ifm electronic






Processes in the Automotive Industry

www.ifm.com/gb/automotive

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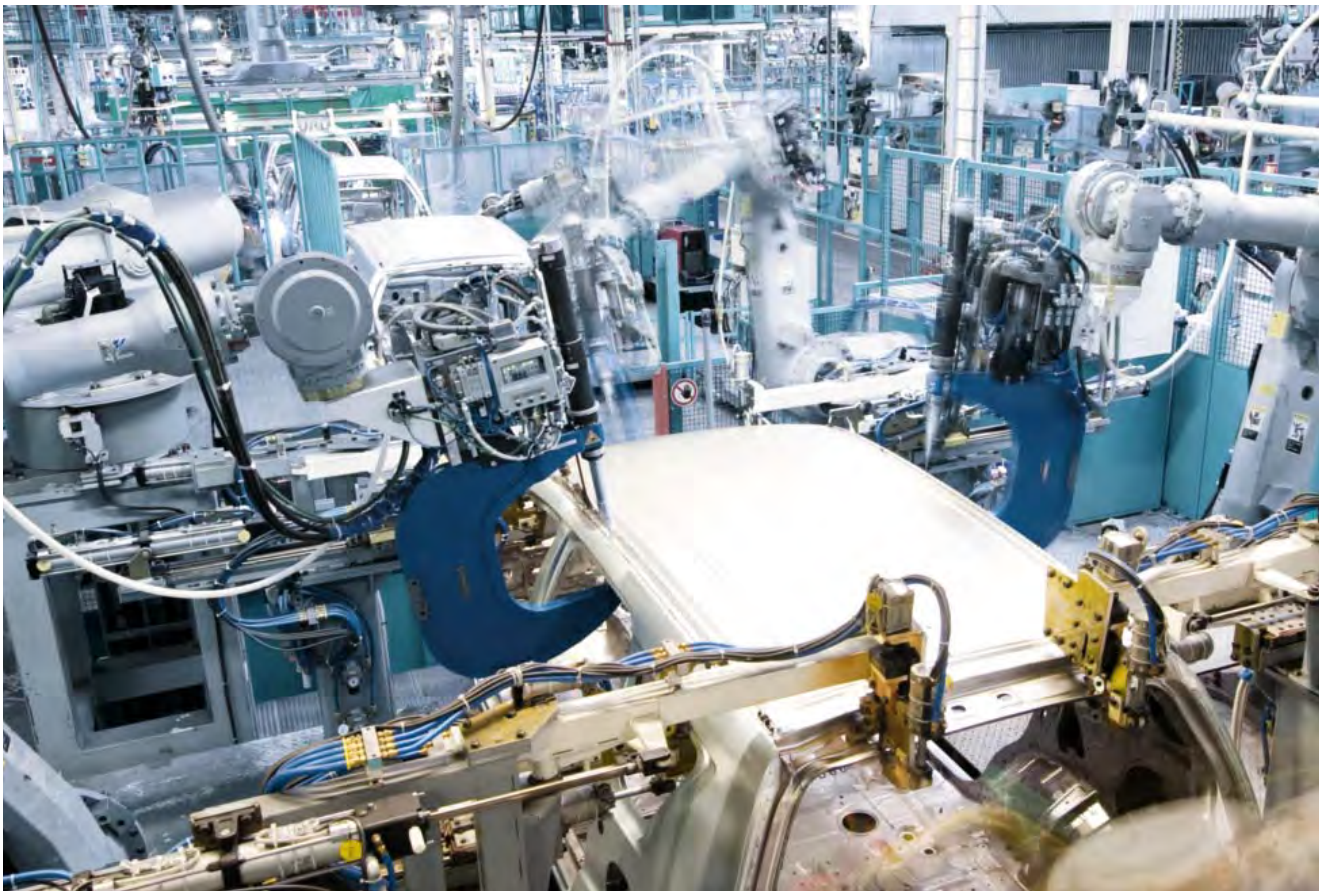
Reliable solutions for your applications



The automotive industry is one of the world's most innovative industries.

It has always been an important driving force of the economy. With a view to ensuring quality, reliability and economic efficiency, the manufacture of vehicles and automotive components such as engines and gearboxes is only possible in automated manufacturing facilities.

A central objective of the ifm group of companies is to increase the reliability and operational availability of manufacturing equipment. In addition to the proven sensor technology, new areas of application such as condition-based maintenance or monitoring of consumables in plants are constantly opened up.

In the future, too, ifm will remain a reliable and innovative partner for the automotive industry.

ifm – close to you!

ifm electronic

The company in your vicinity.

State-of-the-art communication.

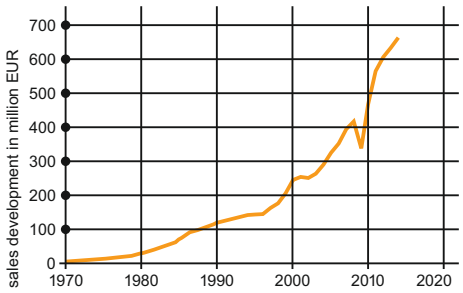
With the right address – www.ifm.com – only a mouse click separates you from the world of automation technology. See the power of our products in interactive representations. Gain an impression with 3-dimensional views of our units. Download CAD drawings for direct integration in your applications. Or order online in ifm's e-shop – fast, convenient and reliable.

We are there for you.

Close contact with our customers is part of our success. Therefore we have consistently developed our sales network right from the start. Today the ifm group of companies is represented in more than 70 countries – close to you! With application advice and service at the heart of our operation. For the introduction of new products and technologies we support you with workshops and seminars in our training centres or in your plant.

Security by success.

Since its foundation in 1969 ifm has constantly grown, now having more than 5500 employees worldwide, and achieved a turnover of more than EUR 720 million in 2015. This success gives you the security of having a reliable partner for the implementation of your automation projects. Comprehensive service and a warranty of 5 years on standard units are just two examples of this reliability.



Turnover development since 1970.

Not only components.

ifm stands for a large range of different sensors and systems for automation. Our range of of more than 7,800 articles guarantees flexibility and compatibility. So there is always a reliable solution for your automation projects – from the individual sensor with practical accessories to the complete system.

Availability guaranteed.

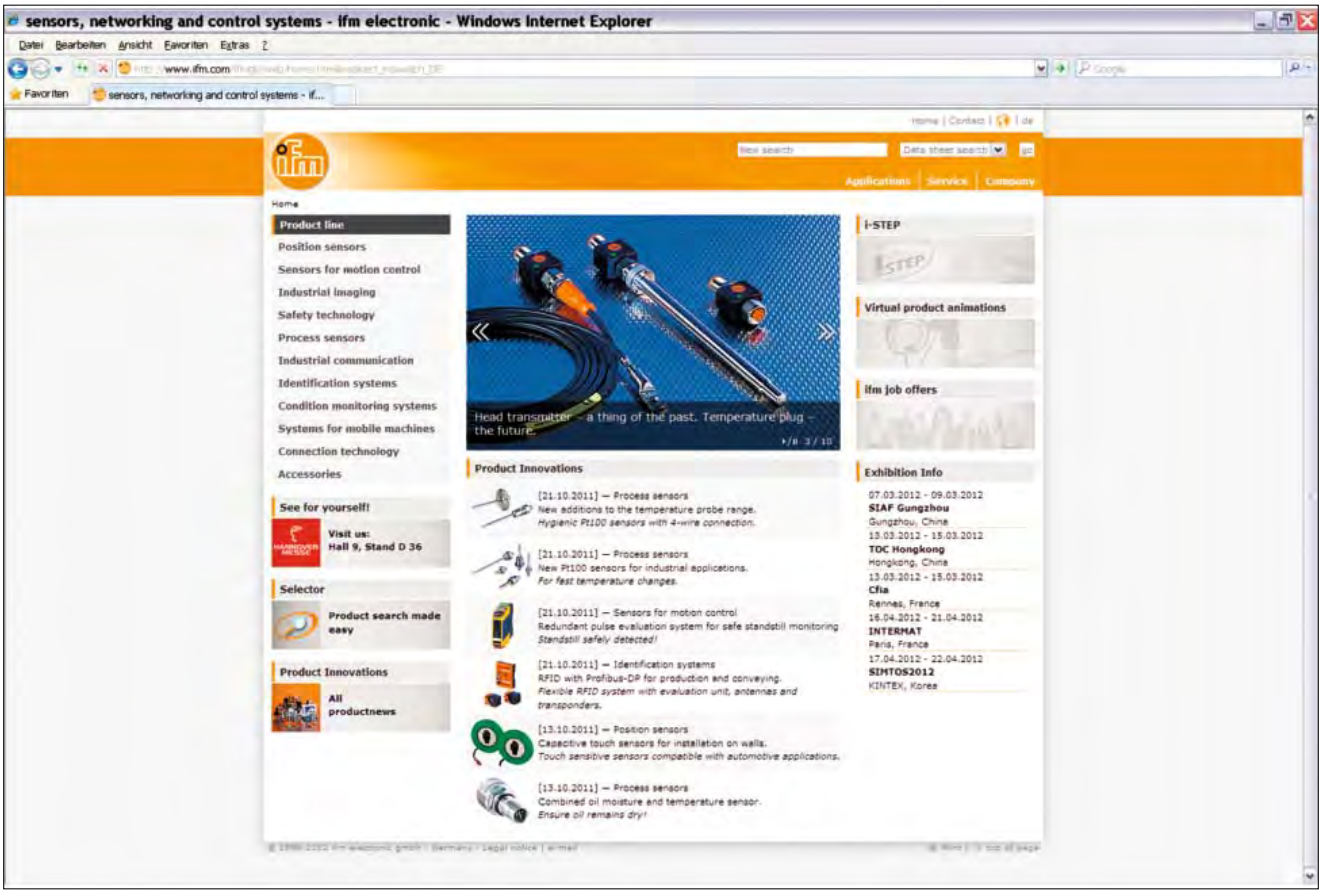
Your deadlines matter to us. That is why we are constantly optimising our production processes in order to be able to quickly and flexibly produce large quantities at a constantly high quality – and to continue to shorten delivery times. Your order is dispatched via our centralised logistics centre reliably and on time.

Quality as part of our philosophy.

The quality standard of our products is an integral part of our company philosophy. And we guarantee it! So we provide you, the users, with a maximum degree of security: By means of our own production technology, ifm film technology, as well as by means of extensive quality assurance measures such as 100 % final testing. By quality we understand, for example, ecologically conscious production – Made in Germany!

The development of innovative products is one of our core competences. From high-quality standard solutions to products specially tailored to the requirements of the individual industries – from mobile machines to the food industry.

www.ifm.com
Information around the clock and around the globe in 23 languages on the internet.



• Information

- product innovations
- company news
- exhibition info
- locations
- jobs

• Documentation

- data sheets
- operating instructions
- manuals
- approvals
- CAD data

• Communication*

- request for documents
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• Selection

- interactive product selection aids
- configuration tools
- data sheet direct

• Animation

- virtual product animations
- flash movies (video sequences)

• Application

- applications
- product recommendations
- calculation aids

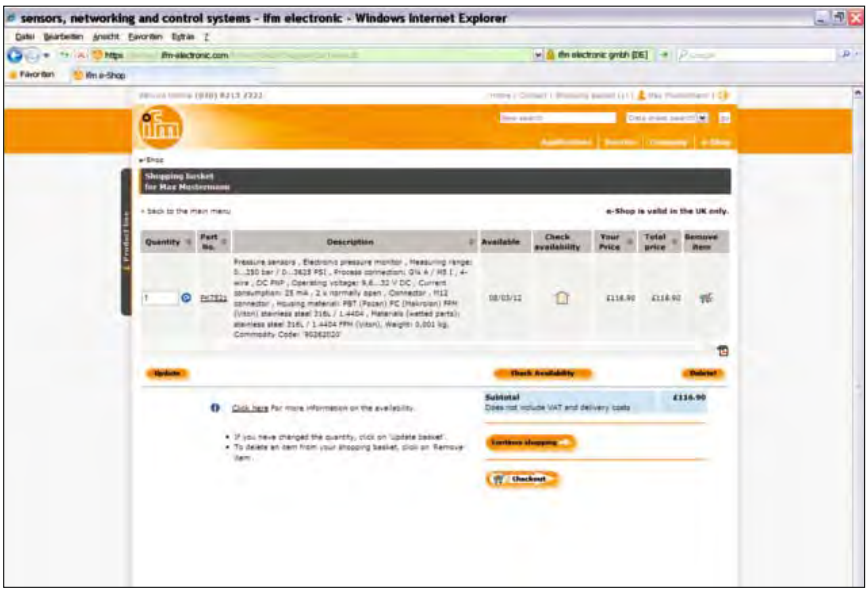
• Transaction*

- e-shop processing
- e-procurement catalogues

*Some offered information is available country-specific

Product selectors and further information can be found at: www.ifm.com

Convenient order processing via the e-shop** on the internet.



Secured authentication

Customer-related price indication

Real time availability check

Personal product favourites

Online parcel tracking

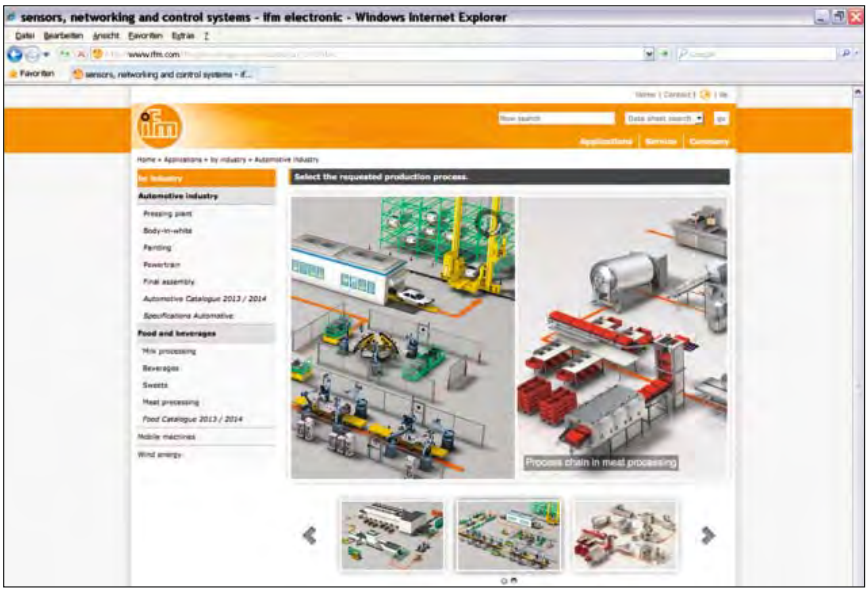
Individual order history

Convenient quick input form

Simple order processing

Management of shipping addresses

Confirmations by e-mail

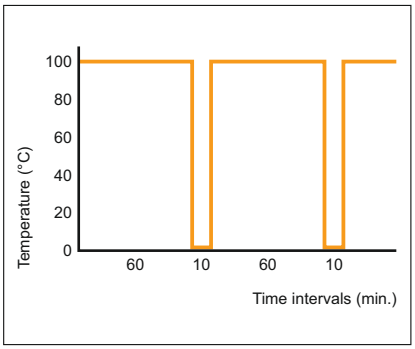


ifm application database

ifm's automation technology is used to for applications in many different types of plant in almost all industries. Learn how ifm can improve your production.

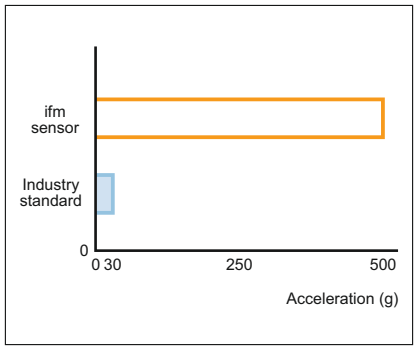
Application examples can be found on our website at: www.ifm.com/gb/applications

** Already available in many countries.



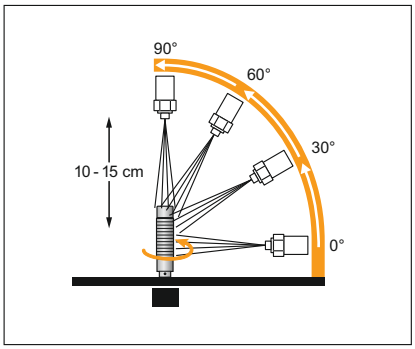
Thermal shock test

In pressure cleaning environments, proximity sensors are exposed to extreme temperature conditions.
This is why ifm performs thermal shock tests on the sensors by cycling the temperature between 0 and 100 °C in short time intervals. After the test, the sensors' characteristics are tested to ensure high reliability.



Shock test

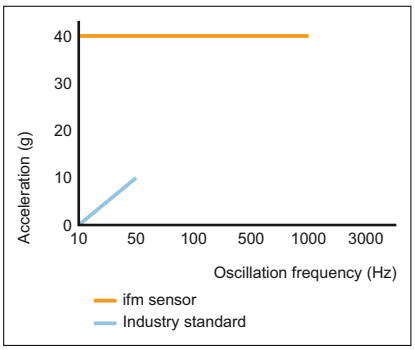
Sensors can be exposed to high levels of shock in industrial environments. This is why ifm sensors are tested at a shock level of 500 g. This test standard sets a new benchmark for inductive sensor product development.



IP 69K high-pressure cleaning test

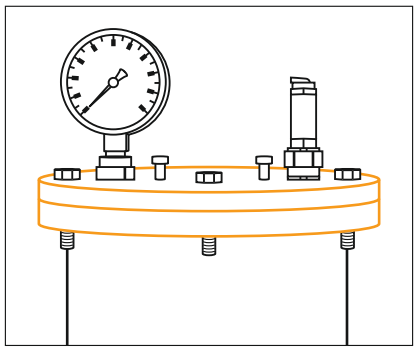
ifm inductive proximity sensors are tested in accordance with the IP 69K standard. The goal is to duplicate pressure cleaning conditions on a plant floor.

In the test fixture, the sensors are exposed to a 80 - 100 bar spray of water at a temperature of 80 °C. The duration of each cleaning cycle is 30 seconds. The test is performed at specified angles using a spray nozzle located at a distance of 10 - 15 cm from the sensor. ifm inductive sensors can withstand test conditions and are still operable providing 100 % of their sensing range.



Vibration test

A vibration test is performed on the sensors at a level of 40 g with the oscillation frequency spanned between 0 and 2,000 Hz. This test checks the integrity of the electronic circuit and the surface-mounted components.
The vibration test is designed to far exceed manufacturing plant conditions on industrial automation machinery.



Steam boiler test

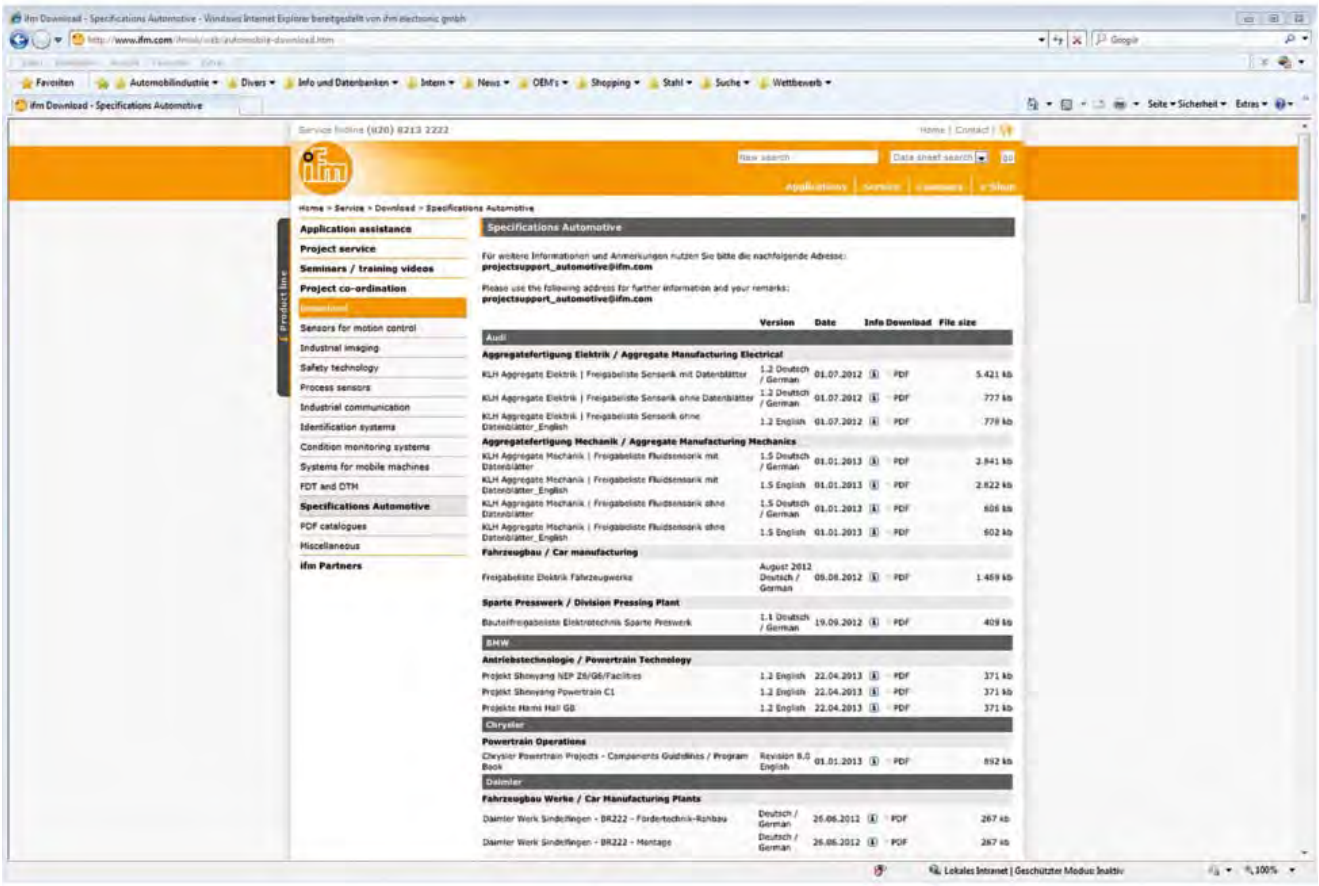
To simulate the aging process, the washdown sensors are placed in a steam boiler.

For inductive sensors: the test simulates whether penetrating water molecules can disturb the sensor behaviour. This is recognisable by a change in the sensing range.

For photoelectric sensors: the test simulates whether water can penetrate into the sensor optics. Abrupt cooling in ice water will cause any moisture to fog up the lens on the inside.

