

Jenoptik uses customer-specific solenoid interlock

Safe laser processing – also in set-up mode

Jenoptik Automatisierungstechnik GmbH has developed a new generation of especially compact plants for laser machining. Within the scope of the development of the new “Votan A Compact” plants, the safety concept was once more enhanced: a customer-specific solenoid interlock safely distinguishes between the guard door being ajar and locked. In this way, another safety sensor and the presence of a second person are no longer needed during the machine set-up. This special operating mode for adjustment or set-up purposes guarantees a high safety level.

Laser machining plants place high requirements on the machine safety and Jenoptik Automatisierungstechnik GmbH has implemented these requirements in an exemplary manner. The parent company Jenoptik AG, which sets approximately 3000 collaborators to work and is operational in approximately 70 countries, develops and produces lasers with performance levels up to the kilowatt range. The subsidiary has successfully specialised in the manufacturing of complete laser machining plants: the company, which has approximately



Image 1 (sijenoptik-Votan-A-compact): A worldwide applied specialty of Jenoptik Automatisierungstechnik GmbH: laser plants, which generate invisible seams for vehicle airbags. The image shows a plant in the production line at Jena shortly before its completion.

160 collaborators, develops plants, in which different types of lasers weld, cut, perforate or otherwise process materials such as plastic, glass or metal.

Depending on their configuration, the partially highly complex plants are equipped with multiple robots and tool changing facilities. Other plants are individual processing stations, which are designed for integration in concatenated production lines.

Predetermined breaking point: invisible joint for the airbag

The worldwide core specialties of the company for the automotive industry include, amongst other things, plants, which create the predetermined breaking points of integrated vehicle airbags (image 1). A robot picks up the part, e.g. a dashboard or the door coating, and moves it along a stationary laser cutting head, which applies blind holes with a diameter ranging from 0.2 to 0.4 mm with approximately 0.6 mm spacing onto the backside of the part. In this way, a material weakness is created, which causes the seam to break when the airbags explodes. On the “good side” of the interior part, a sensor directly checks the light reflection penetrating through the seam, thus ensuring an inline check, which is of paramount importance for this kind of safety-relevant component. The entire process only takes approximately one minute for each part and is completely documented.

The automobile manufacturers and suppliers, who are using these plants all over the world, are looking for utmost flexibility. Therefore, Jenoptik has developed the new Votan A Compact series, a plant concept, in which all compo-



Image 2 (sijenoptik 7 oder 10): Dipl.-Ing. Benno Bornhöft, Jenoptik (right) and Christian Heller, Product Manager from K.A. Schmersal GmbH (left).

nents are fitted onto a common base frame. These plants can be smoothly integrated into the manufacturing process.

High requirements placed on the plant safety

When laser-machining plants are used, high requirements are placed on the machine safety and with DIN EN ISO 11553 (“Safety of Machinery – Laser-machining plants”), a proper C-standard exists for this machine type. The existence of such standard is justified, considering that the laser beam involves injury risks, which must be considered during the design of the safety guard. Dipl.-Ing. Benno Bornhöft, Designer of the „Electrics & Software“ department from Jenoptik Automatisierungstechnik GmbH (image 2): “As the laser is invisible, the operator cannot protect himself against that. Therefore, the safety guards are designed for Performance Level e in set-up mode according to our risk analysis and for Performance Level d in normal mode.”

Safety concepts with four operating modes

The Jenoptik designers have intensively dealt with the safety concept of the new Votex A Compact plants and realised an innovation for

one of the four operating modes, namely for the adjustment mode. Benno Bornhöft: "In this situation, one of our collaborators accesses the hazardous area through a service door to adjust the laser beam by means of a visible pilot laser, which operates in the milliwatt range."

To avoid that in this operating mode, the laser beam is projected outwards when it is deflected by a metal part, the collaborator must close the safety guard behind him. Simultaneously, it must be ensured that no second person can access to the hazardous area or that the plant is shut down due to the safety guard being opened. As the safety guards may only be locked from outside, the former generations of machines were equipped with, besides a solenoid interlock, a safety sensor to retrieve the door position "Closed and not locked". As such sensor leads to additional mounting and wiring costs, the Jenoptik designers searched a solution to replace the second safety sensor.

Modified solenoid interlock: ajar door is detected

This solution was found together with K.A. Schmersal GmbH by modifying their AZM 200 solenoid interlock. Jenoptik uses the basic version of this safety switchgear to protect the safety guards of accessible hazardous areas for a couple of years already. This device offers, amongst other things, the advantage



Image 3 (sijenoptik 4): With the panic handle, a trapped person can leave the hazardous area even when the solenoid interlock is closed

that no second safety switch with different operating principle is required to reach a high safety level. In addition to that, no additional door-handle is required, considering that all functions are integrated in two units (interlocking unit with door-handle and actuator as well as LED indication), which provide for a smooth fitting and an intuitive operation. Jenoptik chose the variant with the red panic handle as emergency escape, by means of which the trapped operator can leave the hazardous area in next to no time (image 3).

A task for the Application Center

For the special requirement from Jenoptik, the Safety Consultants of the "Application Center" from Schmersal upgraded the AZM by means of special software. In the normal version, a non-contact CSS sensor retrieves the position of the door and the actuator. Only when both targets are detected, both safety outputs are enabled.



Image 4 (sijenoptik 1): For Jenoptik, Schmersal developed a variant of the AZM 200, which detects the position "Safety guard ajar/closed, but not locked".

In the version developed for Jenoptik, the so called AZM 200 D (image 4), both targets are separately evaluated and two safety outputs are assigned to each target. In set-up mode, only the door target is retrieved, so that the plant can be set up with the door ajar. In normal mode, both target – door detection and actuation – are evaluated. Due to this modification, two safety functions can be realised with a single safety switchgear.



Image 5 (sijenoptik 11): The MZM 100 non-contact solenoid interlock is also used on the Jenoptik plants.

The practical advantage for the builders and the users of the laser plants is that a deflected laser beam cannot penetrate outwards. Simultaneously, the operator can leave the hazardous area at all times. And, what is even more important: no second technician can get into the hazardous area: as soon as he opens the door, the laser plant is immediately switched to safe state.

In this way, all safety requirements are met and the Jenoptik designers no longer need to provide for other components, such as an individual latchkey: this solution simplifies fitting, reduces the costs and simply looks good. Benno Bornhöft: „In this way, the necessary machine safety is provided so as to enable one service technician to execute the onsite set-up.“

Throughout safe – also at the manmachine interface

In addition to the customer-specifically modified AZM 200 D for the service doors, Jenoptik also uses other safety switchgear from Schmersal. On small protective flaps for instance, the MZM 100 non-contact solenoid interlock is used, in which the holding force is generated magnetically instead of mechanically (image 5). On other safety guards, the AZM 200 is combined with the BDF 200 operating panel (image 6). And on the latest generation of pneumatically-powered bulk-heads, through

which the parts to be processed are fed and removed, three compact safety sensors of the BNS 260 type (image 7) retrieve the current position of the bulkheads (top, bottom and centre), thus only enabling the laser operation when the bulkhead is closed.



Image 6 (sijenoptik 14): The combination of AZM 200 and BDF 200 provides for a smooth configuration of ergonomic man-machine interface at the safety guard.

Photo material: image 1
Jenoptik Automatisierungstechnik GmbH,
images 2-7 K.A. Schmersal GmbH



Image 7 (sijenoptik 13): When the laser plants are loaded, the safety sensors of the BNS 260 type retrieve the position of the pneumatically-powered bulkheads.