire rope that would be used on a similar-sized winch. When referring to soft rope, we are normally dealing with polyester, which can be anywhere from 60mm to 112mm, or High Modulus Polyethylene (HMPE) which can be 44mm to 64mm, or even larger. These are generally the sizes that you will find on tugs that have BP in the range of 50 tonnes to 75 tonnes.



Figures 1 and 2: Section of 64mm AmSteel Blue damaged because it was not secured to the winch drum or bedded in.

I have sought advice from several prominent tug people, Arie Nygh of PB Towage and Ben Burns from Svitzer, as well as Samson Rope, and received some ideas from Blaine Dempke and Barry Griffin of Markey Machinery. I am sure that some tug operators will have existing guidelines and I would be grateful if they could send me copies so I can include them in any future publications.

The Samson Commercial Marine catalogue has some suggestions, including the following extract:

WINCH AND SHEAVE INFORMATION

Winding rope: tug assist lines

A minimum of the first three to four wrap layers of rope around the winch storage drum should be installed so the rope has a close and tight fit on the drum. The installation tension on the rope should be approximately 10 per cent of the rope's minimum breaking strength. For new rope installations, the greater the number of wrap layers installed under the suggested tension will minimise or prevent subsequent wraps from diving or burying down into lower wraps. As the rope is used, the wrap tensions may loosen; it is suggested the total rope be re-tensioned at original installation loads and thereby prevent potential downward wrap slippage. A single drum or split drum winch should always keep a minimum of eight wraps of rope on the drum at all times. This is to ensure that the connecting point of the rope to the winch does not undergo load.

More specifically, Samson doesn't have a recommended connection method for winches, but is finding that a backer rope (a smaller diameter polyester or polypropylene rope) is helpful with:

- Slipping on the winch barrel
- Compression deformation

This is particularly important on very narrow winches where a full complement of eight to ten wraps (depending on the size of the rope) is not able to remain on the drum. We have seen high loads in escort jobs migrate all the way to the winch barrel and cause the line to slip from the termination hardware. A rope with a higher co-efficient of friction (COF) (Polyester or SSR1200) helps alleviate this issue. It is not imperative that the backer have the same MBL as the working line as the load is significantly dissipated as it migrates to the drum, eg a 64mm SSR1200 Round Plait (12-strand) (71.4 tonne MBL) is used to back an 80mm Amsteel Blue (411 Tonne MBL). This backer will also help with compression deformation, acting as a 'pillow'. We see a lot of rope-on-rope wear as the rope works back and forth on itself. As the surface abrasion takes hold, the COF of the rope is raised and the yarns begin to work on each other due to the loss of lubrication that, to some extent, the backer helps to alleviate.

Markey Machinery gave me the following useful suggestion for fitting soft ropes to their winches, which also takes into account those winches that are fitted with a level winder:

DRUM SPOOLING

Double-open spooling eight- or 12-strand soft-line

- Spooling of the drum for eight- or 12-strand soft-line must be accomplished in a certain manner in order to help prevent pull-down and resultant damage to the line or equipment.
- A properly spooled drum has the first two layers being spooled tightly, one wrap against the other, cinching the line tight using the tug-propulsion approximately every third wrap. This procedure requires declutching the level-wind and manually traversing the level-wind head using the handwheel.
- Once the first two bedding-layers are on the drum, engage the clutch and allow the level-wind drive to spool all remaining layers, applying tension using the tug-propulsion approximately every third wrap.

Additional thoughts were put together from a conversation between Barry Griffin and Blaine Dempke:

- Dead-end the rope to the drum using the procedure defined by the type of termination designed into the winch;
- Declutch the level-wind and have a man stationed at the level-wind handwheel so that it can be manually advanced for spooling the first two bedding layers;
- Deploy the full length of line to a bit;
- Prepare to in-haul the line using the winch;
- Inhaul three wraps at no more than 10 per cent tug-power (about five tonnes) (advance the level-wind as necessary to permit parallel wraps);
- Inhaul three more wraps at no more than 10 per cent tug-power;
- Inhaul three more wraps at no more than 15 per cent tug-power (about 10 tonnes);
- Inhaul the remaining wraps, three at a time, at no more than 20 per cent tug-power (about 15 tonnes) until the first two layers are full and packed;
- Engage the level-wind (which will revert the level-wind to open-weave spooling) and allow the level-wind to spool the line for all remaining layers; and
- Spool the remainder of the line, three wraps at a time, at about 10 tonnes – 15 tonnes line-pull until the drum is full.

