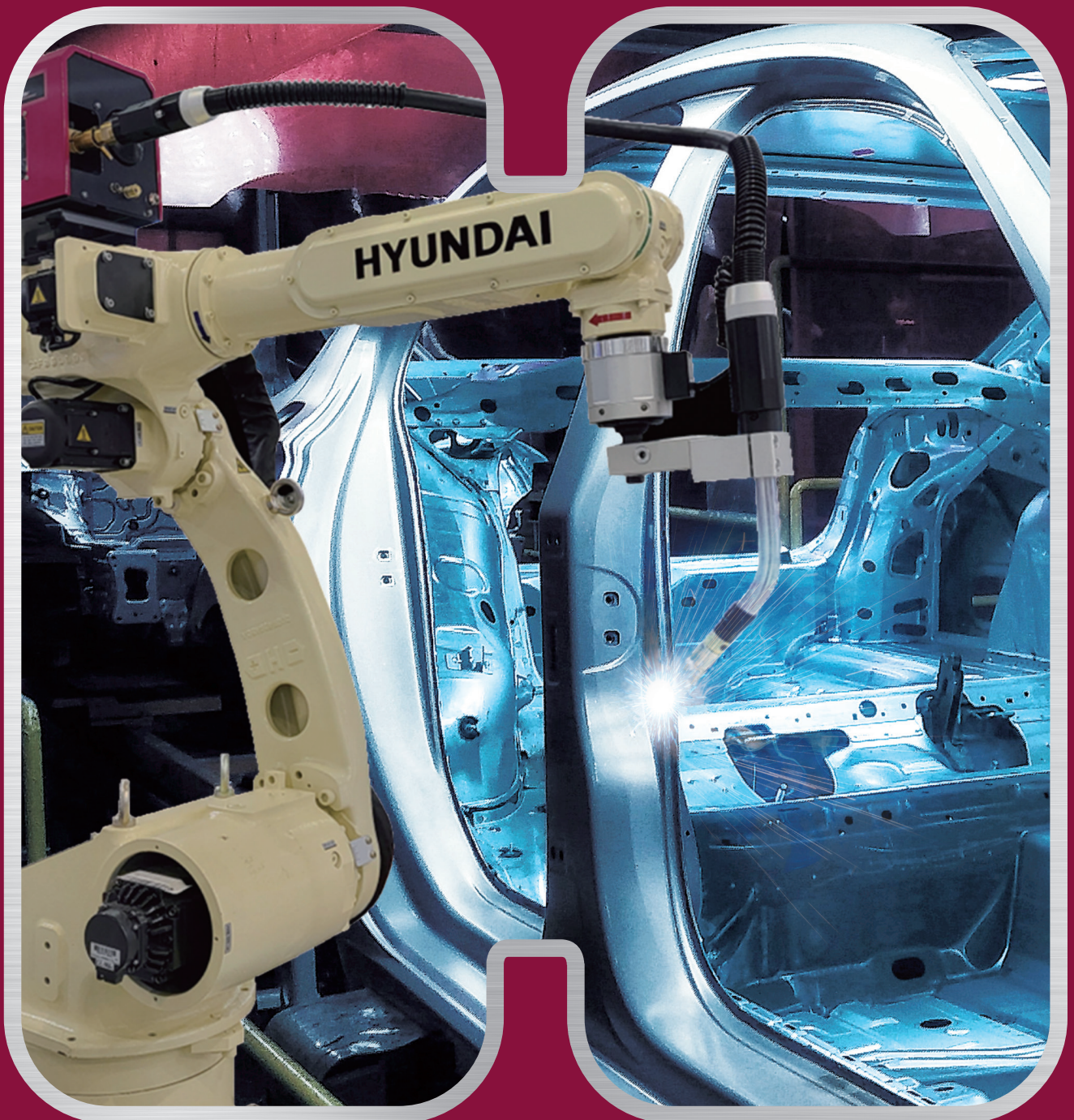


WELDING SOLUTIONS FOR THE AUTOMOTIVE INDUSTRY





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HYUNDAI WELDING STAYING ON TOP OF AUTOMOTIVE MANUFACTURING TRENDS

After a historic economic downturn due to Covid-19, followed by more recent global disruptions and shortage of microchips, the automotive industry is passing through one of its most challenging periods in history. Triggered by environmental, social and government (ESG) policies worldwide, the industry has embarked upon a journey to produce cleaner, lighter and safer cars. One of the most significant global trends is the focus on electric vehicles (EVs) and the crucial improvement of battery performance and charging infrastructure. To produce affordable EVs and gain market share, OEM's and suppliers are forced to search for next level efficiency and re-think every manufacturing step in the supply chain, including the use of even more robotics and automation in production.

For car body components, the trend in the automotive industry is shifting towards the use of thinner, high tensile strength steel, pre-coated components and aluminium parts. Welding these components efficiently at a high quality standard requires total control of the welding process, enabled by advances in automation and software and the use of dedicated welding consumables.

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 car division. The resulting wide range of automotive consumables includes innovative solutions for the welding of main car body frames and panels, suspension components and exhaust systems. A good example is SM-70MT; our ultra-low silicates solid wire which allows electro-deposited (E-) coating without post-weld cleaning. With products like these, we support automotive manufacturers all over the world to increase their efficiency, productivity and competitiveness.

