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HYUNDAI WELDING

HEAVY EQUIPMENT WELDING SOLUTIONS

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HYUNDAI WELDING PRODUCTIVITY PARTNER FOR HEAVY EQUIPMENT FABRICATORS

Many heavy equipment fabricators act in a dynamic, global market which is subject to a multitude of influentials such as overall economic conditions, technological advancements and fluctuating demand from industries like construction, infrastructure, agriculture and mining. The industry was particularly hit by the Covid-19 pandemic during the first years of the decade - forcing many companies to shut down production sites - but now shows notable signs of recovery. Regionally, the heavy equipment business is booming in Asia Pacific, due to an increasing focus on infrastructure and industrialisation by local economies in this region.

The fabrication of heavy equipment takes place against a background of strict safety protocols and tough industry standards, to ensure quality, reliability and safety of the finished products. There is a strong focus on weight reduction through the use of high strength steel to increase payload of machines and save on fuel costs. Those companies that can best process these materials enjoy a competitive advantage. This also requires efficient, often robotised welding of high quality welds - a number one requirement throughout the industry.

As a full daughter of the Hyundai conglomerate, HYUNDAI WELDING has been involved in the development and supply of welding products for its world famous heavy equipment division as well as other global brands. The resulting wide range of mild and high strength steel consumables includes innovative solutions for the welding of booms, cabins, chassis and undercarriages of heavy equipment. A good example are our SM-70G and SM-70GS solid wires which feature an electrically copper-coated surface and adapted wire chemistry to facilitate stable, very high current fillet welding of, for instance, booms and arms in the down-hand position. With products like these, we support heavy equipment manufacturers all over the world to increase their efficiency, productivity and competitiveness.

LIGHTER, STRONGER AND SAFER MACHINES

Historically, the demand for heavy equipment has increased in line with the growing population and urbanisation worldwide. This trend carries on today. Major cities across the world keep on housing new inhabitants – even to the point when they get overcrowded – and new equipment is needed to build dwellings, offices and infrastructure. The industry is dynamic and sees many innovations:

1. Advanced Material Technology: Lightweight and high-strength materials are explored to enhance the durability and performance of heavy equipment while reducing overall weight.

2. Advanced Safety Features: Heavy equipment manufacturers are investing in safety innovations, such as collision avoidance systems, operator fatigue detection, and improved visibility from the operator's cabin.

3. Remote Operation and Connectivity: Advancements in connectivity allow remote operation of heavy equipment, enabling operators to control machinery from a centralized location, improving productivity, and reducing on-site risks.

4. Telematics and Data Analytics: Integration of telematics technology in heavy equipment provides real-time monitoring of machine performance, fuel efficiency, and maintenance needs. Data analytics is increasingly important for predictive maintenance and optimized equipment utilization.

These and future technological innovations drive the fabrication of lighter, stronger, safer and more efficient heavy equipment and will provide growth opportunities to fabricators all around the world. Efficient and flawless welding of heavy equipment components remains a crucial step for success in this challenging market.

HEAVY EQUIPMENT MODELS

The label “heavy equipment” refers to the large, robust machines used for tasks that require significant power, strength and efficiency, in segments such as construction, infrastructure, agriculture and mining. The most important types of heavy equipment (yellow goods) are highlighted in the following overview:

CONSTRUCTION EQUIPMENT

The construction equipment segment covers a broad category of machines designed for specific tasks in the construction of buildings and infrastructure. Used for the lifting and transportation of heavy loads, they are elementary in projects of different scales and complexity.

Crawler Excavator

Wheel Loader

Wheeled Excavator

Drilling Rig

Crawler Loader

Motor Grader

MINING EQUIPMENT

Mining equipment refers to the type of machinery used for the extraction and handling of ore, coal, minerals and other geological materials. They are designed for the unique challenges and requirements of surface, open-pit or underground mining operations and are usually much bigger than common heavy equipment.

Mining Excavator

Mining Dozer

Dragline

AGRICULTURE & FORESTRY EQUIPMENT

They are designed and used in agricultural and forestry activities to enhance productivity and efficiency. These equipment types are tailored to meet the unique needs of farming, crop cultivation, and forestry operations.

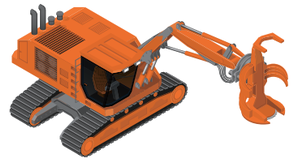
Telehandler

Harvesting Equipment

Front Loader

Swing Machine

Skidder



Tracked Feller Buncher

CRANES & MATERIAL HANDLING EQUIPMENT

Like material handling equipment, cranes are commonly used to lift, lower, and move heavy materials in the construction industry. They are also essential in manufacturing, shipping, and other industries where heavy lifting is required.

Material Handler

Telehandler

Crawler Crane

All Terrain Crane

Loader Crane

Forklift

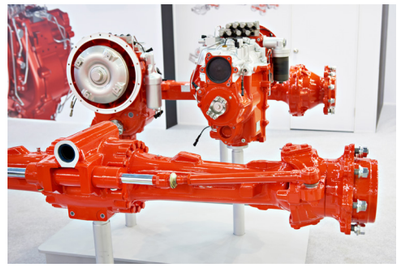
WELDED PARTS OF HEAVY EQUIPMENT

Buckets & Shovels

Hydraulic Cylinder

Beam

Cabin / Cab



Powertrain System
(Axles, Driveshaft, Gear etc.)

Boom

WELDING APPLICATIONS FOR THE HEAVY EQUIPMENT INDUSTRY

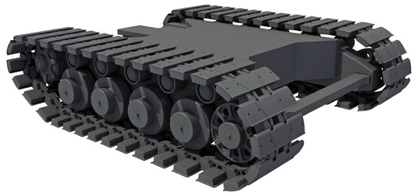
Fuel and Hydraulic Tanks

Wheel

Exhaust Components

Agriculture Accessories
(Plough, Tillage etc.)

