novotechnik
Siedle Gruppe

Small and Low-Cost - But Oh, So Efficient!

Non-contacting Sensors Helping to Bring in the Harvest

Users of linear and rotational measuring technologies frequently opt for magnetic measuring principles, today. For instance, sensors utilizing the Hall Effect (see Technology Box), yield absolute measurements and perform reliably even under adverse environmental conditions. And because of their relatively low cost in comparison to other measurement technologies, they are suitable for countless applications in machine engineering and plant design as well as for mobile applications, such as state-of-the-art agricultural machinery.

Josef Brettmeister, a family-run business in Kühbach (Bavaria, Germany), is recognized as a specialist in application-specific solutions for metal and vehicle engineering, particularly in regards to technologies for agricultural machinery. A typical example is the overloader K3 (Image #1), which facilitates seamless potato harvesting, thereby enabling farmers to achieve distinct efficiency increases. No longer do the transport vehicles have to move onto the fields in order to collect the harvest. Instead, they can remain on road during the loading process. The potatoes are gently conveyed from the bunker to the loading bin, via the overloader‘s adjustable 4-jointed boom. The overloading belt frame weighs only about 250kg, despite being quite sturdy and warp resistant. This makes for a low center of gravity and stable footing. At the same time, an additional cleaning unit (Image #2), located between bunker and overloader belt, removes

extraneous soil from the harvest. The soil drops back onto the field, thus remaining where it belongs. A typical cleaning yield per bunker load is up to 3 cubic meters of soil, while the overload capacity is 80 to 150 tons/hour – depending on the amount of soil. The K3‘s permissible total weight is 22 or 23 tons, which varies depending on the features with which it is equipped. The K3‘s permissible road speed is up to 80km/h – depending on its tractor unit.

Position Sensing at the Overloader and in the Cleaning Unit

The task of conveying potatoes necessitates position sensing both at the overloader and in the cleaning unit. At the overloader, the positions of the four joints need to be acquired; and the adjustable cleaning rollers require proper clearances in order to yield optimum results. At the same time, position sensing allowed the implementation of yet another practical overloader feature. Bernhard Brettmeister (Image #3), Head of Development at Josef Brettmeister Metall- und Fahrzeugbau, explains: ”The memory function allows the operator to easily move the overloader belt into the parking position for road travel and back to any saved extended position for overloading – all at the push of a single button. The joints do not need to be positioned individually each time.“

The sensors need to feature a number of specific characteristics, however, to be suitable for harvester vehicles. ”They need to reliably and accurately acquire the rotation angles of the overloader‘s joints as well as the cleaning rollers‘ clearances, despite the adverse conditions of the harvesting process, they must be non-contacting in order to avoid wear and tear, and they need to fit well into the tight joint spaces“, states Brettmeister, thus summarizing the key features. ”It was in the portfolio of sensor specialist Novotechnik (see Company Information Box), that we finally found the right fit.“ The position sensing in the four overloader joints is now handled by the magnetic rotary sensors of the RFD-4000 series (Image #4); in the cleaning unit, a linear sensing variant of similar design, the TFD-4000 (Image #5), is monitoring the roller clearances. The sensors provide the controller with absolute measurements over 180° and/or 5 to 50mm in the form of analog signals with a resolution of 12 bit. They feature an (independent) linearity of approximately +/-0.5% and a repeatability of approximately +/-0.1%. In principle, the rotary sensors are capable of acquiring measurements over the full 360°, but that is not necessary for this particular application.

Easy Installation, Allowing for Tolerances

The fact that sensor and position sensing magnet are physically separate components simplifies the installation process, as the sensor can be placed with an air gap of up to 4mm in relation to the position marker. Lateral offsets of up to 3mm are also tolerable. The K3‘s designers appreciate these installation advantages. Since the setup includes neither shaft nor bearing, and the measuring distance is variable, application-specific installation tolerances are not an issue. If needed, measurements could even be ac-

quired through materials, as long as those were non-magnetic. Depending on the application, this could open up further design possibilities. ”Application-specific customizations during installation are possible as well,“ adds Brettmeister.

Further facts supporting the company's choice were: These sensors are quite budget-friendly, and given their compact design, they easily fit into the joint eye and/or the shearing compartment of the cleaning rollers. After all, the sensor requires only little space, thanks to its miniaturized design of 40mm length, 27mm width, and only 7mm height. The position marker is attached to the joint pin; in the cleaning unit, it was installed on the motor carrying arm. ”The fact that this results in a slight twisting of the position marker does not affect the measuring results,“ Brettmeister happily observes.

Designed for Tough Environmental Conditions

The tough environmental conditions of the harvesting process are not a problem for the magnetic sensors. ”The housing is made of high-quality, temperature-resistant plastic. In addition, the sensor‘s completely potted housing makes it impervious to moisture and contaminants,“ adds Brettmeister. The electrical connections are established with individual wires, which are also potted. This sensor series features a protection rating of IP67 and/or IP69K. The sensors work in temperature conditions between -40°C and +125°C, which makes them well-suited for the adverse conditions on harvester vehicles in this regard as well.

Technology Box: The Hall Effect Principle

When a current flows through a Hall component, and a magnetic field is applied perpendicular to both, the Hall component yields a voltage that runs transversely in relation to the current. Since this voltage is proportionally related to the intensity of the magnetic field, it allows for touchless angular measurements by way of installing a positioning magnet on a rotating shaft (Image #6). When several sensor elements are combined, and the entire signal processing fits into a few components, the construction of complex sensor systems with tiny footprints becomes a possibility. The rotary sensor design based on the Hall Effect principle is largely free of wear and tear, and the sensors are not influenced by fluctuating field strengths from the position marker magnets. This technology further impresses with high resolutions and good dynamics, high mechanical installation tolerances, and rapid development of specialized solutions for customer-specific demands.