

# Detecting the position

The application areas for electrical drives are as varied as they are demanding. This results in special challenges and tasks for sensors. So what should users look out for to ensure they satisfy these diverse requirements? What new technologies are available? And which technical “tricks” offer the best results in each environment? Answers, solutions and trends.

by Arnold Hettich



Encoders for installation in drives are subjected to particularly heavy mechanical loads and here it is very important to ensure that very solid bearing assemblies and housings are used so that their functionality remains unimpaired. For this reason Sendix encoders from Kübler are fitted with a Safety-Lock™-Design bearing assembly. This comprises very large double row ball bearings, which additionally are interlocked. The bearing assembly has been so designed that the span between the two bearings is as large as possible and that an extra strong outer bearing can be built in. This means that even very high loads will not present any problem.

The sturdy, thick-walled die-cast housing of the Sendix encoders is caulked at various places to the encoder flange. Wherever the encoder cover lies directly on the outside and thus could be vulnerable to possible blows, or where there are extreme shocks or vibration, then the really rugged option of fixing by means of grooved pins is to be recommended.

The high IP67 protection level as well as the wide temperature range of -40 °C up to +90 °C permits outdoor use without problems. The connection technology is just as tough: an extremely sturdy socket is located on the die-cast housing, to which the connector is fixed by means of four screws.

## For tight conditions...

Just as important as the bearing assemblies are the methods of mounting and fixing. Using the correct technology here is not only a guarantee for the accuracy of the encoder, but also for a long service life.

With shaft encoders it is important to pay special heed to the use of high quality couplings, as the coupling corrects the angle error between the drive and the encoder. Misalignments, which can lead to considerable bearing loads and to premature failure of the encoder, can thus be avoided from the beginning. For normal application the use of economical bellows couplings is recommended and for high speeds spring-washer type couplings. If available installation space is scarce then hollow-shaft encoders are the right choice. Here the use of the correct fixing elements and couplings is crucial for accuracy and reliability. Furthermore, installation methods that have been tailored to the application in question can prevent installation errors and considerably reduce installation time. For this reason Kübler offers a wide choice of diverse fixing elements and stator couplings, based on decades of experience. In drive motors, finding the best method of integration ‘under the fan cowl’ can present a real challenge.

So for this application Kübler designed a special housing with a tangential cable outlet, in order that the encoder can be installed with the smallest possible pitch circle. But most important however is an intelligent integration solution, so that the device can also be mounted correctly. To accommodate and correctly attach the encoder within the very restricted space within the geared motor housing Kübler offers appropriate fixing kits; these can, for example, use the fan cowl as a hold point. Also available are extremely compact M23 right-angle connectors or M12 connectors, specially designed for these applications; these are mounted directly on the motor housing and not on the encoder housing, as would normally be the case.



Special geared motor encoders for installing under the fan cowl.

Such solutions save money, as no additional housing is required, as well as saving time, as the motor housing does not have to be removed in the first place in order to be able to connect the encoder. At the same time the performance of the motor is increased, as the correct fixing and optimal protection of the encoder ensure that no external influences can impair the functional efficiency.

For high-precision direct coupling, as is required with direct drives, Kübler offers tapered shaft mounting kits for simple upgrading of standard hollow-shaft encoders.

## ... and rugged applications

Especially with large drives, such as asynchronous and AC vector motors, so-called heavy duty encoders are employed. In the past devices used in this area normally had a very large installation depth and were very expensive. In extreme applications these specialist encoders were fine; however in practice many applications in the crane industry, for drives in the steel industry or generally in heavy industry require heavy-duty encoders that are a sensible compromise between purchase cost and performance. For this reason many users opt for a standard encoder with a large hollow shaft – with however dubious success. This is because this type of product is not up to handling the high bearing loads, shocks and high speeds, with the result that the rate of failure is unacceptably high.

The Kübler A02H encoders solve these problems. Their installation depth is up to three times smaller than traditional heavy duty devices, whilst they are many times more robust than standard hollow shaft encoders. The user avoids expensive installation or mounting structures for the drives, and eliminates high rates of failure. Offering a hollow shaft of up to 42 mm diameter and an installation depth of max. 50 mm, these encoders are able to cover many applications. At the core of this lies an ingenious mechanical design, which prevents an axial displacement of the hollow shaft following hefty axial impacts. 90% of current encoder failures can thus be eliminated. The high-quality hub/shaft fixing is made of stainless-steel and is balanced, thus allowing for a continuous rotation speed of up to 6000 rpm.

Recommended for applications in coastal or offshore areas are the seawater-resistant versions of the Sendix encoders. These devices have been certified to IEC 68-2-11 for resistance to the effects of salt-spray over a period of up to 672 hours – the highest test level. The housing and the flange of the Sendix ATEX encoders are manufactured as standard from seawater-resistant aluminium.

