Document Title		RHGSE Capstan Size Clarification				
Document #	Rev	Type	Reason	Recommendation	Original Release Date	
ZSB-024	Original	Service Bulletin	Clarification	Informational - IMPORTANT	2017/10/19	

Zephyr RHGSE Three Groove Capstan Size Selection Criteria

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Purpose: The purpose of this service bulletin is to discuss the cable wrapping behavior when using the three groove Zephyr RHGSE Capstans, and to clarify the effects of the capstan size versus cable size on the cable wrapping under various load conditions.

Note: This service bulletin does note the importance of the Rotatub Clutch Adjustment, as discussed in ZSB-007, but not the use of four groove capstans as discussed in ZSB-015. All following discussion assumes the Rotatub clutch is properly adjusted.

Scope: The rescue hoists in use today use a 3/16 diameter cable for 600 lb. rated load. However, the exact diameter of the cable can vary due to the hoist OEM specifications. Sometimes the variation in exact diameter requires using different sized capstans. Observations of user's experiences with the various sized cables led Zephyr to develop two different sized capstans to improve the performance of the RHGSE.

Capstan Size Selection Criteria

For larger diameter cables .188-.194 inches or 4.77 to 4.9 mm - Use ZGS-10113-20 and ZGS-10113-20-1 capstans.

For smaller diameter cables .181 to .192 or 4.59 to 4.87 mm – Use ZGS-12472-1 and ZGS-12474-2 capstans

Note that there is an overlap between .192 to .188 where the ZGS-12472-1 and -2 Capstan will work successfully with any cable when used on the hydraulic or Electric RHGSE, primarily because the cable is always being extended under a steady load between 30 to 100+ lbs.

OEM Cable tolerances: The cable diameter tolerance range is specified on the OEM manufacturing drawings. One hoist manufacturer uses a Mil Standard tolerance requirement but slightly modified on the high end. While, the other hoist manufacturer uses the same Mil Standard tolerance requirement but takes exception to the minimum diameter requirement.

Cable Diameters When New: MIL DTL-83140B Specification Cable diameter is 3/16 +.009/ -.000 inches.

A. OEM A cable diameters are typically .188 to .194 inches in diameter.

B. OEM B Cable diameters vary by the type of hoist they are installed on.

The most prevalent new OEM B cable diameter is .187 +.006/ -.007.

Therefore, OEM A cable can be .194 maximum diameter and an acceptable .188 minimum diameter.

OEM B cable diameter can vary to a much larger degree. The maximum of .193 is acceptable and a minimum of .180 is acceptable.

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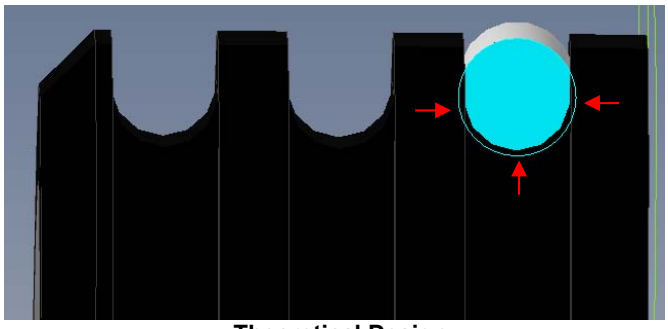
Note:

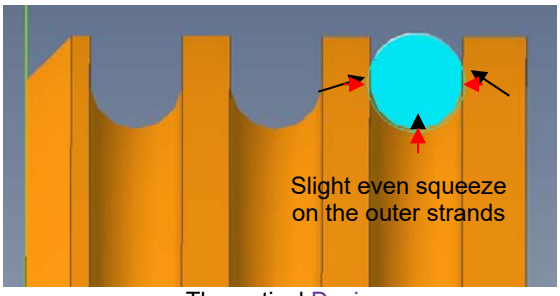
The Pitch Diameter of the cable coming off the Capstan must be in a correct range match the Spooler diameter and the clutch's ability to compensate for any error, or the cable behavior on the capstans, the Rotatub and Spooler will be affected.

Capstan Groove Grip explained: The capstans maintain a grip on the cable to insure adequate friction to exert a tensile force on the cable due to the Capstan Effect. If the contact between the cable and the capstan is lowered then the friction is lowered and the force exerted on the cable is lowered and slippage increases. Conversely if the grip is raised the cable position in the groove is affected and a small twist is imparted due the entrance angle of the cable into to the grooves. Too large a grip results in higher twisting of the cable and higher speed as it is coming off the capstans.

Cable Grip Illustrations of various cable-capstan combinations:



Theoretical Design
.194 Diameter Cable pulled tight into groove of ZGS-12474-1.
There is heavy squeeze on the outer strands.
Larger pitch diameter.



