

# SELECTION OF WELDING CONSUMABLES

HOT ROLLED STEEL PLATES, SHEETS AND COILS

**RUUKKI**

Energy-efficient steel solutions for better LIVING. WORKING. MOVING.

This brochure presents the welding consumable recommendations of hot rolled steels for the following welding processes:

- GMAW (gas-metal arc welding) or MAG/MIG welding
- FCAW (flux-cored arc welding)
- MMAW (Manual metal arc welding) or SMAW (Shielded metal arc welding)
- SAW (submerged arc welding).

In addition to the consumables mentioned in the tables, corresponding welding consumables from other suppliers/manufacturers are equally recommended. The validity of any recommendations is advised to be verified with the manufacturer before welding.

The chemical composition of Ruukki's hot rolled steel grades as well as other technical data are shown on the web site [www.ruukki.com](http://www.ruukki.com).

**Table 1. Gas-metal arc welding (GMAW), recommended welding consumables**

<b>MAG WELDING (solid wire)</b>				
<b>Steel grade Standard</b>		<b>ESAB Wire + gas OK AristoRod/Autrod + gas</b>	<b>ELGA Wire + gas Elgamatic + gas</b>	<b>Wire + gas ISAF + gas</b>
EN 10025-2	S355J0, S355J2	12.50/12.51 + M20, M21, CO <sub>2</sub>	100 + M21, CO <sub>2</sub>	IS-10 BRONZE + M21, CO <sub>2</sub>
Multisteel	Multisteel	12.50/12.51 + M20, M21, CO <sub>2</sub>	100 + M21, CO <sub>2</sub>	IS-10 BRONZE + M21, CO <sub>2</sub>
EN 10025-3	S355N	12.50/12.51 + M20, M21, CO <sub>2</sub>	100 + M21, CO <sub>2</sub>	IS-10 BRONZE + M21, CO <sub>2</sub>
	S355NL	13.28 + M21	162 + M21, CO <sub>2</sub>	IS-10 BRONZE + M21, CO <sub>2</sub>
	S420N	12.50/12.51 + M20, M21	100 + M21, CO <sub>2</sub>	IS-10 BRONZE + M21, CO <sub>2</sub>
	S420NL	13.28 + M20, M21	162 + M21, CO <sub>2</sub>	IS-10 BRONZE + M21, CO <sub>2</sub>
Optim®; heavy plate	Optim 500 ML	13.28 + M20, M21	103 + M21, CO <sub>2</sub>	
	Optim 700 QL	69 + M21	135 + M21, CO <sub>2</sub>	
Ruukki Laser®	Ruukki Laser 250 C	12.50/12.51 + M20, M21, CO <sub>2</sub>	100 + M21, CO <sub>2</sub>	IS-10 BRONZE + M21, CO <sub>2</sub>
	Ruukki Laser 355 MC	12.50/12.51 + M20, M21, CO <sub>2</sub>	100 + M21, CO <sub>2</sub>	IS-10 BRONZE + M21, CO <sub>2</sub>
	Ruukki Laser 420 MC	12.50/12.51 + M20, M21	100 + M21, CO <sub>2</sub>	IS-10 BRONZE + M21, CO <sub>2</sub>
Optim®; strip	Optim 500 MC	55 + M20, M21	103 + M21, CO <sub>2</sub>	
	Optim 550 MC	55 + M20, M21	135 + M21, CO <sub>2</sub>	
	Optim 600 MC	69 + M20, M21	135 + M21, CO <sub>2</sub>	
	Optim 650 MC	69 + M20, M21	135 + M21, CO <sub>2</sub>	
	Optim 700 MC	69 + M20, M21	135 + M21, CO <sub>2</sub>	
	Optim 900 QC	89 + M20, M21	135 + M21, CO <sub>2</sub>	
	Optim 960 QC	89 + M20, M21 <sup>1)</sup>	138 + M21, CO <sub>2</sub>	
	Optim 1100 QC	89 + M20, M21 <sup>1)</sup>		
	Optim 550 W	13.26 + M20, M21	140 + M21, CO <sub>2</sub>	
	Optim 960 W	13.26 + M20, M21 <sup>1)</sup>	140 + M21, CO <sub>2</sub> <sup>1)</sup>	
	Optim 960 W	89 + M20, M21		
COR-TEN®	COR-TEN® A	13.26 + M20, M21	140 + M21, CO <sub>2</sub>	
	COR-TEN® B	13.26 + M20, M21	140 + M21, CO <sub>2</sub>	
Raex® Boron steel	Undermatching consumable <sup>2)</sup> Raex 400/450/500 B24, B27	12.50/12.51 + M20, M21, CO <sub>2</sub>	100 + M21, CO <sub>2</sub>	IS-10 BRONZE + M21, CO <sub>2</sub>
Raex® Boron steel	High strength consumable Raex 400/450/500 B24, B27	69 + M20, M21	135 + M21, CO <sub>2</sub>	

<sup>1)</sup> Undermatching consumable (strength of the consumable lower than that of the base material).

