Unleashing the potential of Forta EDX 2304

ONS 2018

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Content

- Why use stainless steel?
- What would be the most cost-effective solution?
- Different stainless steel grades for different applications
- Duplex stainless steel EDX 2304 for off-shore topside applications

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Why use stainless steel?

Why use stainless steel?

- Carbon steel corrodes
- Carbon steel needs coating
- Coating needs maintenance
- Maintenance means higher life cycle costs (LCC)
- **Stainless steel reduces the LCC and the impact on environment, health & safety**

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What would be the most cost-effective solution?

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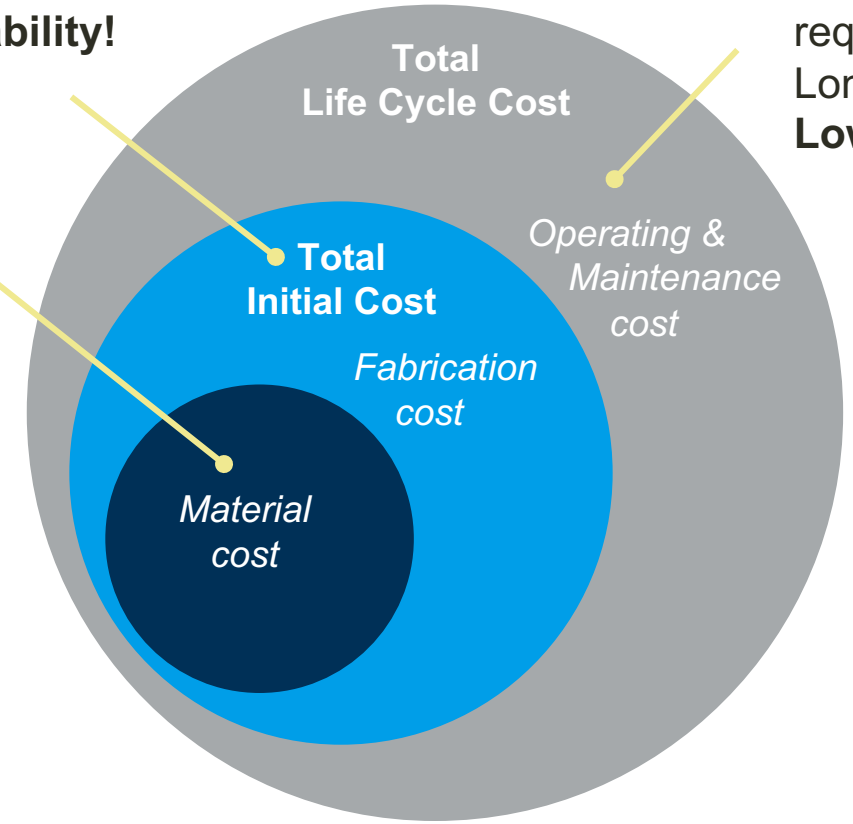
What would be the most cost-effective solution?

Coated carbon steel or high strength stainless steel?

- For platform lifetime expectancy >50 years
- To renew platforms without adding more weight

No coatings –
Higher Durability!

Strength utilization –
Weight Savings!



Less or no maintenance required.
Longer service life –
Lower life cycle cost!

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Different stainless steel grades for different applications

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For environment where type 316 is insufficient...

Atmospheric corrosion in chloride bearing environment:

Type 316

- Limited resistance to uniform and pitting corrosion in harsher environments
- Susceptible to stress corrosion cracking
- Moderate mechanical strength

Forta DX 2205

Ultra range Highly Alloyed Austentic and Nickel alloys:
For extremely corrosive environments

Forta range Duplex alloys:
For optimal combination of high strength and high corrosion resistance

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General characteristics

Ultra range

- Austenitic structure
- For use in a wide temperature range
- Very good resistance to uniform corrosion
- Good to exceptionally good resistance to pitting and crevice corrosion (PRE 28 to 56)
- Very good resistance to stress corrosion cracking
- Excellent formability
- Good weldability
- Non-magnetic

Forta range Duplex

- Austenitic-Ferritic structure
- High mechanical strength ($R_{p\ min}$ > 400 MPa)
- High resistance to localized corrosion (PRE 26 to 43) and stress corrosion cracking
- High wear resistance
- Low thermal expansion
- High energy absorption
- Good fabricability

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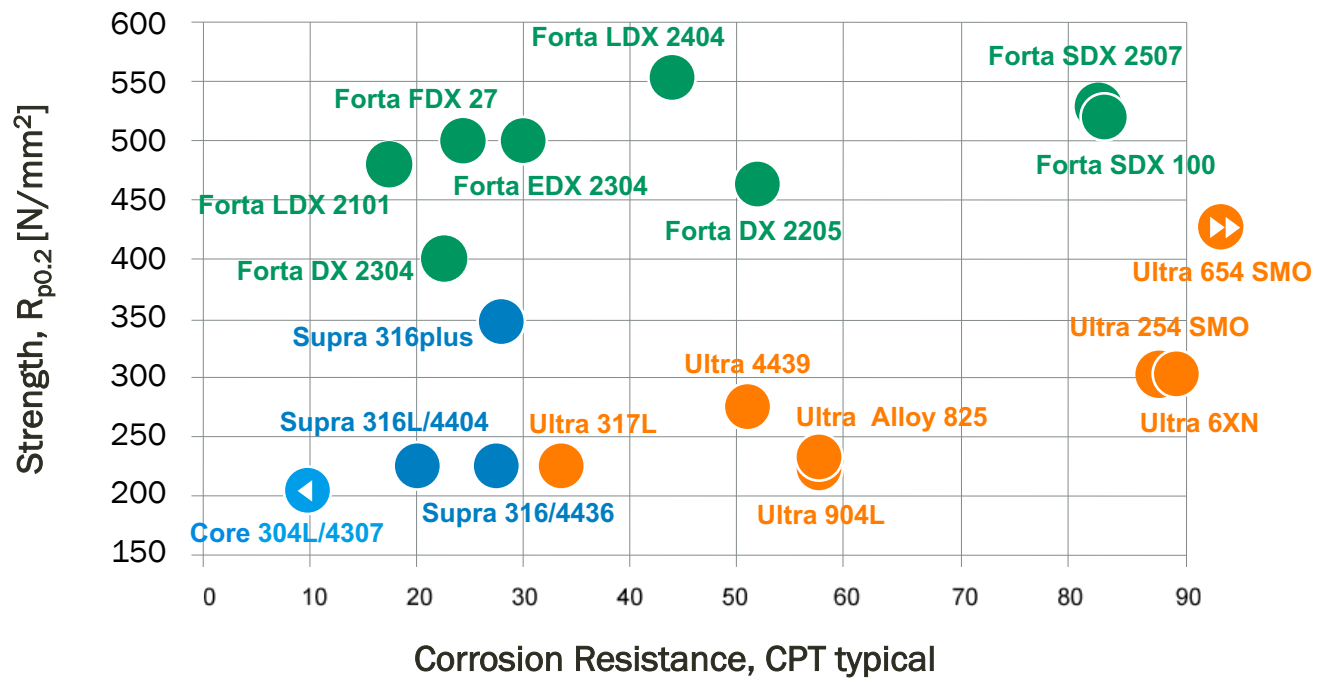
Outokumpu Supra, Forta and Ultra grade ranges



