

Weldable High-tensile Strength Steel Plates: WEL-TEN™ Series

1. Outline of Series and Specifications

WEL-TEN™ Series is high tensile and superior weldability steel featuring a rich variety of product categories. It has a wide range of applications, including pressure vessels, oil storage tanks, penstock, bridges, buildings, construction equipment, and industrial equipment.

Brand name	Applicable plate thickness (mm)	Chemical composition (%) ¹⁾															Mechanical properties												
		C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Nb	Ti	B	C _{eq} ²⁾	P _{CM} ²⁾	Tensile test			Impact test (test piece: JIS No.4, 2mm V-notch, L direction)				Bending test (test piece: JIS No.1) ³⁾					
																	Yield point or proof stress (N/mm ²)	Tensile strength (N/mm ²)	Elongation		Test piece JIS	Thickness (mm)	Test temperature (°C)	Absorbed energy (J)		Inside bending radius			
																			Thickness (mm)	Min. elongation (%)				Average value	Each value	Bending angle	Thickness (mm)	Radius	
WEL-TEN540	1.6 t 50	0.20	0.55	1.70	0.035	0.035	—	—	—	—	—	—	—	—	—	0.45	0.32	355	540	t 16 16<t 20<t	20 28 23	No.5 No.5 No.4	12<t 50	0	47	27	180	—	1.5t
WEL-TEN590	6 t 200	0.16	0.55	2.00	0.030	0.025	0.50	1.20	0.50	0.40	0.10	0.05	—	0.005	0.44(t 50) 0.46(t 75) 0.49(t 100) 0.52(t 150) 0.56(t 200)	0.26(t 50) 0.28(t 100) 0.30(t 150) 0.31(t 200)	450(t 50) 430(50<t)	590~710(t 75) 570~690(75<t)	t 16 16<t 20<t	20 28 20	No.5 No.5 No.4	12<t 32 32<t	-5 -10	47	27	180	t 32 32<t	1.5t 2.0t	
WEL-TEN610	6 t 200	0.16	0.55	2.00	0.030	0.025	0.50	1.20	0.50	0.40	0.10	0.05	—	0.005	0.45(t 50) 0.47(t 75) 0.50(t 100) 0.53(t 150) 0.57(t 200)	0.26(t 50) 0.28(t 100) 0.30(t 150) 0.31(t 200)	490(t 50) 470(50<t)	610~730(t 75) 590~710(75<t)	t 16 16<t 20<t	19 27 20	No.5 No.5 No.4	12<t 32 32<t	-5 -10	47	27	180	t 32 32<t	1.5t 2.0t	
WEL-TEN690	6 t 100	0.16	0.55	2.00	0.030	0.025	0.50	1.30	0.60	0.60	0.10	0.05	—	0.005	0.50(t 50) 0.55(t 75) 0.60(t 100)	0.28(t 50) 0.32(50<t)	550(t 50) 530(50<t)	690~830(t 50) 670~810(50<t)	t 16 16<t 20<t	17 25 17	No.5 No.5 No.4	12<t 32 32<t	-15 -20	47	27	180	t 32 32<t	1.5t 2.0t	
WEL-TEN780	6 t 200	0.16	0.55	2.00	0.020	0.015	0.50	0.40-2.00 (t 100) 0.40-3.00 (100<t)	0.80	0.60	0.10	0.05	—	0.005	0.60(t 100) 0.63(t 150) 0.67(t 200)	0.30(t 50) 0.32(t 100) 0.34(t 150) 0.36(t 200)	685(t 50) 665(50<t)	780~930(t 50) 760~910(50<t)	t 16 16<t 20<t	16 24 16	No.5 No.5 No.4	12<t 32 32<t	-20 -25	47	27	180	t 32 32<t	1.5t 2.0t	
WEL-TEN950	6 t 150	0.16	0.55	2.00	0.015	0.010	0.50	0.50-3.50 (t 100) 0.50-4.50 (100<t)	1.20	0.90	0.10	0.03	—	0.005	0.76	0.34(t 50) 0.36(t 75) 0.38(t 150)	885(t 50) 865(50<t)	950~1130	t 16 16< 20<t	13 19 13	No.5 No.5 No.4	12<t 32 32<t	-25 -30	47	27	180	t 32 32<t	1.5t 2.0t	
WEL-TEN590E	6 t 100	0.18	0.55	2.00	0.030	0.025	—	—	—	—	—	—	—	—	0.52	0.30	450(t 50) 430(50<t)	590~710(t 50) 570~690(50<t)	t 16 16<t 20<t	20 28 20	No.5 No.5 No.4	12<t	-5	47	27	180	t 32 32<t	1.5t 2.0t	
WEL-TEN690E	6 t 100	0.18	0.55	2.00	0.030	0.025	0.50	—	1.60	0.60	0.10	—	—	0.005	0.55(t 50) 0.60(t 100)	0.32	550(t 50) 530(50<t)	690~830(t 50) 670~810(50<t)	t 16 16<t 20<t	17 25 17	No.5 No.5 No.4	12<t	-10	47	27	180	t 32 32<t	1.5t 2.0t	
WEL-TEN780E	6 t 100	0.22	0.55	2.00	0.025	0.015	0.50	—	1.60	0.60	0.10	—	—	0.005	0.60(t 50) 0.63(t 100)	0.34	685(t 50) 665(50<t)	780~930(t 50) 760~910(50<t)	t 16 16<t 20<t	16 24 16	No.5 No.5 No.4	12<t	-15	47	27	180	t 32 32<t	1.5t 2.0t	
WEL-TEN950E	6 t 100	0.22	0.55	2.00	0.025	0.020	0.50	—	1.60	1.10	0.10	—	—	0.005	0.76	0.38	885(t 50) 865(50<t)	950~1130	t 16 16<t 20<t	13 19 13	No.5 No.5 No.4	12<t	-20	47	27	180	t 32 32<t	1.5t 2.0t	