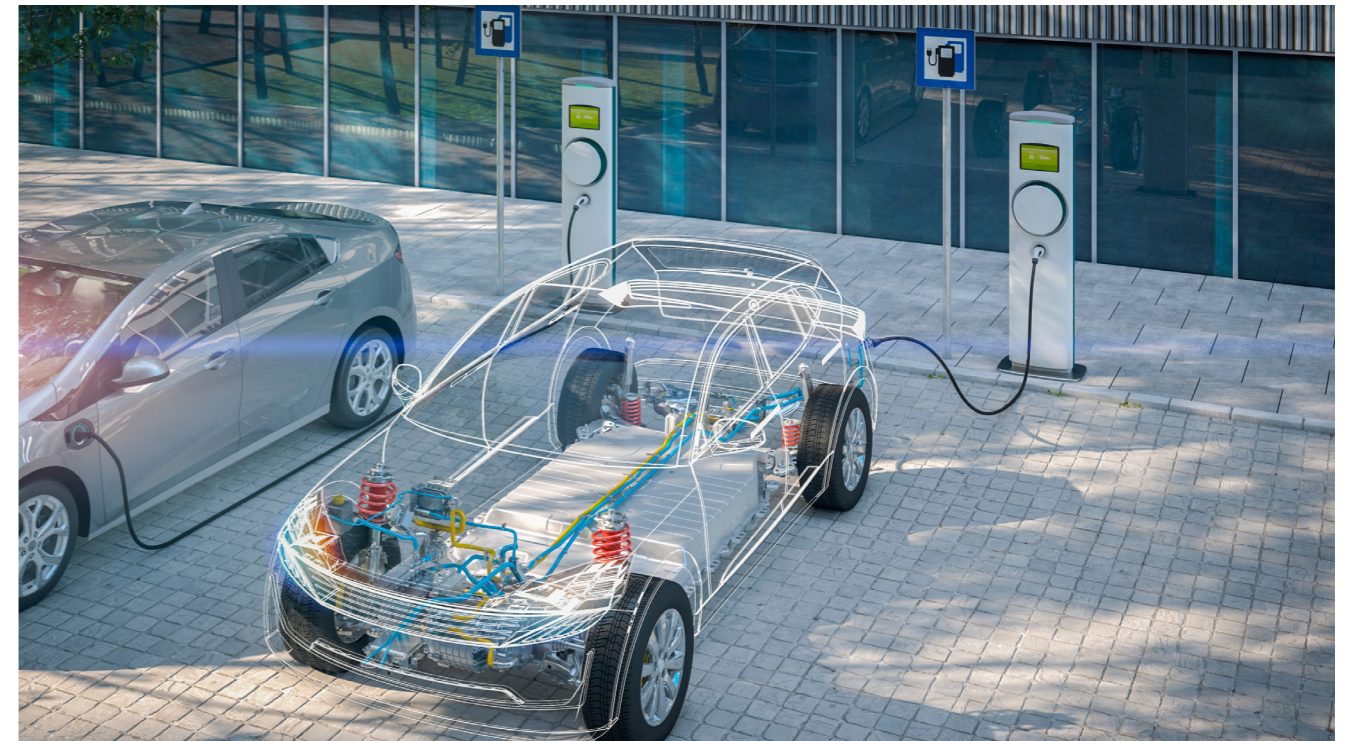


LIGHTER, STRONGER AND MORE EFFICIENT CARS

In line with the adaptation of electric vehicles, the automotive industry has seen the development of new possibilities, such as autonomous driving technology and the use of connectivity and smart features in cars. The industry is constantly researching and developing new technologies to improve the performance, safety, and efficiency of vehicles. One area of focus is the chassis and recent developments in chassis technology include:

- 1. Lightweight materials:** The use of materials such as aluminium, carbon fiber and advanced high-strength steels help reduce the overall weight of a vehicle and improve fuel efficiency and performance.