<sup>2)</sup> The yield strength of the consumable is lower than that of the hardened base material.

To be continued

<b>MAG WELDING (solid wire)</b>				
<b>Steel grade Standard</b>		<b>LINCOLN ELECTRIC Wire + gas Lincoln + gas</b>	<b>Wire + gas Böhler Welding + gas</b>	<b>Wire + gas Oerlikon + gas</b>
EN 10025-2	S355J0, S355J2	LNМ 26 + M21, CO <sub>2</sub>	EMK 6 + M21	Carbofil 1 + M21, CO <sub>2</sub>
Multisteel	Multisteel	LNМ 26 + M21, CO <sub>2</sub>	EMK 6 + M21	Carbofil 1 + M21, CO <sub>2</sub>
EN 10025-3	S355N S355NL S420N S420NL	LNМ 26 + M21, CO <sub>2</sub> LNМ 26 + M21 LNМ Ni 1 + M21 LNМ Ni 1 + M21	EMK 6 + M21 EMK 6 + M21 EMK 6 + M21 Union Ni 2,5 + M21	Carbofil 1 + M21, CO <sub>2</sub> Carbofil NiMo1 + M21 Carbofil 1A + M21, CO <sub>2</sub> Carbofil NiMo1 + M21
Optim®; heavy plate	Optim 500 ML Optim 700 QL	LNМ Ni 2,5 + M21 LNМ MONIVA + M21	Union MoNi + M21 Union NiMoCr + M21	Carbofil NiMo1 + M21 Carbofil NiMoCr + M21
Ruukki Laser®	Ruukki Laser 250 C Ruukki Laser 355 MC Ruukki Laser 420 MC	LNМ 26 + M21 LNМ 26 + M21 LNМ 26 + M21	EMK 6 + M21 EMK 6 + M21 EMK 6 + M21	Carbofil 1 + M21, CO <sub>2</sub> Carbofil 1 + M21, CO <sub>2</sub> Carbofil 1 + M21, CO <sub>2</sub>
Optim®; strip	Optim 500 MC Optim 550 MC Optim 600 MC Optim 650 MC Optim 700 MC  Optim 900 QC Optim 960 QC Optim 1100 QC  Optim 550 W Optim 960 W	LNМ 26 + M21 LNМ MONIVA + M21 LNМ MONIVA + M21 LNМ MONIVA + M21 LNМ MONIVA + M21 LNМ MONIVA + M21    LNМ 28 + M21	DMO-IG + M21 Union NiMoCr + M21 Union NiMoCr + M21 Union NiMoCr + M21 Union NiMoCr + M21 Union NiMoCr + M21  Union X90 + M21 Union X96 + M21  Union Patinax + M21 Union X90/X96	Carbofil NiMo1 + M21 Carbofil NiMo1 + M21 Carbofil NiMo1 + M21 Carbofil NiMoCr + M21 Carbofil NiMoCr + M21    Union X90 + M21 Union X96 + M21  Union Patinax + M21 Union X90/X96
COR-TEN®	COR-TEN® A COR-TEN® B	LNМ 28 + M21 LNМ 28 + M21	Union Patinax + M21 Union Patinax + M21	
Raex® Boron steel	Undermatching consumable <sup>1)</sup> Raex 400/450/500 B 24, B 27	LNМ 26 + M21, CO <sub>2</sub>	EMK 6 + M21	Carbofil 1 + M21, CO <sub>2</sub>
Raex® Boron steel	High strength consumable Raex 400/450/500 B 24, B 27	LNМ MONIVA	Union NiMoCr + M21	Carbofil CrMo 1 + M21

<sup>1)</sup> The yield strength of the consumable is lower than that of the hardened base material.

