BROSA

Salalah, Oman
31. August - 02. September 2025

Know Your Loads, Weights and Forces for a Safe and Secure Operation

Facts & Figures

About BROSA

Headquarters

BROSA GmbH, Tettnang, Germany
- Production and R&D Sensors

Subsidiaries

BROSAtronic AG, Switzerland
- Production and R&D Electronics, SW

BROSA B.V., Oss, Netherlands
- Sales Office

BROSA Pte Ltd, Singapore
- Sales Office

BROSA (Nanjing) Co., Ltd., China
- Sales Office

Key Figures

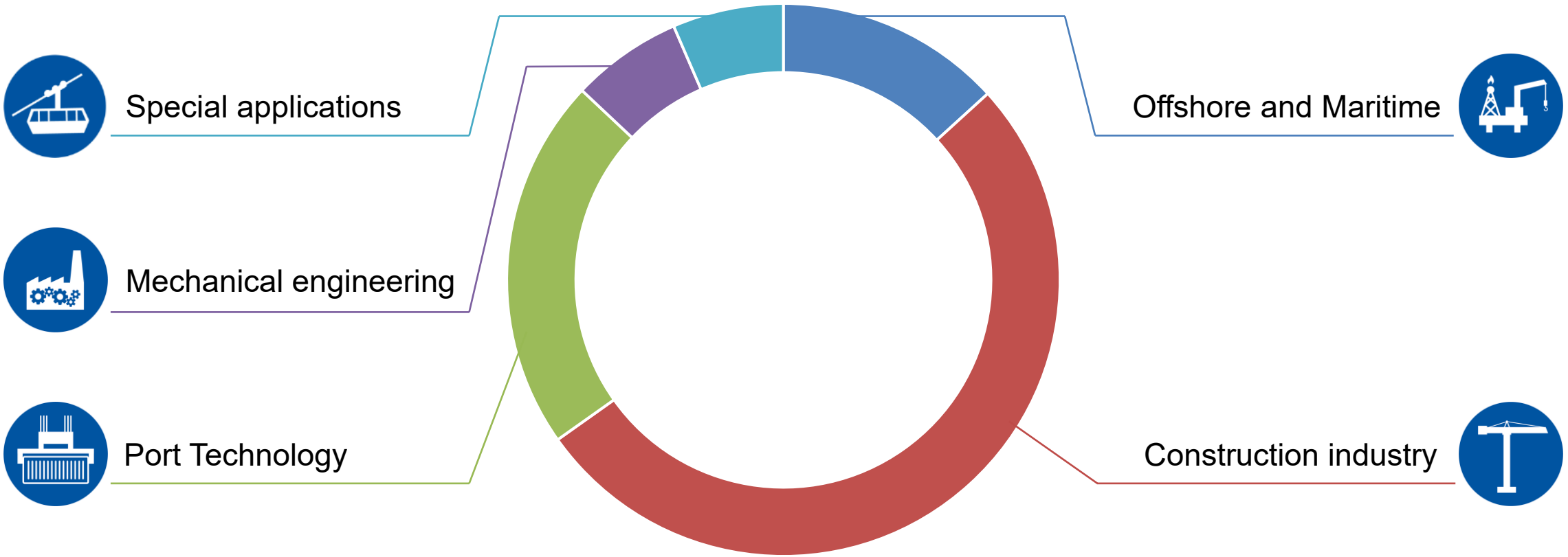
- Founded in 1935
- 100 Employees
- ISO 9001 and ISO 14001 certified

Facts & Figures

About BROSA

- Products are developed in close collaboration with our customers
- Understanding the Trends & Industries
- Compliance with worldwide safety standards
- “Made in Germany”
- More than 90% in house manufacturing
- Full scope of product engineering and manufacturing
  - Specification
  - Technical proposals
  - Production: mechanical, electrical, assembly
  - Calibration
  - Certification, Type Approvals,
  - Customer Acceptance Tests

Markets


Special applications
Mechanical engineering
Port Technology
Offshore and Maritime
Construction industry

Product Portfolio

					 	
Force measuring pin	Tension load cell	Force sensor washer	Tubular load cell	Compression load cell	Weighing and Overload Systems	
						
Support jack load cell	Angle sensor MEMS	Normal force sensor	Sensor for Ex area	Pressure transducer	Pressure transducers	BROSA electronics

Safety Sensor Concept

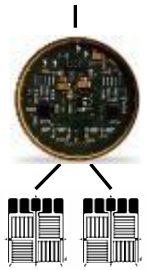
Single output

PL c / SIL 1

1 measuring system
1 amplifier
1 output

4-20 mA
CANopen
PROFINET

PL d / SIL 2

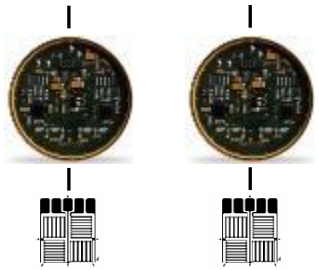


2 measuring systems
1 amplifier
1 output

4-20 mA
CANopen
CANopen safety
PROFINET
PROFINET PROFIsafe

Redundant (double output)