- 2. Advanced suspension systems:** Suspension systems that use air or electronic controls can provide improved handling and driving comfort, as well as the ability to adjust the vehicle's height to different terrains.
- 3. Electric drivetrains:** With the increasing popularity of electric vehicles, chassis design must be optimized to accommodate the unique requirements of electric drivetrains, including battery placement and cooling systems.
- 4. Autonomous driving:** As vehicles become more autonomous, chassis design must adapt to accommodate the additional sensors, cameras and other technologies required for self-driving capabilities.

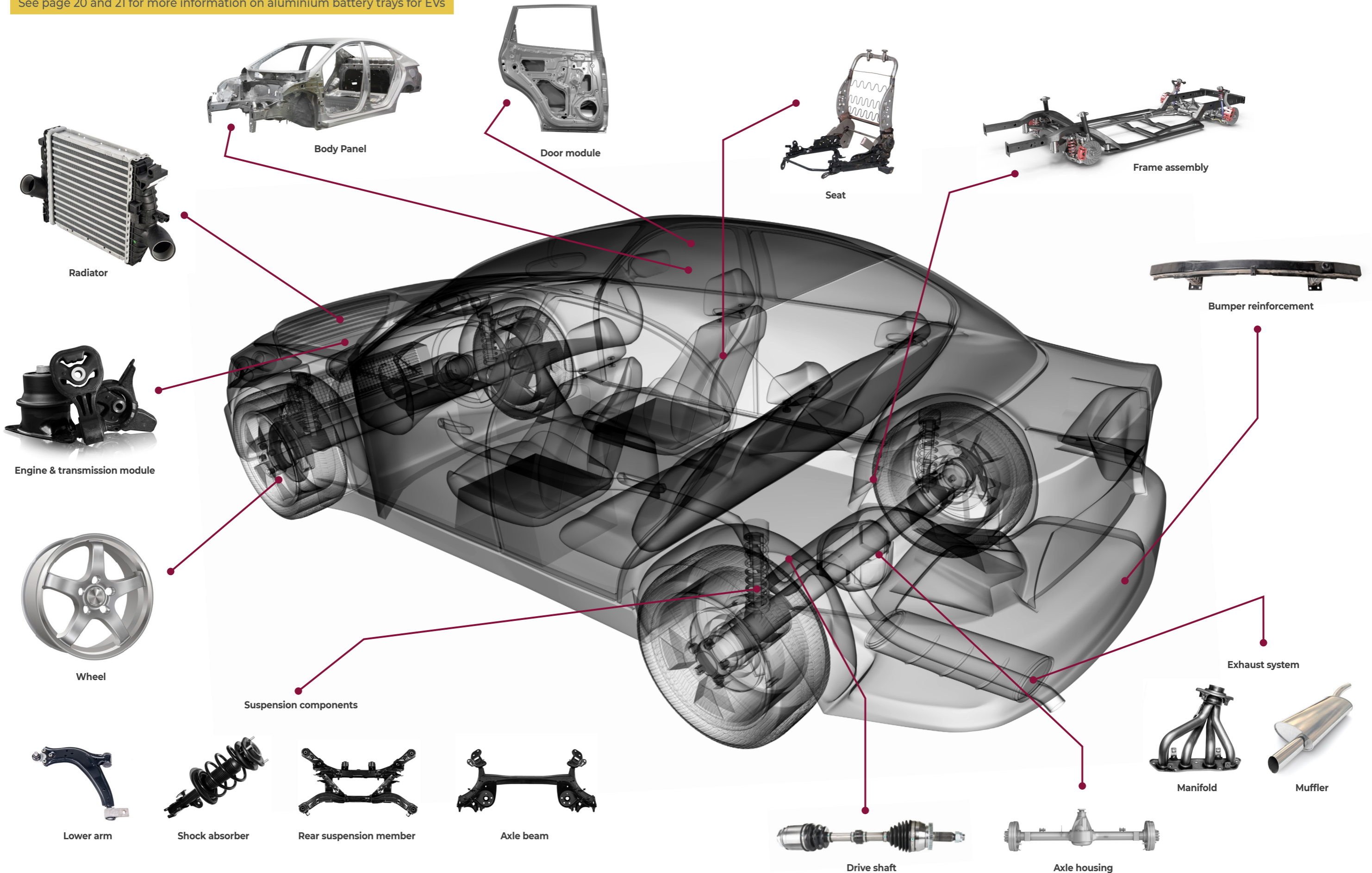
There are many other parts and systems that are critical to the safe and efficient operation of a vehicle, and ongoing research and development is focused on improving these parts and systems to make vehicles safer, more efficient, and more sustainable.