**Table 2. Flux-cored arc welding (FCAW), recommended welding consumables**

Flux-cored arc welding				
Steel grade Standard		ESAB		
		Metal-cored wire OK Tubrod + gas	Flux-cored wire OK Tubrod + gas	Self-shielding wire
EN 10025-2	S355J0, S355J2	14.12 + M21	15.14 + M21, CO <sub>2</sub>	Coreshield 8
Multisteel	Multisteel	14.12 + M21	15.14 + M21, CO <sub>2</sub>	Coreshield 8
EN 10025-3	S355N	14.12 + M21	15.14 + M21, CO <sub>2</sub>	Coreshield 8
	S355NL	14.04 + M21	15.11 + M21	
	S420N	14.12 + M21	15.14 + M21, CO <sub>2</sub>	Coreshield 8
	S420NL	14.04 + M21	15.11 + M21	
Optim®; heavy plate	Optim 500 ML	Coreweld 50 + M21	15.11 + M21	
	Optim 700 QL	14.03 + M21	15.09 + M21	
Ruukki Laser®	Ruukki Laser 250 C	14.12 + M21	15.14 + M21, CO <sub>2</sub>	Coreshield 8
	Ruukki Laser 355 MC	14.12 + M21	15.14 + M21, CO <sub>2</sub>	Coreshield 8
	Ruukki Laser 420 MC	14.12 + M21	15.14 + M21, CO <sub>2</sub>	Coreshield 8
Optim®; strip	Optim 500 MC	Coreweld 50 + M21	Dual Shield 55 + M21	
	Optim 550 MC	14.03 + M21	Dual Shield 55 + M21	
	Optim 600 MC	14.03 + M21	Dual Shield 62 + M21	
	Optim 650 MC	14.03 + M21	15.09 + M21	
	Optim 700 MC	14.03 + M21	15.09 + M21	
	Optim 900 QC	Coreweld 89 + M21	15.09 + M21 <sup>1)</sup>	
	Optim 960 QC	Coreweld 89 + M21	15.09 + M21 <sup>1)</sup>	
	Optim 1100 QC	Coreweld 89 + M21 <sup>1)</sup>	15.09 + M21 <sup>1)</sup>	
	Optim 550 W		15.11 + M21	
	Optim 960 W	Coreweld 89		
COR-TEN®	COR-TEN® A	14.04 + M21	15.17 + M21	
	COR-TEN® B	14.04 + M21	15.17 + M21	
Raex® Boron steel	Undermatching consumable <sup>2)</sup>	14.12 + M21	15.14 + M21, CO <sub>2</sub>	
	Raex 400/450/500 B 24, B 27			
Raex® Boron steel	High strength consumable	14.03 + M21	15.09 + M21	
	Raex 400/450/500 B 24, B 27			

<sup>1)</sup> Undermatching consumable (strength of the consumable lower than that of the base material).

<sup>2)</sup> The yield strength of the consumable is lower than that of the hardened base material.

To be continued

<b>Flux-cored arc welding</b>			
<b>Steel grade Standard</b>		<b>ESAB Metal-cored wire Filarc + gas</b>	<b>Flux-cored wire Filarc + gas</b>
EN 10025-2	S355J0, S355J2	PZ 6102 + M21	PZ 6113 + M21, CO <sub>2</sub>
Multisteel	Multisteel	PZ 6102 + M21	PZ 6113 + M21, CO <sub>2</sub>
EN 10025-3	S355N S355NL S420N S420NL	PZ 6102 + M21 PZ 6104 + M21 PZ 6102 + M21 PZ 6104 + M21	PZ 6113 + M21, CO <sub>2</sub> PZ 6138 + M21 PZ 6113 + M21, CO <sub>2</sub> PZ 6138 + M21
Optim®; heavy plate	Optim 500 ML Optim 700 QL		PZ 6138 + M21 PZ 6148 + M21
Ruukki Laser®	Ruukki Laser 250 C Ruukki Laser 355 MC Ruukki Laser 420 MC	PZ 6102 + M21 PZ 6102 + M21 PZ 6102 + M21	PZ 6113 + M21, CO <sub>2</sub> PZ 6113 + M21, CO <sub>2</sub> PZ 6113 + M21, CO <sub>2</sub>
Optim®; strip	Optim 500 MC Optim 550 MC Optim 600 MC Optim 650 MC Optim 700 MC  Optim 900 QC Optim 960 QC Optim 1100 QC		PZ 6138 + M21 PZ 6146 + M21 PZ 6146 + M21 PZ 6147 + M21 PZ 6148 + M21  PZ 6149 + M21 PZ 6149 + M21 <sup>1)</sup> PZ 6149 + M21 <sup>1)</sup>
COR-TEN®	COR-TEN® A COR-TEN® B	PZ 6104 + M21 PZ 6104 + M21	PZ 6112 + M21, CO <sub>2</sub> PZ 6112 + M21, CO <sub>2</sub>
Raex® Boron steel	Undermatching consumable <sup>2)</sup> Raex 400/450/500 B 24, B 27	PZ 6102 + M21	PZ 6113 + M21, CO <sub>2</sub>
Raex® Boron steel	High strength consumable Raex 400/450/500 B 24, B 27	PZ 6102 + M21	PZ 6148 + M21