- Forta range Duplex
- Core range Austenitic
- Supra range Austenitic
- Ultra range Austenitic

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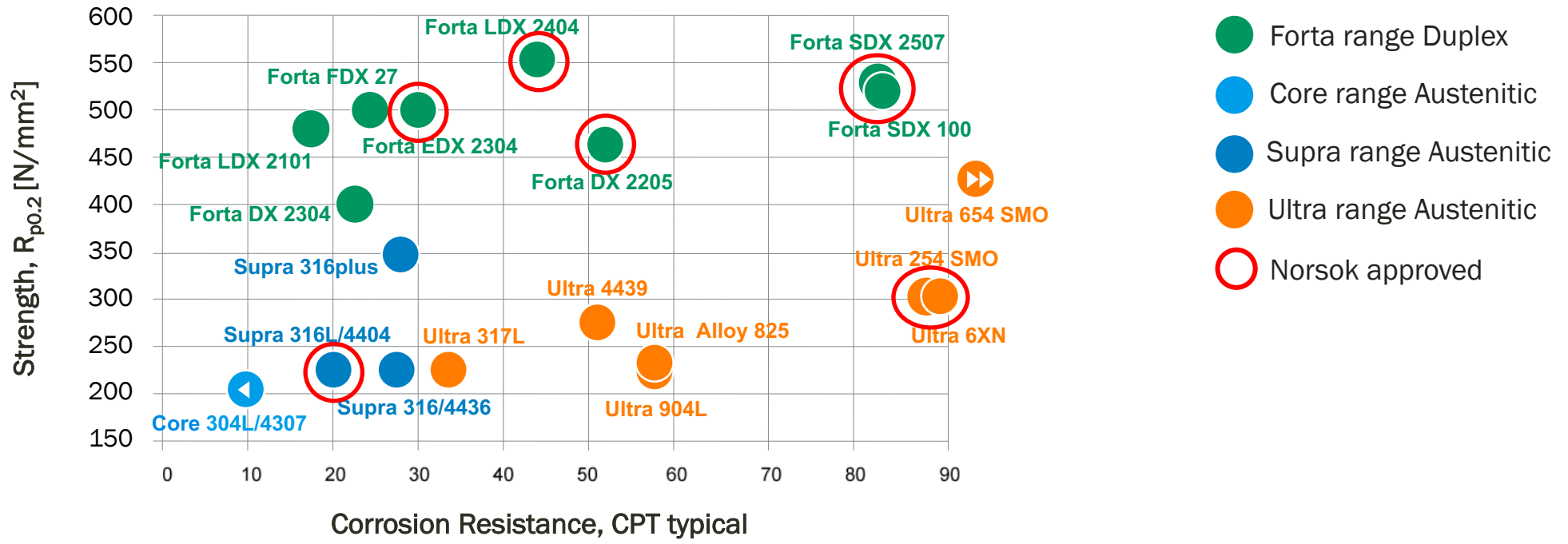
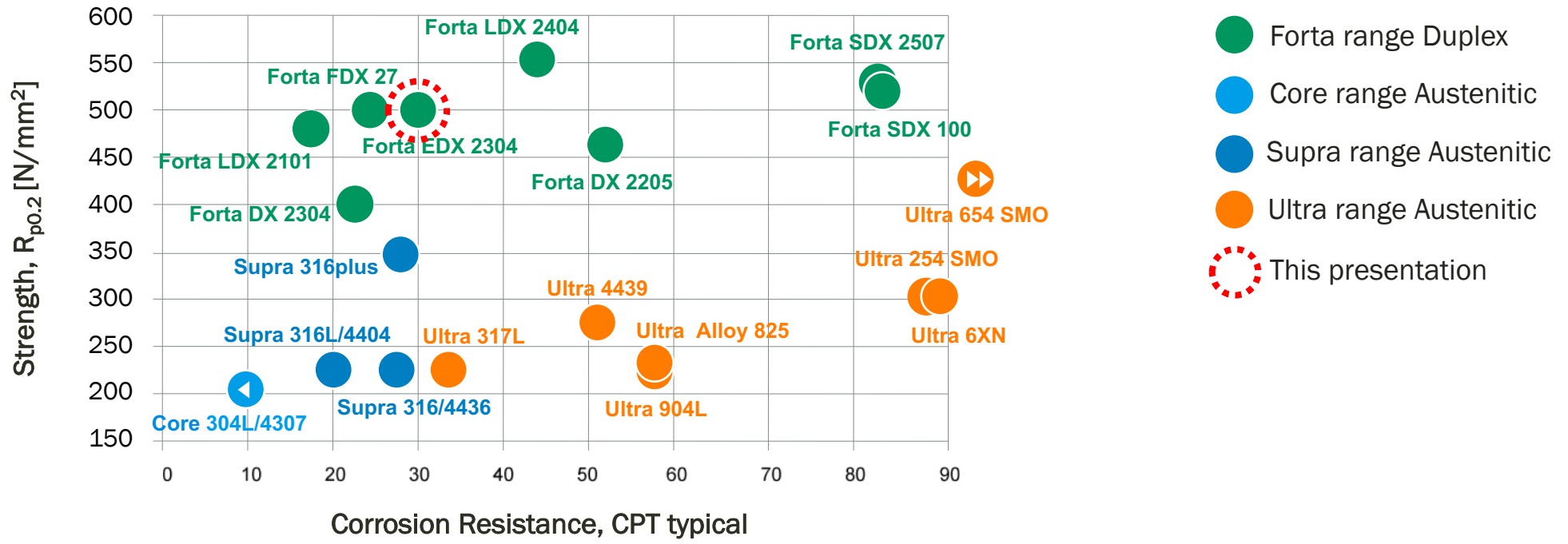
Outokumpu Supra, Forta and Ultra grade ranges