## Dealing with destructive bearing currents



Isolation inserts: protection against bearing currents.

Encoders can be very sensitive to the effects of bearing currents. This danger applies particularly to encoders in large drives, as are to be found for example in mixers and grinders and in plastic-film manufacturing plants. Bearing currents that arise here can cause lasting damage to the encoders. The current flowing across the bearing housings of the rollers leads gradually to the destruction of the bearing races of the motor or the encoder.

To combat this, Kübler has developed an isolation insert, which provides galvanic isolation between the encoder shaft and the motor shaft, and prevents current passing across the motor and encoder bearings. For optimum results the torque stop must also be isolated. Kübler has designed isolated torque stops specifically for these applications. For a relatively low outlay, this leads to an increase in maintenance interval times and in the service life.

Isolation inserts are available for the large heavy duty encoders A02H with shafts up to 31.75 mm, as well as for the compact Sendix 5020 hollow shaft encoders for shafts up to 12.7 mm.

## Magnetic brakes – a source of interference

Many electrical drives work with magnetic brakes. These emit particularly strong magnetic fields, which can interfere with sensitive electronic sensors and communications. Alongside good shielding practice (with shielded cables and a conducting housing material), it is recommended to use a highly-accurate technology that is completely insensitive to magnetic fields.

Kübler thus offers firstly a wide range of optical incremental encoders (from a miniature encoder in 24 mm format up to the large hollow shaft encoder in 100 mm format), and secondly multiturn encoders based 100% on optical technology. The absolute multiturn encoders of the Sendix 58 series are based on highly integrated OptoASIC technology in combination with a mechanical gear. The special low-wear gear technology allows for a through hollow shaft of up to 14 mm for a size of just 58 mm, as well as for high speeds of up to 9000 rpm with a wide temperature range.

However drives that are becoming increasingly more compact demand a new technology alongside the classic mechanical multiturn stage; this must offer a high degree of ruggedness as well as highly compact design. The new Sendix F36 family achieved this compact revolution with an absolute multiturn encoder measuring just 36 mm in diameter, yet that still boasts a through hollow shaft of 8 mm. At its heart lies a novel electronic multiturn stage, where for the first time it has been possible to integrate a multiturn stage directly in the OptoASIC with the help of a new scanning technique.

## The solution with the ring

What is to be done, if there is not enough room left for a miniature encoder and the installation space available does not even stretch to 20 mm? Which incremental rotary measuring system could fit in here? The new magnetic rings RI50 from Kübler in combination with the tried-and-tested LIMES sensor head provide a solution to this problem. With an installation depth of only 16 mm this highly compact rotary measurement system can be installed more or less everywhere. And the small dimensions do not at all mean a reduction in safety or performance.

The system excels with its non-contact sensor technology offering a very high level of shock and vibration resistance. The complete freedom from wear guarantees a long service life and a safe, long-lasting functionality. The sturdy housing and high IP67 protection permit use even in harsh industrial environments, as this combination is completely unaffected by dust or liquids.

The measurement system allows for resolutions up to 3600 pulses per revolution and offers the choice of push-pull or RS 422 interfaces. It is installed easily and quickly by just pushing the ring over the shaft, screwing it on and then orientating the sensor head position appropriately. There is a tolerance of up to 1.0 mm for the distance between sensor head and ring, with a maximal lateral offset of +/-1 mm.



## Safety for the new Machinery Directive

Since the Machinery Directive 2006/42/EC came into force, safety is more than ever “an integral part of plant construction”. When choosing the right encoder for functional safety, the principle applies that safety is achieved through the intelligent combination of encoder, controller and actuator.

Sendix SSI absolute encoders, with an additional Sin/Cos incremental output, as well as Sin/Cos versions of incremental encoders are all available with SIL3/PLe certification.

A 100% reliable mechanical connection is required for a safe function in the applications. The use of suitably dimensioned fixing elements can help eliminate the risk of faults.

Absolute encoders with incremental sine/cosine signals, multiturn stage and integrated functional safety are the economical SIL3/PLe solution for drive technology. Drive control using incremental sine and cosine signals is a tried-and-tested technology with numerous advantages. The high interpolatability of the analogue sine and cosine signals, with more than 1 million steps per revolution, allows for precise control of both slow turning as well as highly dynamic direct drives.

Combined with the high resolution and very accurate position information provided by the optical absolute encoder sensor technology, all the data necessary for a precisely controlled motor start-up with an encoder is available. Furthermore, the multiturn sensor technology permits position control over a wide range. And finally, the high information content of the signals – all independent of one another – forms the basis for a sensor with high functional safety.

## MTTFd values

With regard to the requirements of the Machinery Directive 2006/42/EC the MTTFd values for the most important standard encoders from Kübler are also provided. This thus enables the user to carry out his own calculations according to DIN EN 61800-5-2 and DIN EN ISO 13849.