To be continued

<b>Flux-cored arc welding</b>			
<b>Steel grade Standard</b>		<b>ELGA Metal-cored wire Elga + gas</b>	<b>Flux-cored wire Elga + gas</b>
EN 10025-2	S355J0, S355J2	MXA 100 + M21	DWA 50 + M21
Multisteel	Multisteel	MXA 100 + M21	DWA 50 + M21
EN 10025-3	S355N S355NL S420N S420NL	MXA 100 + M21 MXA 55T + M21 MXA 100 + M21 MXA 55T + M21	DWA 50 + M21 DWA 55L + M21 DWA 50 + M21 DWA 55L + M21
Optim®; heavy plate	Optim 500 ML Optim 700 QL	MXA 55T + M21	DWA 55L + M21 110B + M21, CO <sub>2</sub>
Ruukki Laser®	Ruukki Laser 250 C Ruukki Laser 355 MC Ruukki Laser 420 MC	MXA 100 + M21 MXA 100 + M21 MXA 100 + M21	DWA 50 + M21 DWA 50 + M21 DWA 50 + M21
Optim®; strip	Optim 500 MC Optim 550 MC Optim 600 MC Optim 650 MC Optim 700 MC  Optim 900 QC Optim 960 QC Optim 1100 QC		DWA 65L + M21 DWA 65L + M21 110B + M21, CO <sub>2</sub> 110B + M21, CO <sub>2</sub> 110B + M21, CO <sub>2</sub>  110B + M21, CO <sub>2</sub>
COR-TEN®	COR-TEN® A COR-TEN® B		DW588 + CO <sub>2</sub> DW588 + CO <sub>2</sub>
Raex® Boron steel	Undermatching consumable <sup>2)</sup> Raex 400/450/500 B 24, B 27		DWA 50 + M21
Raex® Boron steel	High strength consumable Raex 400/450/500 B 24, B 27		110B + M21, CO <sub>2</sub>

<sup>1)</sup> Undermatching consumable (strength of the consumable lower than that of the base material).

<sup>2)</sup> The yield strength of the consumable is lower than that of the hardened base material.

To be continued

<b>Flux-cored arc welding</b>							
<b>Steel grade Standard</b>		<b>LINCOLN ELECTRIC</b>					
		<b>Metal-cored wire Lincoln + gas</b>	<b>Flux-cored wire Lincoln + gas</b>	<b>Self-shielding wire Lincoln</b>			
EN 10025-2	S355J0, S355J2	OS MC 710-H + M21	OS 71 E-H + M21, CO <sub>2</sub>	IS NR 203 Ni 1			
Raex®	Multisteel	OS MC 710-H + M21	OS 71 E-H + M21, CO <sub>2</sub>	IS NR 203 Ni 1			
EN 10025-3	S355N	OS MC 710-H + M21	OS 71 E-H + M21, CO <sub>2</sub>	IS NR 203 Ni 1			
	S355NL	OS MC 715-H + M21	OS 81 Ni 1-H + M21	IS NR 400			
	S420N	OS MC 715-H + M21	OS 81 Ni 1-H + M21	IS NR 400			
	S420NL	OS MC 715-H + M21	OS 81 Ni 1-H + M21	IS NR 400			
Optim®; heavy plate	Optim 500 ML	OS MC 1100 + M21	OS 81 K 2-H + M21	IS NR 400			
	Optim 700 QL		OS 690-H + M21				
Ruukki Laser®	Ruukki Laser 250 C	OS MC 710-H + M21	OS 71 E-H + M21, CO <sub>2</sub>	IS NR 203 Ni 1			
	Ruukki Laser 355 MC	OS MC 710-H + M21	OS 71 E-H + M21, CO <sub>2</sub>	IS NR 203 Ni 1			
	Ruukki Laser 420 MC	OS MC 710-H + M21	OS 71 E-H + M21, CO <sub>2</sub>	IS NR 203 Ni 1			
Optim®; strip	Optim 500 MC		OS 71 E-H + M21, CO <sub>2</sub>				
	Optim 550 MC		OS 71 E-H + M21, CO <sub>2</sub>				
	Optim 600 MC		OS 71 E-H + M21, CO <sub>2</sub>				
	Optim 650 MC		OS 550-H + M21				
	Optim 700 MC		OS 690-H + M21				
	Optim 900 QC						
	Optim 960 QC						
	Optim 1100 QC						
	COR-TEN®		COR-TEN® A			OS 81 Ni 1-H + M21	IS NR 203 Ni 1
			COR-TEN® B			OS 81 Ni 1-H + M21	IS NR 203 Ni 1
Raex® Boron steel	Undermatching consumable <sup>1)</sup>	OS MC 710-H + M21	OS 71 E-H + M21, CO <sub>2</sub>				
	Raex 400/450/500 B 24, B 27						
Raex® Boron steel	High strength consumable Raex 400/450/500 B 24, B 27	OS MC 1100 + M21					