WELDABLE CAR PARTS

See page 20 and 21 for more information on aluminium battery trays for EVs

WELDING APPLICATIONS IN THE AUTOMOTIVE INDUSTRY



WELDING APPLICATIONS IN THE AUTOMOTIVE INDUSTRY

Base material	Process	Product name	AWS		EN/ISO	Body panel		Door module	Frame assembly	Suspension components	Wheel	Seat	Engine & transmission modules	Axle housing	Drive shaft	Exhaust system	Radiator	Bumper reinforcement	
Mild steel	Solid wire	SM-70	A5.18	ER70S-6	14341-A	G 42 2 C1 3Si G 42 5 M21 3Si	✓	✓	✓	✓	✓	✓	✓		✓			✓	
		SM-70S	A5.18	ER70S-3	14341-A	G 38 2 C1 2Si G 42 3 M21 2Si	✓	✓	✓	✓			✓		✓			✓	
		SM-70MT	-	-	14341-B	G49A 5 M21 SZ G49A 5 M20 SZ	✓	✓	✓	✓									✓
		SM-70G	A5.18	E70S-8	14341-B	G 49A 3 C1 S11 G 55A 3 M21 S11									✓				
		SM-70EN	A5.18	ER70S-6	14341-A	G 42 2 C1 4Si G 46 5 M21 4Si	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
	Cored wire	SC-70Zn	A5.18	E70C-GSM	17632-A	T 3T Z M M21 1	✓	✓		✓									
		Supercored 70NS	A5.18	E70C-6M	17632-A	T 42 3 M M21 3 H5	✓	✓		✓	✓				✓	✓			
		SC-70ML	A5.18	E70C-6M	17632-A	T46 4 M M21 2 H5	✓	✓		✓	✓				✓	✓			
	Austenitic stainless steel	Solid wire	SM-307Si	-	-	14343-A	G 18 8 Mn										✓		
SM-308LSi			A5.9	ER308LSi	14343-A	G 19 9L Si										✓			
Cored wire		SW-309LNS Cored	A5.9	EC309L	17633-A	T 23 12 L M M13/11										✓			
Ferritic stainless steel	Solid wire	SM-430LNb	-	-	14343-A	G 18LNb										✓			
	Cored wire	SF-409Ti	A5.9	EC409	-	-										✓			
		SF-430	A5.9	EC430	-	-										✓			
		SF-430Nb	-	-	-	-										✓			
		SF-436	-	-	-	-										✓			
		SC-439Ti Cored	A5.22	EC439	-	-										✓			
Aluminum	Solid wire	SMT-5183 (S)	A5.10	ER5183	18273	S Al 5183 (AlMg4,5Mn)	✓	✓	✓									✓	
		SMT-5356 (S)	A5.10	ER5356	18273	S Al 5356 (AlMg5Cr)			✓	✓								✓	
		SMT-5087 (S)	A5.10	ER5087	18273	S Al 5087 (AlMg4,5MnZr)												✓	
		SMT-5554 (S)	A5.10	ER5554	18273	S Al 5554 (AlMg2,7Mn)				✓					✓				
		SMT-4043 (S)	A5.10	ER4043	18273	S Al 4043 (AlSi5)	✓				✓							✓	
		SMT-4047 (S)	A5.10	ER4047	18273	S Al 4047 (AlSi12)	✓											✓	
Copper alloy	Solid wire	SMT-CuSi A (S)	A5.7	ERCuSi-A	14640	S Cu 6560 (CuSi3Mn1)	✓		✓										
		SMT-CuAl Al (S)	A5.7	ERCuAl-Al	14640	S Cu 6100 (CuAl8)													✓

