e-chain 1
Factory 3
242 days

e-chain 2
Factory 2
3012 days

e-chain 3
Factory 1
30 days

igus®
IoT Server

icom.plus

smart...
plastics...
igus®.eu...

igus®
smart plastics ...

Foreword

With our energy chains, cables and plain bearing products, we aim to improve the technical performance of your equipment on site, or reduce your costs. Ideally, we can improve technical performance and lower your outgoings by providing products from igus® that are more wear-resistant and have to be replaced less frequently. The sensors and isense systems enable predictive maintenance of e-chains®, dry-tech® plain bearing products and chainflex® cables. Defects are detected before they occur, downtimes are avoided, repair times are shortened due to early intervention, and machine availability is increased. Scheduled maintenance inspections become unnecessary and employees can be more effectively employed.

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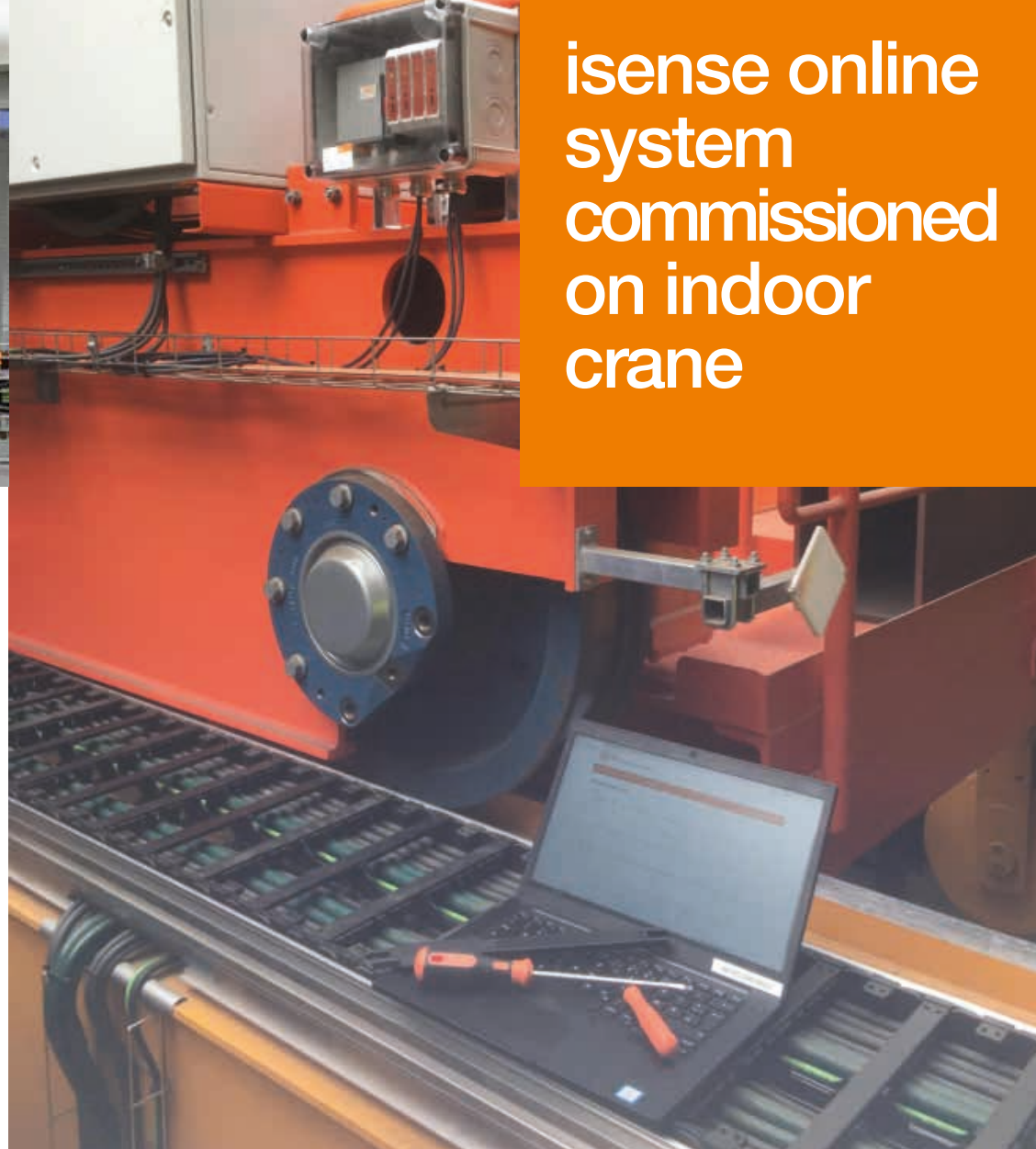
Application example: indoor cranes