Outokumpu Supra, Forta and Ultra grade ranges



Duplex stainless steel EDX 2304 for off-shore topside applications

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Forta EDX 2304 chemical composition

Grade name	EN	ASTM/UNS	C	N	Cr	Ni	Mo	Other
Forta LDX 2101	1.4162	S32101	0.03	0.22	21.5	1.5	0.3	5Mn
Forta DX 2304	1.4362	S32304	0.02	0.10	23	4.8	0.3	-
Forta EDX 2304	**1.4362**	**S32304**	**0.02**	**0.18**	**23.5**	**4.3**	**0.5**	**-**
Forta DX 2205	1.4462	S32205	0.02	0.17	22	5.7	3.1	-
Supra 316L/4404	1.4404	316L	0.02	-	17.2	10.1	2.1	-
Ultra 904L	1.4539	904L	0.01	-	20	25	4.3	1.5Cu

PRE: %Cr + 3.3%Mo + 16%N increased from 25,6 to 28

Lowering of Nickel to balance the ferritic-austenitic microstructure

New grade still within standards
ASTM S32304 and EN 1.4362

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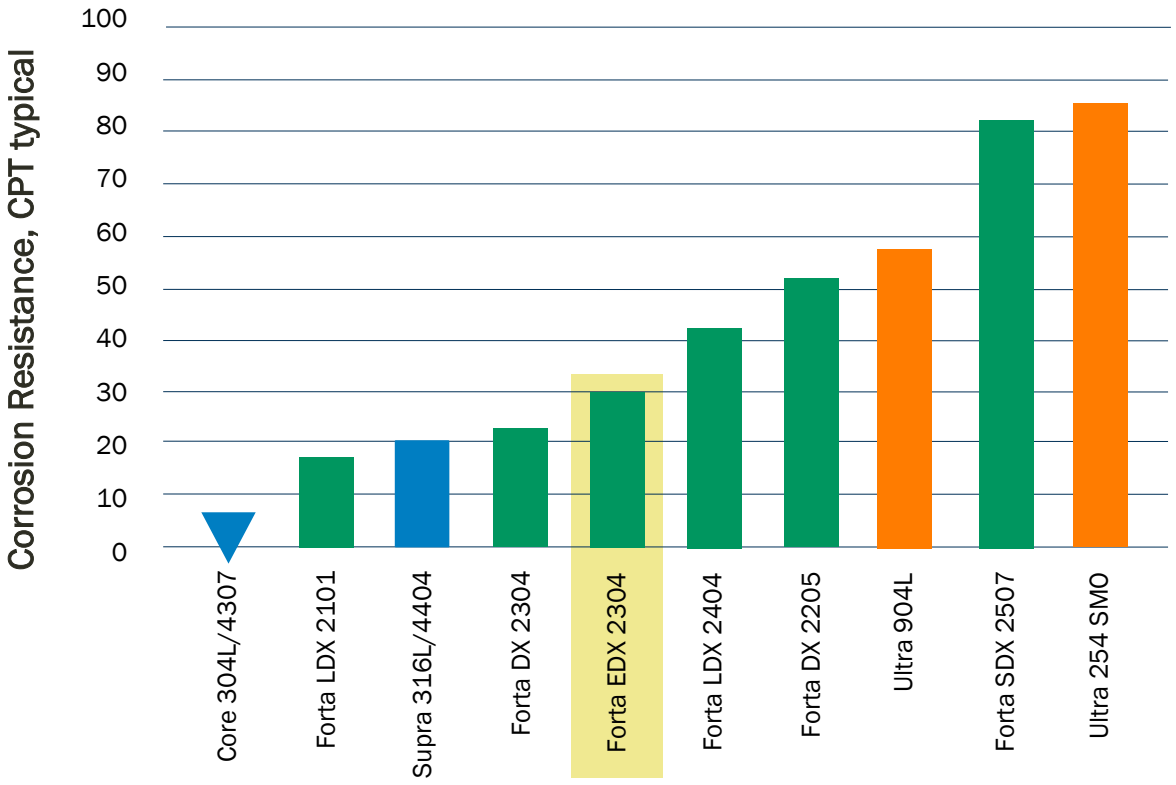
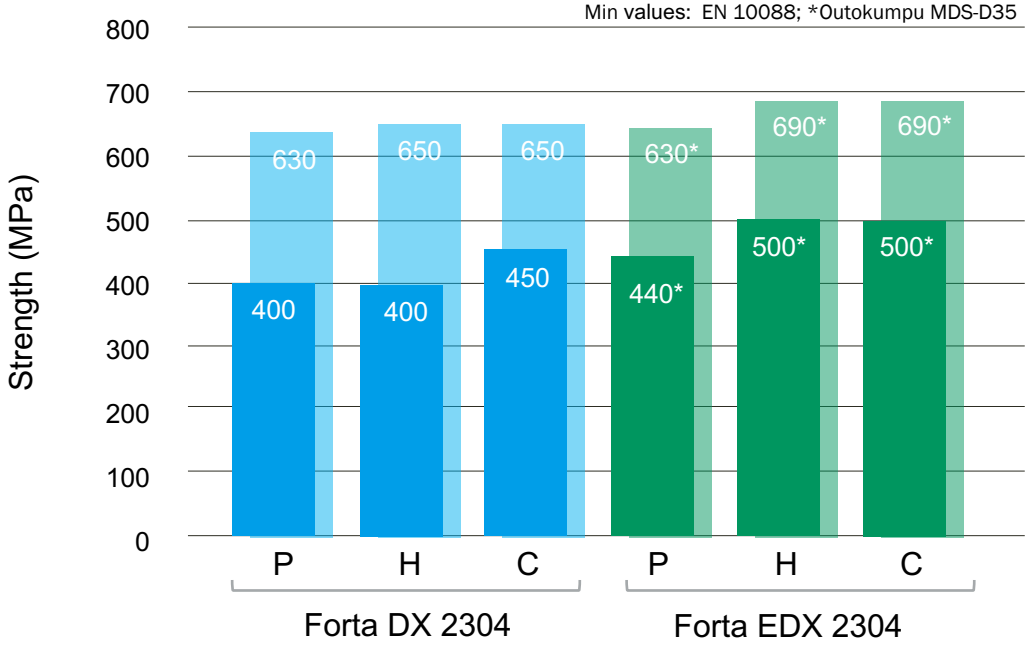
Forta EDX 2304 enhanced properties