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

Base Material	Process	Product Name	AWS	EN ISO	Typical Chemical Composition of All-Weld Metal(%)												Typical Mechanical Properties of All-Weld Metal					
					C	Si	Mn	P	S	Ni	Cr	Mo	Ti	Nb	Al	YS	TS	EL	Impact ISO-V			
					MPa(lbs/in ²)	MPa(lbs/in ²)	(%)	°C (°F)	J (ft.-lbs)													
Mild Steel	Solid Wire	SM-70	A5.18 ER70S-6	ISO 14341-A-G 42 2 C1 3Si	0.07	0.58	1.15	0.010	0.010	-	-	-	-	-	-	-	467 (67,700)	566 (82,100)	28	-30 (-20)	71 (52)	
				ISO 14341-A-G 42 5 M21 3Si	0.07	0.64	1.24	0.010	0.010	-	-	-	-	-	-	472 (68,500)	569 (82,500)	26	-50 (-60)	60 (44)		
		SM-70S	A5.18 ER70S-3	ISO 14341-A-G 38 2 C1 2Si	0.09	0.40	0.85	0.015	0.008	-	-	-	-	-	-	-	430 (62,400)	515 (74,700)	29	-20 (0)	80 (59)	
				ISO 14341-A-G 42 3 M21 2Si	0.08	0.44	0.92	0.015	0.008	-	-	-	-	-	-	440 (63,800)	535 (77,600)	28	-30 (-20)	85 (63)		
		SM-70MT	-	ISO 14341-B-G 49A 5 M21 SZ														426 (61,800)	512 (74,300)	32	-50 (-60)	75 (55)
				ISO 14341-B-G 49A 5 M20 SZ														545 (79,100)	606 (87,900)	28	-50 (-60)	96 (71)
		SM-70G	A5.18 E70S-8	ISO 14341-B-G 49A 3 C1 S11	0.07	0.52	1.07	0.015	0.009	-	-	-	-	-	-	-	-	460 (66,700)	560 (81,200)	29	-30 (-20)	90 (66)
				ISO 14341-B-G 55A 3 M21 S11	0.06	0.61	1.20	0.015	0.009	-	-	-	-	-	-	-	-	470 (68,200)	570 (82,700)	27	-30 (-20)	70 (52)
		SM-70EN	A5.18 ER70S-6	ISO 14341-A-G 42 2 C1 4Si	0.09	0.56	1.06	0.015	0.012	-	-	-	-	-	-	-	-	461 (66,900)	560 (81,200)	29	-20 (0)	95 (70)
				ISO 14341-A-G 46 5 M21 4Si	0.09	0.68	1.26	0.015	0.012	-	-	-	-	-	-	-	-	524 (76,000)	617 (89,500)	27	-50 (-60)	61 (45)
Cored Wire	SC-70Zn	A5.18 E70C-GSM	ISO 17632-A-T 3T Z M M21 1	0.45	0.37	1.15	0.008	0.003	-	-	-	-	-	-	2.0	-	545 (79,100)	-	-	-		
	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	0.010	-	-	-	-	-	-	-	480 (69,600)	550 (79,800)	25	-30 (-20)	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	0.010	0.3	-	-	-	-	-	-	476 (69,000)	553 (80,200)	27	-40 (-40)	75 (55)		
Austenitic Stainless	Solid Wire	SM-307Si	-	ISO 14343-A-G 18 8 Mn	0.08	0.87	5.88	0.007	0.009	8.8	18.6	0.05	-	-	-	-	-	629 (91,300)	42	-20 (0)	114 (84)	