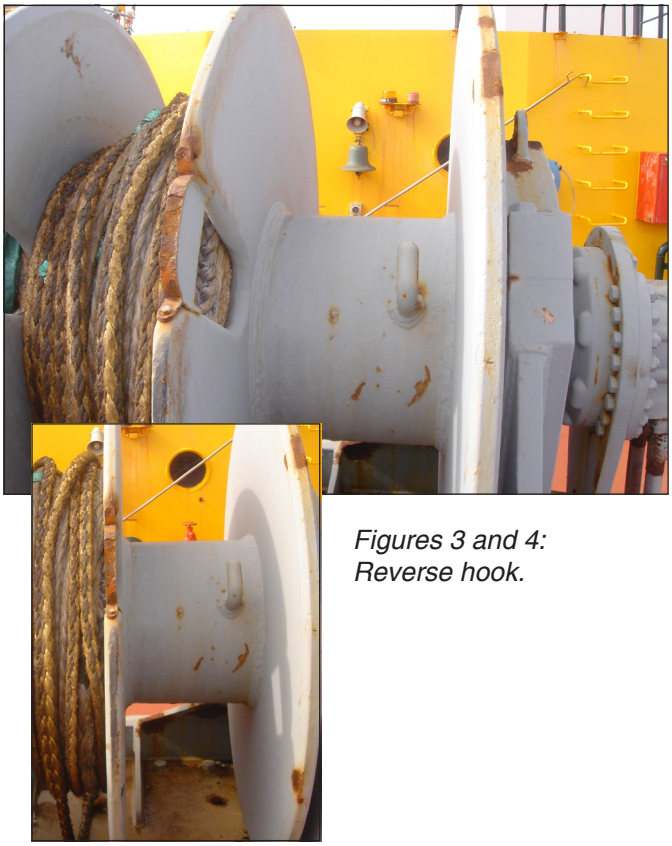
One of the key challenges with fitting a towline on to a winch is the termination. A body of thought is that the 'hard fixing' of the bitter end of the rope is the most important part of the process of fitting a rope to a winch. It is important, but of more concern should be the tension and friction of the initial eight to 10 turns of the rope onto the drum.

There are various methods of fixing the bitter end of the rope to the winch:

1. Many winches, being based on wire rope winch design, will have a securing plate of some sort that is accessed by a hole through the cheek of the winch drum. The end of the rope is passed into this clamp and tensioned down with a plate and bolts. Inevitably these systems are designed for a rope of a diameter about half the actual tow rope size.

2. Another method is to fit either a recessed reverse hook inside the drum of the winch or weld it to the

drum (see Figures 3 and 4 below). This enables the inboard eye of the tow rope to be attached and hold the rope in place while tension is worked onto the bottom turns.



Figures 3 and 4: Reverse hook.

3. Yet another method is to make up a U-bolt from high-tensile stainless steel and drill holes through the cheek of the winch to enable the U-bolt to capture the bitter end of the rope on one side of the winch. With this method some 500mm to 750mm of the tail of the tow rope is passed through the U-bolt before it is tightened.

Figure 5: U-bolt fixing tow rope to cheek of drum.

Figure 6: Bolts on outside of drum.

Inevitably there are other securing methods available and if any delegate is aware of such a method then please share it with me to incorporate in later publications. One factor which should be taken into consideration is that, whatever securing method is used, it should be able to allow the bitter end of the tow rope to fly free if the situation arises where the winch brake fails and all the line is allowed to run off the drum, with the minimum amount of damage to the winch itself. You certainly don't want a fixing method that would have the rope still hard fixed in such a way that the tug becomes secured to the towed vessel by this fixing point.

Another factor to be taken into consideration is the actual 'bedding-in' of the tow rope onto the drum. As stated earlier, it is the friction of the base turns of the tow rope onto the drum that will ensure that the tug is able to apply its maximum power in pulling a vessel without fear of the tow rope slipping or fusing onto the drum. To achieve this at least eight full turns of the tow rope should be turned up on to the base of the drum and some tension applied, 10 – 20 per cent of the bollard pull of the tug is suggested as a guide.

It is probably best when undertaking this exercise to connect the outboard end of the tow rope either to a wharf bollard that is sufficiently strong or to a sister tug. If the winch drum is wide enough to take at least eight turns, then I would suggest putting four turns onto the base and gently applying a load of, say, 10 – 20 per cent of the bollard pull, then turning up the next four turns and applying more power, say up to 40 per cent, and then continue applying turns until the whole of the base of the winch is covered, with the last turn firmly housed onto the opposite end of the cheek where you started.

Depending upon the length of the tow rope, and the length of rope that is normally forming the 'working length', the in-board part of the tow rope should continue to be 'bedded' onto the winch under tension as previously described. The objective is twofold:

- To form a solid bed of rope on the drum to minimize the 'burying' of the rope during towage, and
- Ensuring that the base turns on the drum are sufficiently bedded-in to ensure that under full power the tow rope doesn't slip.

HMPE ropes will have a much lower COF than polyester and as such it is advisable to use a backer rope of polypropylene or polyester, which should be long enough to cover the base of the drum and of sufficient diameter to fit into the securing mechanism. In some cases, the bitter end of this backer rope can be doubled to fit into the securing mechanism. Once the rope is packed on to the drum and normal towage operations commence, the masters should remain conscious of the need to recover as much as possible of the working lengths of the tow rope under as much tension as possible to ensure that the chances of the working end of the rope burying are minimized.

Finally, I would stress that this document is designed as a guideline and initially would ask that the reader consults with his or her colleagues and feeds back to me any further suggestions or logic that will modify this information for general distribution within the tug industry. Any feedback will be gratefully received.