Corrosion resistance



PRE	18	26	24	26	28	33	35	34	43	43

Mechanical properties



Proof strength, $R_{p0.2}$
Tensile strength, R_m

P = hot rolled plate and bar; H = hot rolled strip
C = cold rolled coil and strip, cold drawn bar

Elongation	25	20	20	25*	25*	25*	A_{50} (%)

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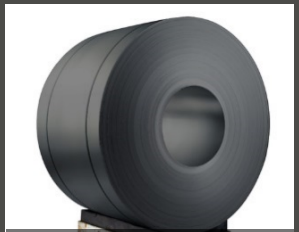
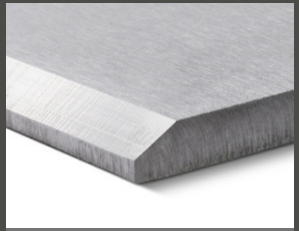
Product program



Hot rolled black strip

Cold rolled strip



Quarto plate

Thickness [mm]	Width [mm]
10.00 – 4.00	1,500
9.00 – 5.00	2,000
6.20 – 1.50	2,000 – 1,500
4.50 – 3.01	1,500 – 80
3.00 – 0.80	1,500 – 48/40/25
0.79 – 0.40	1,450/1,300 – 25
50 – 8	3,200 – 1,500
7	3,000 – 1,500
6	2,600 – 1,500
5	2,200 – 1,500

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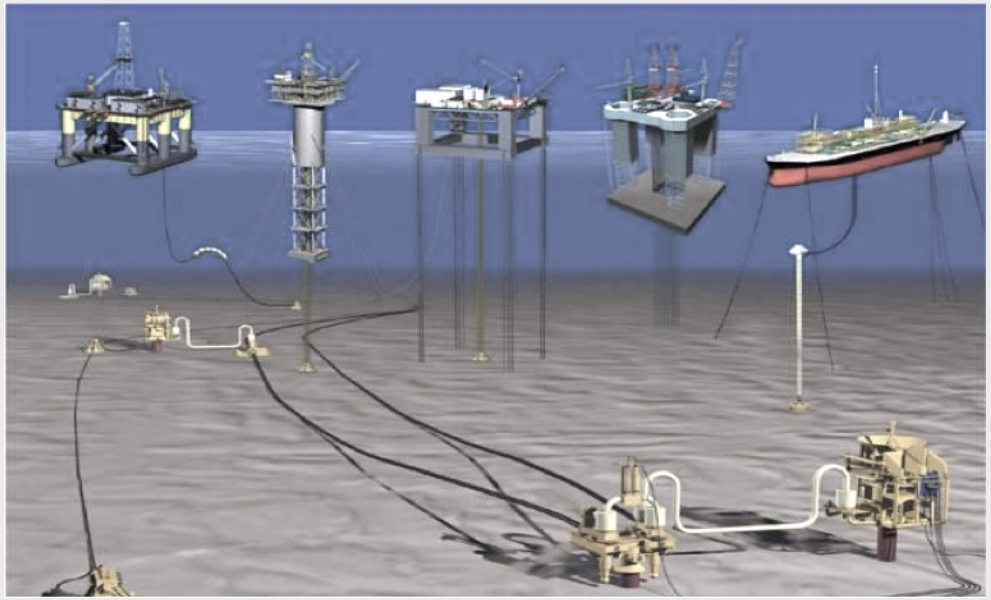
Different demands require different grades

TOPSIDE



SUBSEA

Topside conditions

- Distance to splash zone
- Temperature
- Regular washed or sheltered
- Need for weight saving
- Safety regulations
- Life time expectancy

Subsea conditions

- Deep water pressure
- Exposure to seawater
- Crude oil quality and condition
- Topography of the sea bottom

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Topside applications
– Forta and Ultra for lighter weight and longer lifetime

Superior strength and minimum maintenance for blast walls, firewalls and living quarters.

Traditionally: Supra 316L/4404

To add mechanical strength and corrosion resistance:
Forta EDX 2304 or Forta DX 2205

Absolute safety for cable trays, stairs, tread plates and walkways.

Todays benchmark: Supra 316L/4404

To add mechanical strength and corrosion resistance:
Forta EDX 2304 or Forta DX 2205

High performance required for main process piping.