		SM-308LSi	A5.9 ER308LSi	ISO 14343-A-G 19 9L Si	0.02	0.85	1.55	0.023	0.001	9.5	19.1	0.13	-	-	-	-	-	615 (89,200)	43	-60 (-75)	70 (52)	
	Cored Wire	SW-309LNS Cored	A5.9 EC309L	ISO 17633-A-T 23 12 L M M13/11	0.02	0.53	1.80	0.016	0.005	13.0	24.0	-	-	-	-	-	590 (85,600)	45	-	-		
Ferritic Stainless	Solid Wire	SM-430LNb	-	ISO 14343-A-G 18LNb	0.02	0.38	0.46	0.023	0.001	0.2	18.1	-	-	0.4	-	-	-	-	-	-		
	Cored Wire	SF-409Ti	A5.9 EC409	-	0.03	0.50	0.55	0.012	0.010	-	12.5	-	0.8	-	-	-	-	-	-	-		
		SF-430	A5.9 EC430	-	0.03	0.30	0.50	0.005	0.010	-	16.5	-	0.5	-	-	-	-	-	-	-		
		SF-430Nb	-	-	0.03	0.40	0.17	0.010	0.010	-	16.5	-	0.4	0.5	-	-	-	-	-	-		
		SF-436	-	-	0.03	0.60	0.40	0.008	0.006	-	16.8	0.8	0.5	-	-	-	-	-	-	-		
SC-439Ti Cored	A5.22 EC439	-	0.03	0.30	0.60	0.005	0.010	-	18.5	-	0.6	-	-	-	-	-	-	-				

Base Material	Process	Product Name	AWS	EN ISO	Typical Chemical Composition of All-Weld Metal(%)												Typical Mechanical Properties of All-Weld Metal		
					Al	Si	Fe	Cu	Mn	Mg	Zn	Cr	Zr	Ti	Be	V	YS	TS	EL
					MPa(lbs/in ²)	MPa(lbs/in ²)	(%)												
Aluminum	Solid Wire	SMT-5183 (S)	A5.10 ER5183	ISO 18273 S Al 5183 (AlMg4,5Mn(A))	Rest	0.40	0.40	0.10	0.50 - 1.0	4.3 - 5.2	0.25	0.05 - 0.25	-	0.15	0.0003	0.05	130 (18,900)	275 (40,000)	18
		SMT-5356 (S)	A5.10 ER5356	ISO 18273 S Al 5356 (AlMg5Cr(A))	Rest	0.40	0.25	0.10	0.05 - 0.20	4.5 - 5.5	0.10	0.05 - 0.20	-	0.06 - 0.20	0.0003	0.05	120 (17,400)	250 (36,300)	18
		SMT-5087 (S)	A5.10 ER5087	ISO 18273 S Al 5087 (AlMg4,5MnZr(A))	Rest	0.25	0.10 - 0.20	0.05	0.70 - 1.10	4.5 - 5.2	0.25	0.05 - 0.25	0.1 - 0.2	0.15	0.0003	0.05	140 (20,300)	285 (41,300)	18
		SMT-5554 (S)	A5.10 ER5554	ISO 18273 S Al 5554 (AlMg2,7Mn)	Rest	0.25	0.40	0.10	0.5-1.0	2.40 - 3.0	0.25	0.05 - 0.20	-	0.05 - 0.20	0.0003	0.05	100 (14,500)	215 (31,200)	18
		SMT-4043 (S)	A5.10 ER4043	ISO 18273 S Al 4043 (AlSi5(A))	Rest	4.5 - 6.0	0.60	0.30	0.15	0.05	0.10	-	-	0.15	0.0003	0.05	40 (5,800)	120 (17,400)	8
		SMT-4047 (S)	A5.10 ER4047	ISO 18273 S Al 4047 (AlSi12(A))	Rest	11.0 - 13.0	0.60	0.30	0.15	0.10	0.20	-	-	0.15	0.0003	0.05	60 (8,700)	130 (18,900)	5