Arm



Chassis & Undercarriage

WELDING APPLICATIONS FOR THE HEAVY EQUIPMENT INDUSTRY

Base material	Process	Product name	AWS	EN	Buckets & Shovels	Hydraulic Cylinders			Fuel and Hydraulic Tanks	Wheels	Exhaust Components	Chassis & Undercarriage	Arms	Booms	Powertrain Systems (Axles, Driveshaft, Gear etc.)	Cabins / Cabs	Beams
Mild Steel	GMAW	SM-70G	A5.18 ER70S-8	ISO 14341-B G 49A 3 C1 S11 ISO 14341-B G 55A 3 M21 S11	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓
		SM-70GS	A5.18 ER70S-G	ISO 14341-A G2Si	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓
		SM-70	A5.18 ER70S-6	ISO 14341-A G42 2 C G3Si1 ISO 14341-A G42 4 C G3Si1	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓
		SM-70EN	A5.18 ER70S-6	ISO 14341-A G 42 2 C G4Si1 ISO 14341-A G 46 4 M G4Si1	✓	✓			✓	✓	✓	✓	✓	✓		✓	✓
	FCAW	SF-71	A5.20 E71T-1C	ISO 17632-A T46 3 P C1 1 H5	✓				✓	✓		✓				✓	
		Supercored 70NS	A5.18 E70C-6M	ISO 17632-A-T 42 3 M M 21 3 H5	✓	✓				✓		✓	✓	✓		✓	✓
		SC-70ML	A5.18 E70C-6M	ISO 17632-A T 46 4 M M21 2 H5	✓	✓				✓		✓	✓	✓		✓	✓
	SAW	Superflux787 / M-12K	A5.17 F6A(P)6-EM12K	ISO 14174-S A FB 1 / 14171-A-S2Si						✓		✓					
		Superflux787 / A-2	A5.17 F8A(P)6-EA2-A2	ISO 14174-S A FB 1 / 14171-A-S2Mo						✓		✓					
		Superflux787 / H-12K	A5.17 F7A(P)8-EH12K	ISO 14174-S A FB 1 / 14171-A-S3Si						✓		✓					
		S-717 / L-8	A5.17 F6A(P)4-EL8	ISO 14174-S A AB 1 / 14171-A-S1						✓		✓					
		S-717 / M-12K	A5.17 F7A(P)6-EM12K	ISO 14174-S A AB 1 / 14171-A-S2Si						✓		✓					
		S-800WT / M-12K	A5.17 F7A8-EM12K	ISO 14174-S A FB 1 / 14171-A-S2Si						✓		✓					
		S-777Q / L-8	A5.17 F7AZ-EL8	ISO 14174-S A AR 1 / 14171-A-S1						✓		✓					
		S-777Q / M-12K	A5.17 F7A2-EM12K	ISO 14174-S A AR 1 / 14171-A-S2Si						✓		✓					
		S-777Q / M-13K	A5.17 F7A0-EM13K	ISO 14174-S A AR 1 / -						✓		✓					
High Strength Steel	GMAW	SM-100	A5.28 ER100S-G		✓	✓				✓		✓	✓	✓	✓	✓	✓
		SM-110	A5.28 ER110S-G		✓	✓				✓		✓	✓	✓	✓	✓	✓
		SM-120A	A5.28 ER120S-G		✓	✓						✓	✓	✓	✓	✓	✓
	FCAW	Supercored 81-K2	A5.29 E81T1-K2C H4	ISO 17632-A T46 6 1.5Ni P C 1 H5	✓							✓		✓			
		Supercored 81MAG	A5.29 E81T1-Ni1M H4	ISO 17632-A-T 46 6 1Ni P M21 2 H5	✓							✓		✓			
		SC-81M	A5.29 E81T1-Ni1M-J H4	ISO 17632-A T 50 6 1Ni P M21 1 H5	✓							✓		✓			
		SC-90M	A5.28 E90C-G	ISO 18276-A-T 55 Z Z M M21 1 H5	✓							✓	✓	✓			✓
		Supercored 110	A5.29 E111T1-GC H4	ISO 17632-A T 69 4 ZMn2.5NiMo P C1 1	✓							✓	✓	✓			✓
		SC-110M Cored	A5.28 E110C-G	ISO 17632-A T 69 4 Mn2NiMo M M21 3 H5	✓							✓	✓	✓			✓
		Supercored 120	A5.29 E121T1-GC H4		✓							✓	✓	✓			✓
	SAW	Superflux787 / F-3	A5.17 F9A(P)8-EF3-F3	ISO 14174-S A FB 1 / 14171-A-S3NiMo						✓		✓					
		S-717 / A-2	A5.17 F78A0(PZ)-EA2-A4	ISO 14174-S A AB 1 / 14171-A-S2Mo						✓		✓					
		Superflux787 / Ni-5	A5.17 F8A(P)8-ENi5-Ni1	ISO 14174-S A FB 1 / 14171-A-S3Ni1Mo0.2						✓		✓					
Ferritic stainless steel	GMAW	SM-430LNb		ISO 14343-A G 18LNB							✓						
		SF-409Ti	A5.9 EC409								✓						
		SF-430	A5.9 EC430								✓						
		SF-430Nb		ISO 12072 G Z 17 L Nb							✓						
		SF-436									✓						
		SC-439Ti Cored	A5.9 EC439								✓						

Process	Hardfacing Product Range	Buckets & Shovels	Hydraulic Cylinders		Fuel and Hydraulic Tanks	Wheels	Exhaust Components	Chassis & Undercarriage	Arms	Booms	Powertrain Systems	Cabins / Cabs	Beams
SMAW	S-350B.B / S-450B.B / S-600B.B / S-700B.B	✓				✓							
FCAW	SC-250H / SC-350H / SC-450H / SC-600H / SC-700H / SC-600HM										✓		
	Supershield CrC / Supershield CrCW / Supershield CrCH / Supershield CrCNb / Supershield CrCB / SC-BU Cored / Supershield 16Mn-O / Supershield AP-O / Supershield 309L-O	✓											
Subarc Wire	SC-30S / SC-45S / SC-48S / SC-55S					✓							