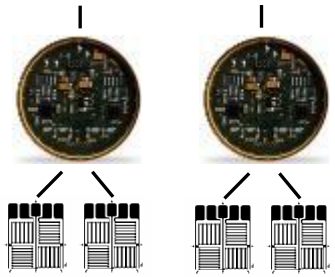
2x PL c / SIL 1 *



2 measuring systems
2 amplifiers
2 outputs

4-20 mA
CANopen
PROFINET

2x PL d / SIL 2 *



4 measuring systems
2 amplifier
2 output

4-20 mA
CANopen
CANopen safety
PROFINET
PROFINET PROFIsafe

* PL e / SIL 3 is possible if used in parent systems DIN EN ISO 13849-1

Functional Safety acc. EN13849

Categories

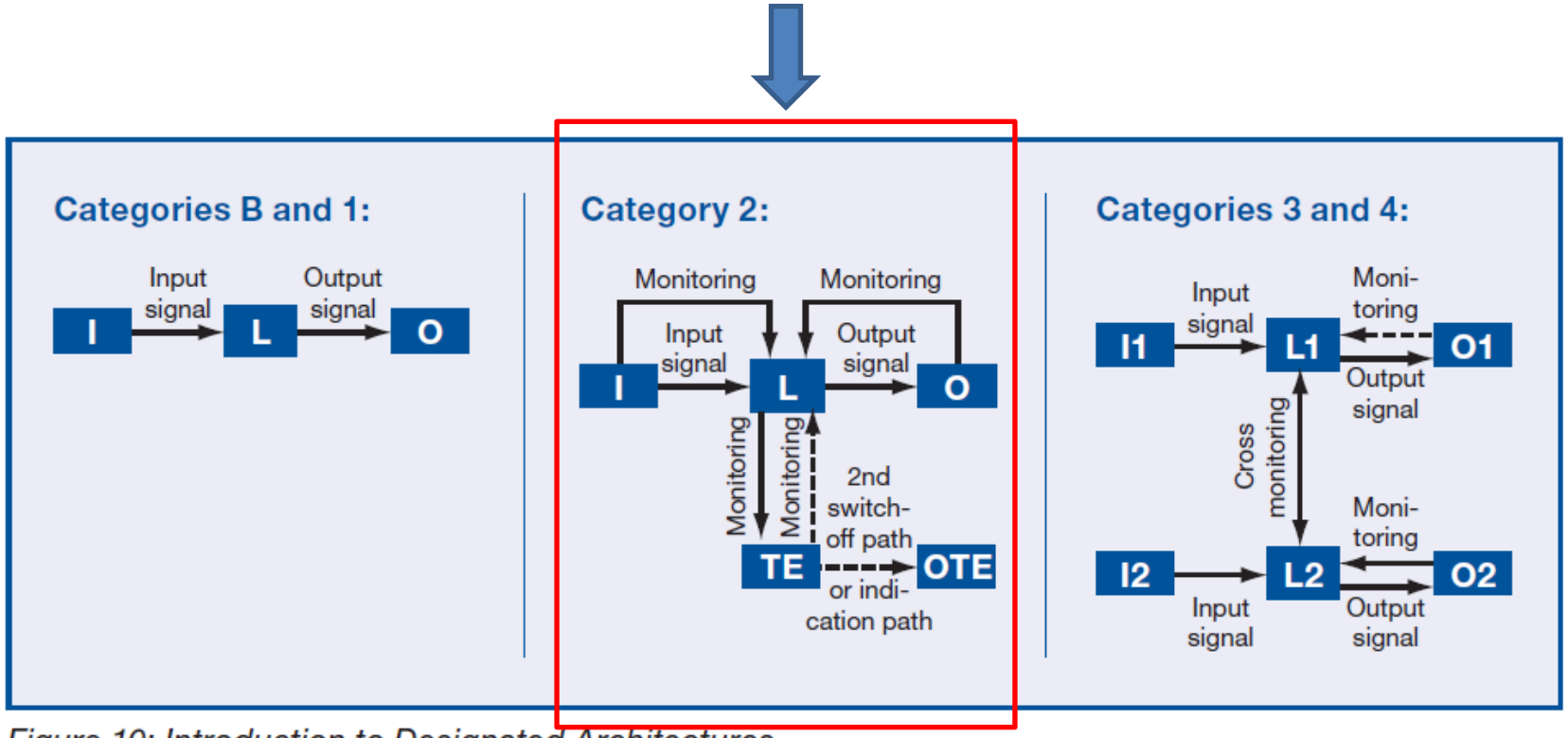
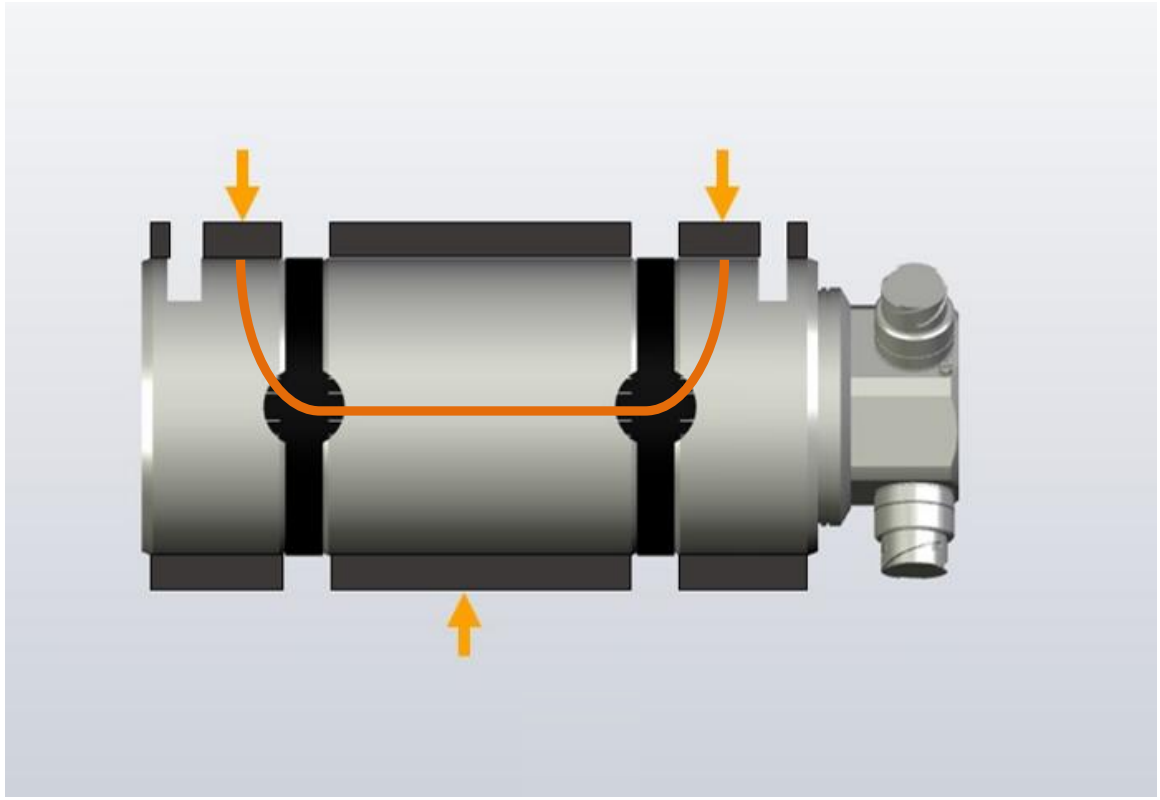
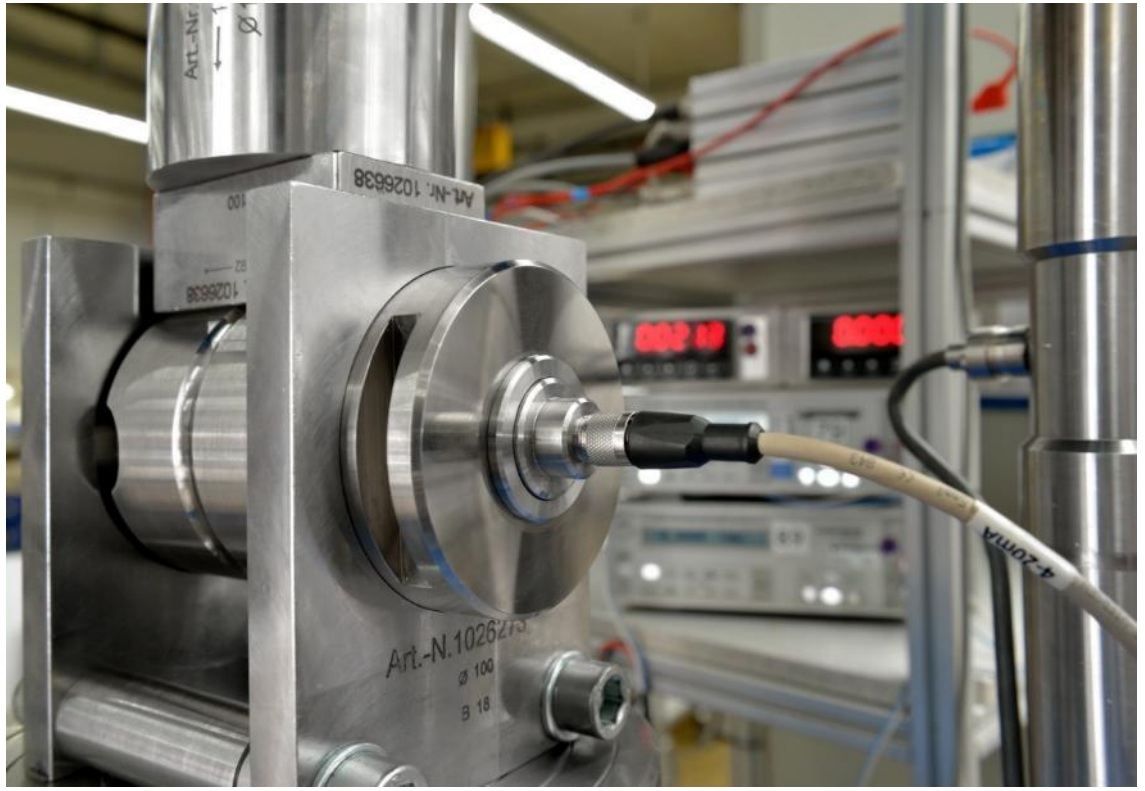