A big German crane manufacturer relies on the isense online system to ensure optimum production.
The EC.B break detection, EC.P push/pull force monitoring and CF.P chainflex® tensile force monitoring products are used as shutdown systems. In addition, the icom.online module together with the EC.M dynamic sensor and the EC.W wear-measurement system supply data on the service life of the energy chains. All dynamic data is loaded into the igus® cloud by the icom module via IoT. Here, using "machine learning" and AI algorithms, a calculation of the service life is performed and displayed in a Web dashboard on any Internet-enabled device as a statement of "days until the next recommended maintenance".

Predictive maintenance and crash avoidance

## Artificial intelligence or easy monitoring ... tailored to your application

The user can determine the degree to which production is monitored digitally.

From a stand-alone solution such as e-chain® breakage detection (EC.B), which independently triggers an alarm when a fault is detected preventing greater damage, to e-chain wear detection (EC.W), which indicates the service life on the existing plant monitor (offline mode) or shows information on a computer (online mode), this information being augmented as a result of machine learning – you can decide how intensively the igus® sensors are integrated into his machinery.

igus® has sensors for e-chains®, chainflex® cables and bearing technology. There are several ways of finding the right system. Starting from the area of use, for example energy chains, with the question of what is to be achieved with the systems. Are the systems to be used for predictive maintenance where the remaining service life is displayed or is an alarm to be given in the event of components becoming worn or defective? The sensors can be integrated in numerous ways. Stand-alone sensors like the drylin® T wear detection

sensor (DLT.W) can also be fully integrated into the customer's system at a later date.
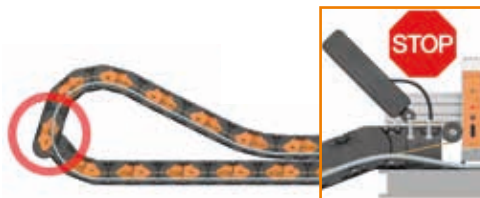
Alarm when a breakage in the e-chain® is detected by the igus® EC.B sensor

Top left picture: Predictive maintenance for igus® plain bearings in agricultural machines

Production monitoring	Module/system	Suitable sensors
Solutions for igus® energy chains		
Predictive maintenance	icom.plus/ isense offline	EC.W EC.I EC.PP
	icom/isense online	EC.M EC.W EC.I EC.PP
Crash avoidance	No module necessary isense stand-alone	EC.P EC.B CF.P EC.T
Solutions for chainflex® cables		
Crash avoidance	No module necessary isense stand-alone	CF.Q CF.D
Solutions for igus® bearing systems		
Predictive maintenance	No module necessary isense stand-alone	DLT.W DLW.W PRT.W isense plain bearing

All sensors can be incorporated in isense integration.

Solutions for energy chains, cables & bearing technology

You have the choice of various concepts for integration into your own infrastructure.

The icom module sends the data gathered by the sensors to a PC or integrates it via a computer into the existing software environment or IT infrastructure. In addition, connection to the igus® cloud is possible. By comparing live data with data collected from many existing test applications conducted at the igus® 3,800m² test facility using machine learning techniques and AI algorithms, maintenance recommendations can be provided. Due to the numerous test findings that are fed into the online service life calculators, igus® is able to predict how long an e-chain® will work reliably in a particular application. The isense modules provide live service life updates of the system, improving overall safety. This is because it includes the current ambient conditions of the actual application. Predictive maintenance ensures that repair or replace tasks are planned only when it is really necessary. This saves time and maintenance costs.