Approximate application thickness (mm)	Steel types				
	Blanks	E	RE	C	EX
	Standard	Economy	Non-heat treated	Cr-added	Weldability
150(200) or less	100 or less	32 or less	150 or less	100 or less	
540	(0)	—	—	—	—
590	(-5)	(-5)	(-5)	—	(-5)
610	(-10)	—	—	—	(-10)
690	(-15)	(-10)	(-15)	—	—
780	(-20)	(-15)	(—)	(-20)	(-20)
950	(-25)	(-20)	(—)	—	—

* With respect to the standards in the table above, it is possible to add the following special requirements upon request.
 SR guaranteed steel (-SR), Lamellar tear-resistant guaranteed steel (-Z35, etc.), Low-temperature specifications < below the stipulated impact test temperature service > (-LT), Constant yield strength specifications (-H)
 (Example of specified specifications: WEL-TEN590-SR, etc.)

Remarks:

- When necessary, alloying elements other than those shown in the table may be added.
- Carbon equivalent, C_{eq}, and weld crack sensitivity, P_{CM}, are calculated for added elements using the following equation.
 $C_{eq} = C + Si/24 + Mn/6 + Ni/40 + Cr/5 + Mo/4 + V/14$ (%)
 $P_{CM} = C + Si/30 + Mn/20 + Cu/20 + Ni/60 + Cr/20 + Mo/15 + V/10 + 5B$ (%)
- In the bending test, cracks shall not occur in the outside of test piece.
 The bending test can be eliminated unless otherwise specified.