Figure 10: Introduction to Designated Architectures

I = Input, L = Logic, O = Output, TE = Test Equipment, OTE = Output of Test Equipment

BROSA Load pins





Typical installations

Installations

Anchor points on dead end of hoist rope

Sheave at rope system

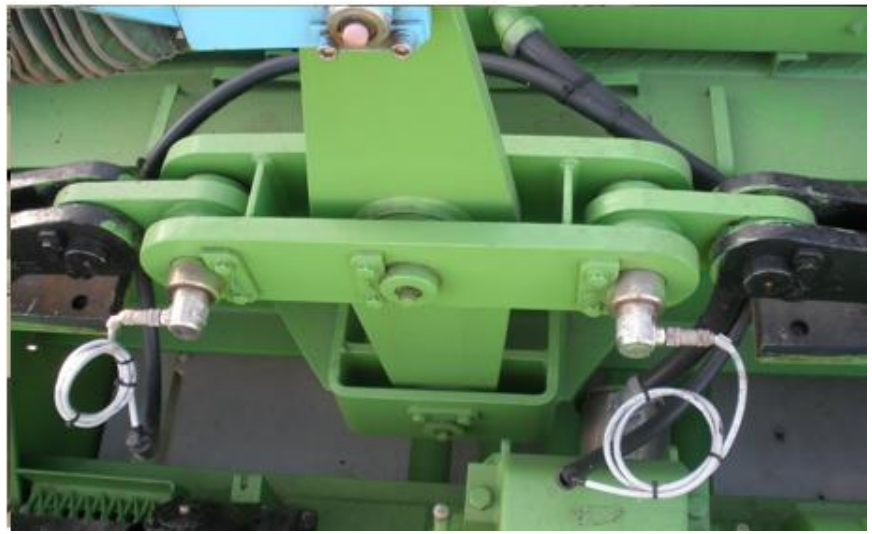
Brakes

Designs

Standard Design, 1 measuring direction

X-Y Measurement, 2 measuring directions with a 90° offset

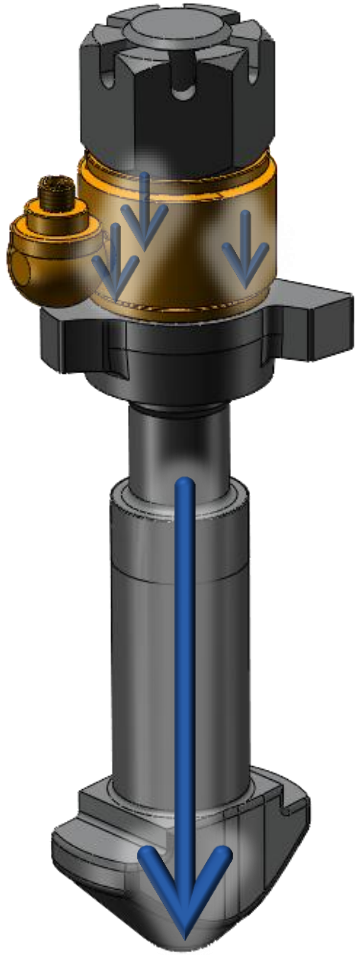
MOP Design, with Mechanical Overload Protection



BROSA 3P sensor washer

Integration of the sensor in a twistlock

- No effect on twistlock cross-section
- Direct force measurement by integrating the sensor into the twistlock assembly
- Tension of the twistlock is transformed into a compression force
- Detachable mechanical assembly
  - Can be re-used during twistlock inspection
  - Can be re-used after twistlock exchange
- Designed and tested for > 2 Mio. load cycles

