POSITAL

WHITE PAPER

Draw-wire Sensors – Service Life

This document is aimed to introduce to you to factors that have an influence on draw wire lifetime.

1. Setup of Draw-wire Sensors

The following explanations are intended to show how the service life of draw-wire sensors is defined and what factors influence it. A draw-wire sensor consists of the following main components (Figure 1).

A measuring wire is wound up on a drum and is tensioned by a spring. When the wire is pulled out, the drum and the spring move. The rotary motion is transmitted to a sensor element (rotary encoder) and output as a signal change. These movements are subject to wear and thus influence the service life of a draw-wire sensor

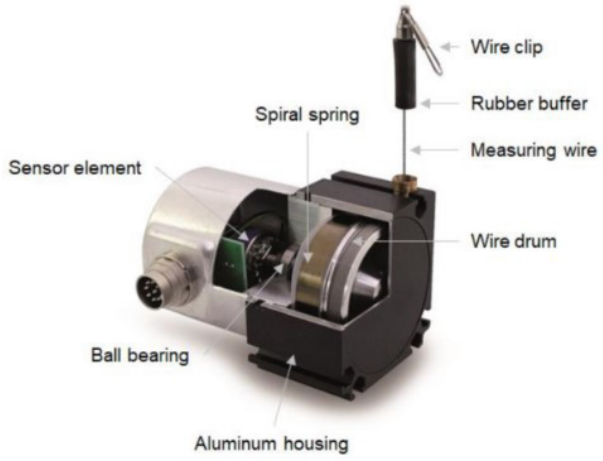

Figure 1: Setup of draw-wire sensors

2. Service Life

The lifetime of a draw-wire sensor is defined as the number of cycles within which a sensor operates according to its specification. One cycle is defined as the single pull-out of the measuring wire and the return to the sensor. Basically, the service life is influenced by two main factors, namely the wear of the spring and the sensor element. For sensors which are equipped with both elements, the lower of the two is considered as the typical lifetime. These influencing factors are examined in more detail in the following

2.1 Spring

A spiral spring is used to tension the wire of the draw-wire sensor. Each of these springs has a specific characteristic curve (see figure 2).

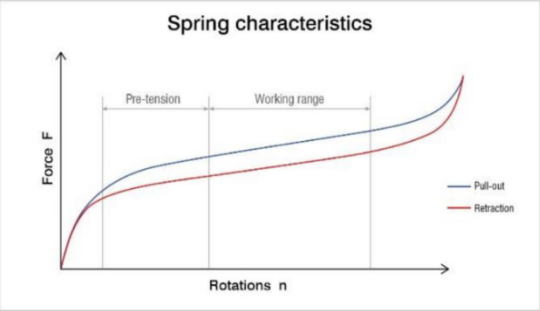

Figure 2: Spring characteristics, qualitative

The specified service life values are only achieved within the working range of the spring. Beyond the working range, the service life is significantly reduced. The respective measuring range is determined by the circumference of the drum and the number of spring rotations. Therefore, a wide variety of spring sizes are used here.

The sensors are designed in such a way that an optimum combination of service life, size and measurement range is achieved. The service life of each spring model must be determined empirically. For this purpose, the wire of several specimens of one type is cyclically pulled out at a defined speed in special test benches and then returned. The test is performed at room temperature indoors.

A typical feature of these tests is that a statistical distribution of the lifetime values is produced over the number of sensors tested. Early failures occur sporadically, but there are also sensors that achieve a significantly higher number of cycles than the typical lifetime value.

Family	Typ. service life
WPS-2400-MK60-M	1,000,000 cycles
WDS-3000-P96-M	3,000,000 cycles
WDS-5000-P115-M	1,000,000 cycles
WDS-7500-P115-M	100,000 cycles
WDS-10000-P115-M	200,000 cycles
WDS-15000-P115-M	100,000 cycles
WDS-xxxxx-P200-M	100,000 cycles
WDS-1740-Z60-M	1,000,000 cycles
WPS-1250-MK46-EB	1,000,000 cycles

Table 1: Typical service life, mechanics

3. Sensor Elements: Encoder

Encoders can also be used for draw-wire sensors.. However, since encoders usually have a much longer service life than the springs, they can be neglected in the analysis. When using other sensor elements, this must be checked individually in the overall system

3.1 Environmental Influences

Superimposed on the two main influences are the environmental conditions that affect the entire system. In principle, the more moderate the environmental conditions are, the longer the expected service life. However, the following exemplary influences reduce the expected service life.

- Humidity, water, ice
- Aggressive media (e.g. chemicals, salt, ...)
- Contamination, dirt
- Mechanical influences (e.g. stone chipping, sharp objects...)
- Shock and vibration
- Increased temperature

However, these influences can be significantly reduced by intelligent installation or protection of the sensors in the application in combination with a suitable sensor design.

**Reference document – Micro Epsilon – Service Life of draw wire sensors – Document number T334599, CNI, 26.06.2020