Product selectors and further information can be found at: www.ifm.com

Many ifm sensors are specified by car manufacturers and their suppliers



Approvals from the automotive industry

In many cases, production equipment and project requirements specify the use of products and technologies in the automotive industry. The devices and applications shown in this catalogue are suggested as solutions. A great number of products from ifm are listed with the renowned manufacturers. A list of globally valid specifications in the download area provides guidance for project engineering.

3A

3A Sanitary Standards, Inc. (3-A SSI) is an independent, not-for-profit corporation dedicated to advancing hygienic equipment design for the food, beverage, and pharmaceutical industries.

AS-i

Actuator-Sensor Interface. Bus system for the first binary field level.

ATEX

Atmosphère Explosible. ATEX comprises the directives of the European Union in the field of explosion protection. On the one hand there is the 94/9/EC ATEX product directive and on the other hand the 1999/92/EC ATEX operation directive.

CCC

CCC (China Compulsory Certification) is a compulsory Chinese certification for certain products put on the market in China. Which products are concerned is specified in a catalogue created by the Chinese authorities.

cCSAus

Testing of a product by CSA according to the safety standards applicable in Canada and the USA.

CE

Conformité Européenne. By affixing the CE marking to a product, the manufacturer declares that it meets EU safety, health and environmental requirements.

cRUus

Testing of components by UL according to the safety standards applicable in Canada and the USA. Components can be used when the "condition of acceptability" is complied with for the final product.

CSA

Canadian Standards Association. A non-governmental Canadian organisation that sets standards and tests and certifies products for their reliability. By now it is active worldwide.

cULus

Testing of components by UL according to the safety standards applicable in Canada and the USA.

DIBt (WHG)

Deutsches Institut für Bautechnik (Federal Water Act). The Federal Water Act (WHG) is the essential part of the German law relating to water. It contains provisions for the protection and use of surface water and ground water and also regulations about the expansion of waters, water planning and flood protection.

DKD

The Deutscher Kalibrierdienst (DKD) is an association of calibration laboratories of industrial firms, research institutes, technical authorities, inspection and testing institutes. The DKD calibration certificates prove traceability to national standards as required in ISO 9000 and ISO / IEC 17025. They also serve as a metrological basis for the control of measurement and test equipment within the framework of quality management.

E1

Approval by the Kraftfahrt-Bundesamt (German Federal Motor Transport Authority). The E1 type approval by the German Federal Motor Transport Authority certifies that the units comply with the automotive standards. Units with this marking are allowed to be mounted on vehicles without expiry of their operating permit.

EG 1935/2004

The Regulation EC 1935/2004 has been taken into account for process sensors from ifm which are intended for use in contact with food. You can obtain a list of the corresponding products and detailed information on request.

EHEDG

European Hygienic Engineering & Design Group. European supervisory authority for food and drugs. This authority grants approvals for products and materials used in the food and pharmaceutical industries.

FDA

Food and Drug Administration. US-American supervisory authority for food and drugs. This authority grants approvals for products and materials used in the food and pharmaceutical industries.

FM

Factory Mutual Research. A US-based insurance company that specializes in loss prevention services in the property insurance market sector. They provide material research, material testing and certifications in the field of fire and explosion protection.

PROFIBUS

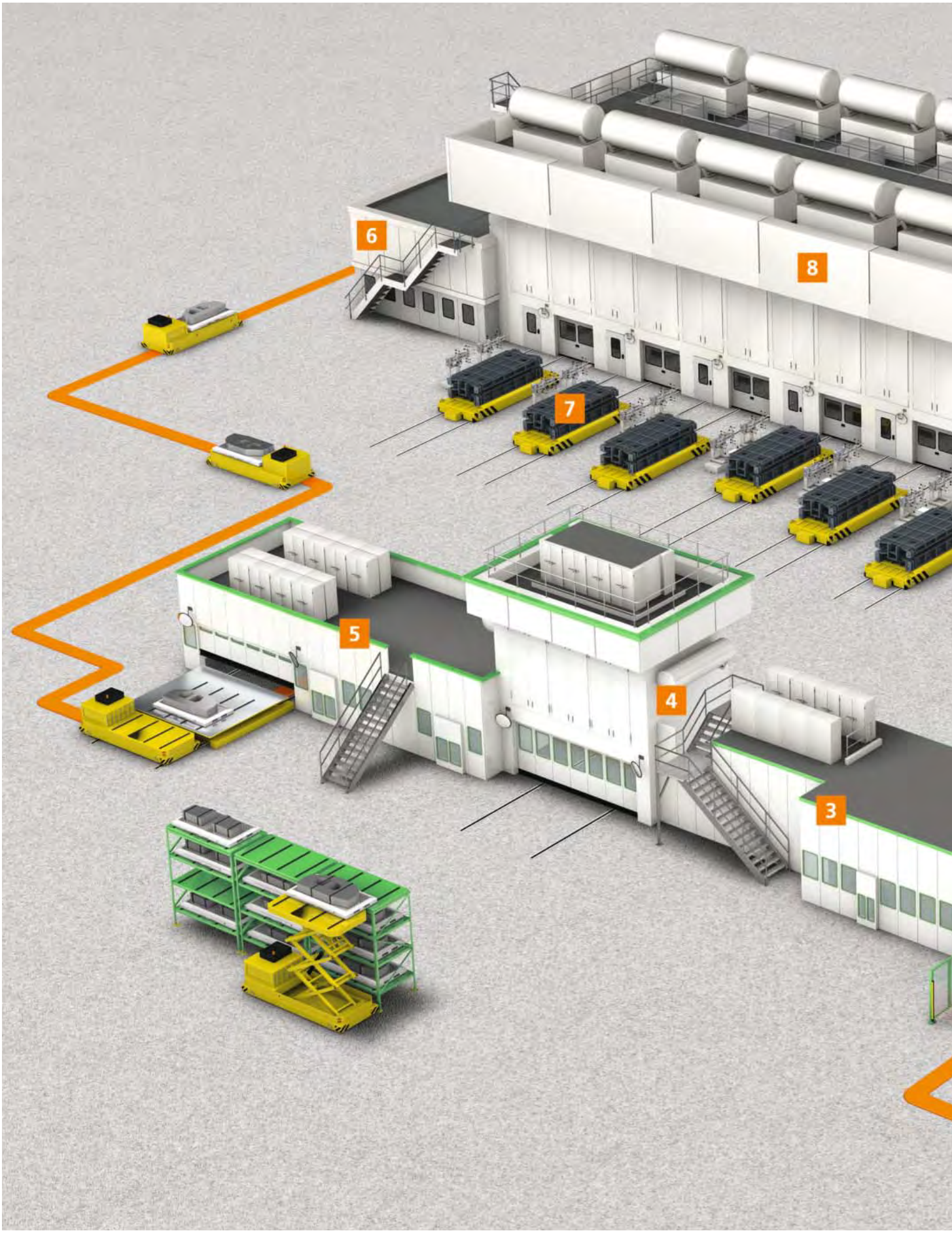
Process Field Bus. Fieldbus system for important data quantities. It is available in several versions such as Profibus FMS, DP or PA. Profibus DP can be used over longer distances, e.g. as fieldbus for AS-i.

TÜV

Technischer Überwachungs Verein (technical inspection association). The German TÜV is a private-sector body carrying out technical safety tests that are stipulated by government laws or instructions.

UL

Underwriters Laboratories. An organisation founded in the USA for testing and certifying products and their safety.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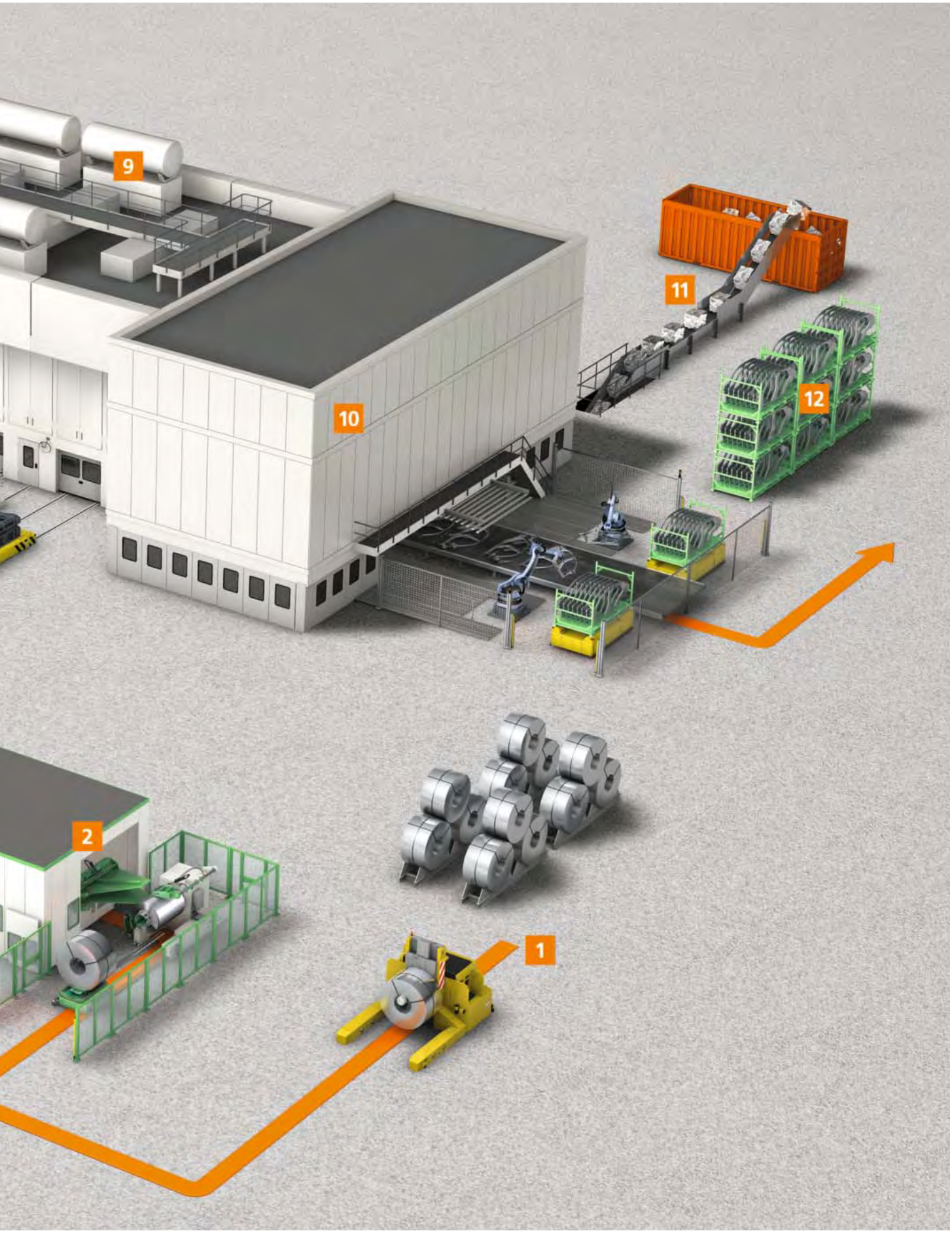
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Machine	Application	Product group
1	**Coil transfer**	
	Level measurement	Capacitive sensors
	Reading of codes	1D/2D code readers
	Safety monitoring	Safety light curtains
2	**Decoiler and strip feed**	
	Hydraulic system pressure detection	Pressure sensors
	Photoelectric detection of strip flow	Laser sensors / distance measurement sensors
	Photoelectric detection of unwinding coil	Laser sensors / distance measurement sensors
	Position signal for threading wedge	Cylinder sensors
3	**Strip washing plant**	
	Hydraulic system pressure detection	Pressure sensors
	Flow monitoring	Flow sensors / flow meters
	Position detection	Laser sensors / distance measurement sensors
	Photoelectric detection of strip flow	Laser sensors / distance measurement sensors
4	**Adjustment and lubrication**	
	Photoelectric detection of sag	Laser sensors / distance measurement sensors
	Position detection	Inductive sensors
	Photoelectric detection of welding seam	Vision sensors
	Monitoring of straightening rollers	Pressure sensors
5	**Blank removal**	
	Pressure measurement	Pressure sensors
	Position check of positioning carriage	Inductive sensors
	Safety monitoring	Safety light grids
	Monitoring of high-speed doors	Fail-safe inductive sensors
6	**Material feed**	
	Position check of load carrier	Fail-safe inductive sensors
	Pressure monitoring of suction grippers	Pressure sensors
	Function check of feed conveyor	Inductive sensors
	Photoelectric detection of material stock	Photoelectric sensors for general applications

Machine	Application	Product group
7	**Tool changeover**	
	Position check of tool	Inductive sensors
	Position check of positioning table	Inductive sensors
	Safety monitoring	Fail-safe inductive sensors
8	**Linking presses**	
	Blank parts check	Inductive sensors
	Pressure measurement	Pressure sensors
	Measurement of compressed air consumption	Flow sensors / flow meters
	Safety monitoring	Fail-safe inductive sensors
9	**Press drives**	
	Temperature measurement in hydraulic power packs	Temperature sensors
	Circulating oil lubrication	Pressure sensors
	Vibration monitoring	Vibration monitoring systems
	Level monitoring in hydraulic power packs	Level sensors
10	**Removal of finished parts**	
	Optical detection	Photoelectric sensors for general applications
	Safety monitoring	Safety light grids
	Part detection	Vision sensors
	Measurement of compressed air consumption	Flow sensors / flow meters
11	**Scrap recycling**	
	Optical detection	Photoelectric sensors for general applications
	Speed measurement	Pulse evaluation systems
	Temperature measurement	Temperature sensors
	Hydraulic system pressure detection	Pressure sensors
12	**Material transport / storage**	
	Optical detection	Photoelectric sensors for general applications
	Location of load carriers	RFID UHF
	Identification	1D/2D code readers
	Locking mechanism acknowledgement	Cylinder sensors

Modern pressing plants are impressive, thanks to the highly automated processes used

First of all, the blanks are cut from steel coils on a coiling unit. Depending on requirements, these base sheets are edged and may be partially pre-punched.

At several points in the process, oils and greases are used to lubricate the sheet metal for punching and pressing operations.

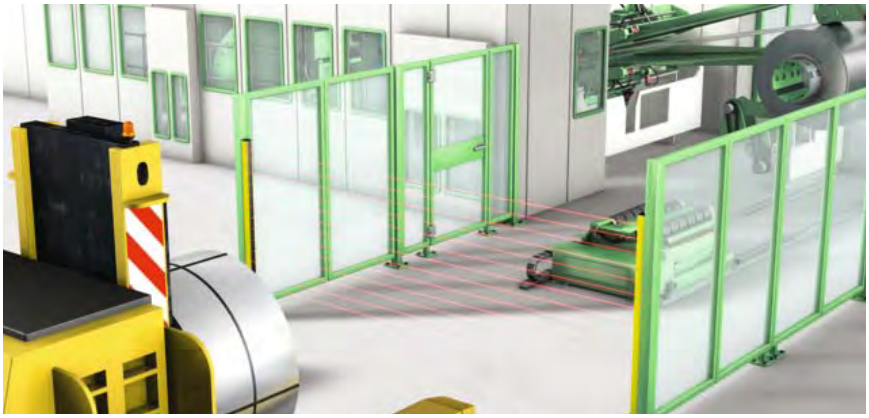
Cracks in the sheet metal result if the elastic limit of the material concerned is exceeded. This is avoided using multi-stage forming. Individual presses are linked together. This chain of presses is known as the press line.

Important components of a pressing plant are the hydraulics, as well as the lubrication and compressed air supply to the presses and grippers. The waste generated by the pressing and punching operation is processed in a scrap press for recycling in electric melting furnaces.

Pressing plants must work reliably, with very high availability of the plant components.

Here the user is supported by sensors from ifm, with their high standards of reliability and robustness.

Coil transfer



Access restriction to coil transfer station

For operator protection, OY series safety light curtains restrict unauthorised access to accessible areas such as the coil transfer station. Depending on the design, the safety light curtains correspond to Type 2 or 4, in accordance with EN 61496.

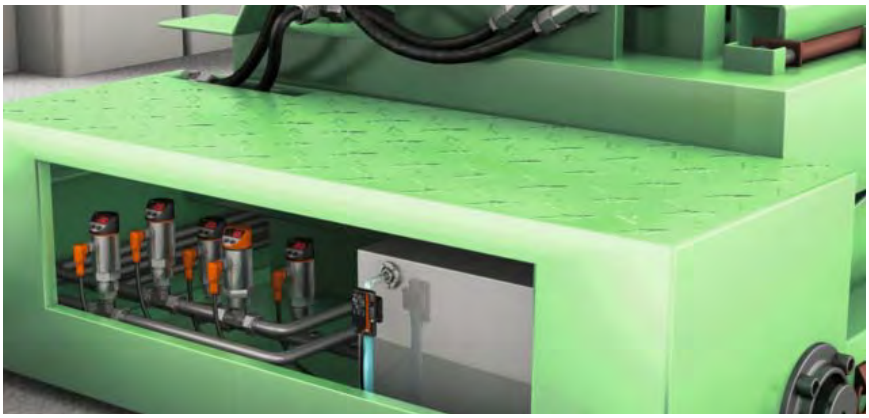
Safety light curtains for access prevention

Type	Sensor length [mm]	Resolution / detection capacity [mm]	Protected area height [mm]	Protected area width [m]	Response time [ms]	U_b [V]	Order no.
	1563	30	1510	0...4 / 3...12	18.5	24	**OY050S**

Multi-code reader for identifying coils

Type	Dimensions [mm]	Max. field of view size [mm]	Type of light LED	Motion speed int. / ext. lighting [m/s]	Process interface	Order no.
	60 x 42 x 53.5	132 x 94	red light	3 / 5	Ethernet TCP/IP, EtherNet/IP, RS-232	**O2I102**

Coil storage trolley



Level detection in the mobile hydraulics of heavy load lifters

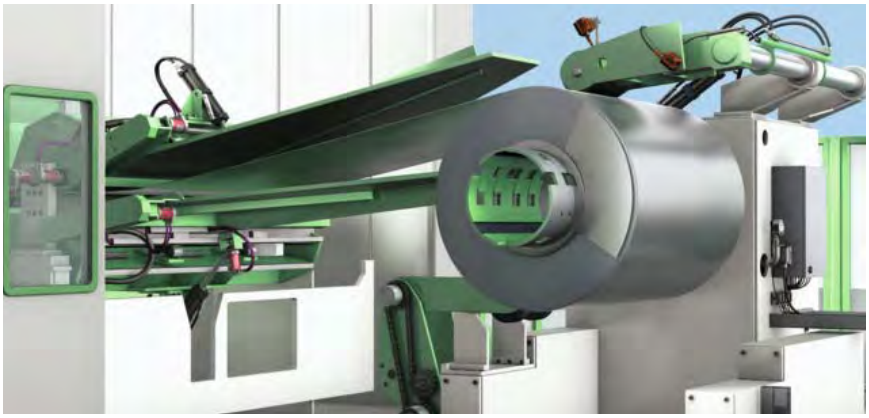
Here, a hydraulic drive is used instead of electric motors.
A KQ series level sensor detects the level in the tank.

Capacitive sensors for level detection

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	20 x 14 x 48	12 nf	PBT	10...30	IP 65 / IP 67	10	100	**KQ6005**

f = flush / nf = non flush

Strip flow



Strip flow in blank cutting plant and coil unwinder

The O1D PMD sensors monitor the correct running of the steel strip and coil unwinding.
Once a defined circumference has been reached, the coil changeover starts automatically.

PMD distance sensors with time of flight measurement

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...10 m	1...50	< 15 x 15	18...30	**O1D100**

Inductive cylinder sensors

Type	Dimensions [mm]	Material	U_b [V]	f [Hz]	Protection	I_{load} [mA]	T_a [°C]	Order no.
	25 x 5 x 6.5	PA (polyamide)	10...30	6000	IP 65 / IP 67	100	-25...85	**MK5159**

Unwinding the coil

System pressure always in view

The PG electronic contact manometer combines an easy-to-read manometer display with the advantages of an electronic pressure sensor. The operator can always see the correct pressure from the control console.

Pressure sensors for monitoring the system pressure

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ½	Display unit	-1...25	100	300	18...32	**PG2453**

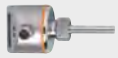
Product selectors and further information can be found at: www.ifm.com

Strip washing plant

The steel strip is washed with high-viscosity oil

Here, an SI series flow monitor detects the flow of the special oil.

Flow sensors

Type	Setting range liquids / gases [cm/s]	Material sensor tip	Medium temperature [°C]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	3...300 / 200...3000	3...100 / 200...800	-25...80	300	1...2 / 1...10	18...36	**SI5010**

Compact temperature sensors

Type	Measuring range [°C]	Process connection	Display	U_b [V]	Current consumption [mA]	I_{load} [mA]	Order no.
	-40...150	M18 x 1.5	Display unit	18...32	50	250	**TN2531**

Lubrication unit

Eccentricity monitoring on contact lubricators

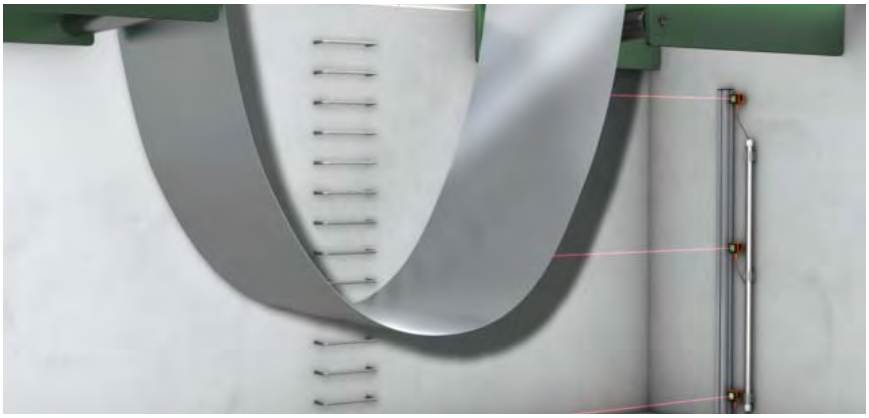
This inductive sensor, with a full-metal design, is ideal for application in rough environments.

Inductive full-metal sensors

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	M12 / L = 60	3 f	High-grade st. steel	10...36	IP 67 / IP 68	100	100	**IFC258**

f = flush / nf = non flush

Loop pit



Sag control with PMD time of flight sensors

The O1D distance sensors continually measure the sag of the coil loop.