Integration into your own infrastructure

The icom modules for predictive maintenance

Degree of integration and networking

icom.plus

The module displays the initially calculated time of fault-free operation on the equipment monitor.
- Module for the isense offline system
- Display by means of the equipment monitor
- Alarm function in the event of problems
- Indication in good time that maintenance is necessary
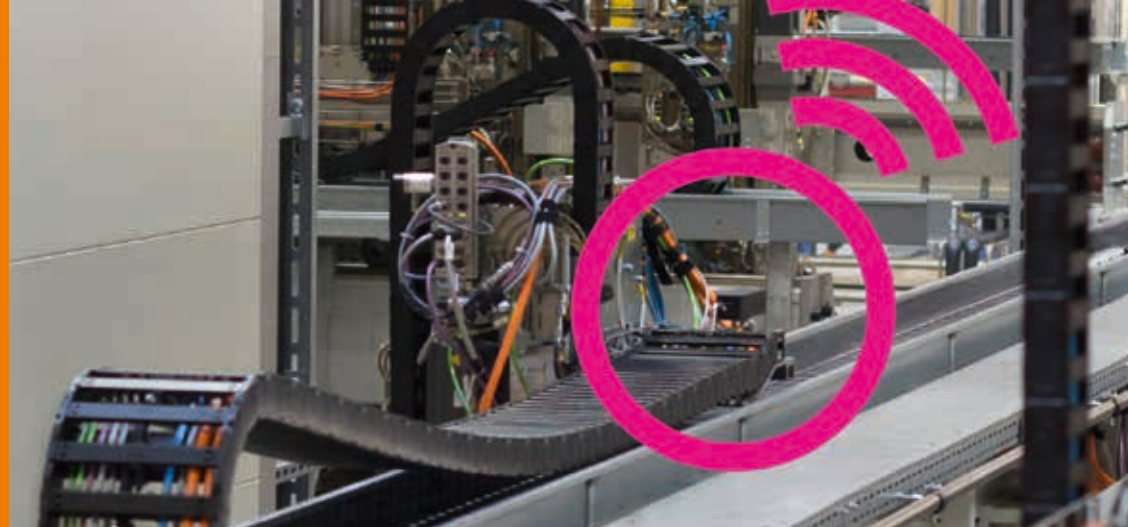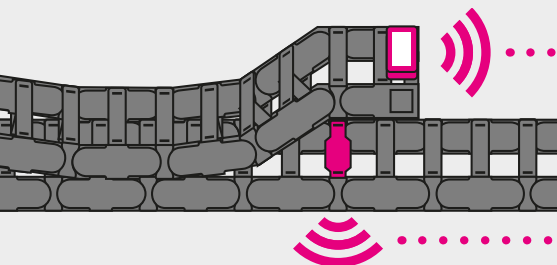
The module for the sensors
EC.W, EC.I, EC.PP

icom

Due to digital networking, the module shows the length of time of fault-free operation in real time.
- Continuous overview of the service life in real time, in all parts of the production plant thanks to "machine learning"
- Module for the isense online system
- Comparison with igus® cloud via IoT
- Indication of information through web dashboard or customer display
- Definition of limits and alarm if limits are exceeded
- Alarm output on dashboard and also by e-mail and SMS

The IoT module for the sensors:
EC.M, EC.W, EC.I, EC.PP

isense stand-alone		**isense online**		**isense offline**		**isense integration**	
Flexibility	■■■□□	Flexibility	■■■■■	Flexibility	■■■□□	Flexibility	■■■■□
Networking	■■□□□	Networking	■■■■□	Networking	■■■□□	Networking	■■■■□
Safety	■■■□□	Safety	■■■■□	Safety	■■■□□	Safety	■■■■□
Cost	■■□□□	Cost	■■□□□	Cost	■■■■■	Cost	■■■■□

Avoid equipment failures in the event of/ after defects
In the case of an existing or imminent defect, the sensors inform the system and recommend a stop. It operates without any additional external data-processing modules.

Comprehensive solution thanks to online mode
Monitoring and predictive maintenance are even more effective with the icom module, machine learning and networking with the igus® cloud and the Internet of Things. Extensive use of the igus® database.

Where there are high IT security requirements
Monitoring and predictive maintenance of e-chains®, cables and bearings (without having to be online). With the icom.plus, the display of information is integrated into the customer's own system.

Full integration into your system
Output of alarms, service life data and raw sensor data to the customer's existing system. Online and offline use possible.