To be continued

<b>Flux-cored arc welding</b>			
<b>Steel grade Standard</b>		<b>Metal-cored wire Böhler Welding + gas</b>	<b>Flux-cored wire Böhler Welding + gas</b>
EN 10025-2	S355J0, S355J2	Union MV 70 + M21, C1	RV 71 + M21, C1
Multisteel	Multisteel	Union MV 70 + M21, C1	RV 71 + M21, C1
EN 10025-3	S355N S355NL S420N S420NL	Union MV 70 + M21, C1 Union MV 70 + M21, C1 Union MV 70 + M21, C1 HL 53.FD + M21	RV 71 + M21, C1 RV 71 + M21, C1 RV 71 + M21, C1 TG 50 Ni + M21
Optim®; heavy plate	Optim 500 ML Optim 700 QL		
Ruukki Laser®	Ruukki Laser 250C Ruukki Laser 355 MC Ruukki Laser 420 MC	Union MV 70 + M21 Union MV 70 + M21 Union MV 70 + M21	RV 71 + M21 RV 71 + M21 RV 71 + M21
Optim®; strip	Optim 500 MC Optim 550 MC Optim 600 MC Optim 650 MC Optim 700 MC  Optim 900 QC Optim 960 QC Optim 1100 QC		
COR-TEN®	COR-TEN® A COR-TEN® B		
Raex® Boron steel	Undermatching consumable <sup>1)</sup> Raex 400/450/500 B 24, B 27	MV 70 + M21	RV 71 + M21
Raex® Boron steel	High strength consumable Raex 400/450/500 B 24, B 27		

<sup>1)</sup> The yield strength of the consumable is lower than that of the hardened base material.

To be continued



<b>Flux-cored arc welding</b>			
<b>Steel grade Standard</b>		<b>Metal-cored wire Trimark + gas</b>	<b>Flux-cored wire Trimark + gas</b>
EN 10025-2	S355J0, S355J2	METALLOY-76 + M21	TM-770 + M21
Multisteel	Multisteel	METALLOY-76 + M21	TM-770 + M21
EN 10025-3	S355N S355NL S420N S420NL	METALLOY-76 + M21	TM-770 + M21 TM-881 K2 + M21 TM-881 K2 + M21 TM-881 K2 + M21
Optim®; heavy plate	Optim 500 ML Optim 700 QL		TM-811 N2 + M21
Ruukki Laser®	Ruukki Laser 250 C Ruukki Laser 355 MC Ruukki Laser 420 MC	METALLOY-76 + M21 METALLOY-76 + M21 METALLOY-76 + M21	TM-770 + M21 TM-770 + M21 TM-770 + M21
Optim®; strip	Optim 500 MC Optim 550 MC Optim 600 MC Optim 650 MC Optim 700 MC  Optim 900 QC Optim 960 QC Optim 1100 QC		TM-811 N2 + M21 TM-881 K2 + M21
COR-TEN®	COR-TEN® A COR-TEN® B		TM-81 W + M21 TM-81 W + M21
Raex® Boron steel	Undermatching consumable <sup>1)</sup> Raex 400/450/500 B24, B27	METALLOY-76 + M21	TM-770 + M21
Raex® Boron steel	High strength consumable Raex 400/450/500 B24, B27		