PMD distance sensors with time of flight measurement

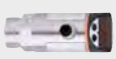
Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...10 m	1...50	< 15 x 15	18...30	**O1D100**

Straightener

Analogue pressure sensors for controlling the straightening rollers

The strip runs through multiple straightening rollers to eliminate the bending stress. The control system receives feedback for further processing via the analogue values.

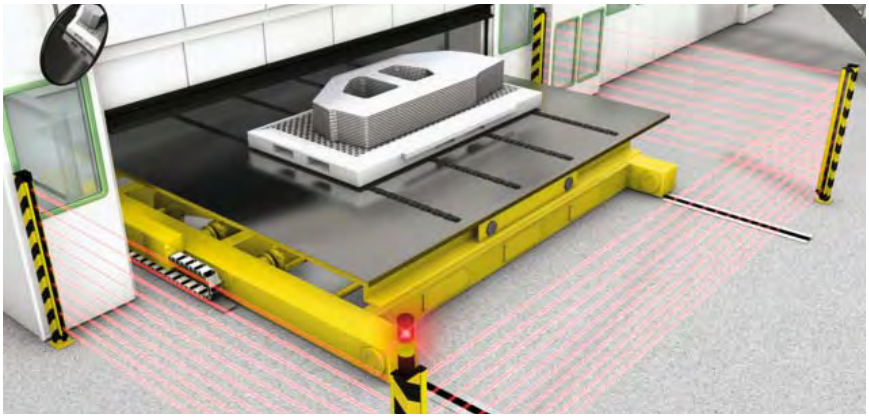
Pressure sensors

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ female	Display unit	-1...25	100	350	18...32	**PN2023**

Photoelectric distance sensors for detecting the strip

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...10 m	1...50	< 15 x 15	18...30	**O1D100**

Blank removal



Access restriction Blank removal

For operator protection, OY series safety light curtains restrict unauthorised access to accessible areas such as the blank removal station. Depending on the design, the safety light curtains correspond to Type 2 or 4, in accordance with EN 61496.

Safety light curtains for access prevention

Type	Sensor length [mm]	Resolution / detection capacity [mm]	Protected area height [mm]	Protected area width [m]	Response time [ms]	U_b [V]	Order no.
	1413	50	1360	0...4 / 3...12	10	24	**OY089S**

Monitoring of high-speed doors

Door monitoring

Category 4 and SIL 3 fail-safe inductive sensors directly detect the end stop of the high-speed door without contact and without requiring a special counter piece.

Fail-safe inductive sensors

Type	Length [mm]	Enable zone [mm]	Housing material	U_b DC [V]	Protection	Response time in case of a safety request / enable time [ms]	Order no.
	66	10...15 nf	PPE	24	IP 65 / IP 67	≤ 50 / ≤ 200	**GM701S**

f = flush / nf = non flush

Load carrier

Position control of load carriers

Category 4 and SIL 3 fail-safe inductive sensors directly detect the safe position of load carriers without contact and without requiring a special counter piece.

Fail-safe inductive sensors

Type	Length [mm]	Enable zone [mm]	Housing material	U_b DC [V]	Protection	Response time in case of a safety request / enable time [ms]	Order no.
	66	4...20 nf	PPE	24	IP 65 / IP 67	≤ 50 / ≤ 200	**GM705S**

f = flush / nf = non flush

Belt conveyors

Part detection on belt conveyors

"R" series full-metal inductive sensors are designed for heavy-duty work in the press shop. Here a sensor detects whether a blank has been placed on the conveyor belt.

Inductive sensors

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	M12 / L = 60	4 f	High-grade st. steel	10...36	IP 67	2	100	**IFR200**
	M12 / L = 40	4 f	High-grade st. steel	10...36	IP 67	75	100	**IFR203**

f = flush / nf = non flush

Tool exchange carrier

Inductive sensors detect the position of interchangeable tools

The rectangular design IDC inductive sensors can be installed overflush. This enables the position of the tool on the positioning table to be determined for automatic locking.

Inductive sensors

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	92 x 80 x 40	50 f	PPE	10...36	IP 67	70	250	**ID5058**

f = flush / nf = non flush

Positioning carriage for exchangeable gripper

Inductive sensors detect the position of the positioning carriage

The rectangular design IDC inductive sensors can be installed overflush. In this way, the position of the positioning carriage can be determined for automatic locking.

Inductive sensors

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	92 x 80 x 40	50 f	PPE	10...36	IP 67	70	250	**ID5055**

f = flush / nf = non flush

Measurement of compressed air consumption

Compressed air consumption sensor for recording energy consumption

The SD series compressed air meter continuously records the compressed air consumption of the suction grippers.

Compressed air meter for the measurement of compressed air consumption

Type	Process connection	Setting range [Nm³/h]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	R1 (DN25)	1.8...225.0	16	< 0.1	18...30	**SD8000**
	R2 (DN50)	5...700	16	< 0.1	18...30	**SD2000**

Vacuum monitoring

Vacuum sensors monitor the suction grippers

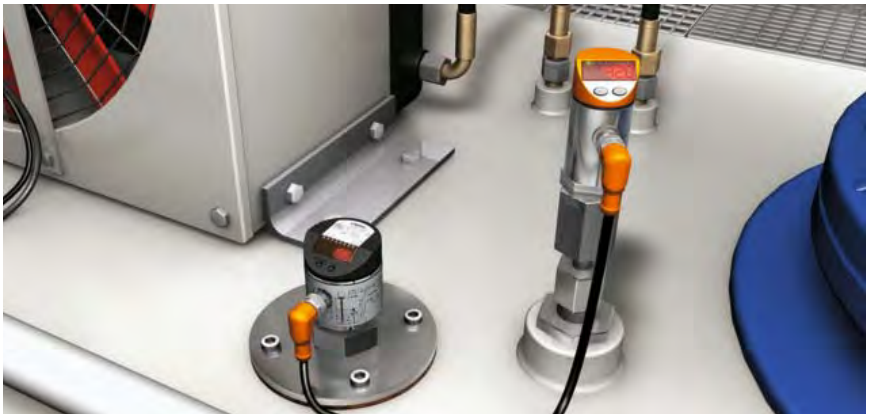
PN7 series vacuum sensors detect the required vacuum for operating the suction grippers.

Vacuum sensors

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ female	Display unit	-1...1	20	50	18...36	**PN7009**

Product selectors and further information can be found at: www.ifm.com

Hydraulics



Monitoring of power packs

LK and TR series sensors detect the level and the temperature in hydraulic power packs.

LK level sensors

Type	Probe length [mm]	Active zone [mm]	Inactive zone [mm]	U_b [V]	Medium temperature water [°C]	Medium temperature oil [°C]	I_{load} [mA]	Order no.
	472	390	53 / 30	18...30	0...35 (LK1023 + E43101: 0...60)	0...70	200	**LK1023**

Temperature sensors

Type	Measuring range [°C]	Process connection	Display	U_b [V]	Current consumption [mA]	I_{load} [mA]	Order no.
	-40...300	G ½ male	Display unit	18...32	50	250	**TR7432**

Lubrication

System pressure always in view

The PG electronic contact manometer combines an easy-to-read manometer display with the advantages of an electronic pressure sensor. The plant service personnel always have the correct pressure in view.

Pressure sensors in the circulating oil lubrication

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ½	Display unit	-1...25	100	300	18...32	**PG2453**

Monitoring of drives

Condition monitoring of drives

VSA series sensors record the vibration levels of the drives, enabling condition-oriented maintenance.

Vibration monitoring systems

Type	Description	Order no.
	Accelerometer · for connection to external diagnostic electronics type VSE · Connector · housing: stainless steel 316L / 1.4404	**VSA001**
	Diagnostics electronics for vibration sensors type VSA / VSP · 4 sensor inputs 0...10 mA or IEPE · TCP/IP Ethernet interface · Frequency-selective machine monitoring of up to 4 measuring points · Integrated history memory with real-time clock · Counter function · Combicon connection · PA	**VSE100**

Transferring signals and data

Controllers and gateways

The controller controls the communication in AS-i networks.
Gateways provide a connection from the AS-i to the higher-level bus system.

Controllers, gateways

Type	Number of AS-i masters	Description	Order no.
	2	AS-i Ethernet / IP Controller E · Full master functions · Graphic display · Housing materials: aluminium / steel sheet galvanised	**AC1337**
	2	AS-i controller E · AS-i controller freely programmable · Profibus DP interface · Ethernet programming interface · Full master functions · Graphic display · Housing materials: aluminium / steel sheet galvanised	**AC1356**

Part detection on conveyor belts

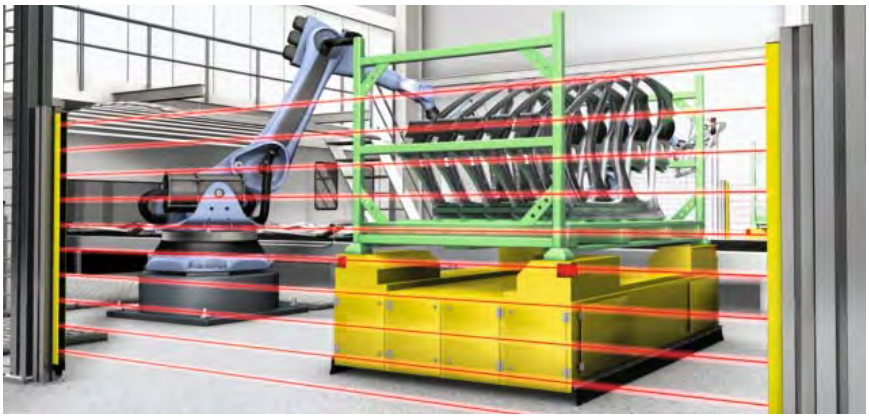
Part detection with through-beam sensors

The O5E / O5S type photoelectric sensors reliably detect the sheet metal parts placed on the conveyor.

Infrared / red light sensors for part recognition

Type	Operating principle	Range	Type of light	Spot Ø at max. range [mm]	Output H = light-on D = dark-on	Order no.
	Receiver	25 m	Red	–	H/D PNP	**O5E500**
	Transmitter	25 m	Red	625	–	**O5S500**

De-stacking sheet metal parts in racks



Access restriction De-stacking sheet metal parts

For operator protection, OY series safety light curtains restrict unauthorised access to accessible areas such as the sheet metal parts de-stacking station. Depending on the design, the safety light curtains correspond to Type 2 or 4, in accordance with EN 61496.

Safety light curtains for access prevention

Type	Sensor length [mm]	Resolution / detection capacity [mm]	Protected area height [mm]	Protected area width [m]	Response time [ms]	U_b [V]	Order no.
	1563	30	1510	0...4 / 3...12	18.5	24	**OY050S**

Scrap press

Loose parts become bales of scrap

The blank offcuts are compressed into bales of scrap in a high-pressure press.

PN7 series pressure sensors up to 600 bar

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ female	Display unit	0...600	800	1200	18...36	**PN7060**

Scrap conveyor – strip flow monitoring

Removal of scrap bales

The compact DIA speed monitor detects the pulses of the conveyor driveshaft.

Compact speed monitors for checking the conveyor

Type	Dimensions [mm]	Sensing range [mm]	Electrical design	U_b [V]	Setting range [puls. / min.]	Start-up delay [s]	Order no.
	M30 / L = 82	10 f	DC PNP	10...36 DC	5...300	15	**DI5009**

f = flush / nf = non flush

Material transport / storage

Traceability of sheet metal components

Traceability plays an important role in the automotive industry.
ifm's RFID system is used to identify press parts.

RFID systems for reading codes on metal

Type	Description	Order no.
	ID tag · ID-TAG/D55x13/04 · Ø 55 x 13 mm · Housing materials: PA 6	**E80351**

RFID UHF antenna

Type	Description	Order no.
	RFID UHF antenna · Housing materials: housing: aluminium / Protective cover: plastics / TNC socket: brass / PTFE · Operating frequency 865...870 MHz	**ANT830**

Locking of transport frames

Monitoring the locking of transport frames

MK series magnetic cylinder sensors detect the travel on a locking cylinder.

Inductive cylinder sensors

Type	Dimensions [mm]	Material	U_b [V]	f [Hz]	Protection	I_{load} [mA]	T_a [°C]	Order no.
	25 x 5 x 6.5	PA (polyamide)	10...30	10000	IP 65 / IP 67	200	-25...85	**MK5108**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Machine	Application	Product group
1	**Skid conveyor system**	
	Position detection of skid	Inductive sensors
	Position detection of body	Photoelectric sensors for general applications
	Position detection of body	Laser sensors / distance measurement sensors
2	**Access control / securing the area**	
	Securing the area	Safety light curtains
	Protective equipment	Safety light curtains
	Safe detection of metals	Fail-safe inductive sensors
	Monitoring of high-speed doors	Fail-safe inductive sensors
3	**Axis range scanning**	
	Range detection Axis 1	Fail-safe inductive sensors
	Range detection Axis 2	Fail-safe inductive sensors
	Range detection Axis 3	Fail-safe inductive sensors
	Range scanning with limit	Fail-safe inductive sensors
4	**Turntables**	
	Loading check	Photoelectric sensors for general applications
	Parts check	Inductive sensors
	Part detection	Vision sensors
	Safe positioning	Fail-safe inductive sensors
5	**Handling**	
	“Empty” detection on material carriers	Laser sensors / distance measurement sensors
	Vacuum detection on suction grippers	Pressure sensors
	Part detection	Vision sensors
	Measurement of compressed air consumption	Flow sensors / flow meters
6	**Gripping / clamping**	
	Locking check on clamps	Inductive sensors
	Connection of sensors	Sockets
	Signal transmission	Splitter boxes

Machine	Application	Product group
7	**Cooling water and industrial gases**	
	Cooling water in welding guns	Flow sensors / flow meters
	Pressure monitoring on welding guns	Pressure sensors
	Measurement of compressed air consumption	Flow sensors / flow meters
	Shielding gas monitoring	Flow sensors / flow meters
8	**Gluing / sealing**	
	Temperature monitoring of mixing head	Temperature sensors
	Temperature monitoring of nozzles	Temperature sensors
	Pressure monitoring of adhesive	Pressure sensors
9	**Type and part detection**	
	Type detection of bodies	Vision sensors
	Quality inspection of components	Vision sensors
	Detection of adhesive pads	Vision sensors
	Detecting nuts and bolts	Laser sensors / distance measurement sensors
10	**Manipulators**	
	Pressure monitoring of pneumatics	Pressure sensors
	Valve connection	AS-Interface AirBoxes for pneumatics
	Detection of pneumatic cylinders	Cylinder sensors
	Measurement of compressed air consumption	Flow sensors / flow meters
11	**Body cleaning**	
	Limit level detection	Level sensors
	Pressure measurement on pumps	Pressure sensors
	Flow monitoring	Flow sensors / flow meters
	Position detection	Inductive sensors
12	**Body storage area**	
	Condition monitoring of drives	Vibration monitoring systems
	Cable monitoring on lifts	Fail-safe inductive sensors
	“Compartment occupied” detection	Photoelectric sensors for general applications
	Identification of bodies	1D/2D code readers

The reliability of the sensors increases the availability of the plant

In the body-in-white, up to 200 individual parts and assemblies are put together to form a self-supporting body.

As well as the well-established resistance welding, also known as “spot welding”, depending on the mix of materials a variety of joining processes are used.

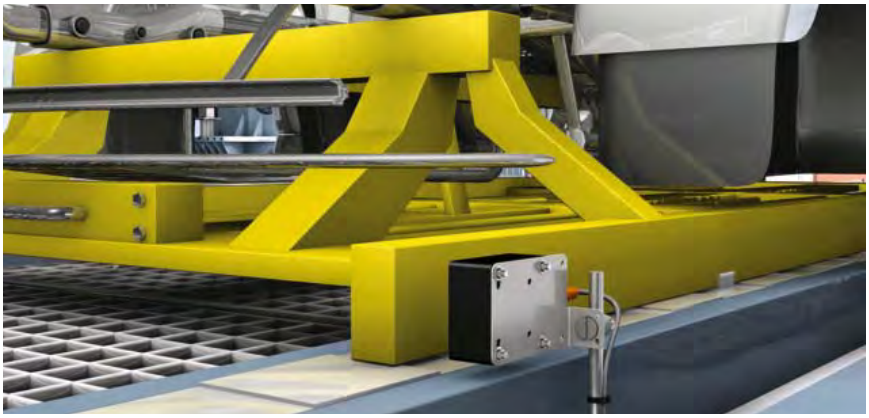
For lightweight materials such as aluminium and magnesium, joining processes such as laser welding, flanging or clinching are more appropriate.

Suitable adhesives are also available nowadays. These adhesives also contribute in part to damping noise as well as sealing seams and joints.

The requirements for the reliability and availability of the plant are very high in body-in-white manufacture, since the material flow must not stall in the subsequent painting process.

Here, sensors from ifm, with their high standards of reliability and robustness, help to achieve these goals sustainably.

Monitoring the skid position



Monitoring the skid position

The IDC-type inductive sensors reliably detect the positions of the skids.

Inductive sensors

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	92 x 80 x 40	50 f	PPE	10...36	IP 67	70	250	**ID5059**

f = flush / nf = non flush

Monitoring the body position

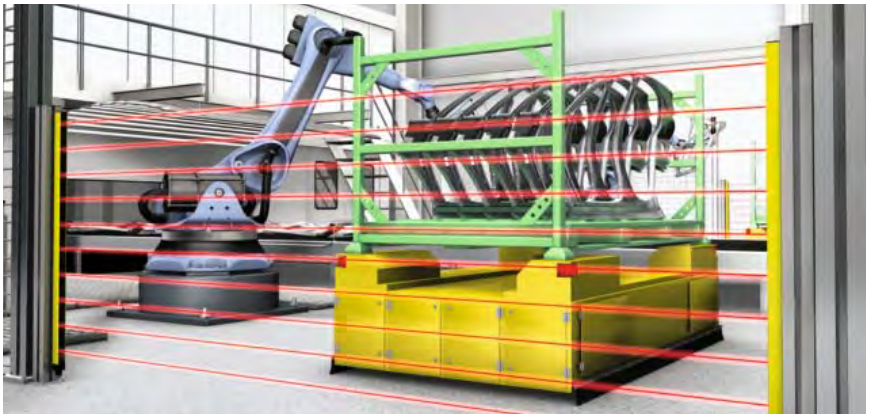
Detecting the body position

Using time of flight measurement, photoelectric sensors reliably detect the position of the body on the skid, for controlling the subsequent welding processes.

PMDLine photoelectric sensors with time of flight measurement

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Background suppression	0.03...2 m	33	< 5	10...30	**O5D100**

Securing the manufacturing cell area



Access restriction
Removal of sheet metal parts

For operator protection, OY series safety light curtains restrict unauthorised access to accessible areas such as the sheet metal parts removal station. Depending on the design, the safety light curtains correspond to Type 2 or 4, in accordance with EN 61496.

Safety light curtains for access prevention

Type	Sensor length [mm]	Resolution / detection capacity [mm]	Protected area height [mm]	Protected area width [m]	Response time [ms]	U_b [V]	Order no.
	1563	90	1510	0...4 / 3...12	6.5	24	**OY110S**

Door protection in transfer areas

Closed check on transfer stations

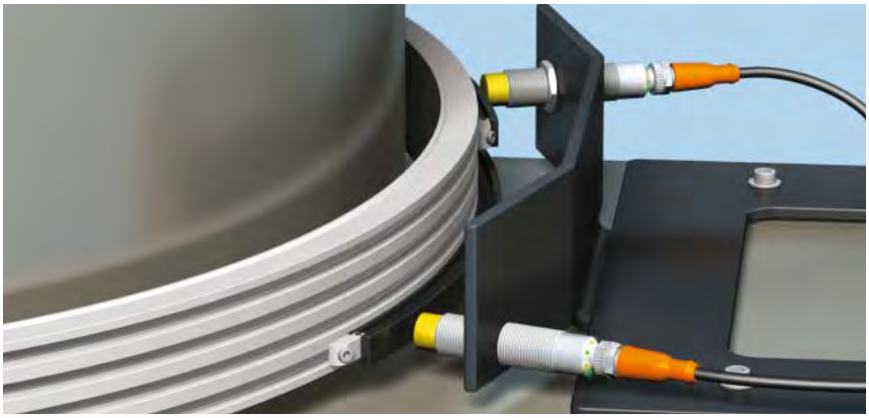
Category 4 and SIL 3 fail-safe inductive sensors directly detect the safe position of high-speed doors without contact and without requiring a special counter piece.

Fail-safe inductive sensors

Type	Length [mm]	Enable zone [mm]	Housing material	U_b DC [V]	Protection	Response time in case of a safety request / enable time [ms]	Order no.
	66	10...15 nf	PPE	24	IP 65 / IP 67	≤ 50 / ≤ 200	**GM701S**
	66	4...20 nf	PPE	24	IP 65 / IP 67	≤ 50 / ≤ 200	**GM705S**

f = flush / nf = non flush

Axis range scanning with reference circles



Range scanning Axis 1 for robots

Category 4 and SIL 3 fail-safe inductive sensors directly detect the safe working range of robots without contact and without requiring a special counter piece.

Fail-safe inductive sensors

Type	Length [mm]	Enable zone [mm]	Housing material	U_b DC [V]	Protection	Response time in case of a safety request / enable time [ms]	Order no.
	35	1...8 nf	High-grade st. steel	24	IP 65 / IP 67	≤ 1 / ≤ 1	**GG711S**

f = flush / nf = non flush

Axis range scanning with limit fields

Range scanning Axis 1 for robots

Category SIL 2 fail-safe inductive sensors detect the presence of metals without contact and without requiring a special counter piece. This minimises the mechanical effort involved.

Fail-safe inductive sensors for the reliable detection of metals

Type	Length [mm]	Enable zone [mm]	Housing material	U_b DC [V]	Protection	Response time in case of a safety request / enable time [ms]	Order no.
	53	> 10 f	Brass	24	IP 65 / IP 67	≤ 5 / ≤ 5	**GG851S**

f = flush / nf = non flush

Loading check on turntables

Photoelectric sensors detect the side part in a turntable

All parts must be placed correctly in the clamping frame.
Here, the OGH500 photoelectric sensors ensure reliable detection.