TYPICAL MECHANICAL PROPERTIES AND CHEMICAL COMPOSITION (%) OF ALL-WELD METAL

Base Material	Process	Product Name	AWS	EN	Typical Chemical Composition of All-Weld Metal(%)												Typical Mechanical Properties of All-Weld Metal				
					C	Si	Mn		P	S	Ni	Cr	Mo	Ti	V	B	YS	TS	EL	Impact ISO-V	
																	Mpa (lbs/in^2)	Mpa (lbs/in^2)	(%)	°C (°F)	J (ft·lbs)
Mild Steel	GMAW	SM-70G**	A5.18 ER70S-G	ISO 14341-B G 49A 3 C1 S11	0.07	0.52	1.07		0.015	0.009	-	-	-	-	-	-	460 (66,717)	560 (81,221)	29	-30 (-22)	90 (66)
				ISO 14341-B G 55A 3 M21 S11	0.06	0.61	1.20		0.015	0.009	-	-	-	-	-	-	470 (68,168)	570 (82,671)	27	-30 (-22)	70 (52)
		SM-70GS*	A5.18 ER70S-G	ISO 14341-A G2Si	0.08	0.38	1.00		0.014	0.008	-	-	-	-	-	-	480 (69,600)	550 (79,800)	28	155 (114)	100 (74)
		SM-70**/*	A5.18 ER70S-6	ISO 14341-A G 42 2 C1 3Si1	0.07	0.58	1.15		0.010	0.010	-	-	-	-	-	-	467 (67,732)	566 (82,091)	28	-30 (-22)	71 (52)
				ISO 14341-A G 42 5 M21 3Si1	0.07	0.64	1.24		0.010	0.010	-	-	-	-	-	-	472 (68,457)	569 (82,526)	26	-50 (-58)	60 (44)
		SM-70EN**/*	A5.18 ER70S-6	ISO 14341-A G 42 2 C1 4Si1	0.09	0.56	1.06		0.015	0.012	-	-	-	-	-	-	461 (66,862)	560 (81,221)	29	-20 (-4)	95 (70)
				ISO 14341-A G 46 5 M21 4Si1	0.09	0.68	1.26		0.015	0.012	-	-	-	-	-	-	524 (76,000)	617 (89,488)	27	-50 (-58)	61 (45)
	FCAW	SF-71**	A5.20 E71T-1C	ISO 17632-A-T 42 0 P C1 1	0.04	0.49	1.29		0.01	0.009	-	-	-	-	-	-	548 (79,600)	582 (84,500)	28	-20 (-4)	45 (33)
		Supercored 70NS*	A5.18 E70C-6M	ISO 17632-A-T 42 3 M M 21 3 H5	0.05	0.55	1.45		0.011	0.01	-	-	-	-	-	-	480 (69,618)	550 (79,771)	25	-30 (-22)	50 (37)
		SC-70ML*	A5.18 E70C-6M	ISO 17632-A-T 46 4 M M21 2 H5	0.04	0.56	1.57		0.011	0.014	0.35	-	-	-	-	-	476 (73,950)	553 (81,200)	27	-40 (-40)	75 (55)
	SAW	Superflux787 / M-12K	A5.17 F6A(P)6-EM12K	ISO 14174-S A FB 1 / 14171-A-S2Si	0.09	0.2	1.12		0.012	0.008	-	-	-	-	-	-	445 (65,000)	495 (72,000)	36	-62 (-80)	89 (66)
		Superflux787 / A-2	A5.17 F8A(P)6-EA2-A2	ISO 14174-S A FB 1 / 14171-A-S2Mo	0.08	0.25	1.14		0.020	0.002	-	-	-	-	-	0.41	599(87,000)	619(90,000)	28	-51(-60)	81(60)
		Superflux787 / H-12K	A5.17 F7A(P)8-EH12K	ISO 14174-S A FB 1 / 14171-A-S3Si	0.09	0.3	1.5		0.018	0.01	-	-	-	-	-	-	491(71,000)	575(83,000)	32	-62 (-80)	78(58)
		S-717 / L-8	A5.17 F6A(P)4-EL8	ISO 14174-S A AB 1 / 14171-A-S1	0.078	0.2	1.08		0.024	0.004	-	-	-	-	-	-	435 (63,000)	514 (75,000)	36	-51 (-60)	97 (72)
		S-717 / M-12K	A5.17 F7A(P)6-EM12K	ISO 14174-S A AB 1 / 14171-A-S2Si	0.09	0.26	1.4		0.023	0.004	-	-	-	-	-	-	470(68,000)	550(79,000)	34	-51(-60)	102(75)
		S-800WT / M-12K	A5.17 F7A8-EM12K	ISO 14174-S A FB 1 / 14171-A-S2Si	0.09	0.2	1.45		0.023	0.006	-	-	-	0.008	-	0.002	520 (75,400)	570 (82,700)	32	-62 (-80)	130 (95)
		S-777Q / L-8	A5.17 F7AZ-EL8	ISO 14174-S A AR 1 / 14171-A-S1	0.04	0.44	0.85		0.023	0.016	-	-	-	-	-	-	434 (62,900)	508 (73,700)	31	0 (32)	52(39)
		S-777Q / M-12K	A5.17 F7A2-EM12K	ISO 14174-S A AR 1 / 14171-A-S2Si	0.06	0.43	1.01		0.015	0.011	-	-	-	-	-	-	462(67,000)	552(80,000)	32	-29 (-20)	36(27)
		S-777Q / M-13K	A5.17 F7A0-EM13K	ISO 14174-S A AR 1 / -	0.06	0.81	1.31		0.011	0.02	-	-	-	-	-	-	536(78,000)	618(90,000)	24	-18 (0)	53(39)
High Strength Steel	GMAW	SM-100*	A5.28 ER100S-G	-	0.072	0.36	1.32		0.008	0.008	1.61	0.25	0.21	-	-	-	717 (103,992)	785 (113,854)	18.4	-40 (-40)	38 (28)
		SM-110*	A5.28 ER110S-G	-	0.086	0.65	1.53		0.008	0.01	1.74	0.3	0.55	-	-	-	802 (116,320)	870 (126,182)	17.4	-40 (-40)	61 (45)
		SM-120A*	A5.28 ER120S-G	-	0.07	0.61	0.61		0.011	0.005	2.11	0.32	0.44	-	-	-	872 (126,500)	935 (135,600)	18	-40 (-40)	62 (46)
	FCAW	Supercored 81-K2**	A5.29 E81T1-K2C H4	ISO 17632-A-T 46 6 1.5Ni P C 1 H5	0.04	0.35	1.35		0.012	0.011	1.5	-	-	-	-	-	540 (78,400)	620 (90,000)	28	-60 (-76)	60 (44)
		Supercored 81MAG*	A5.29 E81T1-Ni1M H4	ISO 17632-A-T 46 6 1Ni P M21 2 H5	0.05	0.28	1.2		0.008	0.012	0.93	-	-	-	-	-	550 (79,900)	590 (85,700)	26	-60 (-76)	60 (44)
		SC-81M*	A5.29 E81T1-Ni1M-J H4	ISO 17632-A T 50 6 1Ni P M21 1 H5	0.04	0.34	1.15		0.008	0.008	0.91	-	-	-	-	-	550 (79,900)	590 (85,700)	26	-60 (-76)	60 (44)
		SC-90M*	A5.28 E90C-G	ISO 18276-A-T 55 Z Z M M21 1 H5	0.07	0.54	1.35		0.012	0.007	1.17	-	0.18	-	-	-	633 (91,800)	672 (97,500)	25	-50 (-58)	88 (65)
		Supercored 110**	A5.29 E111T1-GC H4	ISO 17632-A T 69 4 ZMn2.5NiMo P C1 1	0.06	0.35	1.55		0.016	0.007	2.2	-	0.5	-	-	-	780 (113,000)	830 (121,000)	19.9	40 (-40)	60 (44)
		SC-110M Cored*	A5.28 E110C-G	ISO 17632-A T 69 4 Mn2NiMo M M21 3 H5	0.04	0.7	1.8		0.015	0.015	2	0.1	0.6	-	-	-	730 (105,900)	800 (116,100)	20	-50 (-58)	40 (30)
		Supercored 120**	A5.29 E121T1-GC H4	-	0.04	0.35	1.8		0.012	0.011	2.2	0.02	0.6	-	0.01	-	800 (116,000)	860 (125,000)	18	-18 (0)	81 (60)
	SAW	Superflux787 / F-3	A5.17 F9A(P)8-EF3-F3	-	0.07	0.35	1.69		0.019	0.003	0.84	-	0.47	-	-	-	675 (98,000)	729 (106,000)	26	-62 (-80)	98 (72)
		S-717 / A-2	A5.17 F78A0(PZ)-EA2-A4	ISO 14174-S A AB 1 / 14171-A-S2Mo	0.08	0.35	1.58		0.023	0.005	-	-	0.49	-	-	-	542 (78,610)	650 (94,300)	29	-18 (0)	60 (44)
		Superflux787 / Ni-5	A5.17 F8A(P)8-ENi5-Ni1	ISO 14174-S A FB 1 / 14171-A-S3Ni1Mo0.2	0.06	0.34	1.38		0.015	0.003	0.83	0.05	0.22	0.015	-	-	592 (86,000)	614 (89,000)	31	-62 (-80)	83 (61)
Ferritic stainless steel	GMAW	SM-430LNb	-	ISO 14343-A G 18LNb	0.02	0.38	0.46		0.023	0.001	0.2	18.1	-	-	-	0.4	-	-	-	-	-
	FCAW	SF-409Ti	A5.9 EC409	-	0.03	0.50	0.55		0.012	0.010	-	12.5	-	0.8	-	-	-	500 (72,600)	20	-	-
		SF-430	A5.9 EC430	-	0.03	0.30	0.50		0.005	0.010	-	16.5	-	0.5	-	-	-	500 (72,600)	40	-	-
		SF-430Nb	-	ISO 12072 G Z 17 L Nb	0.03	0.40	0.17		0.010	0.010	-	16.5	-	0.4	-	0.5	-	520 (75,400)	24	-	-
		SF-436	-	-	0.03	0.60	0.40		0.008	0.006	-	16.8	0.8	0.5	-	-	-	500 (72,600)	35	-	-
		SC-439Ti Cored	A5.9 EC439	-	0.03	0.30	0.60		0.005	0.010	-	18.5	-	0.6	-	-	-	500 (72,600)	40	-	-

*** With M21 Shielding Gas** **** With C1 Shielding Gas**

TYPICAL MECHANICAL PROPERTIES AND CHEMICAL COMPOSITION (%) OF ALL-WELD METAL

Application	Process	Product Name	AWS	EN	Typical Chemical Composition of All-Weld Metal(%)													Typical Mechanical Properties of All-Weld Metal		
					C	Si	Mn	P	S		Ni	Cr	Mo	W	V	B	Nb	Preheat & Interpass Temp.°C (°F)	Hardness	
Hardfacing	SMAW	S-350B.B	-	-	0.26	0.82	1.44	0.015	0.009		-	1.88	-	-	-	-	-	150 (302)	390	HB
		S-450B.B	-	-	0.3	1.06	0.56	0.019	0.010		-	1.64	0.63	-	-	-	-	150 (302) 300 (572)	420 380	HB
		S-500B.B	-	-	0.41	0.75	1.73	0.018	0.007		-	1.6	0.86	-	-	-	-	150 (302) 300 (572)	520 480	HB
		S-600B.B	-	-	0.52	1.10	1.61	0.022	0.009		-	3.9	1.34	-	-	-	-	150 (302) 300 (572)	540 500	HB
		S-700B.B	-	-	0.56	1.26	1.67	0.029	0.011		-	4.06	1.84	-	-	-	-	150 (302) 300 (572)	610 580	HB
	FCAW	SC-250H**	-	-	0.06	0.50	1.30	0.011	0.005		-	1.1	-	-	-	-	-	≥150℃(302°F) 150±15℃(302±59°F)	22~25	HRc
		SC-350H**	-	-	0.10	0.60	1.50	0.010	0.006		-	1.3	0.3	-	-	-	-	≥150℃(302°F) 150±15℃(302±59°F)	35~40	HRc
		SC-450H**	-	-	0.18	0.70	1.50	0.012	0.005		-	2.0	0.6	-	-	-	-	≥150℃(302°F) 150±15℃(302±59°F)	45~49	HRc
		SC-600H**	-	-	0.30	0.70	1.50	0.010	0.005		-	3.5	0.6	-	-	-	-	≥150℃(302°F) 150±15℃(302±59°F)	55~59	HRc
		SC-600HM*	-	-	0.45	0.50	1.60	0.012	0.006		-	6.2	0.3	-	-	-	-	≥150℃(302°F) 150±15℃(302±59°F)	58~62	HRc
		SC-700H**	-	-	0.50	0.70	1.50	0.011	0.005		-	5.2	-	0.4	-	-	-	≥150℃(302°F) 150±15℃(302±59°F)	58~62	HRc
		Supershield CrC (1.2/1.6mm)***	-	-	4.5	0.4	1.2	0.010	0.009		-	24.0	-	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	54~58	HRc
		Supershield CrC (2.4/2.8/3.2mm)***	-	-	5.0	0.5	1.5	0.010	0.008		-	28.0	-	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	58~62	HRc
		Supershield CrCW (1.2/1.6mm)***	-	-	4.5	0.6	0.6	0.012	0.008		-	24.0	-	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	54~58	HRc
		Supershield CrCW (2.4/2.8mm)***	-	-	5.0	1.0	1.8	0.011	0.008		-	26.0	-	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	58~62	HRc
		Supershield CrCH***	-	-	5.0	1.0	0.2	0.010	0.007		-	28.0	-	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	58~62	HRc
		Supershield CrCNb***	-	-	5.0	0.8	0.2	0.012	0.008		-	21.0	-	-	-	-	6.5	150~250℃ (302~482°F) 200~300℃ (392~572°F)	60~64	HRc
		Supershield CrCB***	-	-	4.5	0.6	1.5	0.010	0.006		-	26.0	-	-	-	0.3	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	60~64	HRc
		SC-BU Cored***	-	-	0.12	0.8	2.7	0.011	0.005		-	1.0	-	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	25~35	HRc
		Supershield 16Mn-O***	-	-	0.5	0.5	16.5	0.008	0.005		-	3.0	-	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	18~22 Work Hardening 40~50	HRc
		Supershield AP-O***	-	-	0.4	0.4	16.0	0.010	0.007		-	13.0	-	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	18~22 Work Hardening 40~50	HRc
		Supershield 309L-O***	-	-	0.02	0.3	1.3	0.009	0.006		12.5	22.0	0.05	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	-	HRc
	Subarc Wire	SC-30S	-	-	0.12	0.3	1.6	0.020	0.006		-	2.0	0.3	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	28~32	HRc
		SC-45S	-	-	0.20	0.5	2.0	0.022	0.005		-	3.2	0.5	-	-	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	43~47	HRc
		SC-48S	-	-	0.25	1.0	2.5	0.022	0.005		-	6.0	0.6	-	0.3	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	46~50	HRc
		SC-55S	-	-	0.30	0.8	2.0	-	-		-	6.0	1.5	1.5	0.4	-	-	150~250℃ (302~482°F) 200~300℃ (392~572°F)	50~55	HRc

