Drum Crush
A Historical Perspective and Basic Prevention Tips

In the early 1950s, the first double armored cables featured rubber-insulated conductors and were installed directly from the factory shipping reel to the truck drum. A 2x4 was commonly wedged under the flange of the shipping reel to establish extra tension. Major service companies developed a "dead man" setup where the turnaround sheave was attached to a 500-pound weight. The payoff brakes were adjusted continuously to keep the weight off the ground. This weight was later increased to 1,000 pounds.

The first "very deep" wells (18,000 to 20,000 feet) logged in West Texas experienced several electrical failures in US Steel cables that were categorized as factory defects. However, these failures were located at a point in the cable that had not been off the drum. In fact, these shorts occurred several layers down from any portion of the cable that had been in the hole. This phenomenon became known as "drum crush." To better understand how drum crush occurs, new cable was initially spooled back and forth between two trucks, building up tension — 500 pounds at a time — until a tension that was equal to tension in the field was established. This method was successful in simulating drum crush and provided valuable insight.

By the late 1950s, several drum crush solutions had been developed to reduce spooling tension at the wellsite, including a powered capstan or sheave wheel. Later, truck drums were upgraded to withstand the higher tensions, and capstans were used in the major spooling shops to install cable at the required higher spooling tensions.

The Single Break System

For many years, the standard for spooling a cable on a drum was a single break system. The cable made the first wrap tightly against the flange. Once completed, the cable had to make a severe bend to step over a full cable diameter for the next wrap, which led to electrical failures when encountering high-spooling tensions. Although less frequently employed today, this single break pattern offers the easiest installation. Currently, the preferred spooling method is the double break pattern where the cable moves over half a cable diameter each half revolution of the drum, thus requiring a less severe bend in the cable.

The Double Break System

To establish a double break pattern, the cable makes the first half wrap against the flange. Then, a filler of one-half cable diameter is placed against the drum flange to move the cable over for the last half wrap. A filler is also required for the last half revolution of the final wrap on the drum. For the full cable to spool properly, the breaks must form a straight line across the drum, and the cable must move from the bed layer to the second layer at a point exactly opposite the cable's entry point on the starting flange.

When a covering layer is positioned back over a lower layer, the wraps of the covering layer fall in the grooves between the lower layer wraps. The diameter of the spooled cable fitting in the grooves increases by only 0.87 of a cable diameter.

At the crossover point, the spooled diameter, in theory, increases by a full cable diameter. In practice, however, the cable gets "smashed" at the crossover so the diameter is not a full cable diameter.

On the second and subsequent layers, the breaks fall on top of the breaks of the underlying layer, causing a diameter buildup. If this diameter buildup is just at one point — as with the single break — then the drum full of cable is dynamically out of balance. In deep-hole operations, a drum spooled with a single break will severely shake the truck at high line speeds, while a double break pattern prevents this problem.

Tips to Help Prevent Drum Crush

- Place a straightedge across the drum core. There should be no visible gaps, which would indicate dips in core diameter. This could cause the cable to drop into the valley and lead to gaps in the spool job, which could result in tension changes and field problems that may ultimately cause drum crush.
- Measure and record the distance between drum flanges at the core and top of the flanges. These distances should not differ by more than one-tenth of the cable diameter. After installation of the cable, if this distance has increased by more than one-half a cable diameter, spooling problems may occur in the field. The extra space between the flanges creates gaps in the cable. The cable may squeeze down into these gaps under load, which may lead to drum crush.
- Check the condition and location of the cable entrance hole on the drum flange. This hole must be touching the drum core. The hole should allow the cable to make a smooth entrance onto the drum to properly start the first wrap. If the cable is not laying properly next to the flange as the second layer covers it, a kink may result. As progressively more layers are added under progressively higher tensions, the cable could short out at this location.
- Establish the double break pattern.
- During cable installation, once the bed layers are established, it is important to ensure that you do not stop while spooling the high-tension layers. If spooling is stopped, the cable tension will fall off, resulting in a "soft" section in the cable that could lead to drum crush. If a stop occurs, it is good practice to pull back to the bed layers and start over.
- When running into the well, it is important to prevent the loss of tension. When tension is lost on the cable, the breaking point backs up and the spool job loosens, causing the cable to become soft. A cable under tension ("hard") can withstand much higher axial loading. If tension is pulled across this soft section, the cable can crush itself. This crush may not occur immediately, but rather could happen several jobs later. Once tension is lost, the maximum tension that can be applied safely is twice the tension that was measured when the tension was lost. To prevent damage, the cable must be taken to a service center to reestablish the proper tension profile.
- The cables should be tightened periodically at a qualified service center to ensure that the cables remain normalized, i.e., the outer and inner armors are torque balanced.