Photoelectric sensors

Type	Operating principle	Range	Type of light	Spot Ø at max. range [mm]	Output H = light-on D = dark-on	Order no.
	Background suppression	15...300 mm	Red	25	H/D PNP	**OGH500**

Parts check in welding tools

Inductive sensors detect components in welding equipment without disruption

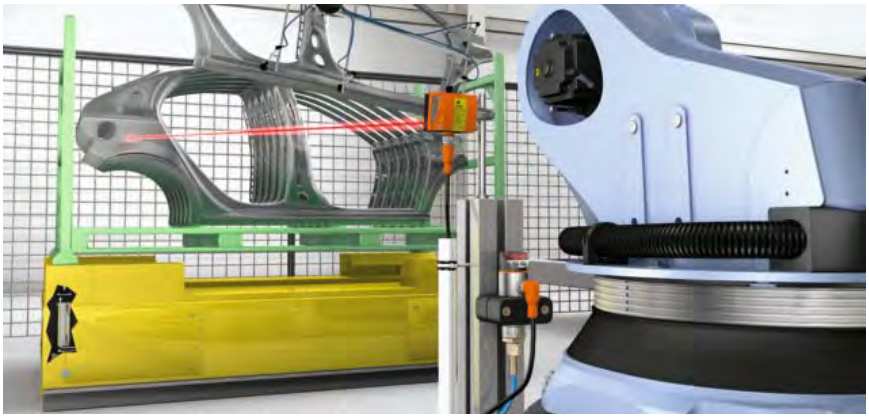
The magnetic field resistant sensors for detecting parts can be directly assembled in the welding tools. Furthermore, the coating helps prevent welding sputter (or 'slag') from sticking.

Electromagnetic field immune sensors with correction factor K = 1

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	M12 / L = 65	3 f	Brass	10...30	IP 67	4000	200	**IFW200**
	M12 / L = 65	8 nf	Brass	10...30	IP 67	4000	200	**IFW201**

f = flush / nf = non flush

Removal of parts from material carriers



"Empty" detection of material carriers

The O1D photoelectric distance sensor uses the analogue output to detect how full the material carrier is.

PMD distance sensors with time of flight measurement for detecting the loading condition

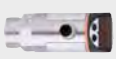
Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...10 m	1...33	< 15 x 15	18...30	**O1D105**

Pressure monitoring on suction grippers

Pressure measurement on suction grippers

The vacuum sensors detect whether there is sufficient vacuum present for a safe gripping operation.

Vacuum sensors

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ female	Display unit	-1...1	20	50	18...36	**PN7009**

Clamping fixtures

Robust full-metal sensors are close by

"R" series full-metal inductive sensors are designed for heavy-duty work in welding equipment.
A non-stick coating ensures a long holding time in the tools.

Full metal sensors with non-stick coating against weld spatter

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	M18 / L = 70	6 f	High-grade st. steel	10...36	IP 67	2	100	**IGR200**

f = flush / nf = non flush

Connection technology for clamping fixtures and sensors

It all depends on the cable

Signals from clamping fixtures and sensors must be transmitted to the controller without disruption.
Here, ifm offers a wide range of cables made from PUR (not crosslinked by irradiation) with grey or orange sheath colour.

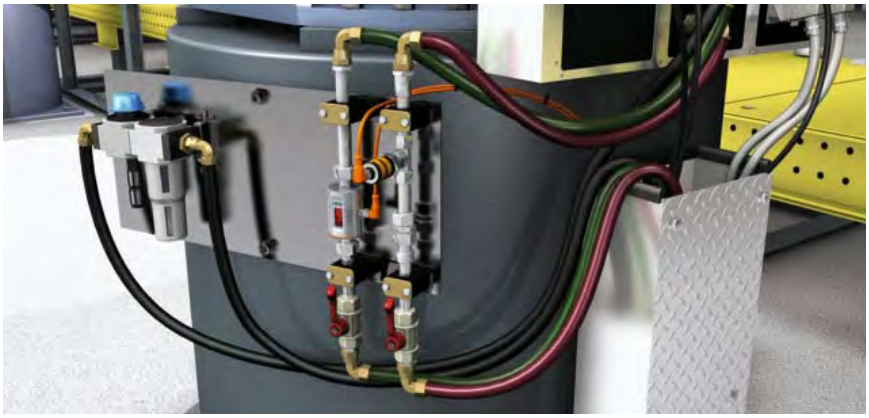
Connectors weld slag resistant

Type	Description	Order no.
	Socket · angled · Free from silicone · Free from halogen · Gold-plated contacts · For welding applications · M12 connector · 2 m · Housing materials: housing: TPU black transparent / sealing: FKM	**EVW007**

Jumpers weld slag resistant

Type	Description	Order no.
	Jumper · straight / straight · Free from silicone · Free from halogen · Gold-plated contacts · For welding applications · 1 m · Housing materials: housing: TPU orange / sealing: FKM	**EVW024**

Cooling water monitoring on welding guns



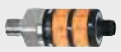
Monitoring of cooling circuits in welding robots

The SM magnetic-inductive volumetric flow sensor detects the amount of cooling water in the system.
The pressure sensor PK recognises the sudden drop in pressure in the circuit, e.g. when changing the caps.

Magnetic-inductive volumetric flow sensors

Type	Process connection	Setting range [Nm³/h]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	G½	0.25...25.00	16	< 0.150	19...30	**SM6000**

Pressure sensors in the cooling circuit with the PK pressure sensor

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ male / M5 female	Operation	0...10	25	300	9.6...32	**PK6524**

Cooling water monitoring in welding stations

Cooling water monitoring in welding stations

The SBY series mechatronic flow sensor switches very quickly when the level falls below the minimum, thus protecting the system.

Mechatronic flow sensors

Type	Process connection	Measuring range [l/min]	Medium temperature [°C]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	Rp ¾	1...25	0...85	40	< 0.01	24	**SBY333**

Measurement of compressed air consumption

Compressed air monitoring in plant and robot installation boards

Here, SD8000 compressed air meters detect both the consumptions at normal pressure (6 bar) as well as in the high-pressure system (12 bar).
Consumptions are recorded and leaks detected.

Compressed air meters for consumption measurement and leakage detection

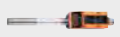
Type	Process connection	Setting range [Nm³/h]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	R1 (DN25)	1.8...225.0	16	< 0.1	18...30	**SD8000**

Shielding gas monitoring in welding equipment

Shielding gas monitoring in welding processes

The SD6100 compressed air meter reliably detects the presence and consumption of argon, carbon dioxide or nitrogen.

Compressed air meters

Type	Process connection	Setting range [Nm³/h]	Medium temperature [°C]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	G ¼ (DN8)	N_2: 0.04...15.00 Ar: 0.08...24.04 CO_2: 0.04...14.36	0...60	16	< 0.1	18...30	**SD5100**
	R½ (DN15)	N_2: 0.2...75.0 Ar: 0.4...122.0 CO_2: 0.2...74.7	0...60	16	< 0.1	18...30	**SD6100**

Gluing body components

Temperature monitoring of mixing head

The temperature of the adhesive components must not fall below predefined values. The TN temperature sensor passes the analogue signals on to the pump controller.

Compact temperature sensors

Type	Measuring range [°C / °F]	Process connection	Installation length [mm]	U_b [V]	Dynamic response T05 / T09 [s]	Order no.
	-40...150 / -40...302	M18 x 1.5	45	18...32	1 / 3	**TN2531**

Sealing of seams

Application of liquid PVC

To improve the vehicle acoustics and corrosion protection, liquid PVC is applied to the folded and flanged edges. The temperature sensor TR2432 detects the correct temperature and reports faults immediately.
The correct pump pressure is controlled using an analogue pressure sensor.

Temperature sensors

Type	Measuring range [°C]	Process connection	Display	U_b [V]	Current consumption [mA]	I_{load} [mA]	Order no.
	-40...300	G ½ male	Display unit	18...32	50	250	**TR2432**

Pressure sensors with analogue output for pump control

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ female	Display unit	0...250	400	850	18...36	**PN3001**

Type identification of car bodies and components

Detection of structural parts

The complexity and diversity of the components places a great demand on the logistics and manufacturing processes.
Here, the O2D series vision sensors help to keep an overview and ensure quality.

Vision sensors

Type	Operating principle	Max. field of view size [mm]	Resolution [mm]	Detection rate [Hz]	Type of light	Ambient temperature [°C]	Order no.
	CMOS image sensor B/W, VGA resolution 640 x 480	400 x 300	0.633	10	Infrared	-10...60	**O2D224**

Detection of adhesive pads for noise damping

Adhesive pads for noise damping

Increasingly, adhesive pads are applied between the welded structural parts to dampen noise.
Here, O2V series vision sensors detect the presence of these pads, thus ensuring process quality.

Vision sensors

Type	Operating principle	Max. field of view size [mm]	Resolution [mm]	Detection rate [Hz]	Type of light	Ambient temperature [°C]	Order no.
	CMOS image sensor B/W, VGA resolution 640 x 480	1320 x 945	2.0	10	White light	-10...60	**O2V102**

Manipulators for the assembly of add-on parts

Manipulators support the operators in the assembly shop

Heavy loads and complex components are lifted and assembled using manipulators.
Here, a PK-type pressure sensor monitors the correct working pressure in the compressed air supply.

Pressure sensors

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ male / M5 female	Operation	0...10	25	300	9.6...32	**PK6524**

Valve connection via AS-i AirBoxes

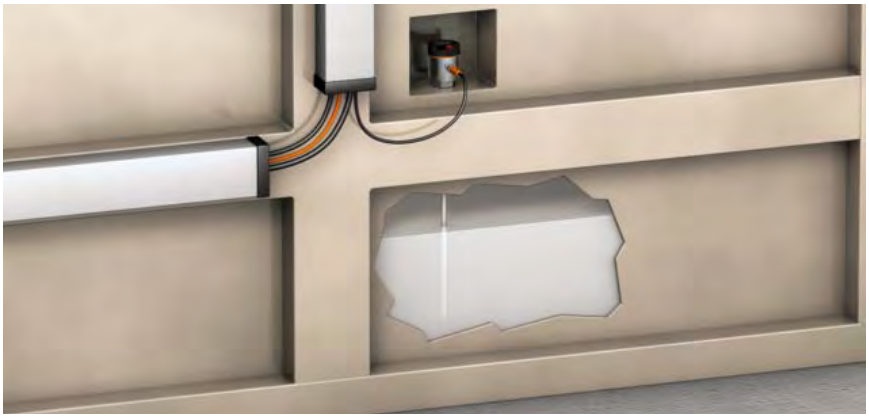
AS-i AirBoxes minimise the connection complexity

The cylinder movements must be scanned. At the same time, the compressed air is required by the cylinders. Here, ifm's AS-i AirBoxes link compact valves with digital feedback inputs.

AS-i AirBoxes

Type	Description	Order no.
	AS-i AirBox · 5/2-way bistable slide valve free from overlapping · Three orientations of the flat cable are possible · AS-i flat cable connection · Version 2.11 and 3.0 with extended addressing mode · Addressing socket · PA / POM / Piercing contacts: CuSn6 surface nickel and tin-plated	**AC5253**

Monitoring the fill level of cleaning agents



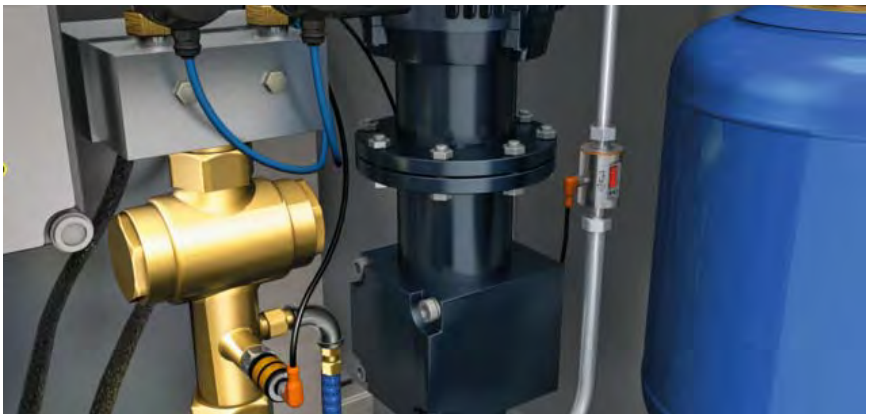
Detecting limit levels with fill level sensors

A special cleaning solution for degreasing is required for an optimum washing process.
Here, the LK81 series sensor monitors the automatic filling of the storage container.

Level sensors

Type	Probe length [mm]	Active zone [mm]	Inactive zone [mm]	U_b [V]	Medium temperature water [°C]	Medium temperature oil [°C]	I_{load} [mA]	Order no.
	728	585	102 / 40	18...30	0...35 (LK8124 + E43102: 0...55)	0...70	200	**LK8124**

Pressure monitoring in the washing plant



Pressure measurement in the car body washing plant

The pressure is generated using a high-pressure pump. A PK series pressure sensor controls the optimum working pressure in the washing plant.

Pressure sensors

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ male / M5 female	Operation	0...400	600	1600	9.6...32	**PK6520**

Monitoring of drives in lifts

Condition monitoring of drives

The VSA vibration sensor monitors the condition of the drive motor.
This enables faults to be detected more easily.

Vibration monitoring systems

Type	Description	Order no.
	Accelerometer · for connection to external diagnostic electronics type VSE · Connector · housing: stainless steel 316L / 1.4404	**VSA001**
	Diagnostics electronics for vibration sensors type VSA / VSP · 4 sensor inputs 0...10 mA or IEPE · TCP/IP Ethernet interface · Frequency-selective machine monitoring of up to 4 measuring points · Integrated history memory with real-time clock · Counter function · Combicon connection · PA	**VSE002**

Cable position detection for deflector pulleys

Cable position detection for deflector pulleys

Category SIL 2 and PL d inductive safety sensors detect the cable position on deflector pulleys in lifts.

Fail-safe inductive sensors

Type	Length [mm]	Enable zone [mm]	Housing material	U_b DC [V]	Protection	Response time in case of a safety request / enable time [ms]	Order no.
	35	1...8 nf	High-grade st. steel	24	IP 65 / IP 67	≤ 1 / ≤ 1	**GG711S**

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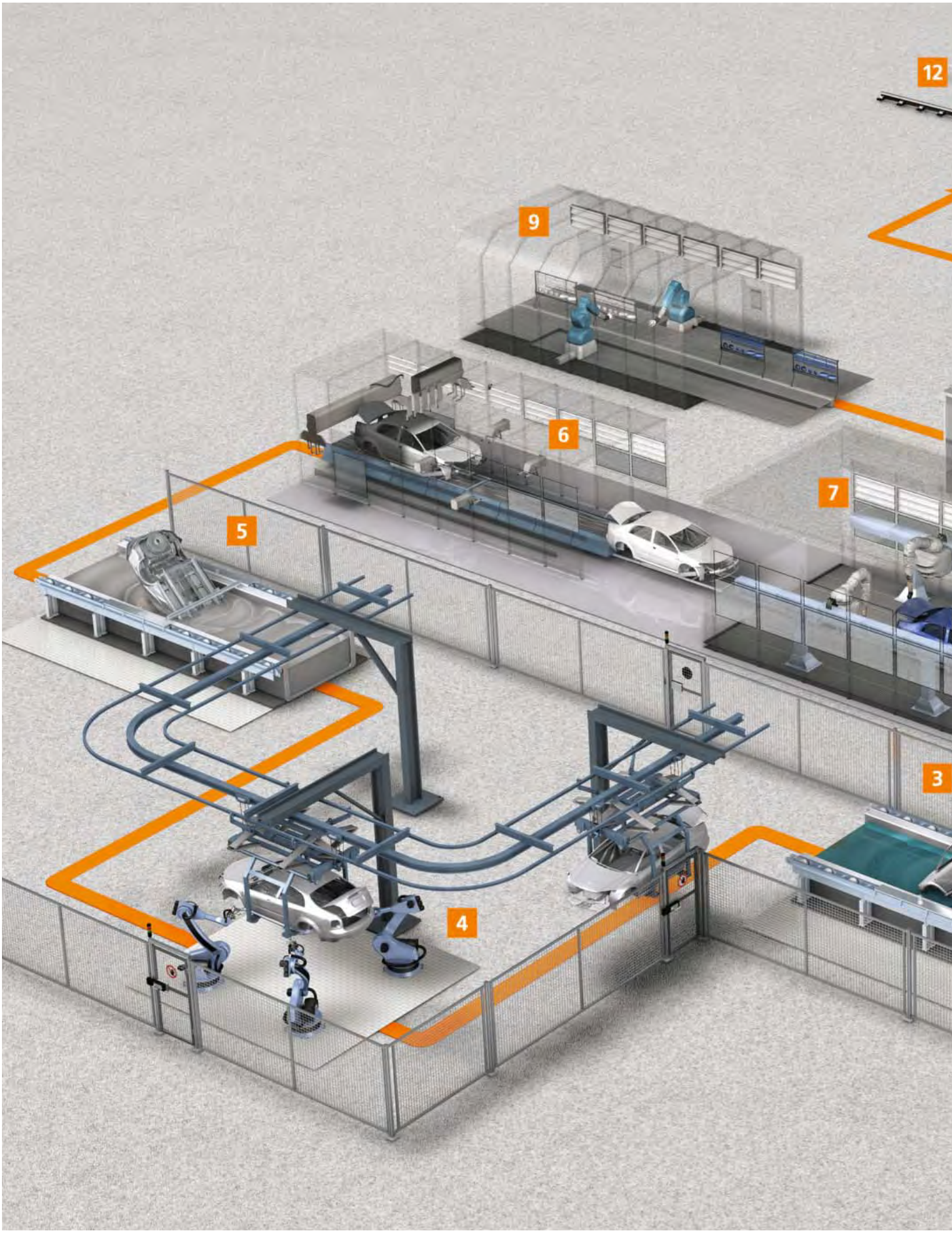
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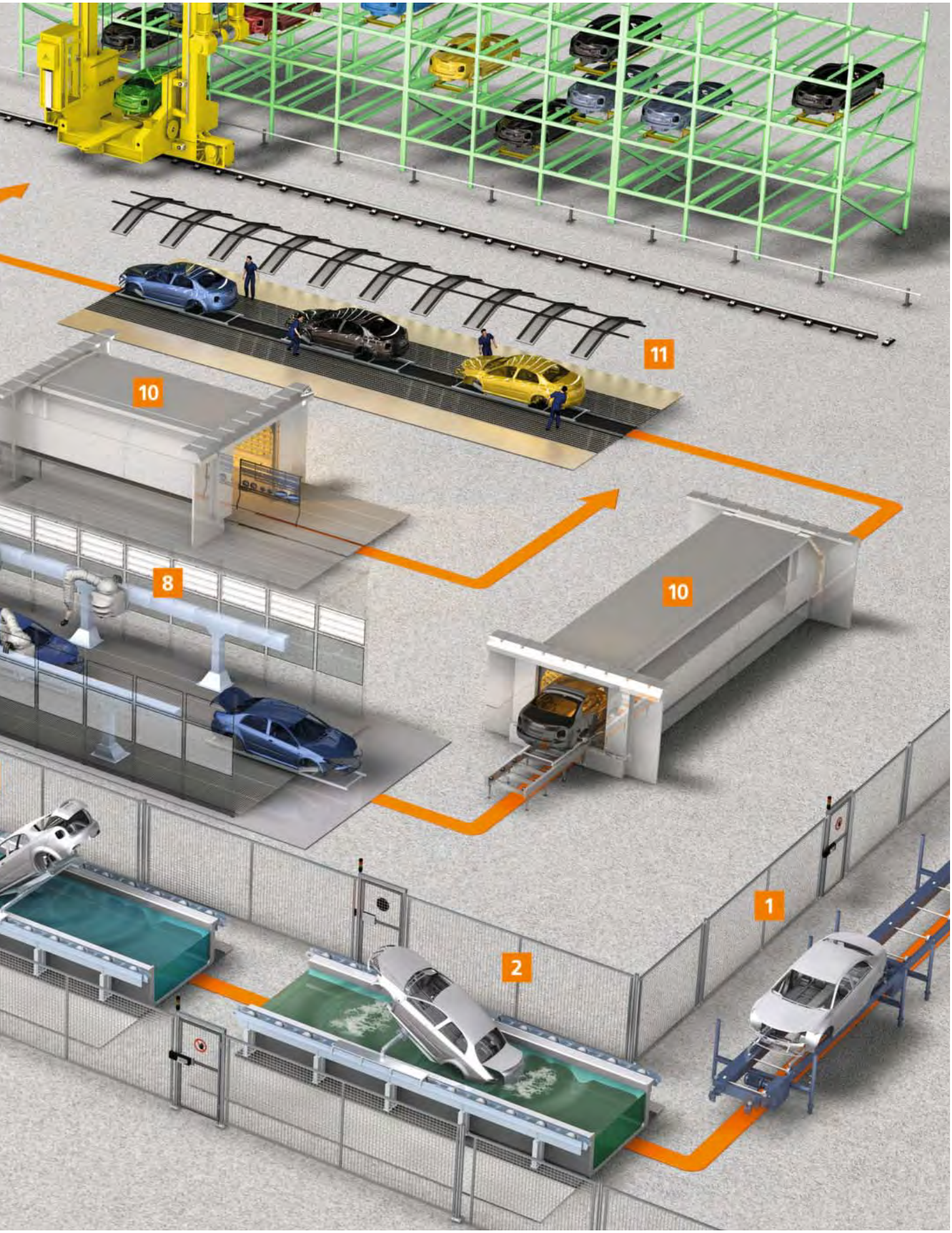
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Machine	Application	Product group
1	**Conveyor technology**	
	Position detection of skid	Inductive sensors
	Locating the skids	RFID UHF
	Position detection of body	Photoelectric sensors for general applications
	Identification of bodies	1D/2D code readers
2	**Pretreatment**	
	Pump pressure control	Pressure sensors
	Freshwater inflow	Flow sensors / flow meters
	Limit level detection	Level sensors
	Position detection	Inductive sensors
3	**Cathodic e-coating**	
	Temperature measurement	Temperature sensors
	Pressure measurement	Pressure sensors
	Limit level detection	Capacitive sensors
	Position detection	Vision sensors
4	**Sealing / conserving**	
	Pressure measurement	Pressure sensors
	Temperature measurement	Temperature sensors
	Position detection	Inductive sensors
	Optical detection	Vision sensors
5	**Water treatment**	
	Position feedback	Inductive sensors
	Pressure measurement	Pressure sensors
	Flow monitoring	Flow sensors / flow meters
6	**Fresh air / Exhaust air**	
	Airflow monitor	Flow sensors / flow meters
	Speed measurement	Pulse evaluation systems
	Compressed air monitoring	Flow sensors / flow meters
	Vibration monitoring	Vibration monitoring systems

Machine	Application	Product group
7	**Paint recycling**	
	Temperature measurement	Temperature sensors
	Level detection	Level sensors
	Differential pressure measurement	Pressure sensors
	Flow monitoring	Flow sensors / flow meters
8	**Painting robots**	
	Temperature measurement	Temperature sensors
	Flow rate measurement	Flow sensors / flow meters
	Optical detection	Laser sensors / distance measurement sensors
	Position detection	Inductive sensors
9	**Painting add-on parts**	
	Identification of parts	1D/2D code readers
	Vibration monitoring	Vibration monitoring systems
	Belt breakage check on fans	Photoelectric sensors for general applications
	Flow rate measurement	Flow sensors / flow meters
10	**Heat generation and distribution**	
	Monitoring of high-speed doors	Fail-safe inductive sensors
	Fan check	Photoelectric sensors for general applications
	Temperature measurement	Temperature sensors
	Vibration monitoring	Vibration monitoring systems
11	**Assembly of add-on parts / final inspection**	
	Identification	1D/2D code readers
	Part detection	Vision sensors
	Identification	RFID UHF
12	**Body storage area**	
	Identification	1D/2D code readers
	Vibration monitoring	Vibration monitoring systems
	Occupation of storage location	Photoelectric sensors for general applications
	Position feedback	Inductive sensors

Position sensors and fluid sensors improve the process quality

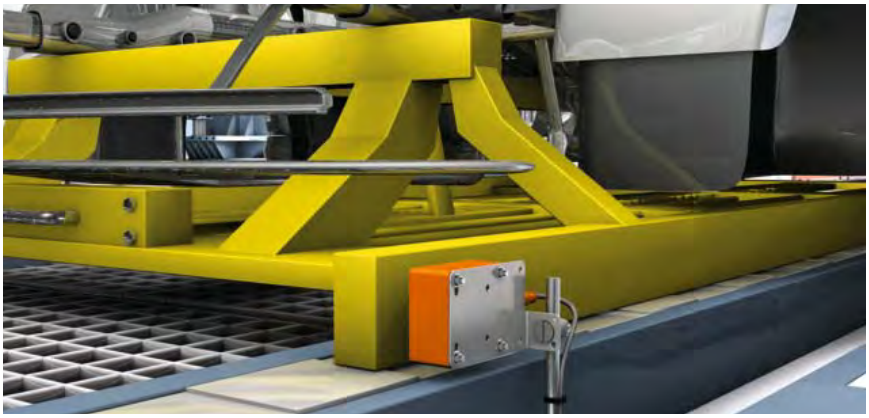
Now it's time for some colour.