To be continued

<b>Flux-cored arc welding</b>			
<b>Steel grade Standard</b>		<b>Metal-cored wire Oerlikon + gas</b>	<b>Flux-cored wire Oerlikon + gas</b>
EN 10025-2	S355J0, S355J2	Fluxofil M8 + M21	Fluxofil 14HD + M21
Multisteel	Multisteel	Fluxofil M8 + M21	Fluxofil 14HD + M21
EN 10025-3	S355N S355NL S420N S420NL	Fluxofil M8 + M21 Fluxofil M8 + M21 Fluxofil M8 + M21 Fluxofil M10 + M21	Fluxofil 14HD + M21 Fluxofil 20HD + M21 Fluxofil 14HD + M21 Fluxofil 20HD + M21
Optim®; heavy plate	Optim 500 ML Optim 700 QL	Fluxofil M42 + M21 Fluxofil M42 + M21	Fluxofil 42 + M21 Fluxofil 42 + M21
Ruukki Laser®	Ruukki Laser 250 C Ruukki Laser 355 MC Ruukki Laser 420 MC	Fluxofil M8 + M21 Fluxofil M8 + M21 Fluxofil M8 + M21	Fluxofil 14HD + M21 Fluxofil 14HD + M21 Fluxofil 14HD + M21
Optim®; strip	Optim 500 MC Optim 550 MC Optim 600 MC Optim 650 MC Optim 700 MC  Optim 900 QC Optim 960 QC Optim 1100 QC	Fluxofil M42 + M21 Fluxofil M42 + M21 Fluxofil M42 + M21 Fluxofil M42 + M21 Fluxofil M42 + M21  Fluxofil M45 + M21	Fluxofil 42 + M21 Fluxofil 42 + M21 Fluxofil 42 + M21 Fluxofil 42 + M21 Fluxofil 42 + M21  
COR-TEN®	COR-TEN® A COR-TEN® B		Fluxofil 18 + M21 Fluxofil 18 + M21
Raex® Boron steel	Undermatching consumable <sup>1)</sup> Raex 400/450/500 B24, B27	Fluxofil M8 + M21	Fluxofil 14HD + M21
Raex® Boron steel	High strength consumable Raex 400/450/500 B24, B27	Fluxofil 36 + M21	Fluxofil 14HD + M21

<sup>1)</sup> The yield strength of the consumable is lower than that of the hardened base material.

**Table 3. Manual metal arc welding (MMA) with covered electrodes, recommended welding consumables**

<b>MMA electrodes</b>			
<b>Steel grade Standard</b>		<b>ESAB</b>	
		<b>General-purpose electrode OK</b>	<b>High-efficiency electrode OK</b>
EN 10025-2	S355J0, S355J2	48.00	38.65
Multisteel	Multisteel	48.00	38.65
EN 10025-3	S355N	48.00	38.65
	S355NL	48.08	
	S420N	48.00	38.65
	S420NL	48.08	
Optim®; heavy plate	Optim 500 ML	48.08	
	Optim 700 QL	75.75	
Ruukki Laser®	Ruukki Laser 250 C	48.00	38.65
	Ruukki Laser 355 MC	48.00	38.65
	Ruukki Laser 420 MC	48.00	38.65
Optim®; strip	Optim 500 MC	74.78	
	Optim 550 MC	74.78	
	Optim 600 MC	75.75	
	Optim 650 MC	75.75	
	Optim 700 MC	75.75	
	Optim 900 QC	75.78	
	Optim 960 QC	75.78	
	Optim 1100 QC	75.78 <sup>1)</sup>	
	Optim 550 W	73.68	
	Optim 960 W	75.78	
COR-TEN®	COR-TEN® A	73.08	
	COR-TEN® B	73.08	
Raex® Boron steel	<sup>1)</sup> Undermatching consumable <sup>2)</sup>	48.00	38.65
	Raex 400/450/500 B24, B27		
Raex® Boron steel	High strength consumable	75.75	
	Raex 400/450/500 B24, B27		

<sup>1)</sup> Undermatching consumable (strength of the consumable lower than that of the base material).

<sup>2)</sup> The yield strength of the consumable is lower than that of the hardened base material.

To be continued

<b>MMA electrodes</b>		<b>ELGA</b>		<b>LINCOLN ELECTRIC</b>	
<b>Steel grade Standard</b>		<b>General-purpose electrode Elga</b>	<b>High-efficiency electrode Elga</b>	<b>General-purpose electrode Lincoln</b>	<b>High-efficiency electrode Lincoln</b>
EN 10025-2	S355J0, S355J2	P48 S / 48 M	MAXETA 20	CONARC 48	CONARC V 180
Multisteel	Multisteel	P48 S / 48 M	MAXETA 20	CONARC 48	CONARC V 180
EN 10025-3	S355N	P48 S / 48 M	MAXETA 11	CONARC 48	CONARC V 180
	S355NL	P62 MR / 48 M	MAXETA 24	KRYO 1	KRYO 1-180
	S420N	P48 S / 48 M	MAXETA 20	CONARC 48	CONARC V 180
	S420NL	P62 MR / 48 M	MAXETA 24	KRYO 1	KRYO 1-180
Optim®; heavy plate	Optim 500 ML	P51	MAXETA 24	KRYO 2	KRYO 1-180
	Optim 700 QL	P110 MR	MAXETA 110	CONARC 80	
Ruukki Laser®	Ruukki Laser 250 C	P48 S / 48 M	MAXETA 11	CONARC 48	CONARC V 180
	Ruukki Laser 355 MC	P48 S / 48 M	MAXETA 11	CONARC 48	CONARC V 180
	Ruukki Laser 420 MC	P48 S / 48 M	MAXETA 11	CONARC 48	CONARC V 180
Optim®; strip	Optim 500 MC	P51	MAXETA 24	CONARC 60 G	
	Optim 550 MC	P51	MAXETA 24	CONARC 60 G	
	Optim 600 MC	P51	MAXETA 24	CONARC 60 G	
	Optim 650 MC	P110 MR	MAXETA 110	CONARC 80	
	Optim 700 MC	P110 MR	MAXETA 110	CONARC 80	
		Optim 900 QC Optim 960 QC Optim 1100 QC			
COR-TEN®	COR-TEN® A	P62 MR / P48 K		KRYO 1	KRYO 1-180
	COR-TEN® B	P62 MR / P48 K		KRYO 1	KRYO 1-180
Raex® Boron steel	Undermatching consumable <sup>1)</sup> Raex 400/450/500 B24, B27	P48 S / 48 M	MAXETA 11	CONARC 48	CONARC V 180
Raex® Boron steel	High strength consumable Raex 400/450/500 B24, B27	P110	MAXETA 110	CONARC 85	