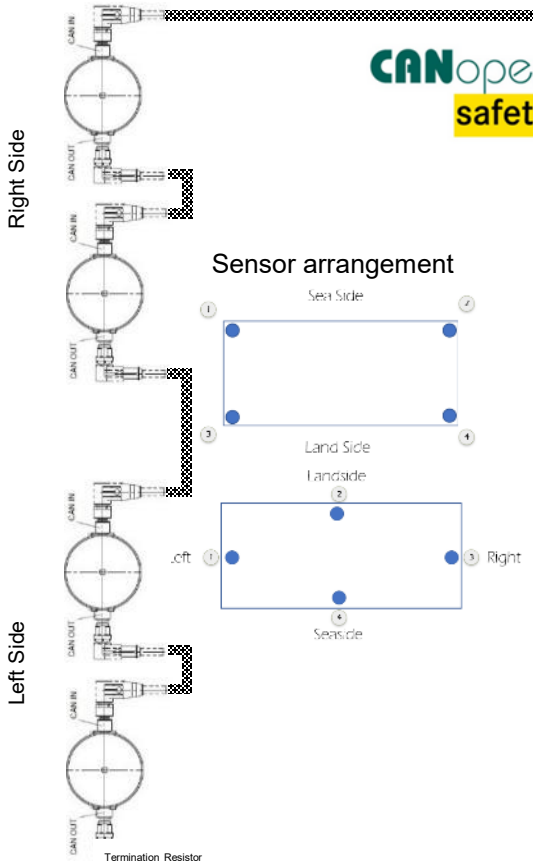


Product Portfolio Systems

Safety System for SIL2 requirements

- Processor TMS570 Texas Instruments
- 8 digital inputs,
- 8 digital outputs
- 3 CAN lines (sensors, display & communication)
- Safety cut-off, Power MOSFET
- Communication controller for interfacing with the main PLC
  - Profinet (ProfiSafe)
  - CANopen (Safety)
  - Profibus DP
  - RS-485 (compatible to BROSA display)
  - RS-232 (for service purposes)
- Firmware FlexLim Safety
- Suitable for headblock installation, shock & vibration proofed
- Area of Use
  - Safety System
  - Weighing System
  - Gateway

Safety System Concept



0656 IN
- Spreader mode selection (1-4)
- Bypass
- Life Pulse
- Lifting height

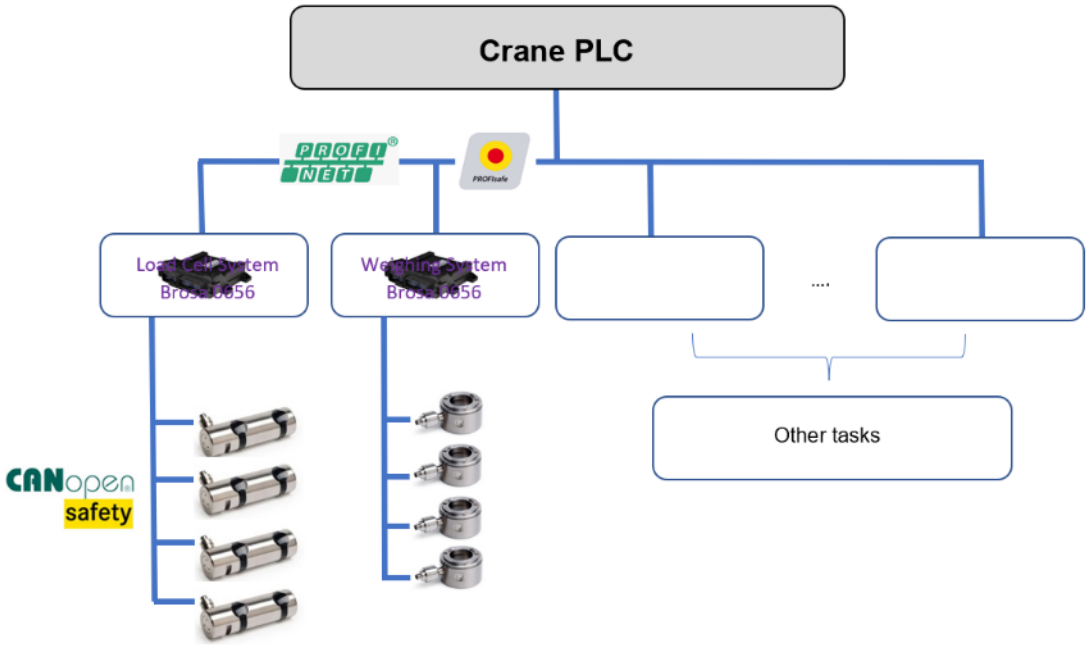
0656 OUT
- Overload (Spreader / Crane)
- Eccentricity (right / left)
- Corner Load
- Spreader landed
- Crane status information
- Error codes

Hardware I/Os

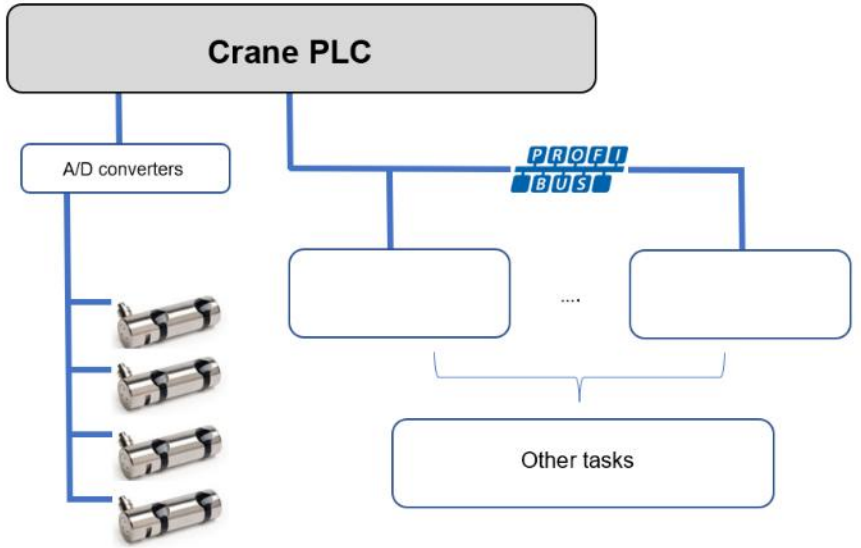
0656 IN
- Spreader mode selection (1-4)
- Bypass

0656 OUT
- Overload (Spreader / Crane)
- Eccentricity (right / left)
- Corner Load
- Spreader landed
- Load limit
- System error

Diversification of Tasks SIL2 (IEC 61508)