First the car bodies must be degreased and other dirt removed. As part of the pretreatment, aluminium parts are lightly sandpapered, in order to enable a perfect coating. The bodies receive their first corrosion protection in an EPD bath (electrophoretic deposition – cathodic dip coating). Then the base coat is applied. This filler smooths out any unevenness. After the base coat and the topcoat, the clear coat is applied to give the bodies their shine.

A paint shop incorporates conveyor technology, various dip tanks as well as numerous robots for applying the individual paintwork. In between, there are evaporation zones and drying chambers. Heat generation, water treatment, paint tank maintenance, exhaust air and fresh air supply are absolutely vital for reliable operation.

Here sensors from ifm, with their high standards of repeatability and switch point stability, help the operator to ensure the high quality of the painting process in series production.

Floor conveyors



Monitoring the skid position

ID series inductive sensors reliably detect the positions of the skids on the floor conveyors.

Inductive sensors

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	92 x 80 x 40	50 f	PPE	10...36	IP 67	70	250	**ID5055**
	92 x 80 x 40	50 f	PPE	10...36	IP 67	70	250	**ID5058**
	105 x 80 x 40	60 nf	PPE	10...36	IP 65	100	250	**ID5005**

f = flush / nf = non flush

Roller conveyor systems

Monitoring the skid position

The IMC series inductive sensors reliably detect the positions of the skids in roller conveyors.

Inductive sensors

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	40 x 40 x 54	40 nf	PA (polyamide)	10...36	IP 67	60	200	**IM5117**
	40 x 40 x 54	40 nf	PA (polyamide)	10...36	IP 67	60	200	**IM5136**

f = flush / nf = non flush

Conveyor technology

Detecting the body position

Photoelectric sensors reliably detect the position of the body on the skid to control the subsequent processes.

Photoelectric sensors for determining position

Type	Operating principle	Range	Type of light	Spot Ø at max. range [mm]	Output H = light-on D = dark-on	Order no.
	Background suppression	50...1800 mm	Red	50	H/D PNP	**O5H500**

PMDLine photoelectric sensors with time of flight measurement

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Background suppression	0.03...2 m	33	< 5	10...30	**O5D100**

Adjustable mounting systems

Type	Description	Order no.
	Mounting set · Clamp mounting · Free-standing M10 · for type O5 · Housing materials: stainless steel 316Ti / 1.4571 / clamp: diecast zinc	**E21083**
	Mounting set · Clamp mounting · With protective cover · rod mounting Ø 12 mm · for type O5 · Housing materials: stainless steel 316Ti / 1.4571 / clamp: diecast zinc	**E21210**

Protective bracket

Type	Description	Order no.
	Mounting set · Clamp mounting · With protective cover · Free-standing M10 · for type O5 · Housing materials: stainless steel 316Ti / 1.4571 / clamp: diecast zinc	**E21084**

Cleaning of the body

Pressure measurement in the car body washing plant

The pressure is generated using a high-pressure pump. Here, the PG series pressure sensor, with an analogue output, controls the optimum working pressure of the pump.

Pressure monitoring in a high-speed pump

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ½	Display unit	0...400	800	1200	18...32	**PG2450**

Magnetic-inductive volumetric flow sensors for freshwater inflow monitoring

Type	Process connection	Measuring range [l/min]	Medium temperature [°C]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	G½	0.25...25.00	-10...70	16	< 0.150	19...30	**SM6000**

Monitoring the fill level of cleaning agents

Level sensors detect the optimum filling level in the tank

A special cleaning solution for degreasing is required for an optimum washing process.
Here, the LK31 series sensors with an analogue output monitor the optimum fill level in the storage tank.

Level sensors

Type	Probe length [mm]	Active zone [mm]	Inactive zone [mm]	U_b [V]	Medium temperature water [°C]	Medium temperature oil [°C]	I_{load} [mA]	Order no.
	728	585	102 / 40	18...30	0...35 (LK3124 + E43102: 0...55)	0...70	200	**LK3124**

EPD bath (electrophoretic deposition – cathodic dip coating)

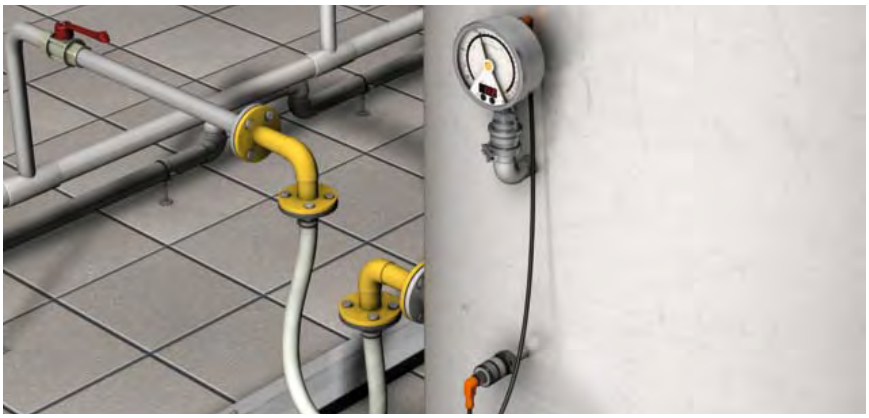
Detecting the state of doors and flaps

The bodies receive their first corrosion protection in an EPD bath.
Here, the O2D series vision sensors detect whether plastic spacing sleeves are keeping the doors and flaps slightly open.

Vision sensors for position detection

Type	Operating principle	Max. field of view size [mm]	Resolution [mm]	Detection rate [Hz]	Type of light	Ambient temperature [°C]	Order no.
	CMOS image sensor B/W, VGA resolution 640 x 480	1320 x 945	2.0	10	Infrared	-10...60	**O2D222**

Rinsing



Detecting rinsing water in the tank

A temperate rinsing solution is required for an ideal process in the pretreatment. The PG series pressure sensor monitors the pressure in the tank. The TK series temperature sensor activates when the temperature falls below a minimum level.

Pressure sensors

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	Sealing cone G1 male	Display unit	-1...10	50	150	18...32	**PG2894***

Attention: The unit must only be installed in a process connection for G1 sealing cone!
The G1A sealing cone of the unit is only suited for adapters with metal end stop!

Cavity sealing

Sealing cavities with liquid wax

To improve corrosion protection, liquid wax is applied in the cavities.
Here, the temperature sensor TR detects the correct temperature and reports faults immediately.
The pump pressure is controlled using an analogue pressure sensor.

Temperature sensors

Type	Measuring range [°C]	Process connection	Display	U_b [V]	Current consumption [mA]	I_{load} [mA]	Order no.
	-40...300	G ½ male	Display unit	18...32	50	250	**TR2432**

Pressure sensors with analogue output for pump control

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ female	Display unit	0...250	400	850	18...36	**PN3001**

Sealing

Temperature monitoring on the dispensing head

The temperature of the sealant may not fall below defined values. The TN temperature sensor passes the analogue signals on to the pump controller.

Compact temperature sensors for temperature monitoring

Type	Measuring range [°C / °F]	Process connection	Installation length [mm]	U_b [V]	Dynamic response T05 / T09 [s]	Order no.
	-40...150 / -40...302	M18 x 1.5	45	18...32	1 / 3	**TN2531**

Freshwater supply

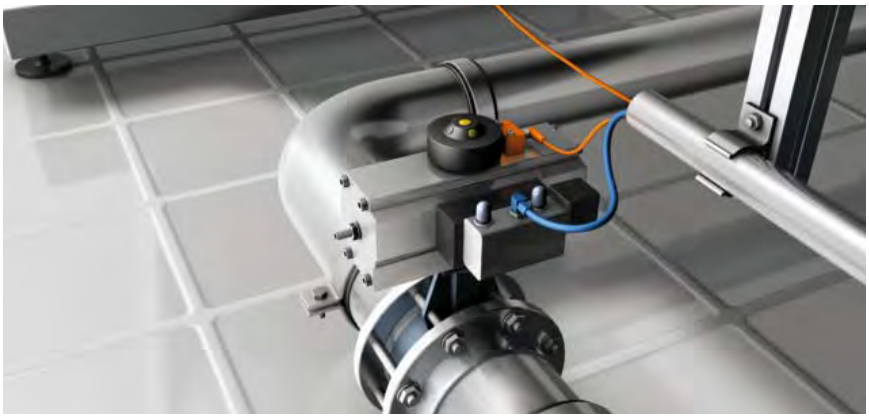
Monitoring the freshwater feed

Treated water is required for all the different rinsing zones.
The SI flow sensor continuously monitors the inflow of water.

Flow sensors

Type	Setting range liquids / gases [cm/s]	Material sensor tip	Medium temperature [°C]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	3...300 / 200...3000	3...100 / 200...800	-25...80	30	1...10	19...36	**SI5000**

Control of the pneumatic valve actuators



Position feedback on valve actuators

The IN series dual sensor contains two inductive sensors for "Open / Closed" detection of the valve position using control cams. The digital output controls the solenoid valve of the pneumatic valve actuator.

Inductive dual sensors for position feedback on pneumatic valve actuators

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f AC / DC [Hz]	I_{load} AC / DC [mA]	Order no.
	40 x 26 x 26	4 nf	PBT	10...36	IP 67	1300	250	**IN5224**

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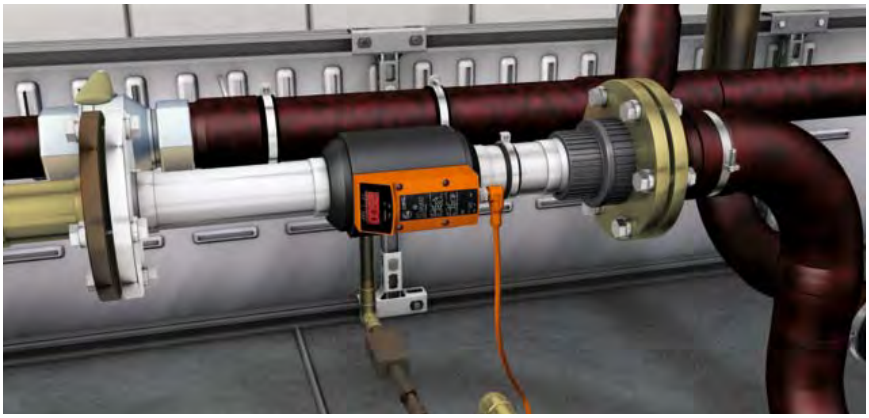
Fresh air supply



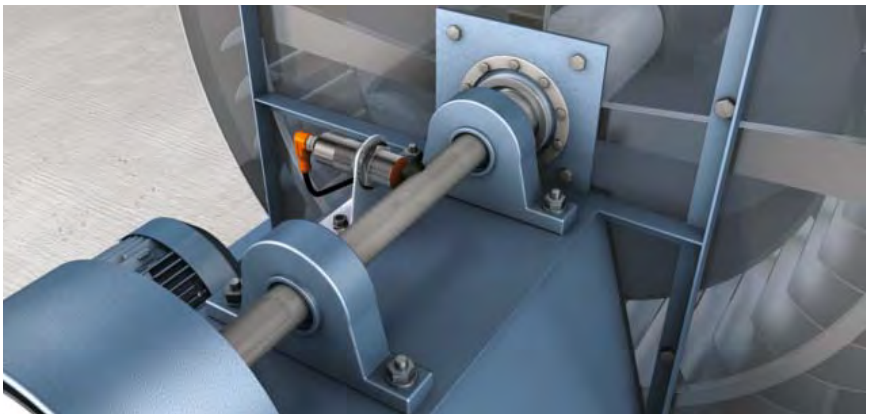
Air consumption measurement

The SD compressed air meter continuously measures the air flow. The measured values are used as a basis to determine the actual consumption.

Compressed air meters determine the actual consumption

Type	Process connection	Setting range [Nm³/h]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	R1½ (DN40)	3.5...410.0	16	< 0.1	18...30	**SD9000**

Exhaust



Speed detection on fans

The exhaust air from the painting cabins is extracted and delivered to the thermal post-combustion.
The speed sensor monitors the fans for underspeed and blockages.

Speed detection

Type	Dimensions [mm]	Sensing range [mm]	Electrical design	U_b [V]	Setting range [puls. / min.]	Start-up delay [s]	Order no.
	M30 / L = 82	10 f	DC PNP	10...36 DC	5...300	15	**DI5009**

f = flush / nf = non flush

Vibration sensors for bearing monitoring in drives

Type	Description	Order no.
	Accelerometer · for connection to external diagnostic electronics type VSE · Connector · housing: stainless steel 316L / 1.4404	**VSA001**

Bath maintenance

Ultrafiltration

A proportion of the paint is continuously removed from the dip-bath and fed through the ultrafiltration unit. The residual solid content is mixed back into the bath. The clean filtrate is used as a rinsing solution. Here the temperature sensor monitors the correct temperature.

Temperature sensors

Type	Measuring range [°C]	Process connection	Display	U_b [V]	Current consumption [mA]	I_{load} [mA]	Order no.
	-40...300	G ½ male	Display unit	18...32	50	250	**TR2432**

Paint recycling

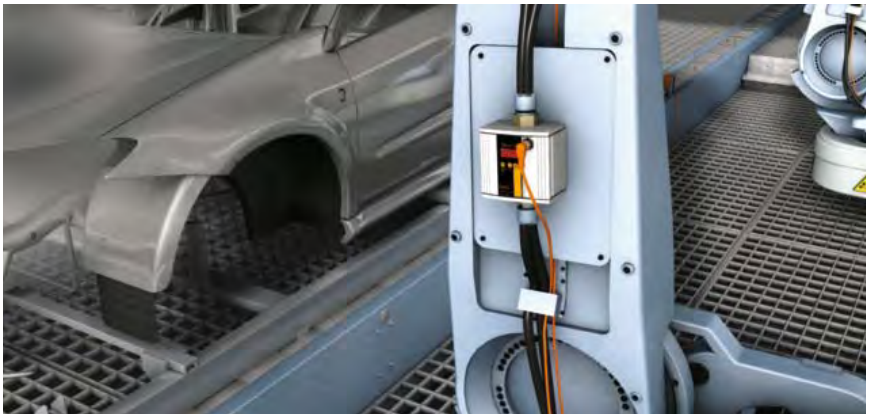
Detecting the fill level in the tanks

The paint spray, precipitated by the water, is captured and filtered. The paint acquired in this way can be reintroduced to the mixture. The LMT100 level sensor detects whether the level in the tank falls below a minimum value.

Point level sensors

Type	Process connection	Process pressure max. [bar]	Application	Protection	Order no.
	G ½ male	-1...40	liquid, viscous and powdery media	IP 68 / IP 69K	**LMT100**

Monitoring the painting robot nozzles



Flow measurement on painting robots

The paint application demands a high degree of availability from the systems. Here, the SU volumetric flow sensor detects any blockages of the nozzles.

Flow meters

Type	Process connection	Measuring range [l/min]	Medium temperature [°C]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	G¾	0.1...50.0	-10...80	16	< 0.250	19...30	**SU7000**
	G1	0.2...100.0	-10...80	16	< 0.250	19...30	**SU8000**

Control of the painting robots

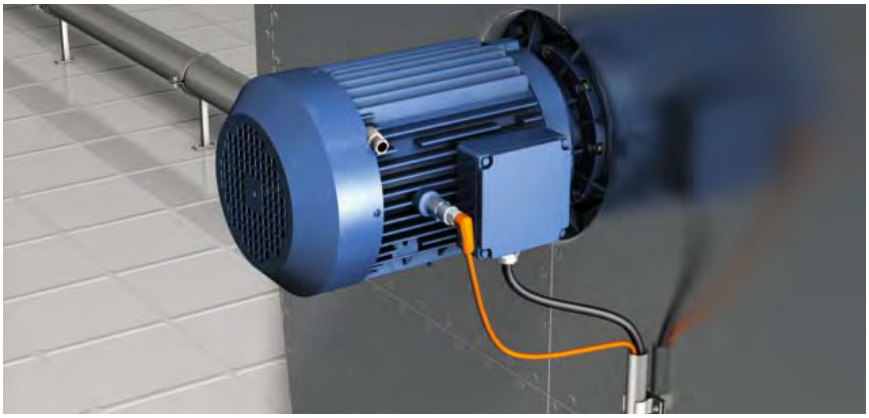
Detect start position for the painting process

Water-soluble clear coats give the painted car bodies their shimmering shine. The O1D102 photoelectric distance sensor detects the start position for the paint process.

PMD distance sensors with time of flight measurement

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...3.5 m	1...50	< 6 x 6	18...30	**O1D102**

Paint supply



Pump monitoring

The paint supply demands a high degree of availability from the pumps. The VSA vibration sensor monitors the function of the pump motor.

Vibration monitoring systems

Type	Description	Order no.
	Accelerometer · for connection to external diagnostic electronics type VSE · Connector · housing: stainless steel 316L / 1.4404	**VSA001**
	Diagnostics electronics for vibration sensors type VSA / VSP · 4 sensor inputs 0...10 mA or IEPE · TCP/IP Ethernet interface · Frequency-selective machine monitoring of up to 4 measuring points · Integrated history memory with real-time clock · Counter function · Combicon connection · PA	**VSE002**

Fan monitoring

Belt breakage check on fans

The spray booths are maintained at a slight positive pressure to keep impurities from the air at bay. If the fan breaks down, quality problems result. The photoelectric sensor scans the fan belt for breakages.

Photoelectric sensors

Type	Operating principle	Range	Type of light	Spot Ø at max. range [mm]	Output H = light-on D = dark-on	Order no.
	Background suppression	50...1800 mm	Red	50	H/D PNP	**O5H500**

Heat production

Temperature measurement in heating channels

Heated air must be provided for the evaporation zones. The temperature evaluation unit continually measures the temperature of the air.
If the temperature falls below a minimum level, it gives an alarm signal.

Evaluation systems for temperature sensors

Type	Measuring range [°C]	Process connection	Display	U_b [V]	Current consumption [mA]	I_{load} [mA]	Order no.
	-40...300	G ½ male	Display unit	18...32	50	250	**TR2432**

Temperature sensors

Type	Measuring range [°C]	Diameter [mm]	Installation length [mm]	Sensor element	Dynamic response T05 / T09 [s]	Order no.
	-40...150	10	160	1 x Pt 1000	1 / 3	**TT1050**

Monitoring of high-speed doors

Door monitoring

Category 4 and SIL 3 fail-safe inductive sensors directly detect the end stop of the high-speed door without contact and without requiring a special counter piece.

Fail-safe inductive sensors

Type	Length [mm]	Enable zone [mm]	Housing material	U_b DC [V]	Protection	Response time in case of a safety request / enable time [ms]	Order no.
	66	10...15 nf	PPE	24	IP 65 / IP 67	≤ 50 / ≤ 200	**GM701S**

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Identification of add-on parts

Identifying appropriate add-on parts

The painted add-on parts must be assigned to the corresponding body. The multi-code reader detects the codes on the build-tickets.
This prevents incorrect assembly of add-on parts.

Multicode reader

Type	Dimensions [mm]	Max. field of view size [mm]	Type of light LED	Motion speed int. / ext. lighting [m/s]	Process interface	Order no.
	60 x 42 x 59	400 x 300	red light	3 / 5	Ethernet TCP/IP, EtherNet/IP, RS-232	**O2I104**

Skid identification

Determining the whereabouts of skids

The painted car bodies travel through the final inspection on skids, to the high stack storage. At any time, the RFID system can determine the whereabouts of the skids in each of the zones.

RFID systems for reading codes on metal

Type	Description	Order no.
	RFID UHF antenna · Housing materials: housing: aluminium / cover: plastics / TNC socket: brass / PTFE · Operating frequency 902...928 (FCC) MHz	**ANT930**

ID tag

Type	Description	Order no.
	ID tag · ID-TAG/D55x13/04 · Ø 55 x 13 mm · Housing materials: PA 6	**E80351**

Occupation of storage location

Optically detecting whether a compartment is occupied

After the paint process, the bodies are stored temporarily.
Using the prismatic reflector, the retro-reflective sensor with polarisation filter on the transport lift can detect whether a compartment is occupied or not.