To withstand: Seawater, H_2SO_4, CO_2
Mixtures of oil, gas and sand

Suitable grades:
Forta DX 2205, Forta SDX 2507 Ultra Alloy 825, Ultra 254 SMO

Enhanced corrosion resistance for off shore heat exchangers.

With seawater as a coolant:

Suitable grades:
Ultra 254 SMO or Forta SDX 2507

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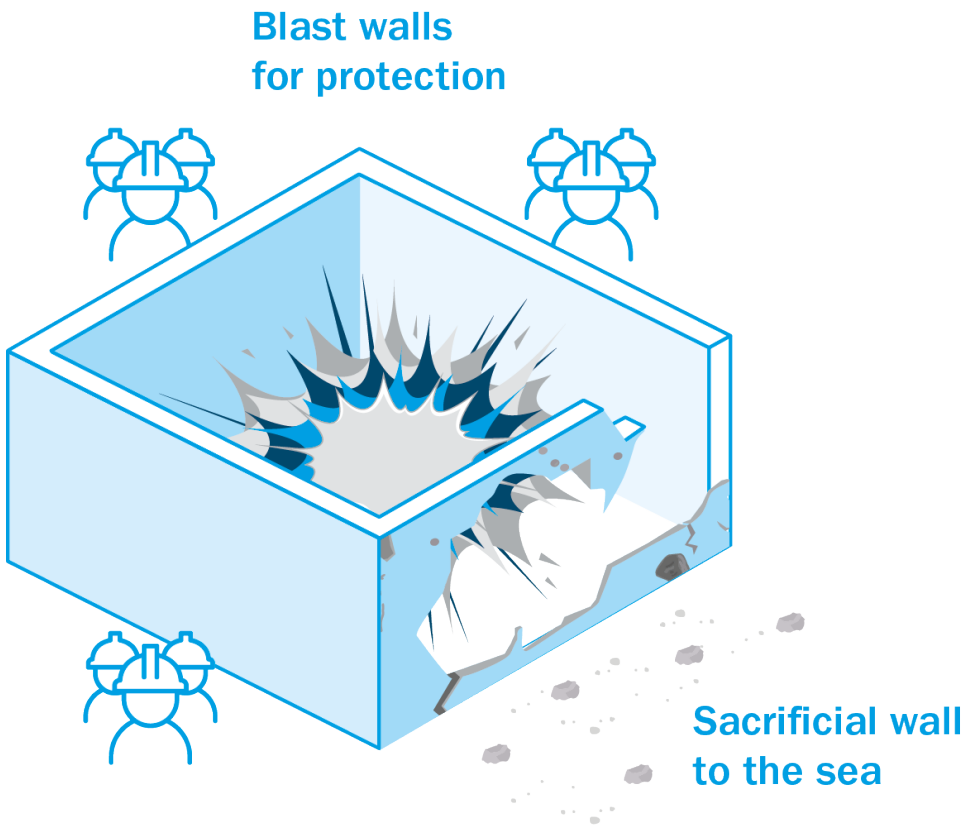
Forta EDX 2304 increases safety on platforms



Challenge

To protect workers and other vital platform areas, blast walls are used. Blast walls need to absorb energy rapidly as well as having a good corrosion resistance.

Solution

Forta EDX 2304 provides these properties and with appropriate designs can offer significant weight savings and therefore reduce costs compared to 316L.

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Forta EDX 2304 increases safety on platforms

Material and design challenge:

- PRE >28
- Reduced maintenance and increased service life compared to austenitic stainless solutions
- High strength for safe design
- Shall withstand situations of fire or explosion

Material and design solution:

- Forta EDX 2304
- Higher energy absorption
- Potential weight savings of at least 15% compared to 316L
- Adapted corrosion resistance compared to Forta DX 2205
- Minimal maintenance needed

Facts about Fire & Blast walls and Escape tunnels:

Design: By IKM dsc Eng.
Design life: 25-50 yrs. Deliveries to oil fields Ivar Aasen, Gina Krogh etc
Delivered: 2015