Brand name	Applicable plate thickness (mm)	Chemical composition(%) ¹⁾															Mechanical properties											
		C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Nb	Ti	B	C _{eq} ²⁾	P _{CM} ²⁾	Tensile test				Impact test(test piece:JIS No.4, 2mm V-notch, L direction)				Bending test (test piece: JIS No.1) ³⁾			
																	Yield point or proof stress (N/mm ²)	Tensile strength (N/mm ²)	Elongation		Test piece JIS	Thickness (mm)	Test temperature (°C)	Absorbed energy (J)		Inside bending radius		
																			Thickness (mm)	Min. elongation (%)				Average value	Each value	Bending angle	Thickness (mm)	Radius
WEL-TEN590RE	2.3 t 32	0.12	0.55	2.00	0.030	0.025	0.40	0.40	—	0.15	—	—	0.15	—	0.45	—	450	590 - 710	t 16 16<t 20<t	20 28 20	No.5 No.5 No.4	12<t 32	-5	47	27	180	—	1.0t
WEL-TEN690RE	2.3 t 20	0.14	0.55	2.00	0.030	0.025	0.40	0.40	—	0.15	—	—	0.25	—	0.50	—	590	690 - 830	t 16 16<t	17 25	No.5 No.5	12<t 20	-15	47	27	180	—	1.5t
WEL-TEN780RE	2.3 t 9	0.16	0.55	2.00	0.030	0.025	0.40	0.40	—	0.15	—	—	0.30	—	0.55	—	685	780 - 930	t 9	15	No.5	—	—	—	—	180	—	1.5t
WEL-TEN950RE	3 t 8	0.16	0.55	2.00	0.025	0.020	—	0.50	—	—	—	—	0.30	0.005	0.50	—	885	950 - 1250	t 6 6<t	8 11	No.5 No.5	—	—	—	—	180	—	1.5t
WEL-TEN780C	6 t 150	0.16	0.55	2.00	0.025	0.015	0.50	0.35	0.30 - 1.20	0.60	0.10	0.05	—	0.005	0.62(t 50) 0.68(t 100) 0.70(t 150)	0.30(t 50) 0.32(t 100) 0.34(t 150) 0.37(t 150)	685(t 50) 665(50<t)	780 - 930(t 50) 760 - 910(50<t)	t 16 16<t 20<t	16 24 16	No.5 No.5 No.4	12<t 150	-20	47	27	180	t 32 32<t	1.5t 2.0t
WEL-TEN590EX	6 t 76	0.09	0.40	2.00	0.030	0.025	0.50	0.80	0.30	0.35	0.10	0.05	—	0.005	—	0.20	450(t 50) 430(50<t)	590 - 710	t 16 16<t 20<t	20 28 20	No.5 No.5 No.4	12<t 32 32<t	-5 -10	47	27	180	t 32 32<t	1.5t 2.0t
WEL-TEN610EX	6 t 76	0.09	0.40	2.00	0.030	0.025	0.50	0.80	0.30	0.35	0.10	0.05	—	0.005	—	0.20	490(t 50) 470(50<t)	610 - 730	t 16 16<t 20<t	19 27 20	No.5 No.5 No.4	12<t 32 32<t	-5 -10	47	27	180	t 32 32<t	1.5t 2.0t
WEL-TEN780EX	6 t 50	0.07	0.55	0.60 - 1.50	0.020	0.015	0.80 - 1.30	1.50	0.80	0.60	0.10	0.05	—	—	0.55	—	685	780 - 930	t 16 16<t 20<t	16 24 16	No.5 No.5 No.4	12<t 32 32<t	-20 -25	47	27	180	t 32 32<t	1.5t 2.0t
WEL-TEN590EXS	6 t 40	0.07	0.40	2.00	0.030	0.025	0.30	0.60	0.30	0.30	0.10	0.05	—	—	—	0.18	450	590 - 710	t 16 16<t 20<t	20 28 20	No.5 No.5 No.4	12<t 32 32<t	-5 -10	47	27	180	t 32 32<t	1.5t 2.0t
WEL-TEN610EXS	6 t 40	0.07	0.40	2.00	0.030	0.025	0.30	0.60	0.30	0.30	0.10	0.05	—	—	—	0.18	490	610 - 730	t 16 16<t 20<t	19 27 20	No.5 No.5 No.4	12<t 32 32<t	-5 -10	47	27	180	t 32 32<t	1.5t 2.0t

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$$P_{CM} = C + Si/30 + Mn/20 + Cu/20 + Ni/60 + Cr/20 + Mo/15 + V/10 + 5B \quad (\%)$$

3) In the bending test, cracks shall not occur in the outside of test piece.

The bending test can be eliminated unless otherwise specified.

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(Example of specified specifications: WEL-TEN590-SR, etc.)



Crude oil storage tanks



Penstock branching section



Track crane



Jack up rig offshore structure