Typical SIL2 Layout



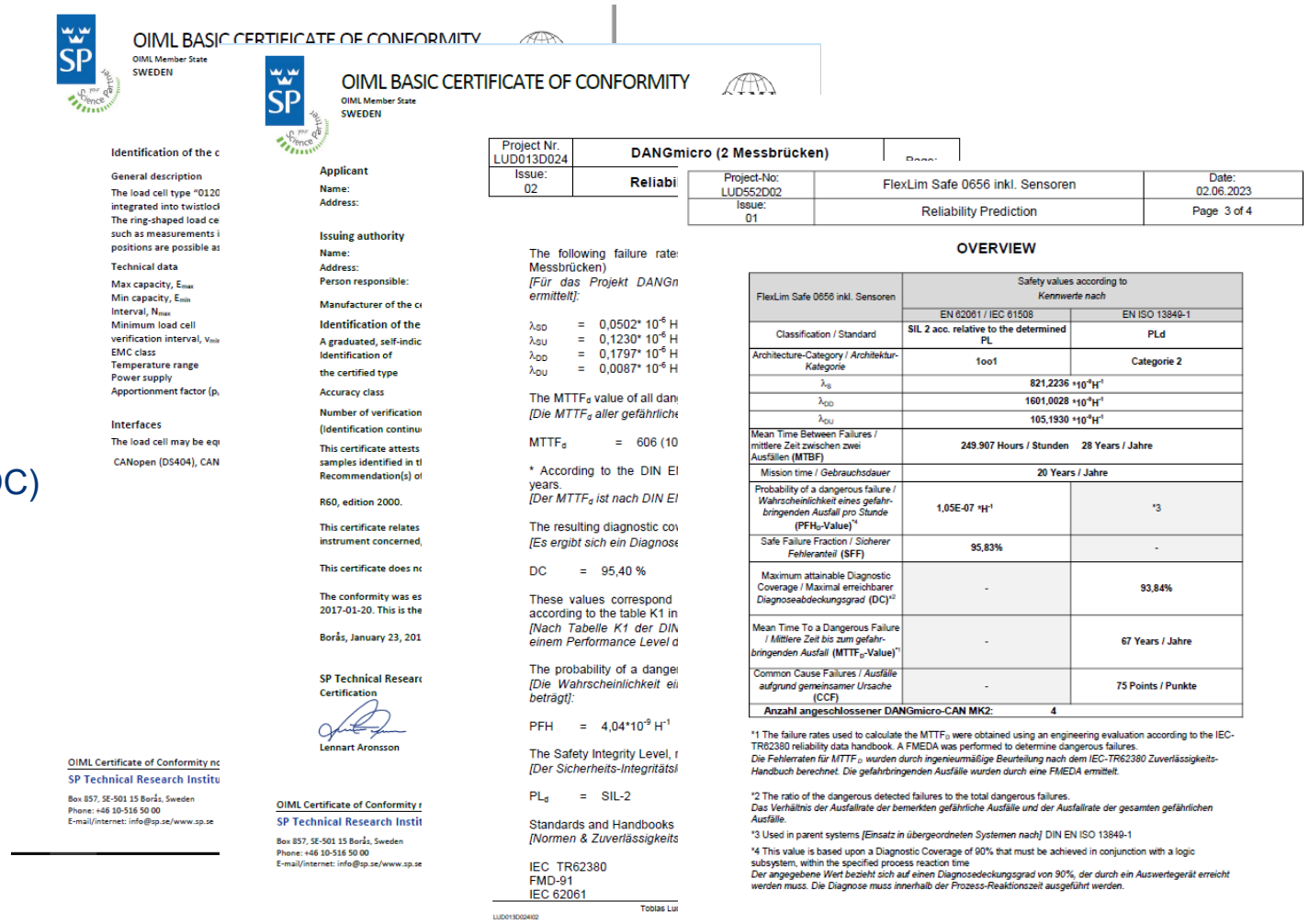
Standard Layout

Certificates

Weighing & Safety, FMEA, OIML Certificate

Key Data from RP & FMEA

- Standard: IEC 61508 / EN 13849
- Architecture-Category
- Probability of a dangerous failure (PFH)
- Mean Time to a dangerous Failure ($MTTF_d$)
- Diagnostic Coverage of dangerous failures (DC)
- Mission time
- Resulting in Safety Integrity Level
  - SIL2 = PL_d



OIML BASIC CERTIFICATE OF CONFORMITY

OIML Member State
SWEDEN

Identification of the c

General description
The load cell type "0120
integrated into twistlock
The ring-shaped load ce
such as measurements i
positions are possible as

Technical data
Max capacity, E_{max}
Min capacity, E_{min}
Interval, N_{max}
Minimum load cell verification interval, v_{min}
EMC class
Temperature range
Power supply
Apportionment factor (p_i

Interfaces
The load cell may be eq
CANopen (DS404), CAN

OIML Certificate of Conformity nc
SP Technical Research Institu
Box 857, SE-501 15 Borås, Sweden
Phone: +46 10-516 50 00
E-mail/internet: info@sp.se/www.sp.se

OIML BASIC CERTIFICATE OF CONFORMITY

OIML Member State
SWEDEN

Applicant
Name:
Address:

Issuing authority
Name:
Address:
Person responsible:

Manufacturer of the c

Identification of the
A graduated, self-indic
Identification of
the certified type

Accuracy class

Number of verification
(Identification continu

This certificate attests
samples identified in tl
Recommendation(s) of

R60, edition 2000.

This certificate relates
instrument concerned,

This certificate does nc

The conformity was es
2017-01-20. This is the

Borås, January 23, 201

SP Technical Researc
Certification

Lennart Aronsson

OIML Certificate of Conformity
SP Technical Research Instit
Box 857, SE-501 15 Borås, Sweden
Phone: +46 10-516 50 00
E-mail/internet: info@sp.se/www.sp.se

Project Nr. LUD013D024	DANGmicro (2 Messbrücken)	
Issue: 02	Reliabi	

Project-No: LUD552D02	FlexLim Safe 0656 inkl. Sensoren	Date: 02.06.2023
Issue: 01	Reliability Prediction	Page 3 of 4

The following failure rate
Messbrücken)
[Für das Projekt DANGm
ermittelt]:

λ_{SD} = 0,0502* 10^{-6} H
λ_{SU} = 0,1230* 10^{-6} H
λ_{DD} = 0,1797* 10^{-6} H
λ_{DU} = 0,0087* 10^{-6} H

The $MTTF_d$ value of all dan
[Die $MTTF_d$ aller gefährliche

$MTTF_d$ = 606 (10

* According to the DIN EI
years.
[Der $MTTF_d$ ist nach DIN EI

The resulting diagnostic co
[Es ergibt sich ein Diagnose

DC = 95,40 %

These values correspond
according to the table K1 in
[Nach Tabelle K1 der DIN
einem Performance Level d