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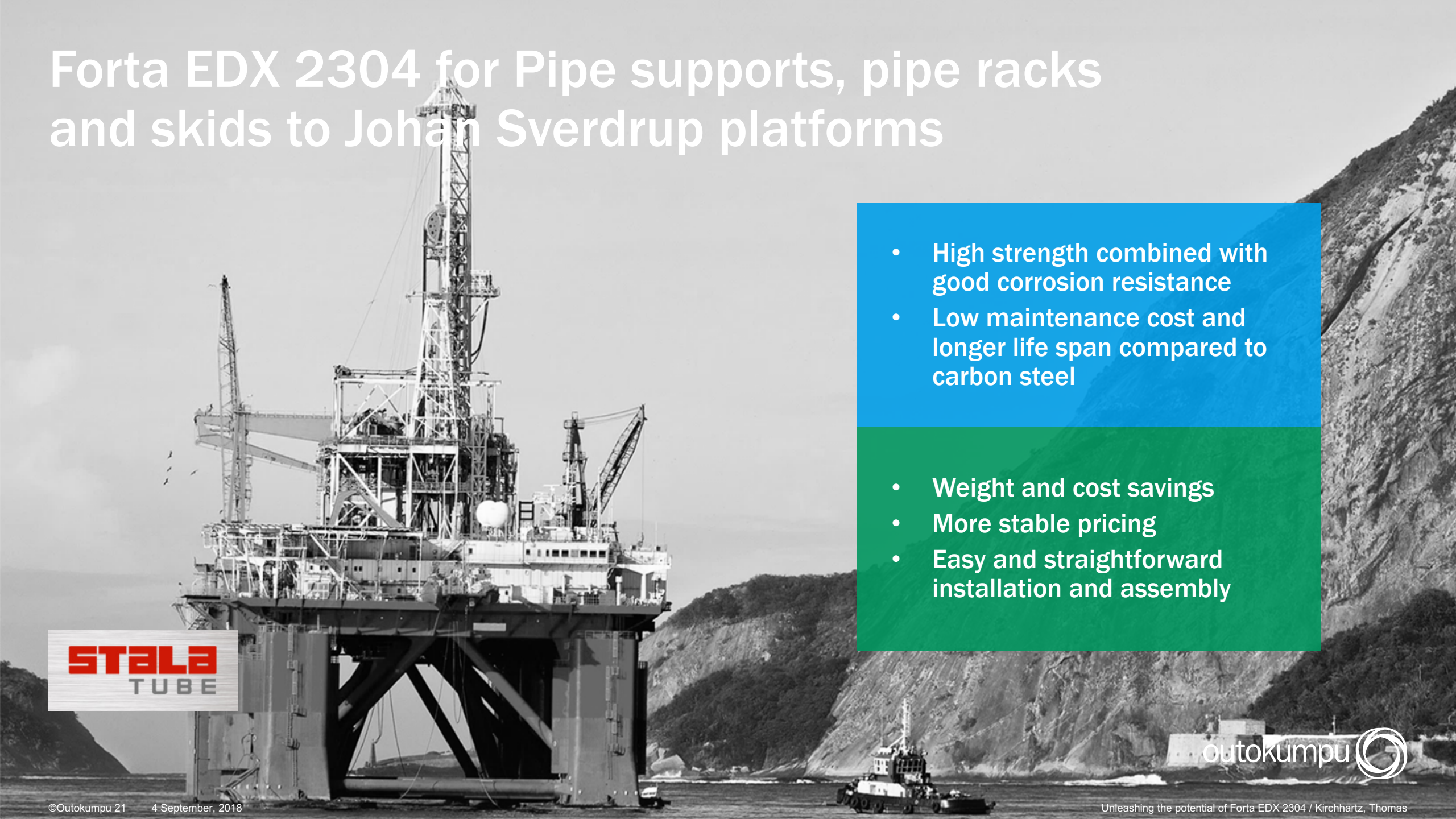
Forta EDX 2304 for Pipe supports, pipe racks and skids to Johan Sverdrup platforms



- High strength combined with good corrosion resistance
- Low maintenance cost and longer life span compared to carbon steel

- Weight and cost savings
- More stable pricing
- Easy and straightforward installation and assembly

STALA TUBE

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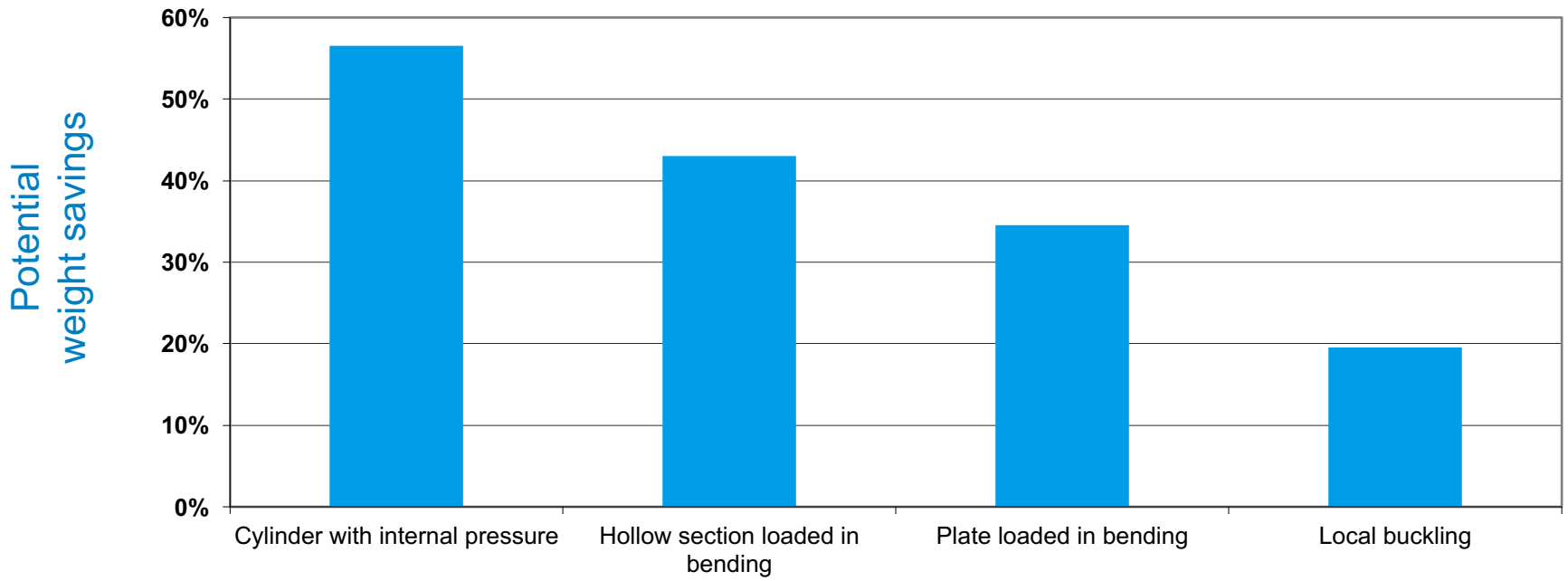
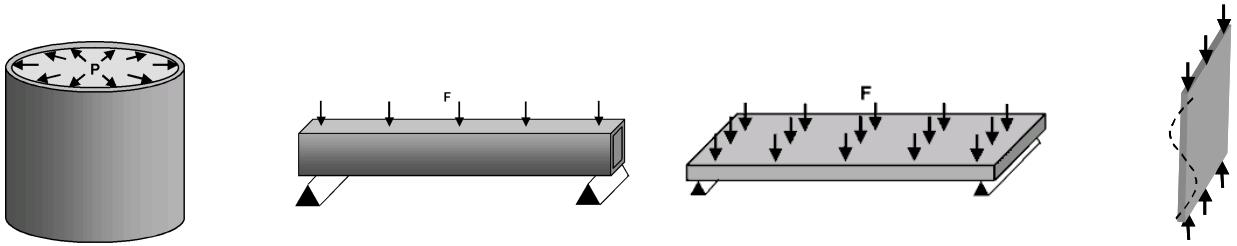
Forta Duplex weight saving potential vs 316L