*** With M21 Shielding Gas** **** With C1 Shielding Gas** ***** Open Arc**

APPROVALS

Base Material	Process	Product Name	AWS	EN	CWB	TÜV	DB	CE	NAKS			KR	ABS	LR	BV	DNV	NK	RS	RINA	CCS	CRS
Mild Steel	GMAW	SM-70	A5.18 ER70S-6	ISO 14341-A G 42 2 C1 3Si1 ISO 14341-A G 42 5 M21 3Si1	✓	✓	✓	✓	✓			3SG, 3YSG(C), 3YSG(M2), 3YMG(M2)	3SA, 3YSA	3YS, 3YM	SA3, SA3YM	IIIYMS	KSW53G(C), KSW53G(M2), KSW53MG(M2)	3YSM	3YS	-	-
		SM-70G	A5.18 ER70S-G	ISO 14341-B G 49A 3 C1 S11 ISO 14341-B G 55A 3 M21 S11	-	-	-	-	-			3SG, 3YSG 3MG, 3YMG (C1)	3SA,3YSA	3YS H15	SA3,3YM	IIIYMS	KSW53G, KAW53MG(C)	-	-	-	-
		SM-70GS	A5.18 ER70S-G	ISO 14341-A G2Si	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-
		SM-70EN	A5.18 ER70S-6	ISO 14341-A G 42 2 C1 4Si1 ISO 14341-A G 46 5 M21 4Si1	-	✓	✓	✓	-			-	-	-	-	IIIY40MS (C1) IVY40MS (M21)	-	-	-	-	-
	FCAW	SF-71	A5.20 E71T-1C	ISO 17632-A-T 42 0 P C1 1	✓	✓	-	✓	-			2SMG, 2YSMG(C) H10	2SA, 2YSA H10, 2Y400SA	2S, 2YS H10	SA2M, SA2YM HH, A2M, A2YM HH	IIY40MS H10	KSW52G(C) H10 KSW52Y40G(C) H10	2, 2YS H10	2YS H10	2SM, 2YSM H10	2HS, 2YHS
		Supercored 70NS	A5.18 E70C-6M	ISO 17632-A-T 42 3 M M 21 3 H5	✓	✓	✓	✓	-			3YSG(M2) H5	3SAH5, 3YSA	3YSH5	SA3M, SA3YM HHH	IIIYMS H5	-	-	3YS H5	-	-
		SC-70ML	A5.18 E70C-6M	ISO 17632-A-T 46 4 M M21 2 H5	✓	✓	✓	✓	-			-	4Y400SA H5	4Y40S H5	SA4Y40M HHH	IVY40MS H5	-	-	4Y40S H5	-	-
	SAW	Superflux787 / M-12K	A5.17 F6A(P)6-EM12K	ISO 14174-S A FB 1 / 14171-A-S2Si	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-
		Superflux787 / A-2	A5.17 F8A(P)6-EA2-A2	ISO 14174-S A FB 1 / 14171-A-S2Mo	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-
		Superflux787 / H-12K	A5.17 F7A(P)8-EH12K	ISO 14174-S A FB 1 / 14171-A-S3Si	✓	✓	-	-	-			-	5Y40M H5	-	-	V Y 40M(H5)	-	-	-	-	-
		S-717 / L-8	A5.17 F6A(P)4-EL8	ISO 14174-S A AB 1 / 14171-A-S1	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-
		S-717 / M-12K	A5.17 F7A(P)6-EM12K	ISO 14174-S A AB 1 / 14171-A-S2Si	✓	✓	✓	✓	-			3M, 3YM	3M, 3YM	3YM	A3 , A3YM	IIIYM	KAW53M	-	✓	-	-
		S-800WT / M-12K	A5.17 F7A8-EM12K	ISO 14174-S A FB 1 / 14171-A-S2Si	-	-	✓	✓	-			-	-	-	-	-	-	-	-	-	-
		S-777Q / L-8	A5.17 F7AZ-EL8	ISO 14174-S A AR 1 / 14171-A-S1	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-
		S-777Q / M-12K	A5.17 F7A2-EM12K	ISO 14174-S A AR 1 / 14171-A-S2Si	-	-	-	✓	-			-	-	3YM	-	-	-	-	3YM	-	-
		S-777Q / M-13K	A5.17 F7A0-EM13K	ISO 14174-S A AR 1 / -	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-
High Strength Steel	FCAW	Supercored 81-K2	A5.29 E81T1-K2C H4	ISO 17632-A-T 46 6 1.5Ni P C 1 H5	✓	-	-	✓	-			5Y40SG(C) H5, L3SG(C) H5	5Y400SA H5	5Y40S H5	SA5Y40 HHH	VY40MS H5, NV2-4L, 4-4L	KSWL3SG(C) H5 KSW54Y40G(C)H5	5Y40SM H5	5YS H10	5Y40S H5	-
		Supercored 81MAG	A5.29 E81T1-Ni1M H4	ISO 17632-A-T 46 6 1Ni P M21 2 H5	✓	✓	✓	✓	-			-	5Y400SA H5	5Y40S H5	SA5Y40M HHH	VY40MS H5	-	5Y42SM H5	5Y40S H5	-	-
		SC-81M	A5.29 E81T1-Ni1M-J H4	ISO 17632-A T 50 6 1Ni P M21 1 H5	-	-	-	✓	-			-	-	-	-	-	-	-	-	-	-
		SC-90M	A5.28 E90C-G	ISO 18276-A-T 55 Z Z M M21 1 H5	-	-	-	✓	-			-	-	-	-	-	-	-	-	-	-
		Supercored 110	A5.29 E111T1-GC H4	ISO 17632-A T 69 4 ZMn2.5NiMo P C1 1	-	-	-	-	-			3Y69S(C) H5	E111T1-GC-H4 (IV-40°C ≥41J)	-	-	-	-	-	-	-	-
		SC-110M Cored	A5.28 E110C-G	ISO 17632-A T 69 4 Mn2NiMo M M21 3 H5	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-
		Supercored 120	A5.29 E121T1-GC H4	-	-	-	-	-	-			E121T1-GCH4	-	-	-	-	-	-	-	-	-
	SAW	Superflux787 / F-3	A5.17 F9A(P)8-EF3-F3	ISO 14174-S A FB 1 / 14171-A-S3NiMo	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-
		S-717 / A-2	A5.17 F78A0(PZ)-EA2-A4	ISO 14174-S A AB 1 / 14171-A-S2Mo	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-
		Superflux787 / Ni-5	A5.17 F8A(P)8-ENi5-Ni1	ISO 14174-S A FB 1 / 14171-A-S3Ni1Mo0.2	✓	✓	-	✓	-			-	A5.23 F8A(P)8- ENi5-Ni1	-	-	-	-	-	-	-	-