Photoelectric sensors

Type	Operating principle	Range	Type of light	Spot Ø at max. range [mm]	Output H = light-on D = dark-on	Order no.
	Polarisation filter	0.075...10 m	Red	250	H/D PNP	**O5P500**

Accessories

Type	Description	Order no.
	Prismatic reflector · Ø 80 mm · round · For red light and infrared light retro-reflective sensors · Housing materials: plastics	**E20005**

Position feedback

Detecting travel lengths and positions of the storage and retrieval machine

The car body lift moves parallel to the high-stack storage.

The IMC series inductive sensors detect the cam switches for the positioning and braking of the stacker crane.

Inductive sensors

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	40 x 40 x 54	20 f	PA (polyamide)	10...36	IP 67	100	200	**IM5123**

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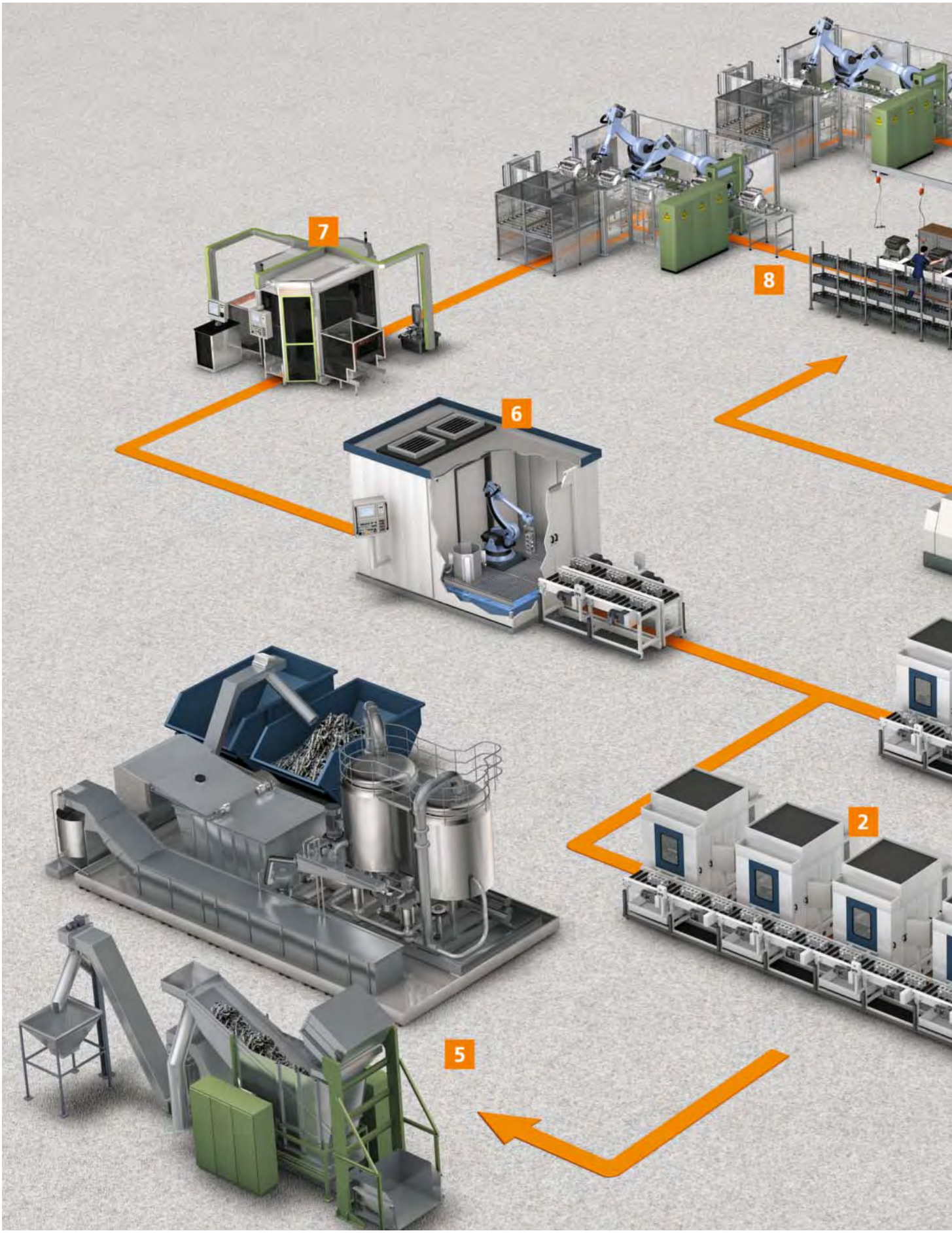
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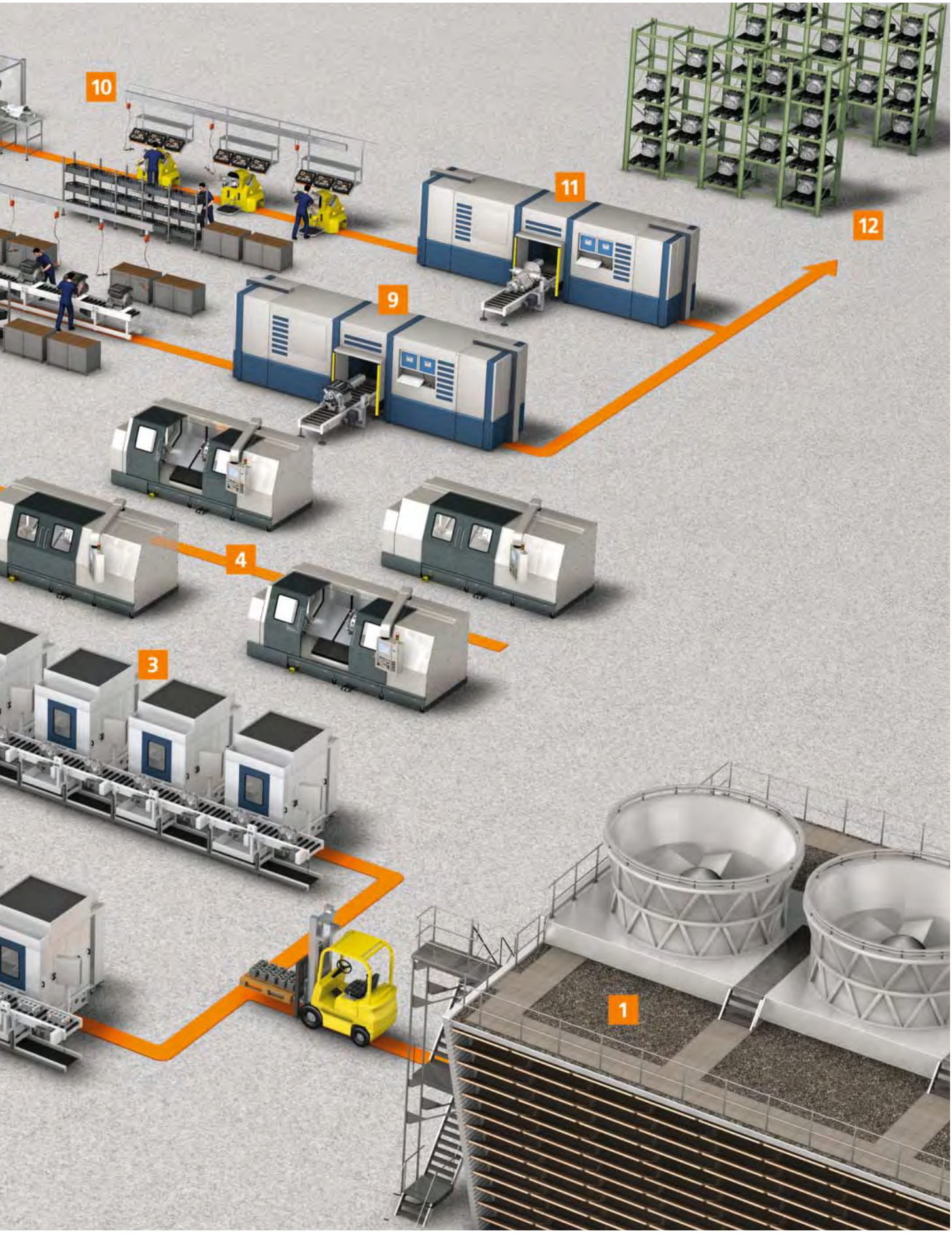
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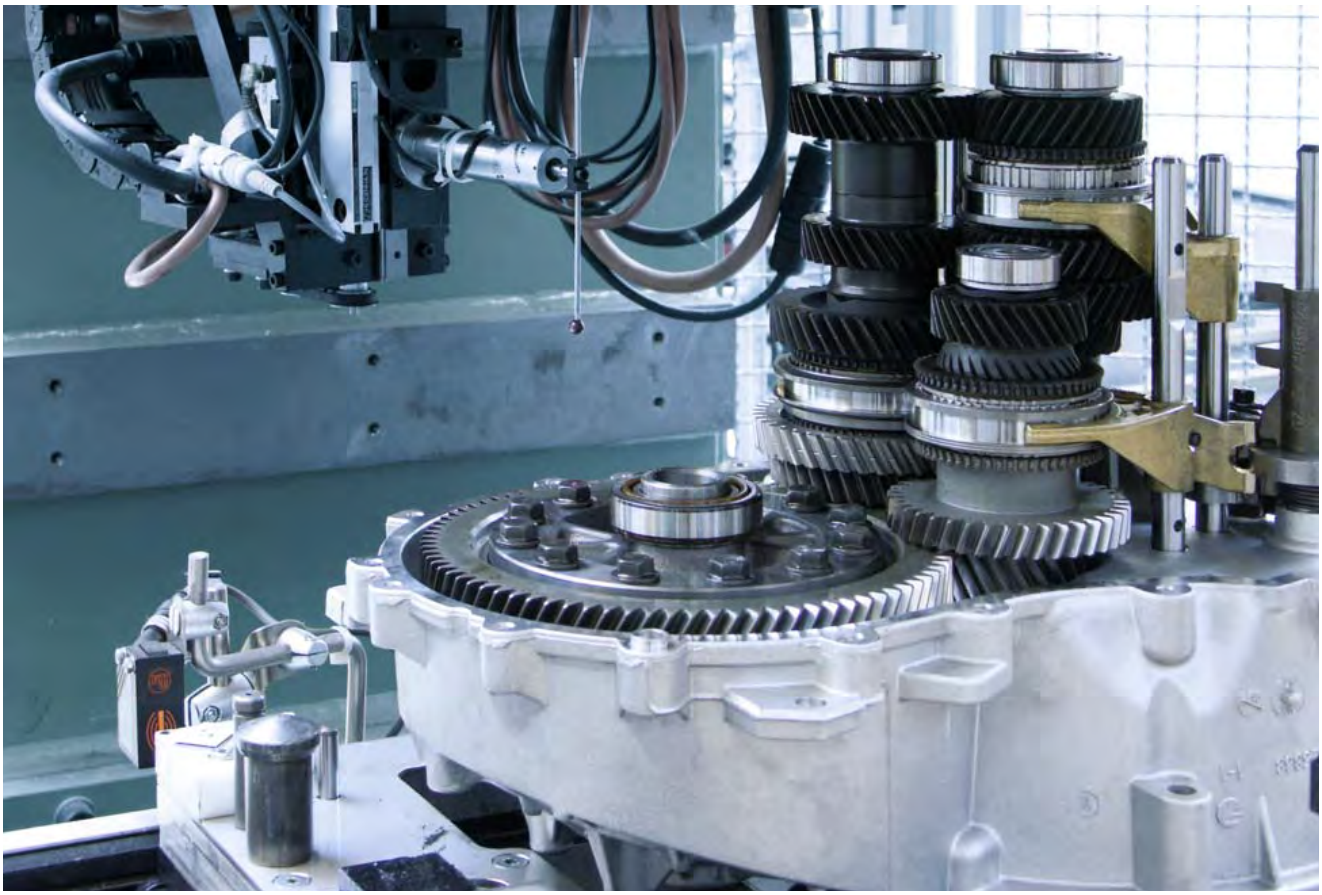
Machine	Application	Product group
1	**Foundry**	
	Flow rate measurement	Flow sensors / flow meters
	Position detection	Inductive sensors
	Part detection	Laser sensors / distance measurement sensors
	Securing the area	Safety light grids
2	**Mechanical processing 1 (Engine / Gearbox)**	
	Measurement of compressed air consumption	Flow sensors / flow meters
	Pressure measurement	Pressure sensors
	Part seat monitoring	Pressure sensors
	Position detection	Inductive sensors
3	**Mechanical processing 2 (Engine / Gearbox)**	
	Internal cooling of drill	Flow sensors / flow meters
	Spindle monitoring	Vibration monitoring systems
	Level detection	Level sensors
	Filter monitoring	Pressure sensors
4	**Component manufacture**	
	Quality assurance	Vision sensors
	Identification	1D/2D code readers
	Flow monitoring	Flow sensors / flow meters
	Part detection	Photoelectric sensors for general applications
5	**Coolant preparation / swarf disposal**	
	Differential pressure measurement	Pressure sensors
	Leakage detection	Level sensors
	Swarf hopper monitoring	Laser sensors / distance measurement sensors
6	**Washing and cleaning parts**	
	Limit level detection	Level sensors
	Position detection	Inductive sensors
	Temperature measurement	Temperature sensors
	Leakage detection	Level sensors

Machine	Application	Product group
7	**Leak test**	
	Position detection	Inductive sensors
	Leakage detection	Pressure sensors
	Detecting assemblies	Vision sensors
	Part detection	Photoelectric sensors for general applications
8	**Engine assembly**	
	Position detection	Inductive sensors
	Measurement of compressed air consumption	Flow sensors / flow meters
	Part detection	Photoelectric sensors for general applications
	Signal transmission	AS-Interface I/O modules
9	**Engine test rig**	
	Cooling on test rigs	Flow sensors / flow meters
	Pressure measurement	Pressure sensors
	Vibration monitoring	Vibration monitoring systems
	Detecting the stop	Cylinder sensors
10	**Gearbox assembly**	
	Quality assurance	Vision sensors
	Identification of parts	RFID 125 kHz
	Position detection	Inductive sensors
	Part detection	Photoelectric sensors for general applications
11	**Gearbox test rig**	
	Detecting the stop	Cylinder sensors
	Finger protection	Safety light curtains
	Vibration monitoring	Vibration monitoring systems
	Position detection	Laser sensors / distance measurement sensors
12	**Delivery / storage**	
	Identification	1D/2D code readers
	Type detection	Vision sensors
	Position detection	Inductive sensors

Manufacturing precision increases customer satisfaction



The combination of engine and gearbox, also called the powertrain, forms the heart of the drive unit.

The basic components such as crankcase, cylinder head or gearbox housing are made in the foundry. These components are then finished by mechanical processing. In many work steps, gear wheels and shafts are processed and then assembled into gearboxes. In engine production, powerful petrol, diesel or hybrid drives are created out of the mosaic of crankshaft, camshafts, connecting rods and many other parts and sub-assemblies.

Here, sensors from ifm – with their high standards of repeatability and switch point stability – help the operator ensure the consistently high quality standards in series production.

Foundry - coolant monitoring

Drawing water from deep wells

Melt furnaces and casting moulds must be cooled. Water is drawn from deep wells for this purpose.
The SM2000 volumetric flow sensor detects whether air is sucked up with it, thus helping to avoid damage to the equipment.

Flow rate measurement

Type	Process connection	Measuring range [l/min]	Medium temperature [°C]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	G2 flat seal	8...600	-10...70	16	< 0.35	18...32	**SM2000**

Foundry - casting moulds

Preparation of casting moulds

The casting moulds are united automatically. O1D photoelectric sensors detect the casting moulds for the control system.

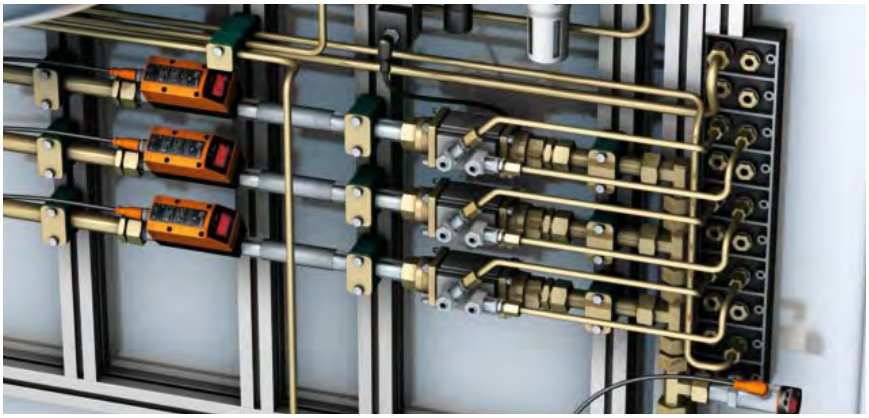
PMD distance sensors with time of flight measurement

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...10 m	1...50	< 15 x 15	18...30	**O1D100**

Safety light grids

Type	Sensor length [mm]	Resolution / detection capacity [mm]	Protected area height [mm]	Protected area width [m]	Response time [ms]	U_b [V]	Order no.
	1053	–	910	0...4 / 3...12	3	24	**OY116S**

Dry processing for chip removal machining



Blowing out drill holes

SD6000 series compressed air meters detect a defined air volume for blowing out drill holes.
The PN5004 pressure sensor monitors the required minimum pressure.

Compressed air meters determine the actual consumption

Type	Process connection	Setting range [Nm³/h]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	R½ (DN15)	0.6...75.0	16	< 0.1	18...30	**SD6000**

Pressure sensors

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ female	Display unit	-1...10	75	150	18...36	**PN5004**

System solution: Part seat monitoring of workpieces

Part seat monitoring

The workpieces to be processed must lie flat on the workpiece carrier to ensure dimensional accuracy. The PS7 control unit detects any contamination due to swarf or abrasion.

Control unit for part seat monitoring

Type	Description	Order no.
	Control unit for part seat monitoring · Setting by adjustment of the pneumatic bridge · Integrated pressure sensor with 2 switching outputs · and 4-digit alphanumerical display for trend display or display of current pressure · Cable	**PS7570**

Position and part detection in machine tools

Full-metal sensors for application in oils and coolants

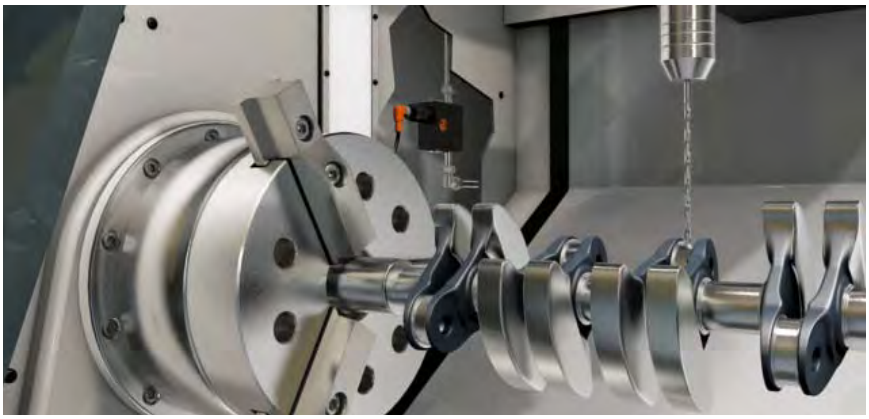
Modern engines and gearboxes are, to a large extent, manufactured from aluminium alloys.
Full-metal inductive sensors with correction factor K = 0 are unaffected by aluminium swarf.

Full-metal inductive sensors with correction factor K = 0

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	M18 / L = 70	4.5 f	High-grade st. steel	10...36	IP 68	100	100	**IGC249**

f = flush / nf = non flush

Flow check for internal cooling of drill



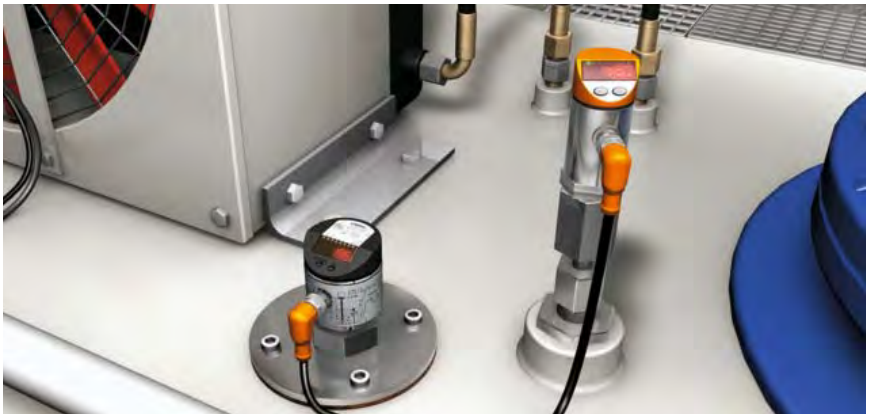
Extending the holding times

Continuous cooling of the drill is essential if not much coolant is being used or if the drill holes are long.
The mechatronic flow sensor is able to detect extremely quickly if the amount of coolant is no longer sufficient.

Flow transmitters with non-return valve

Type	Process connection	Measuring range [l/min]	Medium temperature [°C]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	G ½	0.3...25	0...60	200	< 0.01	24	**SBU623**
	G ½	0.3...50	0...60	200	< 0.01	24	**SBU624**

Hydraulic aggregates



Monitoring of power packs

LR and TR series sensors detect the level and temperature in the hydraulic units.

Temperature sensors

Type	Measuring range [°C]	Process connection	Display	U_b [V]	Current consumption [mA]	I_{load} [mA]	Order no.
	-40...300	G ½ male	Display unit	18...32	50	250	**TR7432**

Level sensors with guided wave radar

Type	Process connection	Probe length [mm]	Active zone [mm]	Inactive zone [mm]	U_b [V]	Medium temperature [°C]	I_{load} [mA]	Order no.
	G ¾ male	–	L-40 (L-60)	30 / 10 (30)	18...30	0...80	200	**LR7000**

Filter monitoring

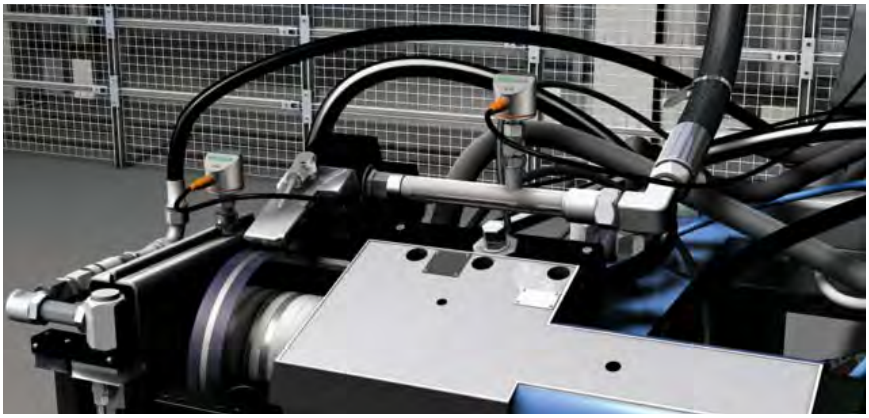
Differential pressure monitoring

PNI-type electronic pressure sensors with an analogue input evaluate the pressure difference in filter elements in combination with PA-type transmitters.