Theoretical Design
.194 Diameter Cable on ZGS-10113-20 Capstan.
There is now even squeeze but the pitch diameter is Ideal

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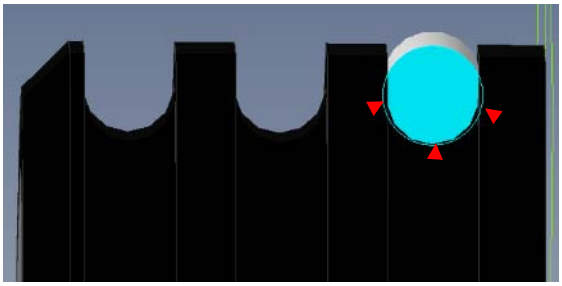
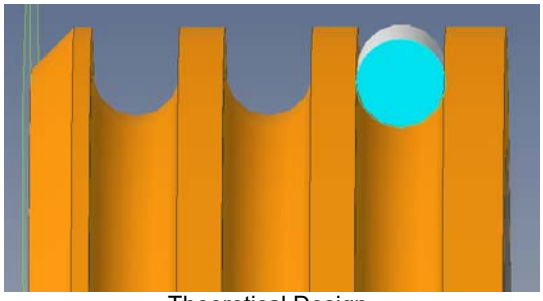


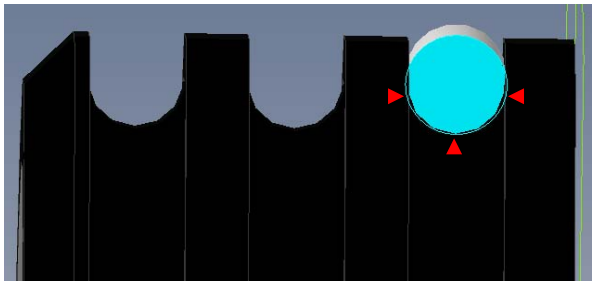
Actual Situation

.192 Diameter Cable loosely fit on ZGS-12474-1 Capstan, using measured values. As you can see the squeeze is on the sides and effectively is holding the cable higher in the groove resulting in a larger than ideal pitch diameter.



Theoretical Design

.188 Diameter Cable on ZGS-10113-20 Capstan. As is shown here **there is almost no squeeze**. The cable loosens between the second and third wraps as the load goes down quickly because there is less squeeze.



Actual Situation

.185 Diameter Cable loosely fit on ZGS-12474-1 Capstan, using measured values. As you can see there is less squeeze and the pitch diameter is smaller.

Effect of Cable Load: The higher the load the further the cable gets pulled down into the grooves of the capstans; therefore, the pitch diameter is reduced and the cable comes off the capstans slower. Conversely the lower the load, the higher the cable rides in the groove; therefore, the greater the pitch diameter and the cable comes off the capstans at a higher speed.

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Immediate Effect of Mismatched Capstan and Cable Size: There are two indications that the capstans being used are not the proper size to use.

1) Cable coming of the Capstans faster than the Rotatub can collect it.

This may be typical of an OEM A hoist cable being used with an OEM B hoist cable Capstans. In this case the actual pitch diameter of the cable on the Capstan is larger than required because the larger cable cannot fit into the grooves. The cable comes off the lower black large guide roller at the Rotatub and appears to twist and back up in the Rotatub when extending as shown below.

Remember, the clutch can slip and slow down the Rotatub, but it cannot increase the Rotatub speed if the Pitch diameter of the cable coming off the capstans is too large and the clutch is adjusted properly.

However, if the clutch is set to low then this may be a result of the clutch slipping, especially when the Rotatub is full of cable at the end of the extending cycle.

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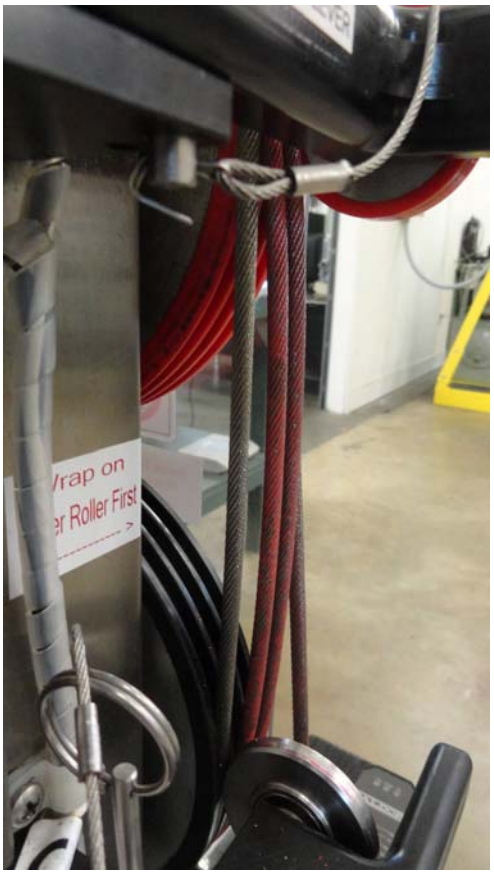
2) Cable appearing to get loose between both upper and lower capstans on the second and third grooves. This may be a smaller diameter cable running in ZGS-10113-20 and -20-2 capstans



This is because the cable is not being squeeze as hard.

Conclusion: For the Three Groove capstans:

A. Use ZGS-10113-20 and ZGS-10113-20-1 for any cable that is on the high side of the Mil Spec tolerance, .188 - .197.

B. Use ZGS 12474-1 and 12474-2 for any cable that is on the lower side of the Mil Spec tolerance, .188 - .180.

Note

Cables that are less than .192 will also work on ZGS-12474-1 and ZGS-12474-2 if they are regularly loaded to 100 lb. min.

Evaluating the two indications above may be a better determination of the correct capstan to use.

Remember, the Rotatub clutch must be checked on a regular basis and the Capstan Pitch Diameter must be checked on a regular basis.

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