To be continued

<b>MMA electrodes</b>					
<b>Steel grade Standard</b>		<b>General-purpose electrode</b>	<b>High-efficiency electrode</b>	<b>General-purpose electrode</b>	<b>High-efficiency electrode</b>
		<b>Böhler Welding</b>	<b>Böhler Welding</b>	<b>Oerlikon</b>	<b>Oerlikon</b>
EN 10025-2	S355J0, S355J2	FOX EV 50	FOX HL 180 Ti	Supercito	OH blau 180
Multisteel	Multisteel	FOX EV 50	FOX HL 180 Ti	Supercito	OH blau 180
EN 10025-3	S355N	FOX EV 50	FOX HL 180 Ti	Tenacito	OH blau 180
	S355NL	FOX EV 60		Tenacito	OH blau 180
	S420N	FOX EV 50		Tenacito	OH blau 180
	S420NL	FOX EV 60		Tenacito	OH blau 180
Optim®; heavy plate	Optim 500 ML	FOX EV 70 Mo		Tenacito 65	
	Optim 700 QL	SH Ni 2 K 100		Tenacito 75	
Ruukki Laser®	Ruukki Laser 250 C	FOX EV 50		Tenacito	Febacito 160S
	Ruukki Laser 355 MC	FOX EV 50		Tenacito	Febacito 160S
	Ruukki Laser 420 MC	FOX EV 50		Tenacito	
Optim®; strip	Optim 500 MC	FOX EV 70 Mo		Tenacito 65	
	Optim 550 MC	SH Ni 2 K 90		Tenacito 65	
	Optim 600 MC	SH Ni 2 K 90		Tenacito 65	
	Optim 650 MC	SH Ni 2 K 90		Tenacito 75	
	Optim 700 MC	SH Ni 2 K 90		Tenacito 75	
	Optim 900 QC	SH Ni 2 K 130		Tenacito 100	
	Optim 960 QC	SH Ni 2 K 130			
Optim 1100 QC					
COR-TEN®	COR-TEN® A	FOX NiCuCr		Tencord KB	
	COR-TEN® B	FOX NiCuCr		Tencord KB	
Raex® Boron steel	Undermatching consumable <sup>1)</sup> Raex 400/450/500 B24, B27	FOX EV 50		Supercito	Febacito 160S
	High strength consumable Raex 400/450/500 B24, B27	SH Schwartz K Ni		Cromocord Kb	

<sup>1)</sup> The yield strength of the consumable is lower than that of the hardened base material.