Sensors for smart energy chains

EC.M
Sensor for movement on e-chains®
- Detects values such as acceleration, speed, temperature and cycles
- Supplies data for calculation of the minimum fault-free operating time
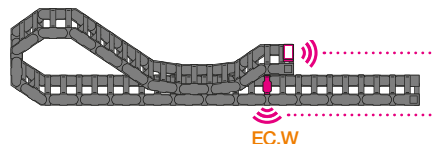
EC.W
Sensor for abrasion on e-chains®
- Depending on the type, measures wear of crossbar, pin/bore connection or liner.
- Compares specified algorithms with real use data.

EC.I
Non-contact wear measurement of e-chains®
- Integrated in the chain link, the component subjected to the greatest mechanical stress
- Measures the percentage of wear of the pin/bore connection in %, without contact occurring
- Sends a signal if the specified limit is reached

EC.P
Push/pull force monitoring
- Measures the push/pull forces acting on the e-chain®
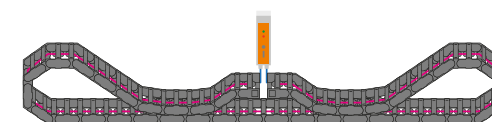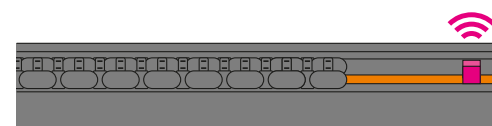- Recommends shutdown of the equipment if a force limit is exceeded

EC.M
- Can be connected to icom/icom.plus
- Predictive maintenance

EC.W
- Can be connected to icom/icom.plus
- Predictive maintenance

- Can be connected to icom/icom.plus
- Predictive maintenance
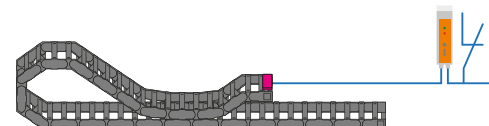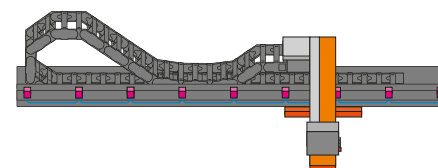
- Crash avoidance

- Can be connected to icom/icom.plus
- Predictive maintenance
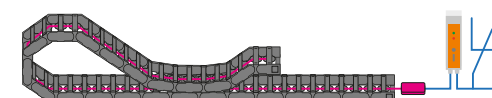
- Crash avoidance

- Crash avoidance

EC.PP
Sensor for position-sensitive push/pull force measurement
- Integrates a positioning system into the e-chain®
- Supplies information on position-dependent push/pull forces
- Position information from the application can be used for other purposes

EC.B
Sensor for breakage detection in e-chains®
- Detects chain breakage in the early stages
- Prevents overloading and subsequent system failures

EC.B / EC.B2
Two sensors and one module for the detection of e-chain® breakage
- For long travels and opposing e-chains®
- Detects chain breakage in the early stages
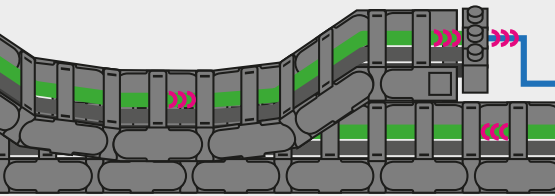- Two sensors send signals to a DIN rail module

EC.T
Sensor for glide bar wear in troughs
- Measures glide bar abrasion
- Determines the remaining service life in days
- When a defined percentage state of wear is reached, a signal is transmitted to a module
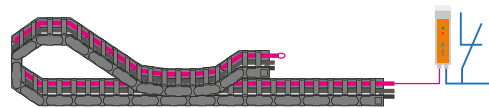
Sensors for smart cables

Sensors for smart bearing technology

CF.Q
Sensor for the electrical properties of chainflex® cables
- Indicates changes in the electrical properties
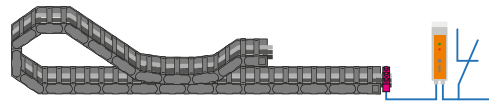- In the event of a fault, information by means of NO contact and a signal

● Crash avoidance

DLT.W
Sensor for wear in drylin® T linear systems
- Integrated into the liner
- Signals wear of the liner in good time
- Predictable replacement of the sliding elements