APPROVALS

Base Material	Process	Product Name	AWS	EN ISO	CWB	TÜV	DB	CE	NAKS		KR	ABS	LR	BV	DNV	NK	RS	RINA	CCS	CRS	
Mild Steel	Solid Wire	SM-70	A5.18 ER70S-6	ISO 14341-A-G 42 2 C1 3Si ISO 14341-A-G 42 5 M21 3Si	✓	✓	✓	✓	✓		3SG, 3YSG(C), 3YSG(M2), 3YMG(M2)	3SA, 3YSA	3YS, 3YM	SA3, SA3YM	IIYMS	KSW53G(C), KSW53G(M2), KSW53MG(M2)	3YSM	3YS	-	-	
		SM-70S	A5.18 ER70S-3	ISO 14341-A-G 38 2 C1 2Si ISO 14341-A-G 42 3 M21 2Si	-	-	-	-	-	-		-	3SA, 3YSA	3YS	-	-	-	-	-	-	-
		SM-70MT	-	ISO 14341-B-G 49A 5 M20/M21 SZ	✓	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-
		SM-70G	A5.18 E70S-8	ISO 14341-B-G 49A 3 C1 3Si ISO 14341-B-G 55A 3 M21 3Si	-	-	-	-	-	-		3SG, 3YSG 3MG, 3YMG (C1)	3SA, 3YSA	3YS H15	SA3, 3YM	IIYMS	KSW53G, KAW53MG(C)	-	-	-	-
		SM-70EN	A5.18 ER70S-6	ISO 14341-A-G 42 2 C1 4Si ISO 14341-A-G 46 5 M21 4Si	-	✓	✓	✓	✓	-		-	-	-	-	IIY40MS (C1) IVY40MS (M21)	-	-	-	-	-
	Cored Wire	SC-70Zn	A5.18 E70C-GSM	ISO 17632-A-T 3T Z M M21 1	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-
		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	IIYMS 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	-	-	
Austenitic Stainless	Solid Wire	SM-307Si	-	ISO 14343-A-G 18 8 Mn	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	
		SM-308LSi	A5.9 ER308LSi	ISO 14343-A-G 19 9L Si	-	-	-	✓	-	-		-	-	-	-	-	-	-	-	-	-
	Cored Wire	SW-309LNS Cored	A5.9 EC309L	ISO 17633-A-T 23 12 L M M13/11	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-
Ferritic Stainless	Solid Wire	SM-430LNb	-	ISO 14343-A-G 18LNb	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	
	Cored Wire	SF-409Ti	A5.9 EC409	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	
		SF-430	A5.9 EC430	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-
		SF-430Nb	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-
		SF-436	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-
	SC-439Ti Cored	A5.22 EC439	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	
Aluminum*	Solid Wire	SMT-5183 (S)	A5.10 ER5183	ISO 18273 S Al 5183 (AlMg4,5Mn(A))	-	✓	✓	✓	-		-	-	-	-	5183	-	-	-	-	-	
		SMT-5356 (S)	A5.10 ER5356	ISO 18273 S Al 5356 (AlMg5Cr(A))	-	✓	✓	✓	-		-	-	-	-	5356	-	-	-	-	-	
		SMT-4043 (S)	A5.10 ER4043	ISO 18273 S Al 4043 (AlSi5(A))	-	✓	✓	✓	-		-	-	-	-	-	-	-	-	-	-	