The probability of a dange
[Die Wahrscheinlichkeit ei
beträgt]:

PFH = 4,04*10^{-9} H^{-1}

The Safety Integrity Level,
[Der Sicherheits-Integritätsl

PL_d = SIL-2

Standards and Handbooks
[Normen & Zuverlässigkeits

IEC TR62380
FMD-91
IEC 62061

Tobias Lu

LUD013D024K02

OVERVIEW

FlexLim Safe 0656 inkl. Sensoren	Safety values according to *Kennwerte nach*	
	EN 62061 / IEC 61508	EN ISO 13849-1
Classification / Standard	**SIL 2 acc. relative to the determined PL**	**PLd**
Architecture-Category / *Architektur-Kategorie*	**1oo1**	**Categorie 2**
λ_S	**821,2236 *10^{-9} H^{-1}**	
λ_{DD}	**1601,0028 *10^{-9} H^{-1}**	
λ_{DU}	**105,1930 *10^{-9} H^{-1}**	
Mean Time Between Failures / mittlere Zeit zwischen zwei Ausfällen **(MTBF)**	**249.907 Hours / Stunden 28 Years / Jahre**	
Mission time / *Gebrauchsdauer*	**20 Years / Jahre**	
Probability of a dangerous failure / *Wahrscheinlichkeit eines gefahr-bringenden Ausfall pro Stunde* **(PFH_D-Value)**[*4]	**1,05E-07 *H^{-1}**	*3
Safe Failure Fraction / *Sicherer Fehleranteil* **(SFF)**	**95,83%**	-
Maximum attainable Diagnostic Coverage / Maximal erreichbarer *Diagnoseabdeckungsgrad* **(DC)**[*2]	-	**93,84%**
Mean Time To a Dangerous Failure / *Mittlere Zeit bis zum gefahr-bringenden Ausfall* **($MTTF_D$-Value)**[*1]	-	**67 Years / Jahre**
Common Cause Failures / *Ausfälle aufgrund gemeinsamer Ursache* **(CCF)**	-	**75 Points / Punkte**
Anzahl angeschlossener DANGmicro-CAN MK2:	**4**	

*1 The failure rates used to calculate the $MTTF_D$ were obtained using an engineering evaluation according to the IEC-TR62380 reliability data handbook. A FMEDA was performed to determine dangerous failures.
Die Fehlerraten für $MTTF_D$ wurden durch ingenieurmäßige Beurteilung nach dem IEC-TR62380 Zuverlässigkeits-Handbuch berechnet. Die gefahrbringenden Ausfälle wurden durch eine FMEDA ermittelt.

*2 The ratio of the dangerous detected failures to the total dangerous failures.
Das Verhältnis der Ausfallrate der bemerkten gefährliche Ausfälle und der Ausfallrate der gesamten gefährlichen Ausfälle.

*3 Used in parent systems *[Einsatz in übergeordneten Systemen nach]* DIN EN ISO 13849-1

*4 This value is based upon a Diagnostic Coverage of 90% that must be achieved in conjunction with a logic subsystem, within the specified process reaction time
Der angegebene Wert bezieht sich auf einen Diagnosedeckungsgrad von 90%, der durch ein Auswertegerät erreicht werden muss. Die Diagnose muss innerhalb der Prozess-Reaktionszeit ausgeführt werden.

Safe Lifting of Loads

Why Safety Systems

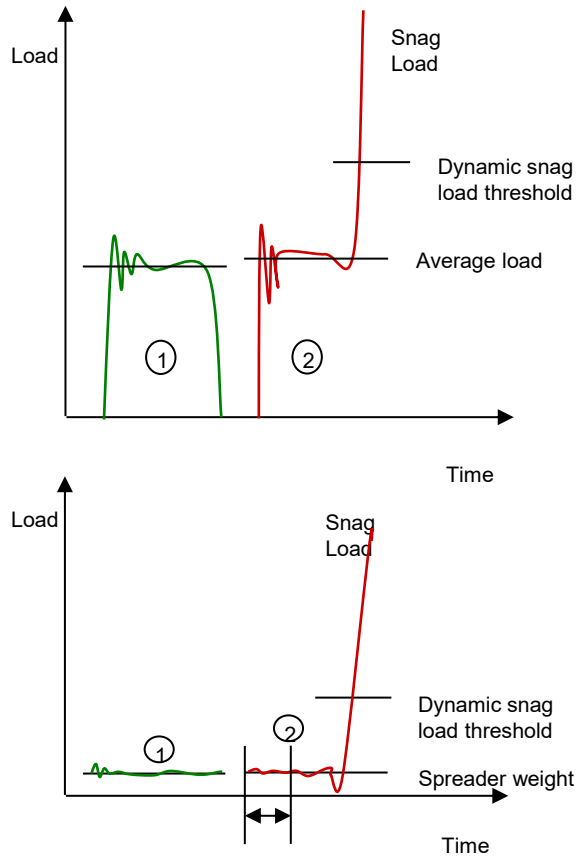
- Safety systems on lifting equipment are a mandatory requirement when loads are lifted
- Nearly 25% of accidents in container ports are load dependant, but not in all cases containers are overloaded.
- Monitoring of Safe Working Limits and Operational Limits at all times
- Safety Systems must comply with Safety Standards
    - European and International Safety Standards
        - Performance Level d (DIN 13849)
        - Safety Integrity Level 2, SIL2 (IEC 61508)