Outokumpu Forta EDX 2304 for gratings

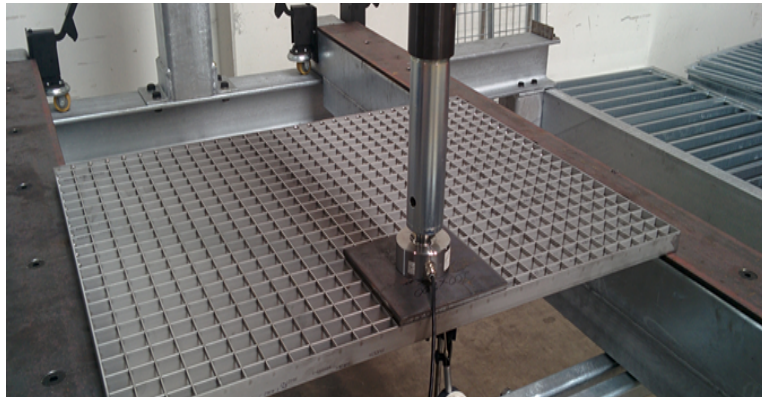
Main advantages by using gratings in Forta EDX 2304

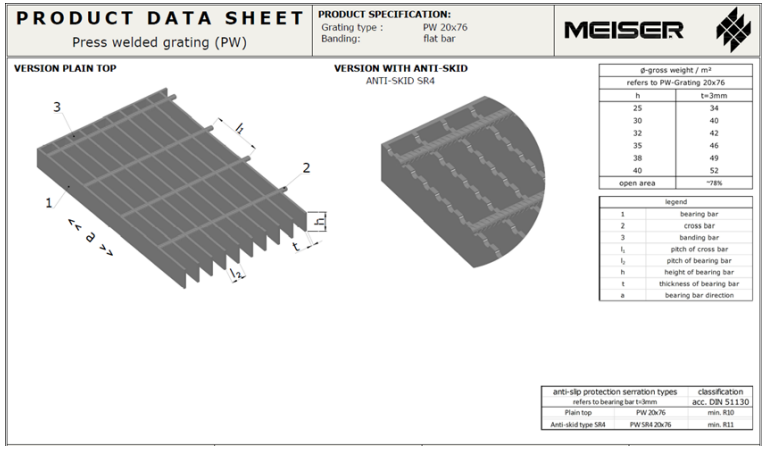
Vs. hot dip galvanized C-steel gratings

- Significantly lighter
- Longer lifetime
- Simple to adjust and reshape on site

Vs. glasfiber reinforced plastic gratings

- Longer lifetime
- Uniform strength in all direction
- Withstand low temperature
- Withstand fire





PRODUCT DATA SHEET
Press welded grating (PW)

PRODUCT SPECIFICATION:
Grating type : PW 20x76
Banding: flat bar

MEISER

VERSION PLAIN TOP

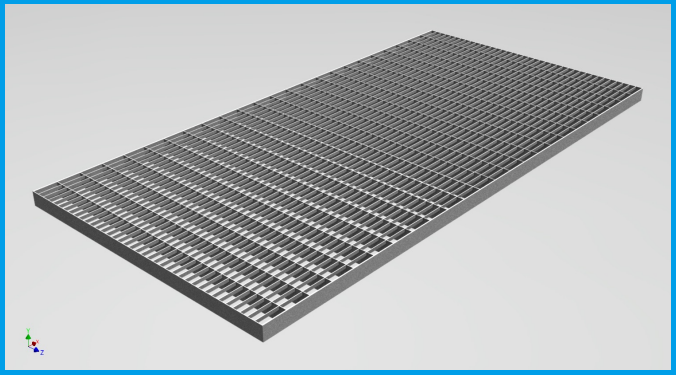
VERSION WITH ANTI-SKID
ANTI-SKID SR4

ø-gross weight / m²	
refers to PW-Grating 20x76	
h	t=3mm
25	34
30	40
32	42
35	46
38	49
40	52
open area	~78%

legend	
1	bearing bar
2	cross bar
3	banding bar
l_1	pitch of cross bar
l_2	pitch of bearing bar
h	height of bearing bar
t	thickness of bearing bar
a	bearing bar direction

anti-slip protection serration types refers to bearing bar t=3mm		classification acc. DIN 51130
Plain top	PW 20x76	min. R10
Anti-skid type SR4	PW SR4 20x76	min. R11

The optimized EDX grating of only 20 kg/m² specific weight is capable to span approx. 1,500 mm unsupported, being of only half the weight of comparable conventional gratings.