● Predictive maintenance

CF.P
Sensor for measuring tensile forces on cables
- Measures the forces directly at the strain relief element
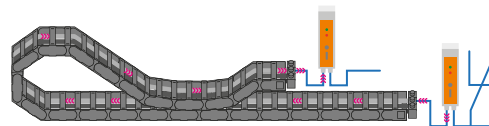- Triggers a shutdown by means of the NC contact if forces are excessive
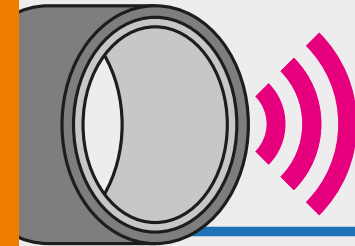
● Crash avoidance

DLW.W
Wear monitoring with the DLW.W sensor
- A sensor measures the wear of the linear bearing in the drylin® W linear guide
- If the limit is reached, it sends a signal to indicate that the bearing liner should be changed.

● Predictive maintenance

PRT.W
Sensor for wear of iglidur® PRT slewing ring bearing
- Sensor measures the abrasion of the sliding elements
- Predictable replacement of the sliding elements

● Predictive maintenance

CF.D
Sensor for measuring the transmission quality of Ethernet bus cables
- Integrated in the cable, no extra measuring cable necessary
- Package losses are detected in good time
- Alarm via LED, NC contact or the network.
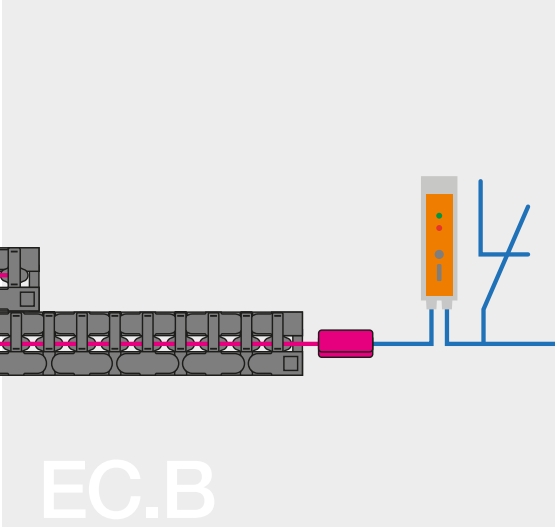
● Crash avoidance

isense plain bearing
Integrated wear measurement
- Integrated sensor system measures wear

● Predictive maintenance

Example of a system module

EC.B

Do you have an idea for a smart project?

Key questions about project planning
If you want to make your machinery smart, we have put together a few questions that prepare you for your project planning conversation with the igus® project manager, and can help you to get to grips with the topic.

To prepare for the conversation, simply fill in an enquiry, photograph it and send it by e-mail to your contact person - Richard Habering (rthabering@igus.net) with a clear indication of the topic on the subject line.

Or directly online:
www.igus.eu/smart-plastics-request

What components does a standard monitoring system consist of?

● Sensor
● Analysis unit
● Accessories

Example of what is shown, based on the sensor for e-chain® breakage detection (EC.B):

● EC.B sensor box
● Sensor cable
● Mounting plate
● Special separators
● Polymer cable
● Evaluation unit for control-cabinet installation
● Optional: icom connection with interface

EC.B unit in use

What do you want to equip your machines for?
Predictive maintenance ☐
Crash avoidance ☐

What do you want to optimise?
Energy chains ☐
Cables ☐
Bearing technology ☐

What systems in detail? (part number, type, number of chain links, length)
e-chains®