Differential pressure measurement with PNI and PA

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ female	Display unit	0...25	100	350	18...30	**PNI023**

Camshaft manufacture



Grinding camshafts

The surface quality produced here is extremely important for the quality of the shafts.
To ensure the quality, the grinding emulsion must be applied constantly.

Flow sensors

Type	Setting range liquids / gases [cm/s]	Material sensor tip	Medium temperature [°C]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	3...300 / 200...3000	3...100 / 200...800	-25...80	30	1...10	19...36	**SI5000**

Crankshaft manufacture

Identifying crankshafts

To ensure traceability, the crankshafts are coded with data such as production date and batch information.
This information is then read and verified by the O2I code reader.

Multi-code reader for identifying codes

Type	Dimensions [mm]	Max. field of view size [mm]	Type of light LED	Motion speed int. / ext. lighting [m/s]	Process interface	Order no.
	60 x 42 x 53.5	132 x 94	red light	3 / 5	Ethernet TCP/IP, EtherNet/IP, RS-232	**O2I102**

Connectors

Type	Description	Order no.
	Jumper · straight / straight · Ethernet · Cross-over patch cable · 2 m · Housing materials: PUR / PC	**E11898**

Lubricant preparation

Leakage detection to section 19 of the German Federal Water Act

The LI214x binary level sensor reliably monitors whether coolant is leaking from any pipes and tanks and collecting in the gutter.
In this case, an alarm is triggered immediately.

Level sensors (to section 19 of the German Federal Water Act WHG)

Type	Probe length [mm]	Output	U_b [V]	Medium temperature water [°C]	Medium temperature oil [°C]	I_{load} [mA]	Order no.
	132	Normally closed	10...36	0...35	0...65	200	**LI2141**

Swarf disposal

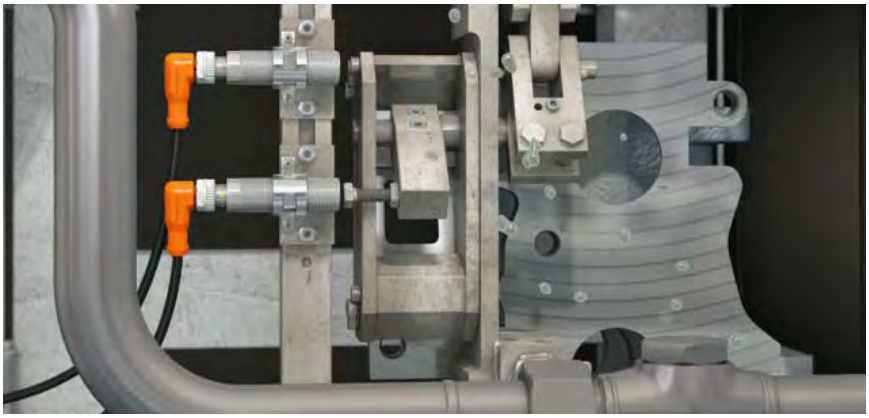
"Full" detection for swarf hoppers

The O1D photoelectric sensor uses the analogue output to the controller to detect the level in the swarf hopper. Both long swarf and short-chipping swarf are detected.

PMD photoelectric sensors for detecting the loading condition

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...10 m	1...33	< 15 x 15	18...30	**O1D105**
	Photoelectric distance sensor	0.3...6 m	1...33	< 8 x 8	18...30	**O1D155**

Cleaning parts



Full-metal inductive sensors with extended temperature range

Components and assemblies must be cleaned after various manufacturing operations. The ifm sensors can withstand ambient temperatures of up to 100 °C.

Full-metal inductive sensors for wet areas

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	M18 / L = 70	5 f	High-grade st. steel	10...36	IP 68 / IP 69K	100	100	**IGT247**
	M18 / L = 70	12 nf	High-grade st. steel	10...36	IP 65 / IP 67 / IP 68 / IP 69K	500	100	**IGT249**

f = flush / nf = non flush

Industrial cleaning equipment

Determining limit levels

The LMT100 limit level sensor has many applications in industrial cleaning systems.
Applications such as detecting levels in flood tanks, oil separators, working tanks and use as a probe to warn of leakages.

Sensors for point level detection

Type	Process connection	Process pressure max. [bar]	Application	Protection	Order no.
	G ½ male	-1...40	liquid, viscous and powdery media	IP 68 / IP 69K	**LMT100**

Leak test

Leak test on components and assemblies

In automated test stations, the test pieces are placed under pressure using compressed air.
Depending on the rate of leakage, the pressure loss must not exceed the tight tolerances.

Inductive sensors for position control

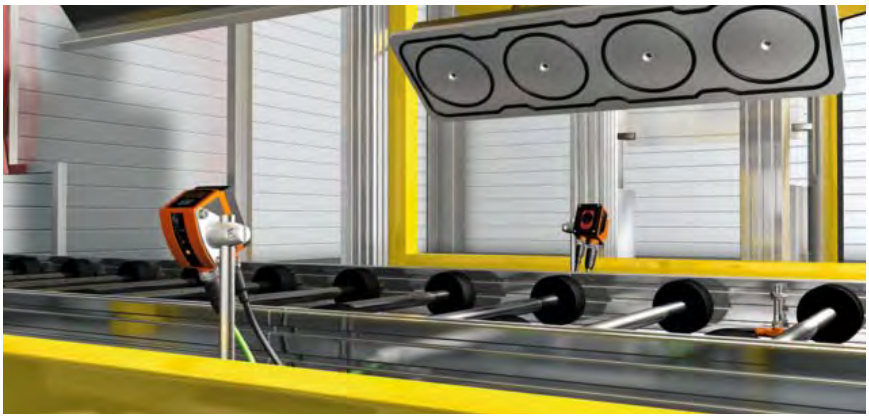
Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	M12 / L = 60	4 f	Brass	10...30	IP 68	700	200	**IFC229**

f = flush / nf = non flush

Pressure sensors

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ female	Display unit	-1...10	75	150	18...36	**PN7004**

Leakage test station



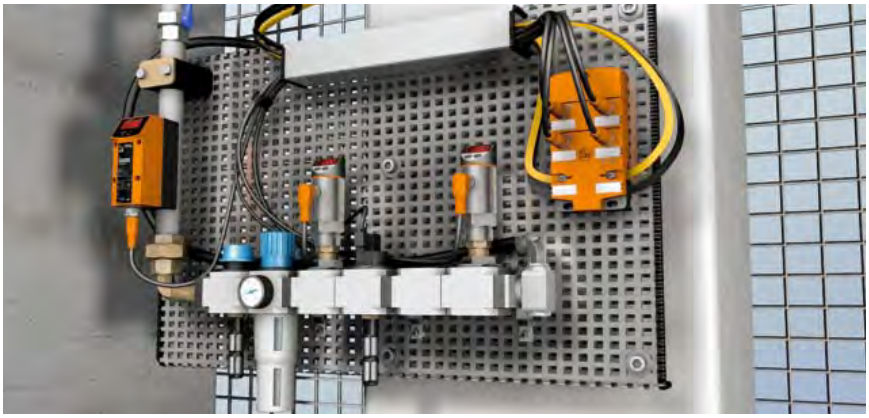
Leak test on components and assemblies

Object detection sensors tell the automated test stations whether the system has been set up correctly for the item being tested.

Vision sensors

Type	Operating principle	Max. field of view size [mm]	Resolution [mm]	Detection rate [Hz]	Type of light	Ambient temperature [°C]	Order no.
	CMOS image sensor B/W, VGA resolution 640 x 480	400 x 300	0.633	10	Infrared	-10...60	**O2D224**

Pneumatic maintenance unit



Flow meters for compressed air

The SD volumetric flow sensor continuously monitors the compressed air consumption of the consumers connected to the maintenance unit. The impulse signals per volume unit are forwarded via the AS-i CompactLine module to the control system.

Compressed air meter for the measurement of compressed air consumption

Type	Process connection	Setting range [Nm³/h]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	R½ (DN15)	0.6...75.0	16	< 0.1	18...30	**SD6000**

CompactLine: AS-i modules for field applications

Type	Description	Order no.
	Active CompactLine module · IR addressing possible · Version 2.11 and 3.0 with extended addressing mode · Digital inputs · Sockets M12 x 1 · PA / socket: Brass nickel-plated / threaded inserts in the lower part: Brass nickel-plated / O-Ring : Viton / Piercing contacts: CuSn6 surface nickel and tin-plated	**AC2457**

Screw stations

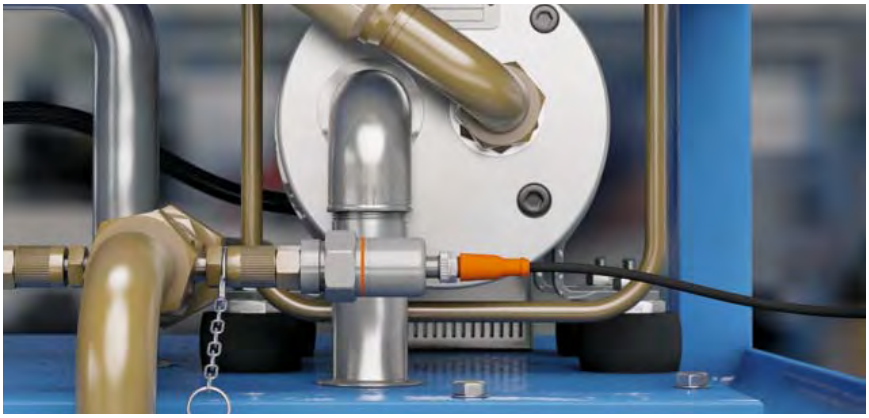
Photoelectric fork sensors in feed equipment

The vibration conveyors are used, for example, to deliver screws to the assembly stations. The OPU photoelectric fork sensor checks the presence of the screws.

Photoelectric sensors

Type	Fork width (w) [mm]	Fork depth (d) [mm]	Smallest detectable object Ø [mm]	Switching frequency [Hz]	Output H = light-on D = dark-on	U_b [V]	Order no.
	50	55	0.5	4000	H/D PNP	10...35	**OPU203**

Fuel supply in engine test rigs



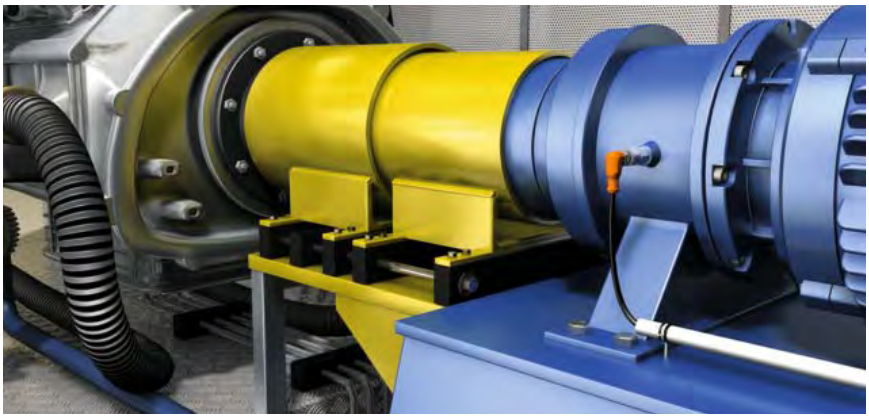
Pressure sensors resist extreme pressure peaks

On the engine test rigs, extreme operating conditions are simulated in the "Hot test". During the test, extreme pressure peaks in the fuel supply are a frequent occurrence.

Pressure transmitter with analogue output

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ¼ female	–	0...100	300	650	16...32	**PA9022**

Vibration monitoring in engine test rigs



Protecting the braking motor

Due to the engine being tested, the induction motor is sometimes exposed to extreme vibration loading. If the values are too extreme, the load is reduced.

Vibration monitoring systems

Type	Description	Order no.
	Accelerometer · for connection to external diagnostic electronics type VSE · Connector · housing: stainless steel 316L / 1.4404	**VSA001**
	Diagnostics electronics for vibration sensors type VSA / VSP · 4 sensor inputs 0...10 mA or IEPE · TCP/IP Ethernet interface · Frequency-selective machine monitoring of up to 4 measuring points · Integrated history memory with real-time clock · Counter function · Combicon connection · PA	**VSE002**

Quality assurance in driveshaft manufacture

Checking the assembly

In the manufacture of drive shafts, the object detection sensor checks whether a needle bearing has been assembled, whether it is the correct bearing and whether it has been correctly assembled.

Sensors for object recognition

Type	Operating principle	Max. field of view size [mm]	Resolution [mm]	Detection rate [Hz]	Type of light	Ambient temperature [°C]	Order no.
	CMOS image sensor B/W, VGA resolution 640 x 480	1320 x 945	2.0	10	Infrared	-10...60	**O2D222**

Illumination

Type	Operating principle	Max. field of view size [mm]	Resolution [mm]	Detection rate [Hz]	Type of light	Ambient temperature [°C]	Order no.
	–	100 x 100	–	10	Infrared	0...50	**O2D905**

RFID in the gearbox assembly shop

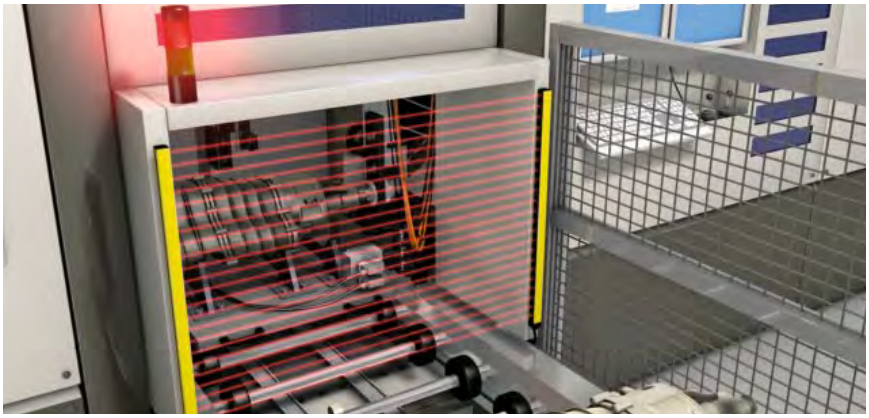
Identifying the part carriers

Thanks to RFID technology, the current work step of the gearbox is always known.

RFID systems with AS interface

Type	Description	Order no.
	Read/write head · With integrated AS-i slave profile 7.4 · M12 connector · Housing materials: housing: PPE / Metal parts: diecast zinc / brass nickel-plated	**DTA300**

Automated loading of gearbox test rig



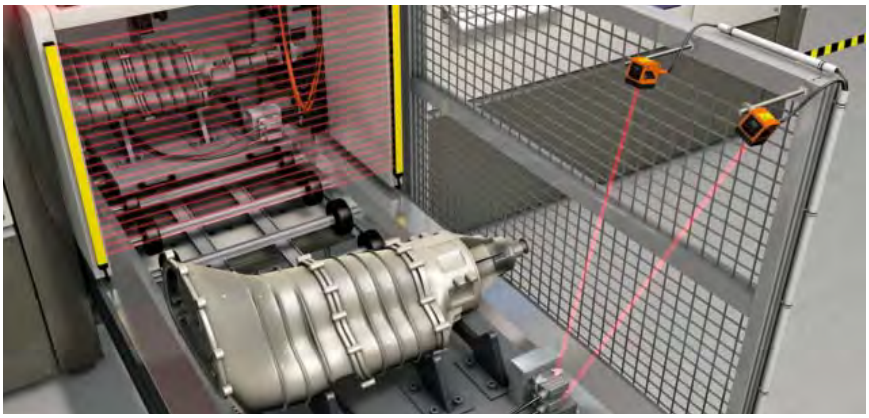
Test rig access restriction

For operator protection, OY series safety light curtains restrict unauthorised access to accessible areas such as the loading zones. The safety light curtains correspond to Type 4, in accordance with EN 61496.

Safety light curtains for access prevention

Type	Sensor length [mm]	Resolution / detection capacity [mm]	Protected area height [mm]	Protected area width [m]	Response time [ms]	U_b [V]	Order no.
	1263	14	1210	0...3 / 1...6	16.5	24	**OY008S**

Workpiece carriers in the gearbox test rig



Locking the workpiece carrier and detecting connectors

On the workpiece carriers, it must be detected whether the connectors have been connected in the correct positions.
During the test run, the gearbox is held in place using locking bolts.

PMD distance sensors with time of flight measurement

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...10 m	1...50	< 15 x 15	18...30	**O1D100**

Inductive cylinder sensors for stroke detection on locking cylinders

Type	Dimensions [mm]	Material	U_b [V]	f [Hz]	Protection	I_{load} [mA]	T_a [°C]	Order no.
	25 x 5 x 6.5	PA (polyamide)	10...30	10000	IP 65 / IP 67	100	-25...85	**MK5107**

Provision of engine and transmission

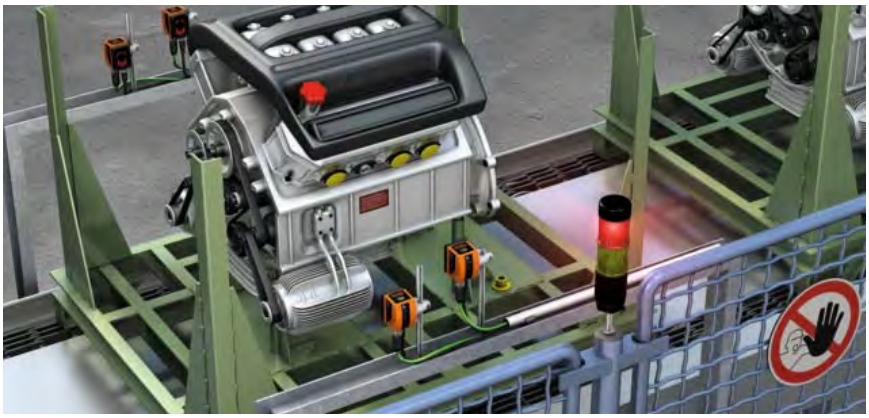
Identification of engine and transmission

Engine and gearbox variants must also be safely assigned for further use, in consideration of country-specific versions.

Multi-code reader for identifying codes

Type	Dimensions [mm]	Max. field of view size [mm]	Type of light LED	Motion speed int. / ext. lighting [m/s]	Process interface	Order no.
	60 x 42 x 53.5	64 x 48	red light	3 / 5	Ethernet TCP/IP, EtherNet/IP, RS-232	**O2I100**

Shipping of engine and transmission

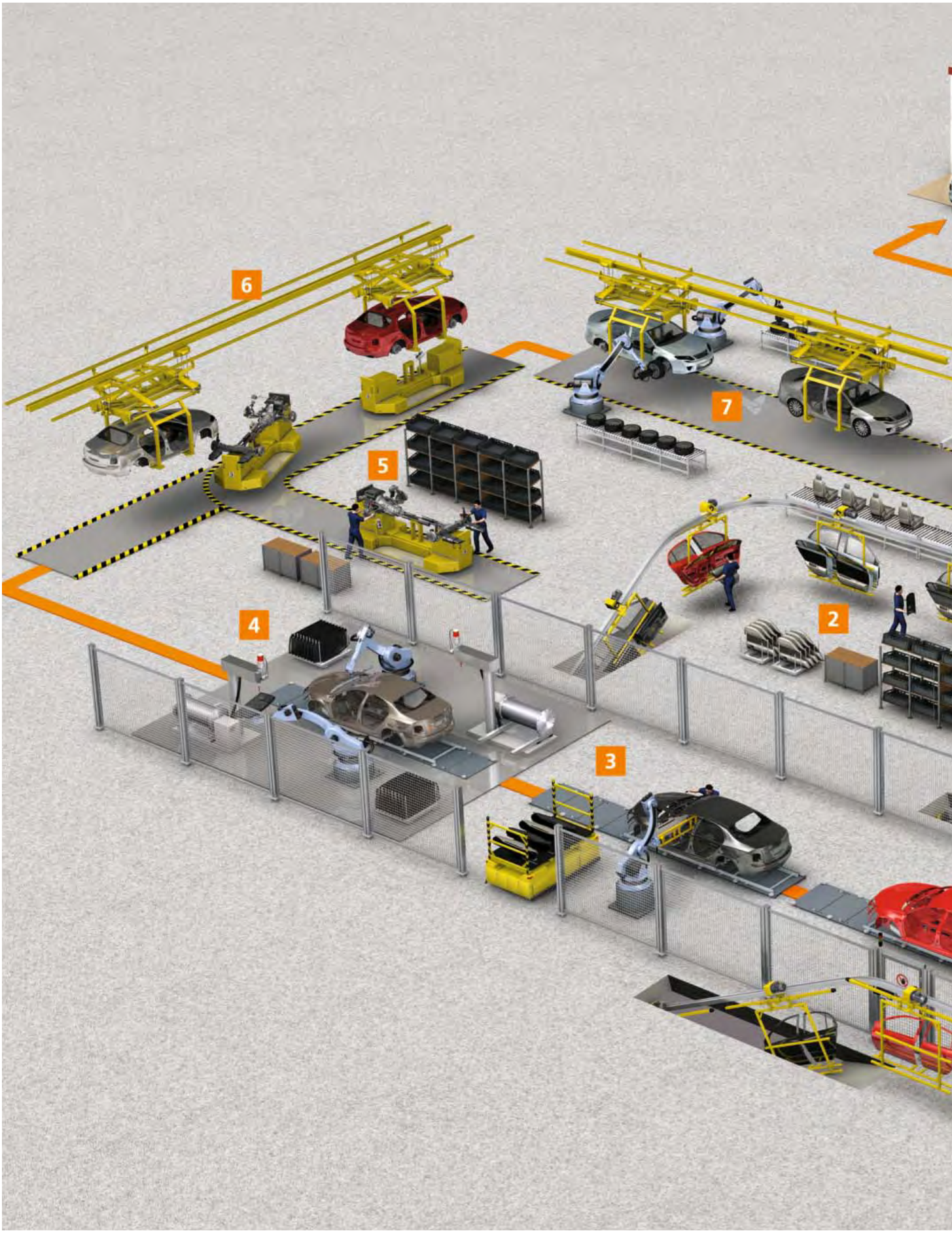


Engine and transmission completeness check

Engine and gearbox variants differ from each other in many ways for country-specific versions.
Before shipping to the assembly plant, the presence of, for example, stoppers, ID marks and similar are checked.