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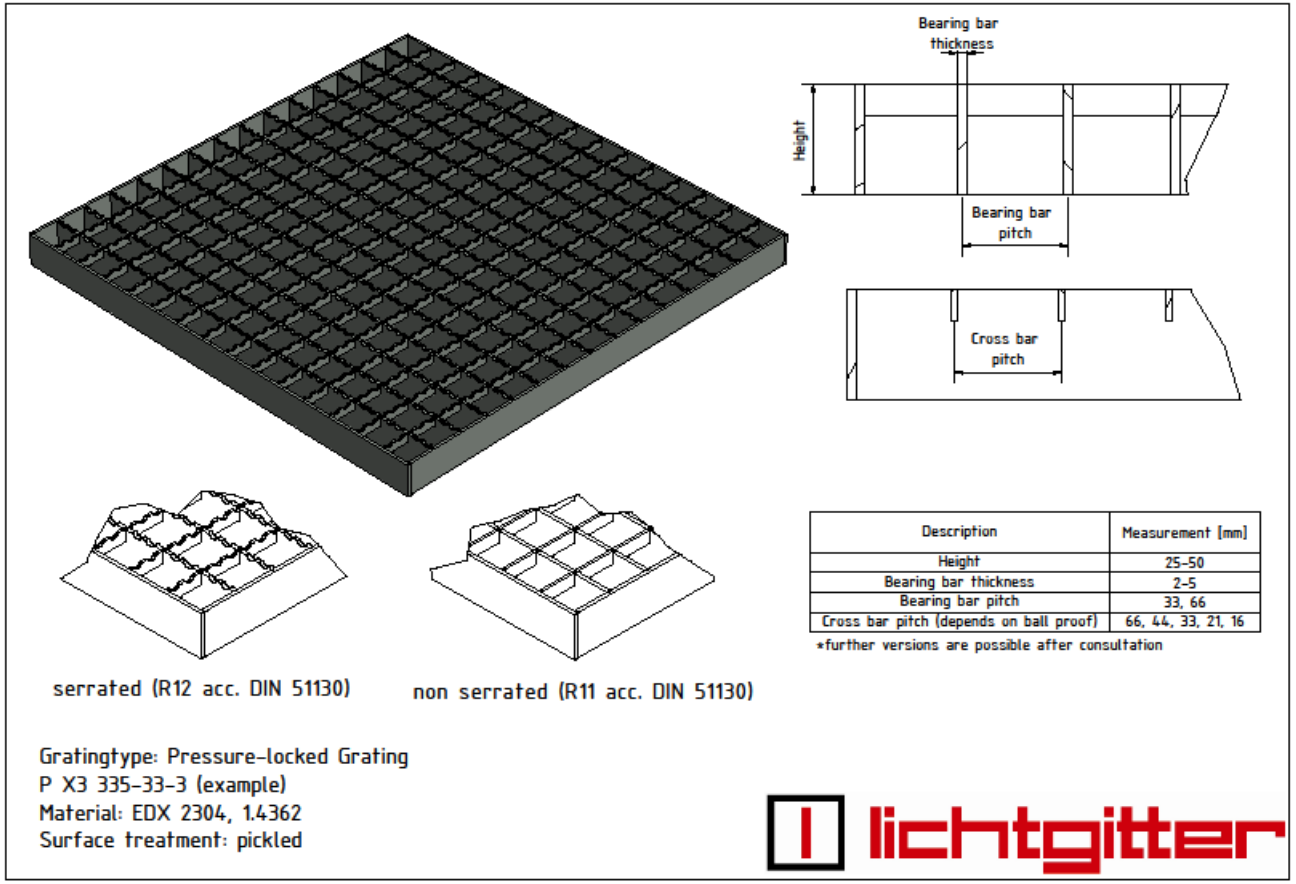
Outokumpu Forta EDX 2304 for gratings



Generally EDX 2304 enables slimmer grating layouts through reduced bar thickness, hence reduced weight, but still carrying the same load.

- EDX design with load bearing bars of only 3 mm thickness can take comparable load as S355 design with 5 mm load bearing bar thickness.
- Weight of EDX design = approx. 44 kg/m² compared to weight of S355 standard offshore design = approx. 63 kg/m², counting for

>30% of weight savings

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Summary

Typical new Forta EDX 2304 weight saved off-shore applications with longer lifetime

- Blast walls
- Pipe supports
- Gratings
- Beams
- Plates

Forta EDX 2304 combination of high-strength and corrosion resistance adds to an unique potential for a variety of applications also on shore as well as in urban and industrial areas.

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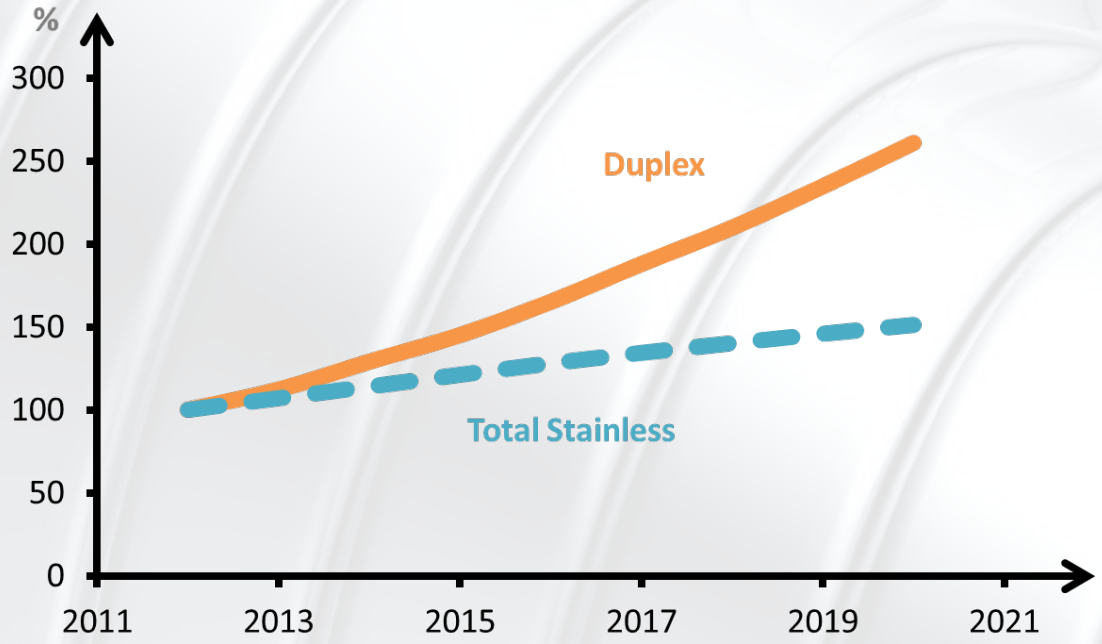
Duplex – the fastest growing grade group



Thank you for listening!

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