Additional & Special Functions

Snag Load Detection

Dangerous situations occurs when

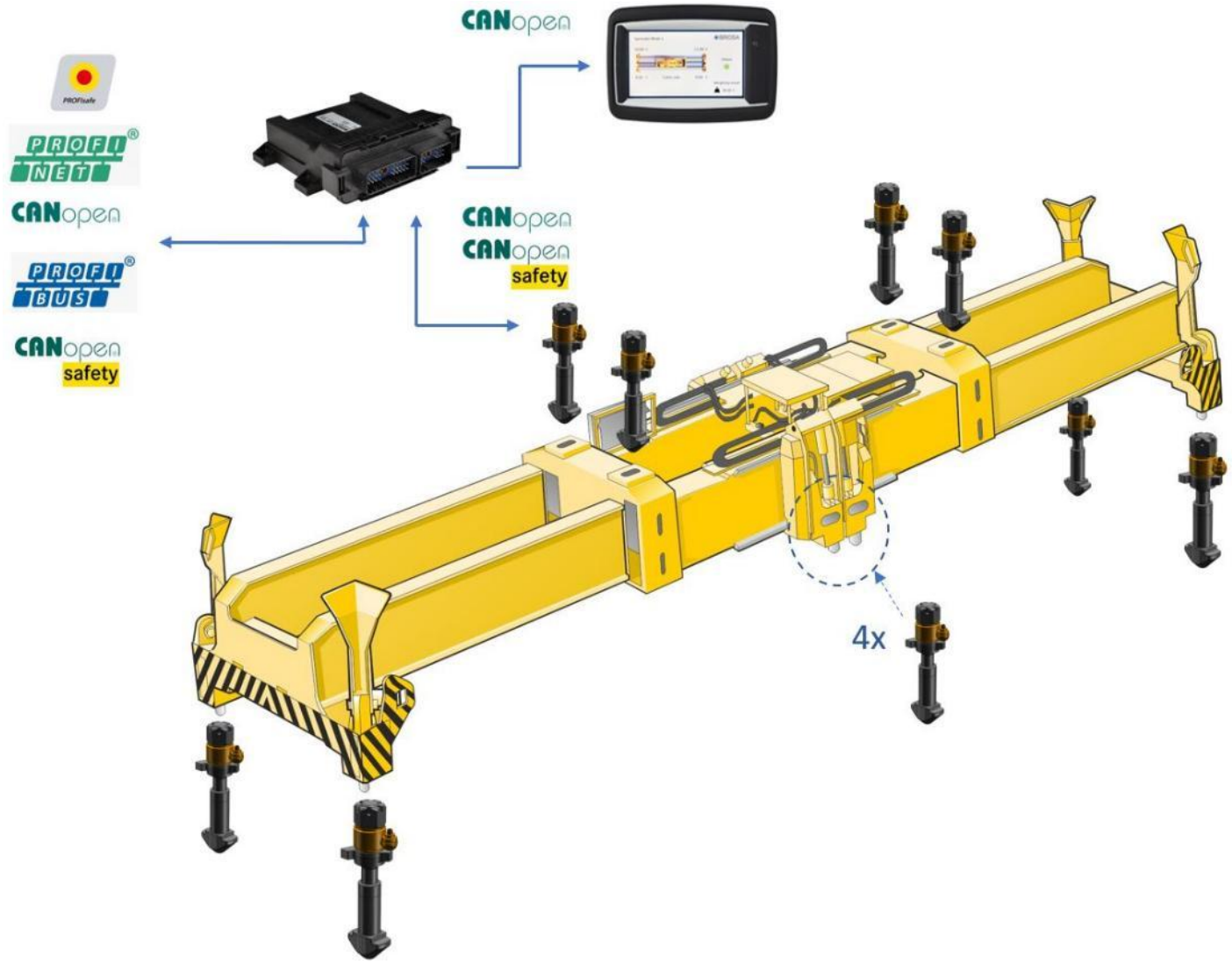
- A container gets stuck in the railings of a vessel during the lift
- Parts of the spreader block the lift
- When the head covers are not completely removed and obstruct the lifting area
- ….
- The load sensors are immediately registering a second increase of the load signal
- Once a second increase is detected on any of the load sensors the snag warning can be triggered
- The threshold for the detection is dynamic, dependant on the weight of the container being lifted.



SOLAS Container Weighing

- Safety issues for extended functions (e.g. SOLAS)
  - Mandatory to verify the VGM of the container before its lifted to a vessel since 01.07.2016.
  - Different methods to verify the VGM (Method 1 & Method 2)
  - Detection of wrongly declared Container Weights
  - Improvement of Ship Stowage Plans
  - All VGM must be taken by a verified system

SOLAS Weighing System Spreader



Additional & Special Functions

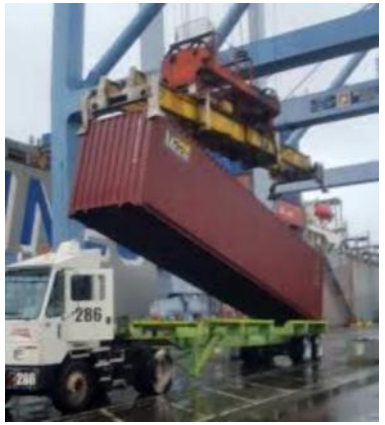
Lock detection for twistlocks

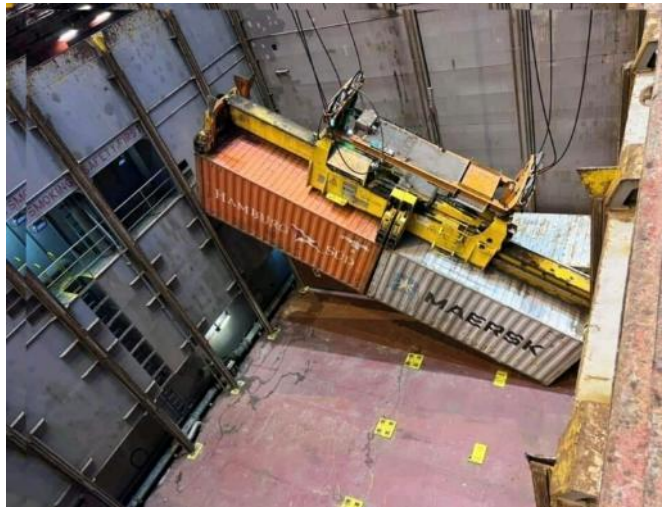
Dangerous situations occurs when

- One of the twistlocks is not correctly locked in corner
- For Twin-Spreaders: the twin detection system does not detect 2 containers, so that inner twistlocks will not lock
- More than just the container is being lifted

Enhancement for better detection and much more safe lifts

- Installation of force sensor washer on each twistlock
- Load measurement and plausible load checks by start lifting





Mobile Port Equipment

- Critical Situations:
  - Driving at high speed
  - Taking turns at high speeds and to sharp
  - Load too high at straddle carrier

  - Load measurement at the twistlocks can reduce the possibility of dangerous situations (known weight)
  - Knowing the centre of gravity and lifting height can also reduce the possibility of dangerous situations (position)

New Developments

Terminal Automation

- Automation or Industry 4.0 is making his way with big steps into the container handling industry
- Not the individual speed but rather a repeatable speed is the key factor to increase efficiency
- Results shall be sellable time of the operation
- Key Performance Indexes are (next to many others):
  - High equipment availability
  - Minimum downtime (Repairs, Maintenance)
  - Accident prevention
  - Extended equipment lifetime
- Maintenance
  - Corrective maintenance
  - Preventive maintenance
  - Predictive maintenance
- Load sensors and systems to calculate and record lifetime data

