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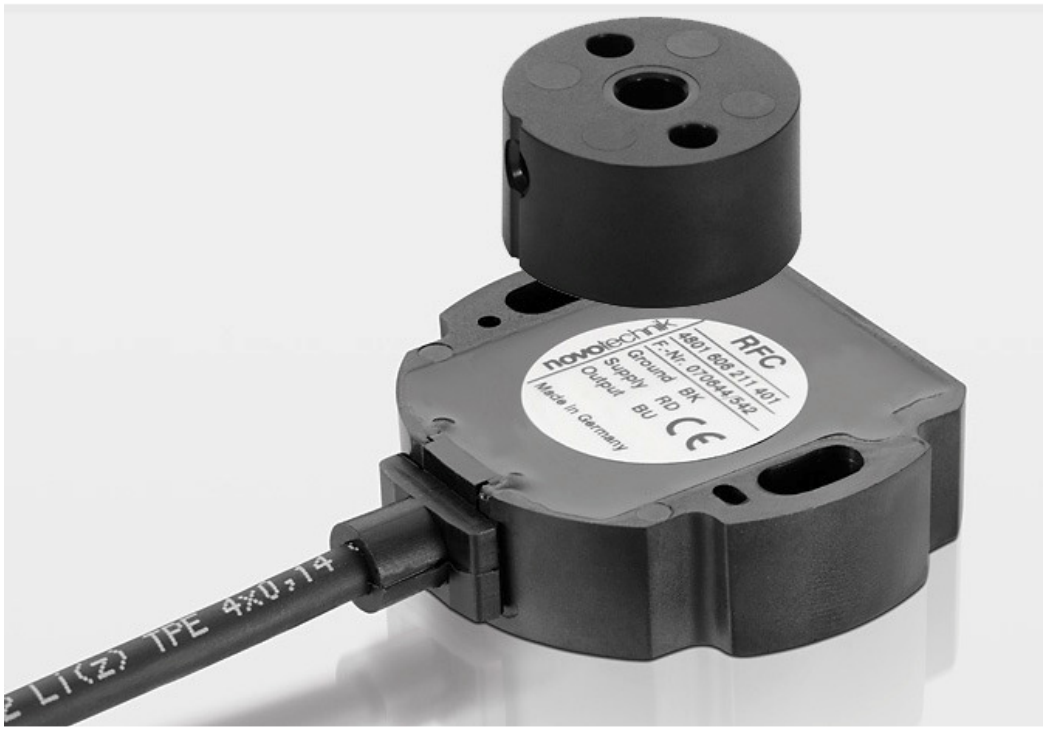

Tough Conditions in the Field:

Magnetic Rotary Sensors Bringing in the Harvest

The demands placed on sensor technology are ever increasing - not only for industrial automation, but also for mobile applications, such as mobile agricultural machinery. Consequently, the demand for non-contacting rotary sensors is increasing. And frequently, magnetic processes are favored. They are reliable even under tough environmental conditions, they yield absolute measurements over the entire 360° range, and they can easily be adapted to the desired application. Their relatively low cost in comparison to other measurement technologies makes them suitable not only for countless applications in machine engineering and plant design but also for mobile applications, such as the one described here.

The Big Bale Transtacker is an innovative piece of agricultural machinery that can be utilized to efficiently collect and stack in the field different sized bales of straw or hay. This machine is pulled and driven by a tractor, and also operator-controlled from the tractor. When the driver uses the joystick to activate the loading mode, for example, the bales of hay are grabbed by the lateral forks of the Transtacker. They are then stacked onto a swiveling turntable, where they

can also be tied for better cohesion. This feature, as well, is activated by the operator with the push of a button on the control panel.

Once the table is full, the bales are pushed onto the load bed. While driving, the table is placed into the vertical position, where it secures the load. In order to switch to “Road Mode“, the operator just needs to move the forks into their road position; which - of course - happens with another push of a control panel button. Upon arriving at the storage facility, the load bed can be tilted. The turntable is utilized to off-load and place the bales. It can also be used to help pick up and reload them. The driver does not need to leave the tractor’s cabin for any of these tasks.

Reliable Sensing is Essential

For a smooth, reliable, and safe workflow, the positions of the rotational joints of pickup fork and turntable mechanism need to be sensed, and the positional data have to be sent to a control unit, so that it can initialize the subsequent steps of the task. “For this reason, the Transtacker’s design features several rotary sensors,” explains Alex Baylis of Big Bale Transtacker. However, it took some time to arrive at the proper choice:

“Unfortunately, following the 2012 harvest season, we experienced some reliability issues with our Transtacker,” Alex Baylis continues. One reason was the choice of Hall Effect-based sensors. The were not up to the tough conditions at the point of use. There were issues with water resistance, for instance. “Furthermore, we were not happy with the accuracy, and on top of it, we found the solution too expensive as well,” adds Alex Baylis. “During the optimization stage, we then discovered the magnetic rotary sensors of the RFC 4800 (see image) series by Novotechnik Not only did their high precision and the standard IP69K degree of protection convince us, but also the favorable cost-benefit ratio as well as the dual-component design, which was very helpful when it came to retrofitting.”

Magnetic Operating Principle Simplifies Integration

Thanks to their magnetic operating principle, the sensors are easy to integrate. A position marking magnet for non-contacting rotary sensing is installed on the rotating axes of the Transtacker’s joints. Depending on the rotation angle, the orientation of the magnetic field changes, and with it the signals from the flat

sensor of approx. 15mm thickness. Within the sensor's integrated circuits, this signal change is then converted into an output signal that is proportionally related to the rotation angle, and provided to the governing control system. The sensor features a 12-bit resolution. The (independent) linearity is +/-0.3 %, permitting precise rotary sensing. Control voltages of 12 to 24V are possible, and for the particular application described, here, measurements are provided as 4 ... 20m output signals. In principle, this design allows the sensing of rotation angles covering the entire 360° range. Depending on the application, the rotation angle can be limited in steps of 30 degrees; redundant designs are available as well.

The physical separation of sensor component and magnetic position marker simplifies installation, as the sensor can be placed at a distance of up to 1.5mm – even 4mm – to the position marker, depending on the strength of the magnetic field. This made retrofitting the Transtacker easy. A marking indicates the correct alignment of magnet and sensor. The sensor housing is made of high-quality, temperature-resistant plastic. Mounting tabs with elongated holes simplify installation and mechanical alignment. This eliminates the need for specialized adjustment devices for installation. The sensor is completely cast and therefore impervious to contaminations. The cables or wires for the electrical connections are molded into the housing.

The designers of the Big Bale Transtacker appreciate these installation advantages. Since neither shaft nor bearings are required, and because the sensing distance is variable, installation tolerances at the joints are not a problem. Even with increasing play due to wear and tear of joints, the sensor's function is initially not impaired. "In addition, the sensor can easily be replaced, when servicing becomes necessary," adds Alex Baylis. It has since proven itself in the Transtacker, which is used all over the globe for the harvesting of hay and straw. And it has weathered all the "field" stresses associated with mobile agricultural use. Shocks, vibrations, dirt, moisture, and large temperature differences do not impair its function.