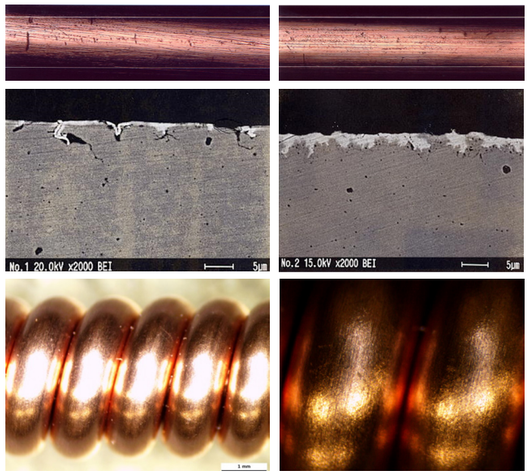
Solid Wires Re-invented

E-LINE

Gas shielded metal arc welding (MIG/MAG) is the most commonly applied welding process in the fabrication of heavy equipment and is applied for a variety of components. Robotic or other forms of mechanised welding are often used for the deposition of long single- or multi-layer fillet welds in lengthy components such as arms and booms, brought in the downhand position by workpiece manipulators. In top, bottom and side frames welds are shorter and more frequent. Wherever possible, the industry uses welding robots or other mechanisation, although manual welding is widely applied for butt and fillet welds that do not qualify for mechanisation. Next to a high welding productivity, there are two main challenges; high quality welds and the avoidance of post weld labour. Heavy equipment is subjected to dynamic loading and fatigue of welded components is a common problem. To avoid this, welds must have a smooth tie-in with the base material and a wide, positive penetration in the root area. In addition, a stable welding process without start failures and feeding irregularities is essential in the avoidance of post weld labour to remove poor craters and spatter.

For these demanding applications, HYUNDAI WELDING introduces E-Line – a unique electrically copper-coated solid wire with a thinner, more homogeneous and better adhering coating than with any chemically copper-coated wire available on the market. The presence of less copper with a stronger adhesion results in a reduced risk of liner clogging by copper flaking. This contributes highly to a stable GMAW process for longer periods of time in welding applications in the heavy equipment industry and may lengthen intervals of operation between maintenance of the welding equipment.

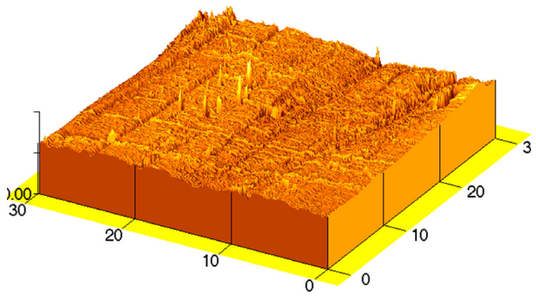
The surface of E-line wires is extremely smooth. The wire surface is first thoroughly cleaned. Any imperfections from the drawing process are subsequently levelled by copper during the electrically coating process. This extremely even and smooth wire surface – which receives a final cleaning – gives improved glide in liner and contact tip with minimal voltage/current fluctuations and thereby a superior arc stability. This is beneficial to the demanding welding operations in the heavy equipment industry at often high welding currents/wire feed speeds and with the application of weaving, as in the fabrication of long arms and booms. The extremely stable GMAW process from E-Line wires brings fabricators advantages in terms of a high welding productivity, straight welds and reduced post weld cleaning. E-Line also features improved start behaviour with reduced arc start time and less start failures, which is beneficial for robotic welding of the many shorter welds in heavy equipment components, requiring many starts and stops of the GMAW process.



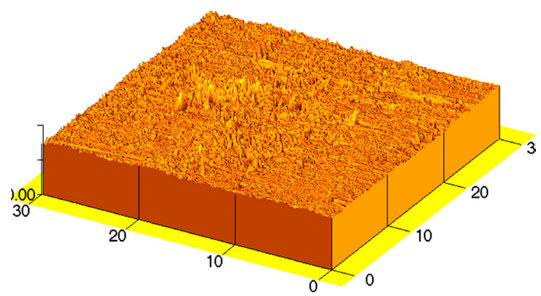
Note: Chemically, with copper sulphate coated wire (left) and electrically coated wire (E-Line). The copper coating of E-Line wires fills up the natural imperfections from the drawing process and adheres better to the wire surface.

Note: Electrically copper-coated wire after extreme deformation showing perfect adhesion of copper on the E-Line surface. It reduces the risk of liner clogging by copper flaking. Visually the colour is brighter than chemically copper coating.

Chemically coated wire

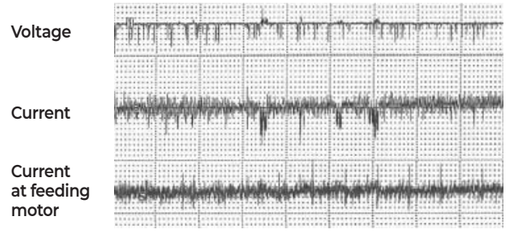


E-Line wire

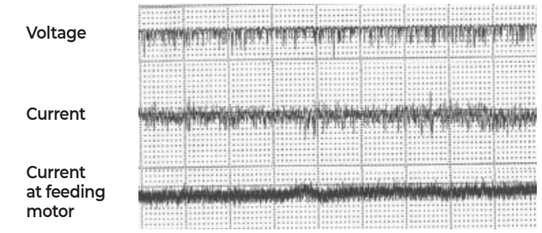


Note: Surface roughness of chemically coated solid wire (left) and E-Line wire measured over 4 mm wire length.

Chemically coated wire



E-Line wire



Note: Electroplated welding wire provides stable arc characteristics during the welding process.

E-Line characteristics and benefits

1. Low feeding force, superior arc stability	Regular welds with a nice appearance
2. Strong adhesion of copper	Reduced copper flaking, reduced feeding irregularities and less downtime for maintenance
3. Low spatter	Less post weld cleaning
4. Improved start behaviour	Less start failures in robotic welding

HYUNDAI WELDING E-Line Mild Steel Wire Range

Product Name	AWS A5.18	EN-ISO 14341-A	Usage
SM-70G *	ER70S-8	G3Si1	Metallurgically stabilized wire for welding at very high current/wire feed speed in 1F and 2F positions
SM-70GS **	ER70S-G	G2Si1	Metallurgically stabilized wire for welding at very high current/wire feed speed in 1F and 2F positions
SM-70 *	ER70S-6	G42 2 C G3Si1 G42 4 C G3Si1	Multi-purpose wire for robotic, mechanized and manual welding in all positions
SM-70EN **	ER70S-6	G42 2 C G4Si1	Multi-purpose wire for robotic, mechanized and manual welding in all positions

* 100%CO_2 or Ar/CO_2 mixed gas ** Ar/CO_2 mixed gas

SM-70G and SM-70GS

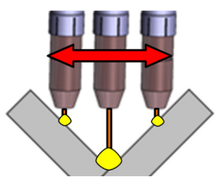
E-LINE

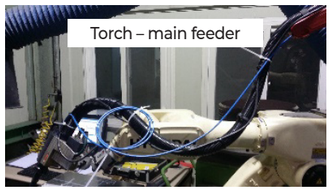
Taking Gas Metal Arc Welding to Extremes

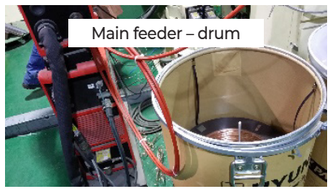
HYUNDAI WELDING SM-70G and SM-70GS solid GMAW wires are specifically developed for the heavy equipment industry. They belong to the innovative E-Line series, but also feature an adapted wire chemistry to facilitate operation at extremely high welding current/wire feed speed and yet retain a good arc stability.