Vision sensors for checking tasks

Type	Operating principle	Max. field of view size [mm]	Resolution [mm]	Detection rate [Hz]	Type of light	Ambient temperature [°C]	Order no.
	CMOS image sensor B/W, VGA resolution 640 x 480	640 x 480	1.0	10	Infrared	-10...60	**O2D220**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Machine	Application	Product group
1	**Disassembling the doors**	
	Identification	1D/2D code readers
	Position detection	Inductive sensors
	Collision protection	Laser sensors / distance measurement sensors
2	**Assembly of door module**	
	Identification	1D/2D code readers
	Part detection	Capacitive sensors
	"Compartment occupied" detection	Photoelectric sensors for general applications
	Position detection	Inductive sensors
3	**Dashboard installation**	
	Optical detection	Photoelectric sensors for general applications
	Positioning	Vision sensors
	Collision protection	Laser sensors / distance measurement sensors
	Position detection	Inductive sensors
4	**Windscreen assembly**	
	Positioning	Photoelectric sensors for general applications
	Door protection	Fail-safe inductive sensors
	Positioning	Photoelectric fork sensors / angle sensors
	Vacuum detection on suction grippers	Pressure sensors
5	**Chassis / driveline assembly**	
	Quality assurance	Vision sensors
	Release for work step	Capacitive sensors
	Optical detection	Photoelectric sensors for general applications
	Position detection	Inductive sensors
6	**Marriage**	
	Position detection	Inductive sensors
	Identification	RFID UHF
	Collision protection	Laser sensors / distance measurement sensors
	Part detection	Vision sensors

Machine	Application	Product group
7	**Wheel assembly**	
	Position detection	Photoelectric sensors for general applications
	Pattern recognition	Vision sensors
	Part detection	Inductive sensors
	Part detection	Photoelectric sensors for general applications
8	**Seat assembly**	
	Identification	RFID 13.56 MHz
	Vacuum detection on suction grippers	Pressure sensors
	Parts check	Capacitive sensors
	Optical detection	Photoelectric sensors for general applications
9	**Reassembling the doors**	
	Identification	1D/2D code readers
	Position detection	Inductive sensors
	Collision protection	Laser sensors / distance measurement sensors
	Optical detection	Photoelectric sensors for general applications
10	**Filling**	
	Limit level detection	Level sensors
	Level measurement	Flow sensors / flow meters
	Collision protection	Laser sensors / distance measurement sensors
	Position detection	Inductive sensors
11	**Function test**	
	Position detection	Inductive sensors
	Flow monitoring	Flow sensors / flow meters
	Vibration monitoring	Vibration monitoring systems
	Temperature measurement	Temperature sensors
12	**Rain test / final inspection**	
	Position detection	Inductive sensors
	Flow rate measurement	Flow sensors / flow meters
	Pressure measurement on pumps	Pressure sensors

The jigsaw becomes a car

Piece by piece, the complete vehicle is formed from many individual components.

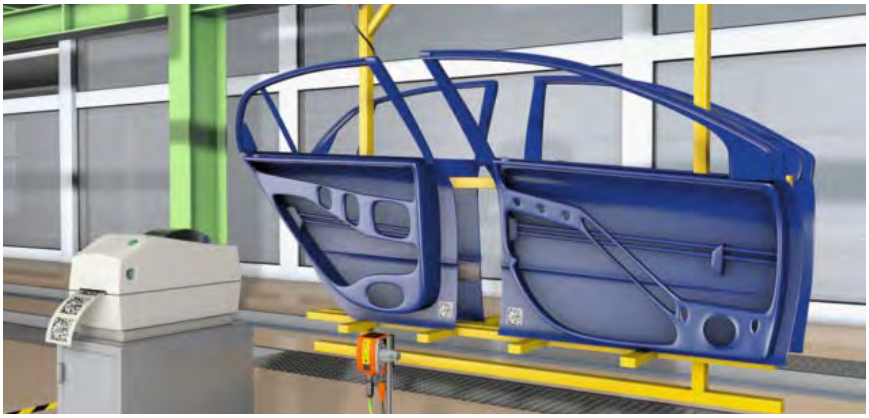
Countless bolts fix the assemblies in their places. Clips hold carpets and the interior trim in place. Kilometres of cables and wiring form the vehicle's nervous system. The tyres and wheel rims are often used to further individualise the wheels.

Customer-specific equipment options make the car more interesting but represent huge logistical challenges. Here it is absolutely essential to assign the parts and components according to the equipment options desired by the customer.

In the end, it is the assembly which determines the success of the transformation of jigsaw pieces into high-quality product.

Here, ifm is able to provide well-proven sensors for the diverse requirements of assembly processes. Our many years of experience also enable us to develop sensors and systems for the assembly tasks of the future, and provide them to the user.

Disassembling the doors



Identifying the appropriate doors

The doors are removed from the car body and forwarded to the door module assembly area. The O2I multi-code reader checks the codes on the doors and / or the build-tickets. This avoids incorrect assignment to the vehicles later on.

Multi-code reader for identifying doors

Type	Dimensions [mm]	Max. field of view size [mm]	Type of light LED	Motion speed int. / ext. lighting [m/s]	Process interface	Order no.
	60 x 42 x 53.5	64 x 48	red light	3 / 5	Ethernet TCP/IP, EtherNet/IP, RS-232	**O2I100**

Transport to door module assembly

Travelling doors

The doors are transported for further processing via the overhead electric monorail conveyor. IMC series inductive sensors detect the position of the hangers.
Photoelectric distance sensors are responsible for preventing collisions.

Inductive sensors for determining position

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	40 x 40 x 54	35 nf	PA (polyamide)	10...36	IP 67	80	200	**IM5116**

f = flush / nf = non flush

Photoelectric sensors for approach check

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.3...6 m	1...33	< 8 x 8	18...30	**O1D155**

Detecting add-on parts for door modules

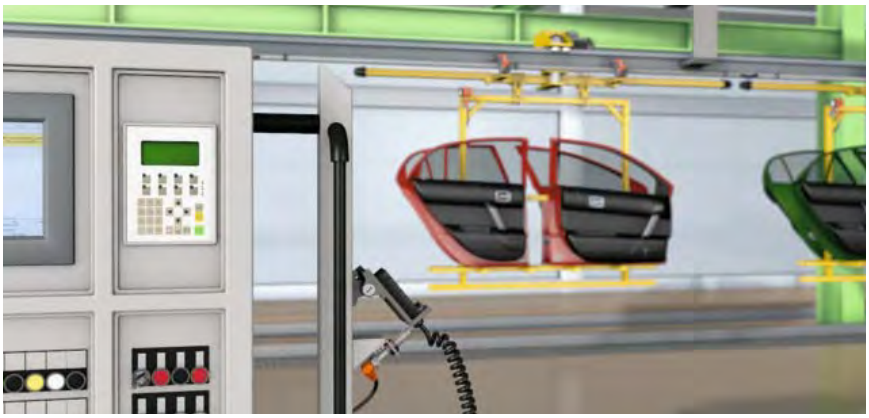
Identifying appropriate add-on parts

The painted components, e.g. wing mirrors, must be assigned to the appropriate car body.
The multi-code reader detects the codes on the build-tickets. This prevents incorrect assembly of add-on parts.

Multi-code reader identification of add-on parts

Type	Dimensions [mm]	Max. field of view size [mm]	Type of light LED	Motion speed int. / ext. lighting [m/s]	Process interface	Order no.
	60 x 42 x 53.5	64 x 48	red light	3 / 5	Ethernet TCP/IP, EtherNet/IP, RS-232	**O2I100**

Function check of electrical equipment



Check connector position for diagnostics

After the assembly of mirrors, locks and window lifts, the electrical function is checked using a diagnostics connector device. The KF5002 capacitive sensor detects whether the diagnostics connector device is still connected after the test and releases the next production step.

Capacitative sensors for determining position

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	M12 / L = 61	8 nf	High-grade st. steel	10...36	IP 65	50	100	**KF5002**

f = flush / nf = non flush

Dashboard removal

Removing instrument panels without collisions

During the gripping operation, the distance sensors measure the distance to the instrument panel. If the distance falls below the value previously stored in the robot's program, the gripping robot reduces its speed to avoid a collision.

Collision monitoring with time of flight sensors

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...3.5 m	1...50	< 6 x 6	18...30	**O1D102**

Dashboard installation

Positioning the instrument panels

The O2V object detection sensors recognise a characteristic form in the car body. The sensors detect the position during the approach, and give correction data to the robot control if necessary.

Vision sensors for controlling installation

Type	Operating principle	Max. field of view size [mm]	Resolution [mm]	Detection rate [Hz]	Type of light	Ambient temperature [°C]	Order no.
	CMOS image sensor B/W, VGA resolution 640 x 480	1320 x 945	2.0	10	White light	-10...60	**O2V102**

Door protection in transfer areas

Closed check on transfer stations

Category 4 / SIL 3 fail-safe inductive sensors directly detect the safe position of high-speed doors without contact and without requiring a special counter piece.

Inductive safety sensor for monitoring high-speed doors

Type	Length [mm]	Enable zone [mm]	Housing material	U_b DC [V]	Protection	Response time in case of a safety request / enable time [ms]	Order no.
	66	10...15 nf	PPE	24	IP 65 / IP 67	≤ 50 / ≤ 200	**GM701S**
	66	4...20 nf	PPE	24	IP 65 / IP 67	≤ 50 / ≤ 200	**GM705S**

f = flush / nf = non flush

Pressure monitoring on suction grippers for windscreen assembly

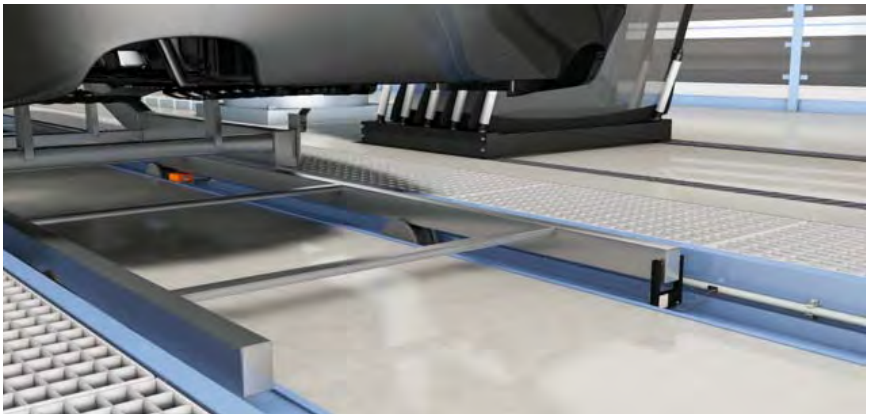
Pressure measurement on suction grippers

The vacuum sensors detect whether there is sufficient vacuum present for a safe gripping operation.

Vacuum pressure sensor for measuring the vacuum on a suction gripper

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G 1/8 female	Display unit	-1...1	20	30	18...32	**PQ7809**

Positioning the car body



Fine positioning of the car body

The IDC inductive sensor detects the presence of the car body before the defined position. The motion slows down until the OPU photoelectric fork sensor signals that the exact position has been reached.

IDC series inductive sensors for position detection

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	92 x 80 x 40	50 f	PPE	10...36	IP 67	70	250	**ID5058**

f = flush / nf = non flush

Photoelectric fork sensors for determining the exact position

Type	Fork width (w) [mm]	Fork depth (d) [mm]	Smallest detectable object Ø [mm]	Switching frequency [Hz]	Output H = light-on D = dark-on	U_b [V]	Order no.
	120	60	0.8	2000	H/D PNP	10...35	**OPU205**

Robot guidance for windscreen assembly

Light scanner for positioning the grippers

The windscreens are removed by grippers. Four O5H series reflection light scanners are used to precisely position the gripper. The windscreen is held in place precisely and without stress.

Photoelectric sensors for gripper positioning

Type	Operating principle	Range	Type of light	Spot Ø at max. range [mm]	Output H = light-on D = dark-on	Order no.
	Background suppression	50...1800 mm	Red	50	H/D PNP	**O5H500**

Quality assurance in the suspension assembly

Position check of brake discs

The ifm vision sensors monitor the exact position of the brake discs. The next assembly step will only be released if their position is correct.
This saves subsequent costs, which used to be incurred due to the rectification work required for incorrectly assembled brake discs.

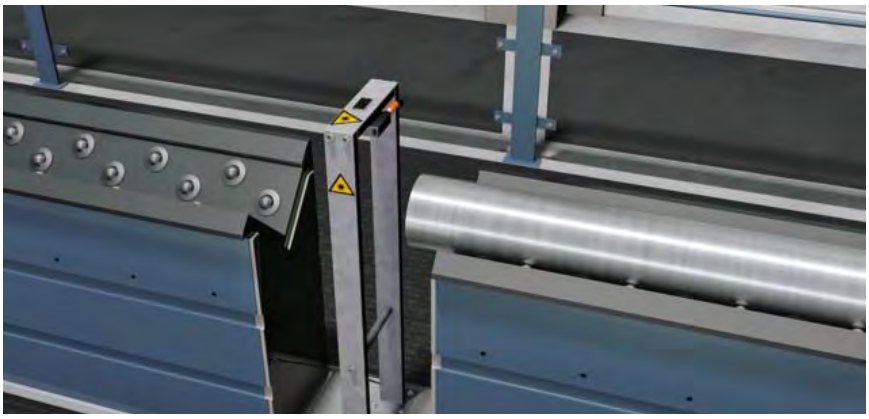
Vision sensors for position detection

Type	Operating principle	Max. field of view size [mm]	Resolution [mm]	Detection rate [Hz]	Type of light	Ambient temperature [°C]	Order no.
	CMOS image sensor B/W, VGA resolution 640 x 480	1320 x 945	2.0	10	Infrared	-10...60	**O2D222**

Touch sensor

Type	U_b [V]	I_{load} [mA]	Current consumption [mA]	Ambient temperature [°C]	Protection	Order no.
	24	200	30	-40...85	IP 67 / IP 69K	**KT5002**

Manufacture of exhaust systems



Cutting pipes for exhaust systems to length

In an automatic saw, the pipes are cut to the appropriate length corresponding to that stored in the program. The OJ reflection light scanner is used to determine the start position for the length measurement, using an absolute shaft encoder.

Laser reflection light scanner for determining the start position

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Background suppression	15...200 mm	–	2x1	10...30	**OJ5152**

Collision protection in the assembly area

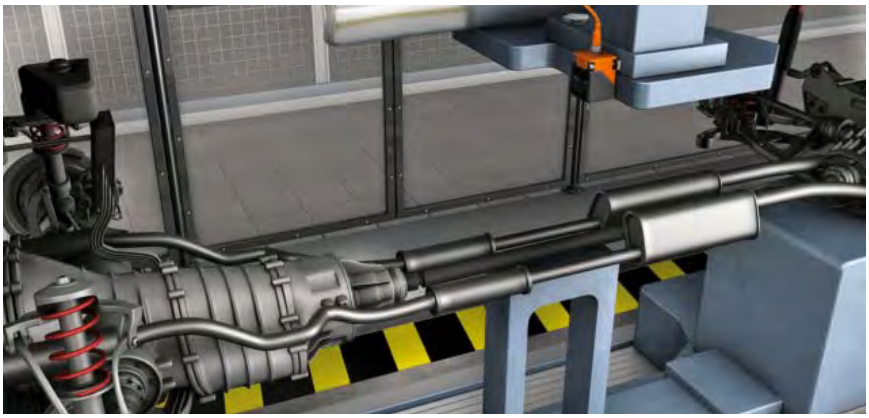
Detecting when the assembly platform is free

Here, the O1D distance sensor detects whether the assembly platform is free. Only when no car body is present will the hangar be lowered and the car body positioned.

Photoelectric detection of car bodies

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...10 m	1...33	< 15 x 15	18...30	**O1D105**
	Photoelectric distance sensor	0.3...6 m	1...33	< 8 x 8	18...30	**O1D155**

Marriage



Uniting the car body with the drivetrain

The IMC inductive sensor controls the lowering of the car body onto the assembly platform.
The O1D distance sensors detect whether other driverless transport systems are approaching the assembly platform.

Inductive sensors for determining position

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	40 x 40 x 54	20 f	PA (polyamide)	10...36	IP 67	100	200	**IM5115**

f = flush / nf = non flush

Photoelectric sensors for approach check

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.3...6 m	1...33	< 8 x 8	18...30	**O1D155**

Wheel transport

Transporting the wheels to the assembly station

The O5S (transmitter) / O5E (receiver) through-beam sensors detect the complete wheels on the roller conveyor. This ensures there are no interruptions in the transport to the assembly stations.

Photoelectric detection of complete wheels

Type	Operating principle	Range	Type of light	Spot Ø at max. range [mm]	Output H = light-on D = dark-on	Order no.
	Transmitter	25 m	Red	625	–	**O5S500**
	Receiver	25 m	Red	–	H/D PNP	**O5E500**

Wheel assembly

Assembling the wheels

The O2V vision sensors detect pre-programmed bolt hole patterns in the wheel rims. The robots can grip the wheels in a defined way and approach the bolting position with extreme precision.

Detecting the pattern of bolt holes

Type	Operating principle	Max. field of view size [mm]	Resolution [mm]	Detection rate [Hz]	Type of light	Ambient temperature [°C]	Order no.
	CMOS image sensor B/W, VGA resolution 640 x 480	640 x 480	1.0	10	White light	-10...60	**O2V100**

Detection of seats

Identifying the seat assemblies

Each seat is clearly identifiable via an integrated RFID tag and so can be assigned to the correct vehicle.

RFID 13.56 MHz aerial

Type	Description	Order no.
	Read/write head · M12 connector · 5 positions of the sensing face selectable · Housing materials: housing: PA / Metal parts: stainless steel	ANT513

Pressure monitoring of suction grippers for seat assembly

Pressure measurement on suction grippers

The vacuum sensors detect whether there is sufficient vacuum present for a safe gripping operation.

Vacuum pressure sensor for measuring the vacuum on a suction gripper

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G 1/8 female	Display unit	-1...1	20	30	18...32	PQ7809

Reassembling the doors

Installation of the door modules

The labels on the doors are read before assembly. This ensures that the completed doors are assigned to the correct vehicle.

Multi-code reader identification of add-on parts

Type	Dimensions [mm]	Max. field of view size [mm]	Type of light LED	Motion speed int. / ext. lighting [m/s]	Process interface	Order no.
	60 x 42 x 59	400 x 300	red light	3 / 5	Ethernet TCP/IP, EtherNet/IP, RS-232	**O2I104**

Transport to the door assembly area

On the way to visual inspection

The assembled vehicle is placed on a conveyor by a lift. The O5P500 retro-reflective sensor with polarisation filter detects whether the transfer station is free. IM5115 series inductive sensors monitor the conveyor motion.

Photoelectric detection of car bodies

Type	Operating principle	Range	Type of light	Spot Ø at max. range [mm]	Output H = light-on D = dark-on	Order no.
	Polarisation filter	0.075...10 m	Red	250	H/D PNP	**O5P500**

Inductive sensors for determining position

Type	Dimensions [mm]	Sensing range [mm]	Material	U_b [V]	Protection	f [Hz]	I_{load} [mA]	Order no.
	40 x 40 x 54	20 f	PA (polyamide)	10...36	IP 67	100	200	**IM5115**

f = flush / nf = non flush

Product selectors and further information can be found at: www.ifm.com

State recognition

Detecting the bonnet condition “open”

If the car body travels to a defined position with an open bonnet, the light beam to the assembly shop floor will be broken and clearance to proceed will be given.
A closed bonnet is also recognised and the automatic docking to the filling station prevented.

Photoelectric detection of car bodies

Type	Operating principle	Range	Sampling rate [Hz]	Spot Ø at max. range [mm]	U_b [V]	Order no.
	Photoelectric distance sensor	0.2...3.5 m	1...50	< 6 x 6	18...30	**O1D102**

Filling with various fluids

Filling tanks and auxiliary units

Before the function test, the car needs to be filled up with various fluids such as windscreen washer, brake fluid and a minimum amount of fuel.
The level sensors detect the preselected amounts on extraction from the appropriate filling station.

Detection of levels of different media

Type	Probe length [mm]	Active zone [mm]	Inactive zone [mm]	U_b [V]	Medium temperature water [°C]	Medium temperature oil [°C]	I_{load} [mA]	Order no.
	472	390	53 / 30	18...30	0...35 (LK1023 + E43101: 0...60)	0...70	200	**LK1023**

Function test – roller dynamometer

Checking the vehicle properties

The roller dynamometer is used for testing, for example, acceleration and deceleration. Adhering to tailpipe emission values is also an important test criterion. The exhaust gases must be extracted under controlled conditions.

Flow monitoring in a suction system

Type	Setting range liquids / gases [cm/s]	Greatest sensitivity [cm/s]	Medium temperature [°C]	Response time [s]	Max. T_0 gradient [K/min]	Pressure rating [bar]	Order no.
	3...300 / 200...3000	3...60 / 200...800	-25...80	1...10	300	300	**SF5200**

Control monitor for flow sensors

Type	U_b / Tolerance [V] / [%]	Current consumpt. [mA]	Power consumpt. [VA]	Power-on delay time [s]	Output when flow is present	Output when temperature is exceeded	Output in case of wire break	Order no.
	24 DC / +10 / -20	90	–	10...80	relay energised	relay energised	relay de-energised	**SR0150***

*** Note for AC and AC/DC units**

Miniature fuse to IEC60127-2 sheet 1, ≤ 5 A (fast acting) Recommendation: check the unit for reliable function after a short circuit.

Rain test

Leakage test in the washing plant

In the "Rain test", the finished vehicles are tested for leaks. The SM6000 volumetric flow sensor measures the water flow rate. The PG2450 pressure sensor with analogue output controls the ideal working pressure of the pump.

Water flow rate monitoring with volumetric flow sensors

Type	Process connection	Measuring range [l/min]	Medium temperature [°C]	Pressure rating [bar]	Response time [s]	U_b [V]	Order no.
	G½	0.25...25.00	-10...70	16	< 0.150	19...30	**SM6000**

Pressure monitoring in a high-speed pump

Type	Process connection	Display	Measuring range [bar]	$P_{overload}$ max. [bar]	$P_{bursting}$ min. [bar]	U_b DC [V]	Order no.
	G ½	Display unit	0...400	800	1200	18...32	**PG2450**

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