To be continued

**Table 4. Submerged arc welding (SAW), recommended welding consumables**

<b>Submerged arc welding</b>				
<b>Steel grade Standard</b>		<b>ESAB Wire + flux OK Autrod + OK Flux</b>	<b>LINCOLN ELECTRIC Wire + flux Lincoln + Lincoln</b>	<b>ELGA Wire + flux Elgasaw + Elgaflux</b>
EN 10025-2	S355J0, S355J2	12.22 + 10.71	L-61 + FX 860	102 + 251 B
Multisteel	Multisteel	12.22 + 10.71	L-61 + FX 860	102 + 251 B
EN 10025-3	S355N	12.22 + 10.71	L-61 + FX 860	102 + 251 B
	S355NL	13.27 + 10.62	L-50 M + FX P 230	103Si + 285 B
	S420N	12.22 + 10.71	L-61 + FX 860	102 + 251 B
	S420NL	13.27 + 10.62	L-50 M + FX P 230	103Si + 285 B
Optim®; heavy plate	Optim 500 ML	13.24 + 10.62	LNS 162 + FX P 230	103Si + 285 B
	Optim 700 QL	13.43 + 10.62	LNS 168 + FX P 230	
Ruukki Laser®	Ruukki Laser 250 C	12.22 + 10.71	L-61 + FX 860	102 + 251 B
	Ruukki Laser 355 MC	12.22 + 10.71	L-61 + FX 860	102 + 251 B
	Ruukki Laser 420 MC	12.22 + 10.71	L-61 + FX 860	102 + 251 B
Optim®; strip	Optim 500 MC	12.34 + 10.71	LNS 140 A + FX 860	
	Optim 550 MC	13.40 + 10.62	LNS 164 + FX P 230	
	Optim 600 MC	13.40 + 10.62	LNS 164 + FX P 230	
	Optim 650 MC	13.43 + 10.62	LNS 168 + FX P 230	
	Optim 700 MC	13.43 + 10.62	LNS 168 + FX P 230	
	Optim 900 QC	13.43 + 10.62 <sup>1)</sup>		
	Optim 960 QC	13.43 + 10.62 <sup>1)</sup>		
COR-TEN®	COR-TEN® A	13.36 + 10.71	LNS 163 + FX P 230	
	COR-TEN® B	13.36 + 10.71	LNS 163 + FX P 230	
Raex® Boron steel	Undermatching consumable <sup>2)</sup> Raex 400/450/500 B24, B27	12.22 + 10.71	L-61 + FX P 230	103Si + 285 B
	High strength consumable Raex 400/450/500 B24, B27	13.43 + 10.62	LNS 168 + FX P 230	
Raex® Boron steel	Raex 400/450/500 B24, B27			

<sup>1)</sup> Undermatching consumable (strength of the consumable lower than that of the base material).<sup>2)</sup> The yield strength of the consumable is lower than that of the hardened base material.

To be continued

<b>Submerged arc welding</b>			
<b>Steel grade Standard</b>		<b>Wire + flux Böhler Welding + Böhler Welding</b>	<b>Wire + flux Oerlikon + Oerlikon</b>
EN 10025-2	S355J0, S355J2	Union S 2 + UV 400	OE-S2 + OP 122
Multisteel	Multisteel	Union S 2 + UV 400	OE-S2 + OP 122
EN 10025-3	S355N S355NL S420N S420NL	Union S 2 + UV 400 Union S 2 Ni 2,5+UV 420 TT Union S 2 Ni 2,5+UV 420 TT Union S 2 Ni 2,5+UV 420 TT	OE-S2 + OP 122 OE-SD3 + OP 121TT OE-SD3 + OP 121TT OE-SD3 + OP 121TT
Optim®; heavy plate	Optim 500 ML Optim 700 QL	Union S 3 Mo + UV 420 TT Union S 3 NiMoCr + UV 421 TT	OE-S3NiMo1 + OP 121TT OP 121TT/W
Ruukki Laser®	Ruukki Laser 250 C Ruukki Laser 355 MC Ruukki Laser 420 MC	Union S 2 + UV 400 Union S 2 + UV 400 Union S 2 + UV 400	OE-S2 + OP 122 OE-S2 + OP 122 OE-SD3 + OP 121TT
Optim®; strip	Optim 500 MC Optim 550 MC Optim 600 MC Optim 650 MC Optim 700 MC  Optim 900 QC Optim 960 QC Optim 1100 QC	Union S 3 Mo + UV 421 TT Union S 3 NiMoCr + UV 421 TT Union S 3 NiMoCr + UV 421 TT Union S 3 NiMoCr + UV 421 TT Union S 3 NiMoCr + UV 421 TT  FC 42 + OP 121TT/W FC 42 + OP 121TT/W	OE-S3NiMo1 + OP 121TT OE-S3NiMo1 + OP 121TT OE-S3NiMo1 + OP 121TT FC 42 + OP 121TT/W FC 42 + OP 121TT/W  FC 45 + OP 121TT/W FC 45 + OP 121TT/W
COR-TEN®	COR-TEN® A COR-TEN® B	Union Patinax + UV 420 TT Union Patinax + UV 420 TT	FC 48 + OP 121TT FC 48 + OP 121TT
Raex® Boron steel	Undermatching consumable <sup>1)</sup> Raex 400/450/500 B24, B27		OE-S2 + OP 122
Raex® Boron steel	High strength consumable Raex 400/450/500 B24, B27		OE-S3NiMo1 + OP 121TT

<sup>1)</sup> The yield strength of the consumable is lower than that of the hardened base material.

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