HYUNDAI WELDING SM-70G is developed for use with 100% CO_2 shielding gas or with Ar/10-30% CO_2 mixed gas. When used with pure CO_2, fabricators benefit from the deep and round weld penetration which is characteristic for this gas. It gives optimal protection against cold laps and lack of root penetration. Both defects are notorious initiators for fatigue cracks in heavy equipment components which are subjected to dynamic loading, such as booms and arms. Used with mixed shielding gas with a high fraction of CO_2, weld penetration is less profound, but still acceptable. HYUNDAI WELDING SM-70GS is a high deposition version developed for markets and fabricators that standardise on the use of Ar/15-20% CO_2 shielding gas.

The set-up below shows a laboratory test for a typical and demanding application in the heavy industry; the welding of heavy fillet welds in the 1F position with oscillation of the torch used to fill-up the joint in one run. Characteristic for this application is that the contact tip to work piece distance (CTWD) varies continuously. To artificially increase the resistance in the feeding system, double loops are installed in the liners from drum to feeder and from feeder to torch. Arc behaviour of a conventional solid wire is compared to that of SM-70G.

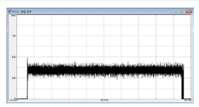
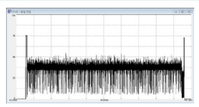
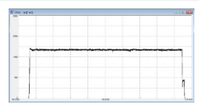
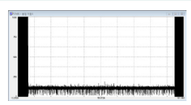
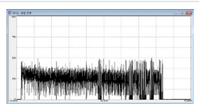
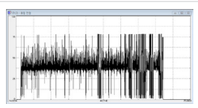
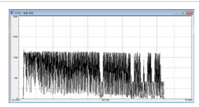
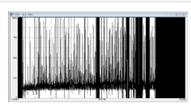






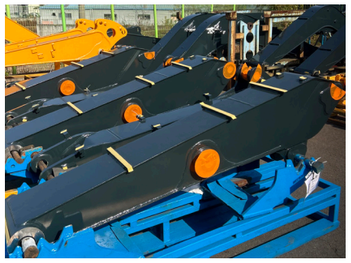
Welding current: 340A	Shielding gas: 100% CO_2
Welding voltage: 36V	Weaving frequency: 1Hz
Wire feed speed: 13m/min.	Travel speed: 30 cm/min.
Wire diameter: 1.4mm	CTWD in centre: 25mm.

Recording of welding parameters reveals extremely stable arc behaviour of HYUNDAI WELDING SM-70G from the E-Line range, whereas the conventional solid wire shows an erratic arc behaviour with occasional arc extinction.

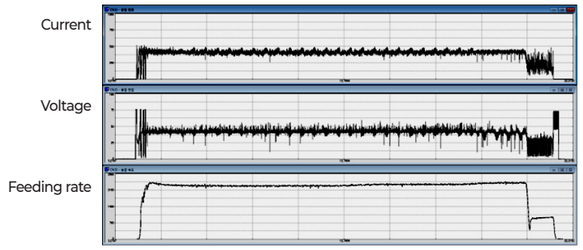
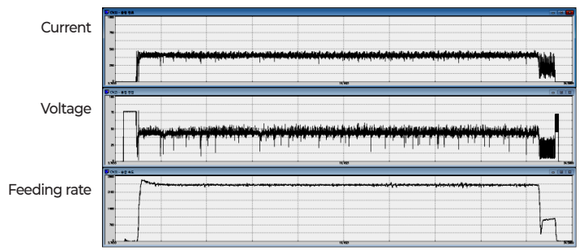
	Current	Arc voltage	Wire feed speed	Welding resistance
1				
2				

1. HYUNDAI WELDING SM-70G 2. Conventional solid wire

HYUNDAI WELDING`s SM-70G and SM-70GS offers productivity across all Heavy Equipment applications industrial segments such as frame and boom welding which allows companies to adapt to needs of the market environments



The figure below shows the same stable arc behaviour of HYUNDAI WELDING SM-70G at elevated current/wire feed speed levels where conventional solid wires are no longer weldable.

Wire feed speed	Conventional solid wire	HYUNDAI WELDING SM-70G
18m/min. (400A/42V)	Welding not possible	
19m/min. (410A/43V)	Welding not possible	

SM-70 and SM-70EN

E-LINE

HYUNDAI WELDING SM-70 and SM-70EN are two multi-purpose solid wires from the E-Line range developed for GMAW in the heavy equipment industry. SM-70 is suited for welding in both 100% CO2 shielding gas and Ar/CO2 mixed gas. SM-70EN has been developed for the European market and is intended for use with mixed gas only. They are multi-purpose wires covering all applications in the heavy equipment industry and therefore perfect for fabricators who wish to standardise on one wire type only. The wires are excellent for the robotic or mechanised and welding of long single or multi-layer fillet welds as in arm and booms, but also for shorter, but more frequent welds in varies types of heavy equipment frames, including circular joints. In addition, the can be used for the manual (pulse) welding of remaining joints that do not qualify for mechanisation.

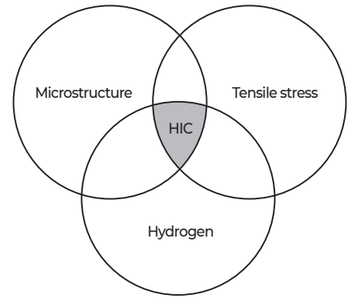
Fabricators benefit from the extremely stable GMAW process from E-Line wires bringing advantages in terms of a high welding productivity, straight welds and reduced post weld cleaning. E-Line also features improved start behaviour with reduced arc start time and less start failures, which is beneficial for robotic welding of the many shorter welds in heavy equipment components, requiring with many starts and stops of the GMAW process. In manual pulse welding, high arc stability promotes the desired one drop per pulse mode with a size equalling the wire diameter.

Solid and Cored Wires for High Strength Steel

HIGH STRENGTH STEEL

The fabrication of heavy equipment takes place against a background of strict safety protocols and tough industry standards, to ensure quality, reliability and safety of the finished products. There is a strong focus on weight reduction through the use of high strength steel to increase payload of machines and save on fuel costs. Fabricators who can best process these materials enjoy a competitive advantage. This also requires efficient, often robotised welding of high quality welds - a number one requirement throughout the industry. Modern high strength steel has an excellent combination of strength and toughness. They are commonly produced through two individual routes; the thermo-mechanically controlled process (TMCP) or the quenched and tempering method (Q&T). When producing durable structures from steel, weldability is an important material property because most constructions require welding at some point of the production chain. The wide scale implementation of TMCP has greatly improved weldability, because this process enables the production of high strength steel with a relatively low carbon content. Yet, it remains a challenge to retain the good balance of strength and toughness after welding, because fusion welding inevitably induces high thermal gradients and microstructural changes in the heat affected zone of the steel.

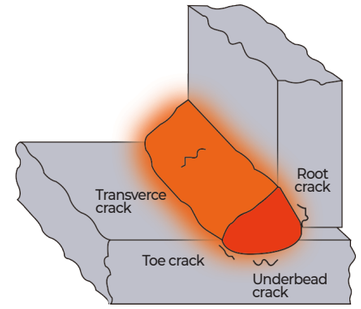
Avoidance of hydrogen induced cold cracking (HIC) is an important aspect in the welding of high strength steel, as these grades may be susceptible to the formation of brittle structures in weld and heat affected zone. HIC requires three factors to occur:



- The presence of brittle structures
- High levels of restraint in the weld zone
- The presence of hydrogen in weld or heat affected zone

Brittle structures in weld and heat affected zone can be avoided by applying strict thermal control of welding. The steel manufacturer provides valuable recommendations for a correct welding procedure in terms of preheating, inter-pass temperature, cooling rate and post weld heat treatment. It is recommended to follow these at all times.

High levels of restraint can be avoided by choosing joint designs and weld sequences that distribute stress rather than concentrating it. Also the way a weld is deposited has its influence. A weld built-up by several smaller beads will have less shrinkage force than a large, single layer weld. Atomic hydrogen, the element H, has a tendency to migrate to areas of concentrated stress and add to the formation and propagation of cracks. This can become visible directly after welding, but also after longer periods of time. Sources of hydrogen are substances in the welding zone that break apart under the heat of welding such as, moisture (dew), grease, fat, paint, temperature chalk and rust, and these must be properly removed prior to welding.