dry-tech® bearing technology

chainflex® cables

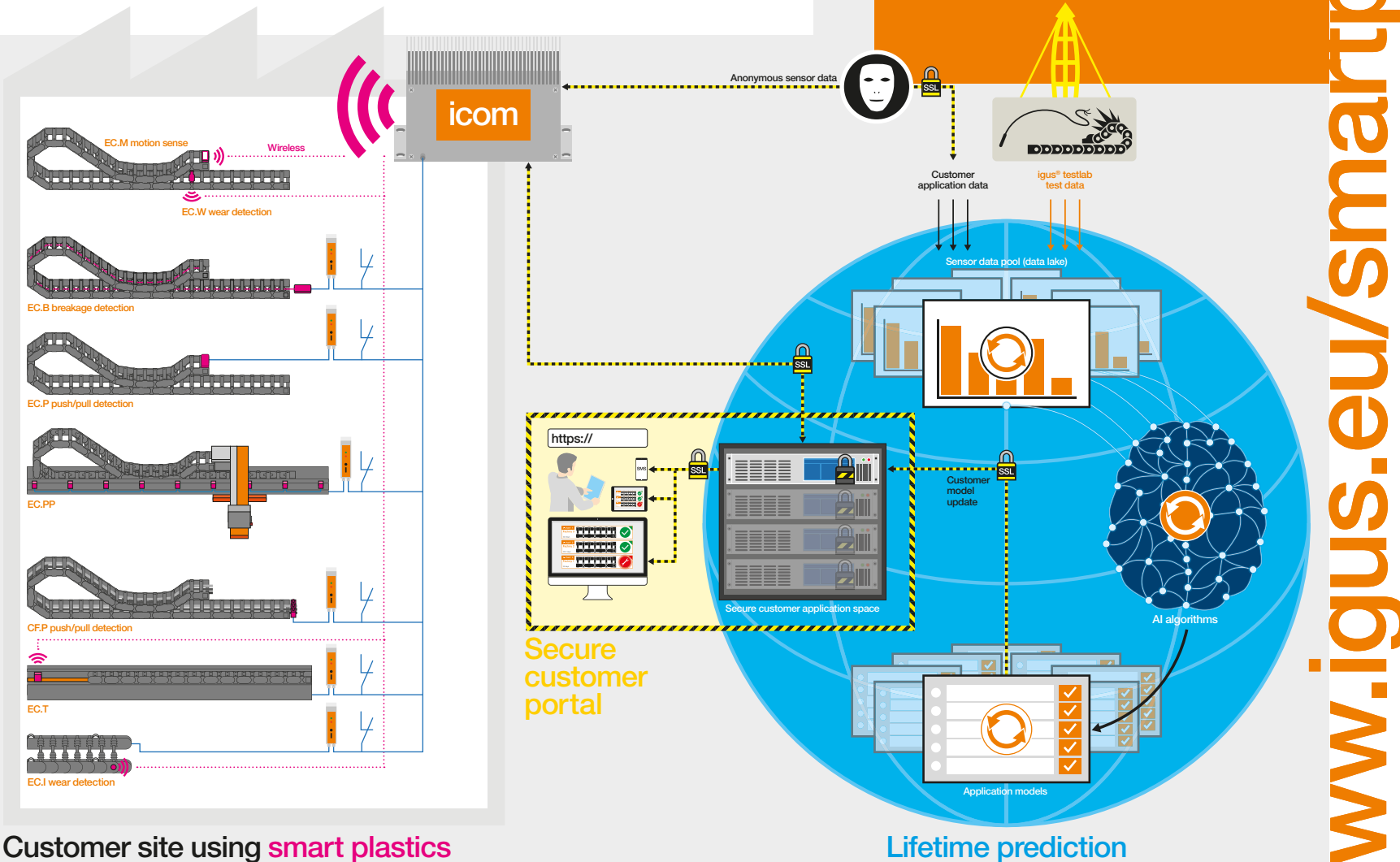**Installation location of the modules (e.g. control cabinet at fixed end or floating end)**

Distance of the planned igus® sensor from the module in the control cabinet:

The benefits at a glance:

The best method to plan maintenance and minimise inspection work

- Operating time data from the protected customer area is compared regularly with the data model
- Efficient maintenance organisation according to priority and, thanks to integration into the ERP, with appropriate replacement parts from stock provided after the sensor alert
- Predictive maintenance due to early information on necessary service or replacement
- Data from the igus® laboratory is processed on a server with anonymised customer data in order to create a full data model
- The system benefits from all of the test data in the igus® database and keeps learning every day

isense online
Optimum maintenance

EC.M motion sense

Wireless

EC.W wear detection

EC.B breakage detection

EC.P push/pull detection

EC.PP

CF.P push/pull detection

EC.T

EC.I wear detection

icom

Anonymous sensor data

SSL

Customer application data

igus® testlab test data

Sensor data pool (data lake)

SSL

https://

SSL

Customer model update

SSL

Secure customer application space

AI algorithms

Application models

Customer site using smart plastics

Secure customer portal

Lifetime prediction

www.igus.eu/smartplastics

15

Tested! In the industry's largest test lab

Anyone who can make reliable and useful predictions about maintenance work is one step ahead of the competition. In the age of digitisation, more than big data is required for such predictions. In order to be able to use the sensor data to derive the correct recommendations for maintenance to be accurately scheduled, long term empirical values from the igus® test database are used.


igus® lab, Cologne. A section of the motion plastics® test laboratory spread over 3,800m².

