Frequently asked Questions

Why are larger diameter cables harder to run in a well than smaller ones?

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The casing in an oil or gas well acts as a big pressure vessel with pressure being exerted equally in all directions. When the tool string and wireline enter the well, this pressure exerts a force on the tool string and wireline pushing against the surfaces of the tool and wireline equally. The design of the tool attached to the wireline is such that the wireline displaces some of the surface area on the top of the tool string where it attaches at the rope socket (see fig. 1 below). The force that would be pushing down on the tool at the connection point is now pushing against the sides of the wireline thus creating an imbalanced upward force on the tool string. Because there is effectively less surface area at the top of the tool than at the bottom of the tool due to the wireline, there is a greater amount of pressure exerted against the bottom of the tool which pushes the tool up. In order to overcome this upward force, weight bars (or sinker bars) are required to increase the weight of the tool string allowing gravitational force to pull the tool string into the well. The larger the diameter of the wireline, the greater the difference in surface area between the top and bottom of the tool string becomes and the more weight is needed to overcome the force differential. Therefore, smaller cables require less weight bars because the wireline takes up less surface area at the top of the tool than a larger diameter cable.

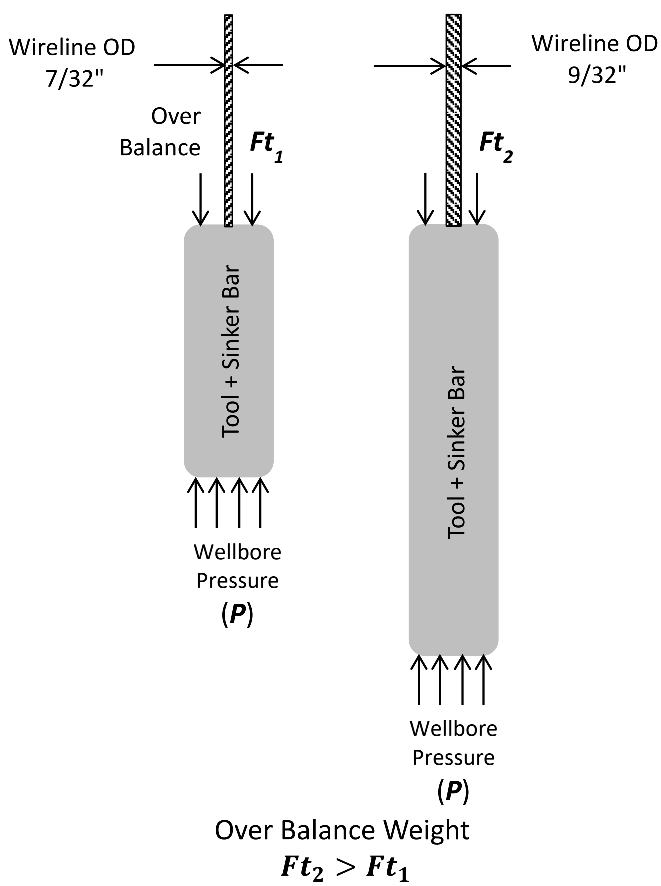

Fig. 1

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The formula for calculating the sinker bar weight to be attached to the tool is as follows:

The *balance weight* needed to overcome well pressure is,

$$F = P \times A$$

Where, P = wellbore pressure (psi), A = cross sectional area of the wireline,

$$A=\pi r^2$$

Where, r is the cable radius and π (Pi) = 3.14

This force or balance weight will counterbalance the wellbore pressure. In order for the wireline to be pulled into the well an additional weight *(over balance)* needs to be applied. Generally a factor of about 20% is chosen to overcome other factors such as frictional forces but each operator may have their own rules of thumb in this regard.

Hence, the *over balance weight (Ft)* is calculated as,

$$Ft = F + (20\% \text{ x } F)$$

The sinker bar weight to be attached to the tool of weight T, is calculated as,

$$W = Ft - T$$

For example: Wireline outer diameter = 7/32” (0.224 in.) with tool string weight, $T = 175$ lb.

$$r_1 = \frac{0.224}{2} = 0.112\ in.$$

$$A_1 = 3.14 \times 0.112^2 = 0.0394\ sq.in.$$

If the wellbore pressure (P) is 7,500 psi, then the balance weight is calculated as,

$$F_1 = 7500\ psi \times 0.0394\ sq.in.$$
$$F_1 \approx 296\ lb.$$

Then over balance weight is,

$$Ft_1 = 296 + (0.2 \times 296) \approx 355\ lb.$$

The sinker bar weight for the 7/32” OD wireline is calculated as,

$$\mathbf{W_1} = 355 - 175 = \mathbf{180\ lb.}$$

To have a comparison, the sinker bar weight for a wireline of OD 9/32” is calculated as follows:

Cross-sectional area for a 9/32” (0.288 in.) wireline would be,

$$A_2 = 3.14 \times \left(\frac{0.288}{2}\right)^2 = 0.0651\ sq.in.$$

The balance weight,

$$F_2 = 7500 \text{ psi} \times 0.0651\ sq.in.$$

$$F_2 \approx 488\ lb.$$

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Hence, the over balance weight would be,

$$Ft_2 = 488 + (0.2 \times 488) \approx 586\ lb.$$

The sinker bar weight to be attached to the tool would be,

$$\boldsymbol{W_2} = 586 - 175 = \mathbf{411}\ \boldsymbol{lb}.$$

Thus, for about a 29% increase in wireline OD from 7/32" to 9/32", the sinker bar weight increases by 128%. Therefore, larger diameter cables can be harder to run in a well than smaller ones if the right sinker bar weight is not selected.

Contact **Dustin Dunning** for more information or suggestions for Camesa's monthly Q&A.
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