Also the welding consumable itself can be a notorious source of hydrogen when they contain moisture in some form. It is still common practice to re-dry stick electrodes and submerged arc fluxes and store them in dry cabinets before welding. Today many manufacturers are able to deliver low-hydrogen consumables with less than 5 (H5) or 4 (H4) ml hydrogen per 100g weld metal and deliver these in moisture resistant packaging, to be used without (costly) re-drying.

GMAW/MIG WIRES FOR HIGH STRENGTH STEEL

HYUNDAI WELDING supplies a range of solid wires that covers most high strength steels grades used in the fabrication of heavy equipment. They are all members of the innovative E-Line family and thereby extremely suited for mechanised and robotic welding. The extremely stable GMAW process from E-Line wires brings fabricators advantages in terms of a high welding productivity, straight welds and reduced post weld cleaning. E-Line also features improved start behaviour with reduced arc start time and less start failures, which is beneficial for robotic welding of the many shorter welds in heavy equipment components, requiring many starts and stops of the GMAW process. Please see page 18 for the details regarding E-Line.

Product Name	AWS A5.28	EN	Shielding Gas
SM-100	A5.28 ER100S-G	-	Ar/CO_2 mixed
SM-110	A5.28 ER110S-G	-	Ar/CO_2 mixed
SM-120A	A5.28 ER120S-G	-	Ar/CO_2 mixed

ALL POSITIONAL FCAW WIRES FOR HIGH STRENGTH STEEL

The Supercored series for high strength steel represents a range of rutile all-positional cored wires for use with 100% CO_2 shielding gas (except Supercored 81MAG). The fast freezing slag systems gives excellent support to the weld pool in positional welding, enabling very high deposition rates. A high weld metal strength is combined with excellent low-temperature CVN- toughness, due to TiB micro-alloying. The wires deposit low-hydrogen weld metal; AWS class H4 and EN class H5.

The wires operate in the spray arc mode over a wide range of applicable welding parameters and are virtually spatter-free. The brittle slag is easily removed and welds are smooth with a nice tie-in onto the plate edges. Weld penetration is round and deep, due to the use of 100% CO_2 shielding gas.

Supercored wires are an excellent choice for both automated and manual welding in the heavy equipment industry, combining productivity with high strength and weld metal toughness. Low-hydrogen weld metal protects against hydrogen induced cold cracking. Weldments require limited post weld labour and the high weld quality counteracts the occurrence of fatigue cracking during dynamic loading.

Product Name	AWS A5.29	EN ISO 18276-A	Shielding Gas	Min. CVN Test Temp
Supercored 81MAG	E81T1-Ni1M-J H4	T 46 6 1Ni P M21 2 H5	Ar/CO_2 mixed	-60°C (-76°F)
Supercored 81-K2 *	E81T1-K2C H4	T 46 6 1.5Ni P C1 1 H5	100% CO_2	-60°C (-76°F)
Supercored 110 *	E111T1-GC H4	T 69 4 ZMn2.5NiMo P C1 1	100% CO_2	-40°C (-40°F)
Supercored 120	E121T1-GC H4	-	100% CO_2	-18°C (-0.4°F)

* SC-81M and SC-110M Cored are the versions which can be used with Ar/CO_2 mixed gas.

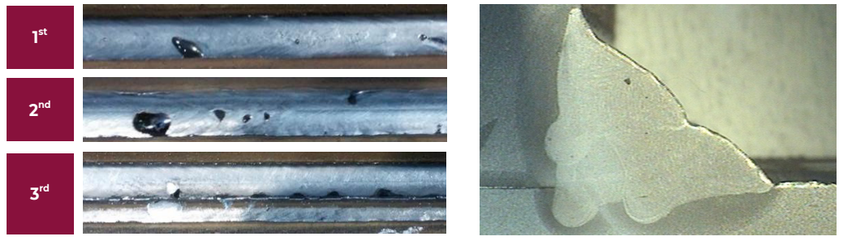
Supercored 70NS

Supercored 70NS (AWS: E70C-6M) is a metal-cored wire designed for high travel speed welding of fillet welds in the 1F and 2F position, using Ar/CO_2 shielding gas. It is developed for mechanised and robotic welding of lengthy constructions, such as booms and arms of heavy equipment. Supercored 70NS is a productive choice for fabricators who prefer the use of mixed gas and require absence of slag on deposited welds.

The arc stability is high. Spatter levels as well as the amount of remaining silicate islands - after multi-layer welding – are low, restricting post weld cleaning to a minimum. The weld penetration profile is remarkably wide and deep for a metal-cored wire and Ar/CO_2 shielding gas. Lack of fusion defects and insufficient root penetration are largely avoided and, thereby, notorious initiation points of fatigue cracks under dynamic loading during use heavy equipment. The weld metal has good CVN impact toughness down to -30°C. The wires deposit low-hydrogen weld metal; EN class H5.

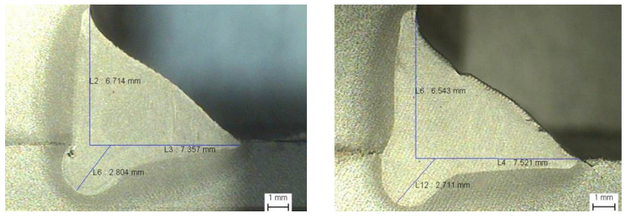
Weld appearance and profile in multi-pass welding:

Welding position: 2F
Shielding gas: 85%Ar / 15%CO_2
Welding sequence: 1 pass → removal of slag → 2 pass → removal of slag → 3 pass
Parameters: 280A / 30V, 40 cpm



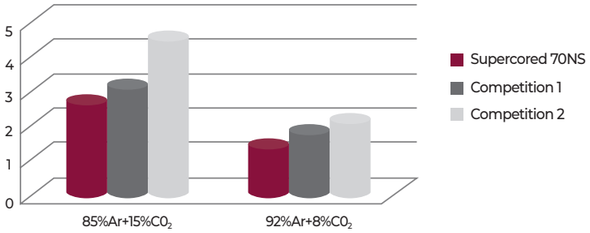
Weld profile in single layer welding

Left: 85%Ar / 15%CO_2
Right: 92%Ar / 8%CO_2
Welding position: 2F
Parameters: 250A / 28V

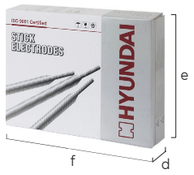


Spatter Generation (% ratio)

Spatter generation (weight of spatter/ weight of weld metal x 100%) of Supercored 70NS compared with two same class competitor wires. Bead on plate: 250A/28V.



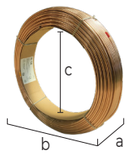
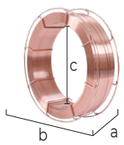
SMAW Electrodes

Type	Packet	Carton
STANDARD	5kg 	20kg 
PVC BOX (HEXAGONAL)	2.5kg (5.5lbs) 	10-20kg (22-44lbs) 

Carton Size mm (in)	
d	82 (3.2)
e	180-275 (7.1-10.8)
f	312-562 (12.3-22.1)

Carton Size mm (in)	
Packet	PVC 2.5kg (5.5lbs)
Carton	10kg (22lbs)
d	80 (3.1)
e	310-330 (12.2-13)
f	360-405 (14.2-16)

Subarc Wire

Type	Wire	Size mm (in)			
		Wire	a	b	c
Coil Type		25kg (55lbs)	75/100 (3.0/3.9)	410/420 (16.1/16.5)	305/315 (12.0/12.4)
		30kg (66lbs)	95 (3.7)	400 (15.7)	305 (12.0)
		100kg (220lbs)	90/100 (3.5/3.9)	760 (29.9)	630 (24.8)
Basket Spool		150kg (330lbs)	90 (3.5)	790 (31.1)	630 (24.8)
		25kg (55lbs)	103 (4.1)	413-419 (16.3-16.5)	297-303 (11.7-11.9)

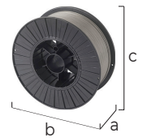
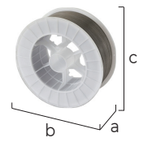
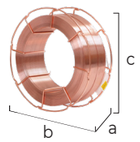
* Other coil sizes available upon request

Subarc Flux

Packaging		
TIN CAN	PE BAG	PAPER BAG
		
15kg, 20kg (33lbs, 44lbs)	20kg, 25kg (44lbs, 55lbs)	20kg, 25kg (44lbs, 55lbs)