"plastics for longer life®" - igus® products are manufactured in accordance with this guiding principle. Products are designed to extend the service life of machines, eliminate maintenance and reduce costs. The service life of all igus® products can be calculated online and delivered quickly. To this end, igus® operates the largest test lab in its industry. The heart of igus® innovation beats there. In an area of 3,800m² individual components and finished systems are tested under real conditions to provide the best plastic products. All test results are documented and archived in the company's database. Based on this, the service life of our products is reliably calculated, new materials are researched and products are developed. In addition, the test results are included in the igus® online calculators and in the algorithms of the smart plastic systems.
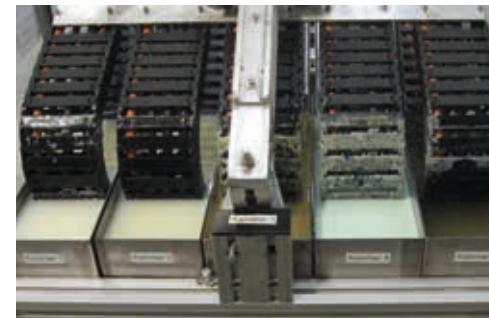
www.igus.eu/test
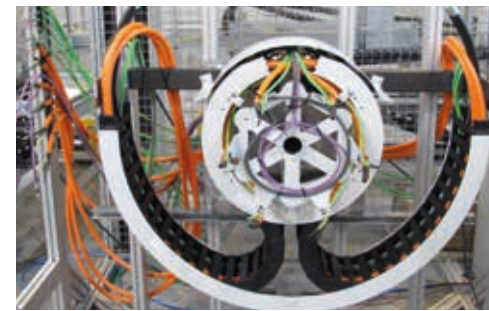
Service life test for circular movement

Testing chainflex® cables under torsion

Durability test in various oils and liquids

Climate chamber. Dynamic tests of cables in e-chains® at -40°C

Facts and figures of the igus® laboratory at a glance:

- 3,800m² test area
- 4,100 energy chain system tests annually at 180 test stations: climate chamber, outdoor tests, noise chamber, travel lengths up to 130m, robot systems etc.
- Two billion test cycles a year for highly flexible cables
- One million electrical measurements recorded annually
- 15,000 tribological tests (friction and wear) in 300 test set-ups
- 140 trillion test movements in the bearings business unit
- Sensors on the test machines provide permanent measurement data, processing in the central database

High-speed tests for long travels

Continuous motion tests with defined bend radius

This engine factory is the biggest and most important engine factory of a large German car manufacturer.

On average, an engine comes off the assembly line every 14 seconds - in peak periods, more than 6,000 engines are produced every working day. This output can only be achieved using a high degree of automation with reliable components. This is why companies rely on smart plastics from igus® to avoid unforeseen failures and machine shutdowns.

With the help of a polymer wire inside the energy chain the isense EC.B sensor unit monitors the condition of the chain. In the event of a chain breakage,

the machine is stopped automatically to prevent subsequent damage.

isense EC.W modules have also been fitted. A sensor built into the crossbar signals advanced wear of the chain. The measurement of wear data means that a chain's remaining service life can be predicted and replacement can be planned at an early stage.

www.igus.eu/smartplastics

igus®.eu/8pm

Place your orders until late. Ordering and deliveries weekdays from 7.00am to 8.00pm, Saturday from 8.00am to 12.00pm. No minimum order quantities, no surcharges. Quick delivery.

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/9001:2015
/16949:2016

igus® is certified in accordance with ISO 9001:2015 and IATF 16949:2016 in the field of energy supply systems, cables and harnessing, as well as plastic bearings.

/smartplastics

igus®.eu

plastics ... smart plastics