New Developments

Lift data vs. Lifetime

Integrated parameters

Sensor

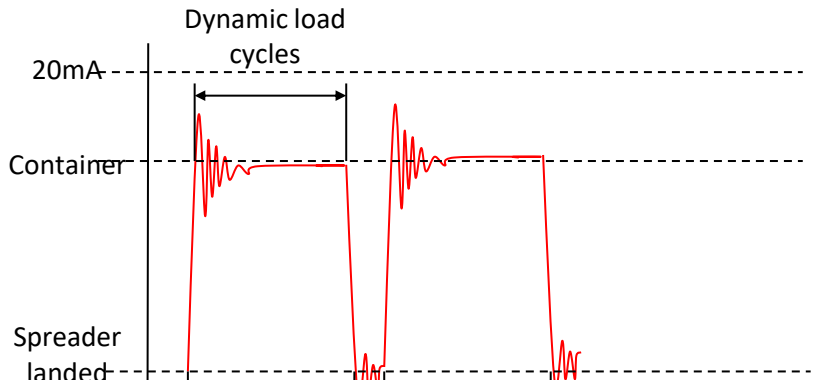
- Service hour meter
- Load collective
- Load cycles
- Overload counter

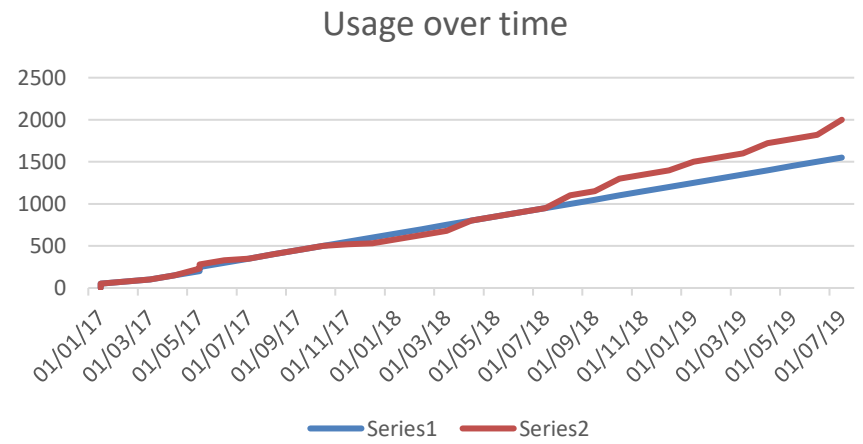
System

- Time based parameters

Calculation for

- Maintenance intervals
- Machine fatigue & lifetime
- Etc…..

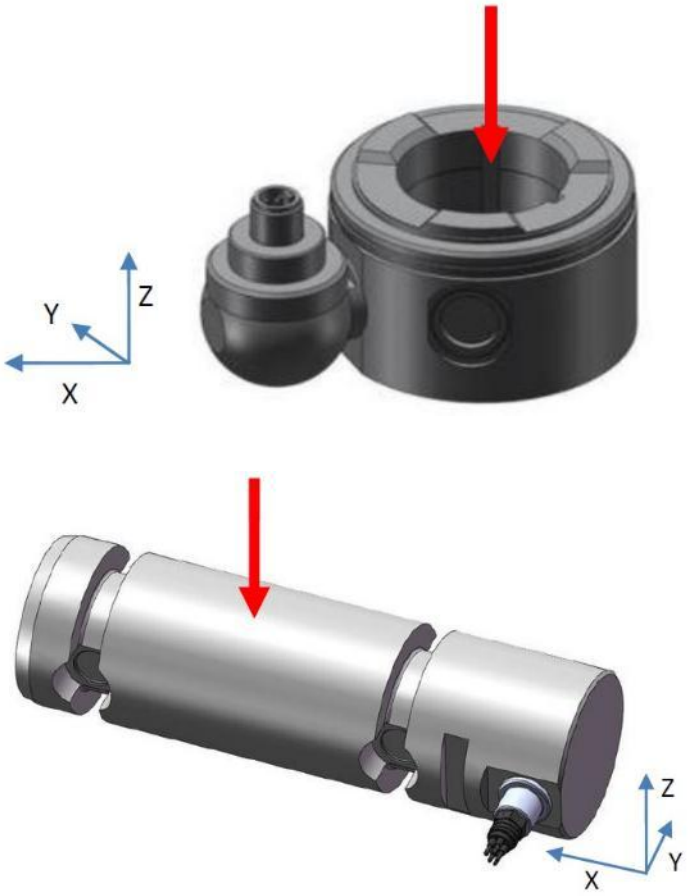




New Developments

Intelligent Sensors

- For sensor installation in the headblock
- Acceleration = change in velocity
  - Change in speed
  - Change in direction
  - Change in both
- During a lift of a container the hoisting speed accelerates while the trolley movement changes the direction.
- This causes unwanted effects into the measurement of the force created by the container
- The amplifier inside the sensor needs to calculate the dynamic forces
- Result shall be an increase of the overall accuracy of the load measurement by splitting the load signal in a static and a dynamic signal



BROSA

Users & Customers

APM TERMINALS
Lifting Global Trade

PSA

stinis

RAM SPREADERS

BROMMA

DP WORLD

DELLNER BUBENZER

SIBRE

Ican

MITSUI E&S

International Container Terminal Services, Inc.

ZPMC
上海振华重工
SHANGHAI ZHENHUA HEAVY

DOOSAN

KONECRANES

LIEBHERR

künz

Sumitomo Heavy Industries
Material Handling Systems Co.,Ltd.

CARGOTEC

CSSC 青岛海西重机有限责任公司
QINGDAO HAIXI HEAVY-DUTY MACHINERY CO.,LTD.

HDHM
华 东 重 机

SANY

BROSA GmbH

- A competent partner for load sensing and monitoring
- A leading supplier to the container handling industry
- An innovation driven development partner for future oriented products
- Supplier to all major crane and port equipment manufactures
- Products are used in all major ports around the world.

Please visit us at our booth outside for detailed technical discussions.

Contacts:

For enquiries you can contact Brosa Pte Ltd in Singapore :

Frank Mussgnug	frank.mussgnug@brosa.sg	+65 6795 2324
Jaswant Sharma	jaswant.sharma@brosa.sg	+65 6795 2324

END

THANK YOU VERY MUCH FOR YOUR ATTENTION