PACKAGING SPECIFICATIONS

GMAW/MIG and Flux Cored Wires - Spools

Type	Spool		
	Plastic Spool (GMAW/MIG Wire Flux Cored Wire) 12.5/15kg		Basket Spool (GMAW/MIG Wire) 15kg
Spool Type			

Spool Size mm (in)		
	Plastic Spool (GMAW/MIG Wire Flux Cored Wire)	Basket Spool (GMAW/MIG Wire)
a	110 (4.3)	98 (3.9)
b	270-280 (10.6-11.0)	298 (11.7)
c	270-280 (10.6-11.0)	298 (11.7)

GMAW/MIG and Flux Cored Wires – Drum Solutions

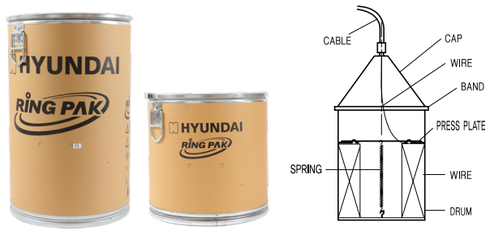
Ball pac

HYUNDAI WELDING's Ball pac® is a new and improved version of our original Pail pack. Our patented 'marble' system, acts as a 'non-static' resistance on top of the wire. Please see page 24 for detailed information.

ECO PLUS

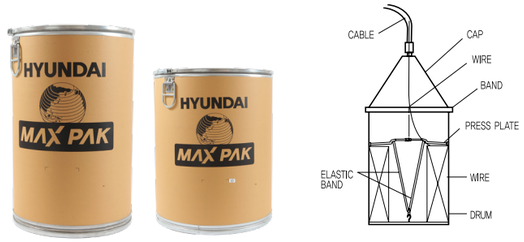
The ECO PLUS drums are made of 100% recyclable cardboard. Please see page 24 for detailed information.

RiNG PAK



RiNG PAK is an effective system to avoid tangling of the wire during pay-off. It uses a press and a spring to keep the remaining wire in place. It guarantees regular, low force feeding resulting in straight welds with good penetration along the intended welding line.

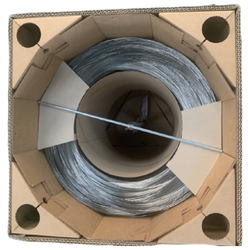
MAX PAK



MAX PAK is an effective system to avoid tangling of the wire during pay-off. It uses a press plate and elastic band to keep the remaining wire in place. It guarantees regular, low force feeding resulting in straight welds with good penetration along the intended welding line. It is easy to see when the drum is almost empty and needs to be replaced.

ECO PLUS

Disposal of waste is expensive, recycling is convenient. For this reason HYUNDAI WELDING presents ECO PLUS, the new drum for welding wires made of 100% recyclable cardboard. It is standard supplied with the exclusive anti-tangling Hyundai Ball pac® technology.



Corrugated cardboard type

- A lightweight structure that does not require separation of materials
- Easy to handle, discard and recycle
- Application of reinforced corrugated cardboard for packaging heavy goods with high functionality and enhanced moisture resistance and strength

Quadrilateral structure

- Improved stability and ease of loading

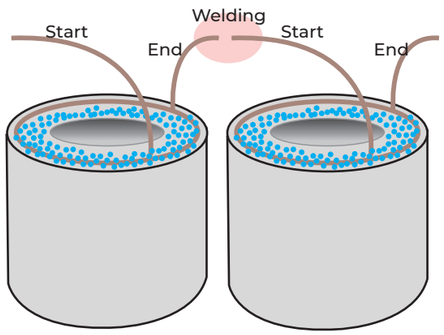
Safe Load Design Criteria

- Applying the safety factor of RSC vertical compressive strength standard
- 545 type safety load 619kgf
- 610 type safe load 939kgf

Model	Weight	Diameter mm (in)	Product Type
Ball pac MAX PAK	Up to 500 kg	0.9 / 1.0 / 1.2 / 1.4 / 1.6 (0.035 / 0.040 / 0.045 / 0.052 / 1/16)	GMAW
Ball pac RING PAK	300 kg	0.9 / 1.0 / 1.2 / 1.4 / 1.6 (0.035 / 0.040 / 0.045 / 0.052 / 1/16)	FCAW
	420 & 500 kg	1.4 / 1.6 (0.052 / 1/16)	

ENDLESS DRUM

By connecting the end of the wire of the drum in use with the beginning of the next drum, an endless wire supply is created. Ideal to keep welding robots in production lines going until planned maintenance.



Ball pac

Our patented marble system allows for better feeding reliability and improves welding efficiency. Hundreds of marbles inside our drums prevent wire deformation and tangling. The wire is extracted directly with this innovative system, reducing friction and tangles, creating an improved welding experience and superior results.

Excellent Feeding

The Ball pac® minimizes friction normally resulting from twisted or tangled welding wire. This results in smooth wire feeding and stable arc, two essential elements of effective welding.

Anti-tangling & Twist Proof Design

Hyundai Ball pac® has proven its superior quality and strong performance in various industries over many years. This patented marble system functions as an anti-tangling device that prevents welding wires from tangling and twisting inside the drum.

Protection Against Damage and Deformation

Because the welding wire is pre-installed in our factories inside a metal container, the welding wire is effectively protected from damage and deformation resulting from stacking during shipping and storage.

Accurate Tracking of Welding Seams

Welding wire is wound inside the drum under tension so that it can be extracted straight out of the drum without rotation. Ensuring that the welding wire is straight allows for more accurate tracking of welding seams.

Reduced Downtime and Improved Productivity

The Ball pac® design increases the weight of welding wire available in a single drum. This substantially reduces downtime between wire changes improving productivity. Design features that reduce intervention during welding activity are particularly suited to robotic and automated welding processes.

Patent & Trademark Principal Register

Patent
US. 5,746,380 / AU. 681988

Utility Model
KR. 135931 / JP. 3040923 / CN. ZL 96 2 18535.3

Trademark Principal Register
KR. 378634 / US. 2139642 / JP. 4181764

Specifications

Product Packages	Drum Dimensions and Weight mm (in)	Cap Dimensions mm (in)	Wire Diameters mm (in)	Wire Types	Conduit
200kg (400lbs) 250kg (551lbs) 300kg (661lbs)	**Diameter** 510 (20.1) **Height** 810 (31.9) **Weight** 10kg (22lbs)	**Diameter** 510 (20.1) **Height** 300 (11.8)	0.9 (.035) 1.0 (.039) 1.1 (.045) 1.4 (.052) 1.6 (1/16)	Solid / Flux Cored Stainless Steel	**Type Flexible Diameter** 11mm (0.43in) **Length** 1-5m (3.28-16.4ft)
400kg (882lbs) 420kg (926lbs)	**Diameter** 660 (26) **Height** 810 (31.9) **Weight** 15kg (33lbs)	**Diameter** 660 (26) **Height** 500 (19.7)			

REFERENCES

HD HYUNDAI CONSTRUCTION EQUIPMENT

HD HYUNDAI INFRACORE

VOLVO

L&T Construction Equipment

SIMEX
HEAVY MADE EASY

HE-VA

HYUNDAI WELDING is a global manufacturer of welding consumables and equipment. As the top leading manufacturer of welding consumables in Korea, and with a global network of sales, distribution and manufacturing plants, HYUNDAI WELDING has developed into a key player in the international welding industry.

Our company is fully committed to the ever-changing needs of our customers and has evolved in just under 50 years to provide welding expertise and breakthroughs in welding technology. HYUNDAI WELDING understands customer needs and offers customers world-class products and world-class solutions.

HYUNDAI WELDING's heavy equipment welding solutions meet customer requirements for heavy equipment fabrication backed with a superior customer service and support. By using high quality consumables and equipment portfolio of HYUNDAI WELDING, our customers experience improved productivity and competitiveness in the market.

HYUNDAI WELDING is a world-class manufacturer that specializes in providing optimum welding solutions to its customers, by supplying top-notch welding consumables and equipment. HYUNDAI WELDING has contributed to the development and success of the global welding industry for more than 40 years since its foundation in 1975.

For more information on HYUNDAI WELDING, please visit www.hyundaiwelding.com

E-book

HYUNDAI WELDING

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