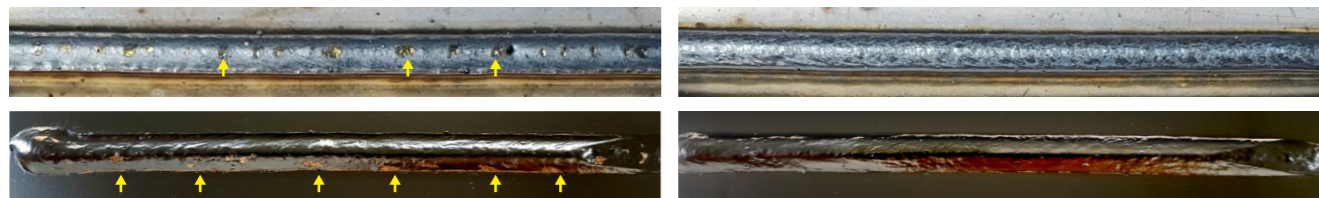
*More approvals available upon request for Aluminium Wires

SM-70MT

The world's first E-coating friendly welding wire

Electrodeposited-coating (E-coating) is a well-established technique in the automotive industry to protect car parts against corrosion, but its application on welded components can be problematic due to poor adherence onto silicate islands left behind on welds by the GMAW process. Lacking solid E-coating protection, these spots may later act as initiators of rust development when vehicles are exposed to corrosive environments such as humidity, temperature changes, sea winds and de-icing salts. Removal of the silicates is an effective measure, but is costly in highly efficient fabrication lines and therefore undesired.

To overcome this problem HYUNDAI WELDING developed the world's first E-coating friendly welding wire, the SM-70MT. This unique product features ultra-low silicates formation and allows car parts to be E-coated without post-weld cleaning of the weld surface, as illustrated by the photos below. It also delivers virtually spatter-free welding along with excellent gap bridging ability - two other essential requirements of automotive fabricators.

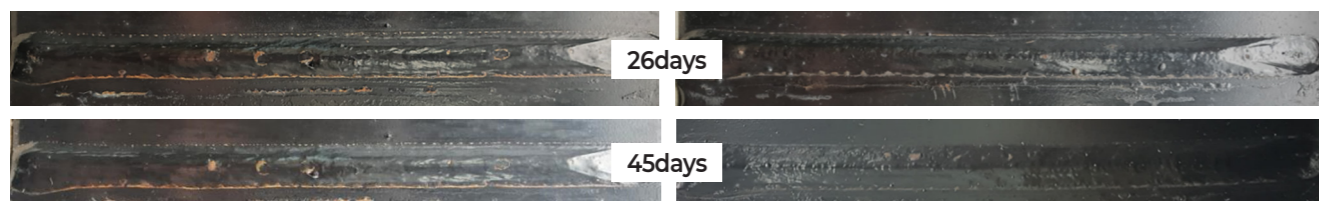


Conventional solid wire, before and after E-coating. Corrosion testing reveals initiations of rust at the locations of silicates.

HYUNDAI WELDING's SM-70MT, before and after E-coating. Corrosion testing reveals no initiations of rust.

Best possible rating in automotive corrosion test

Welds deposited with SM-70MT were submitted to the GMW 15357 corrosion cycle test (CCT), scoring 10 on a scale from 1 to 10 for "no corrosion". CCT is a standardized method within the automotive industry to test the corrosion resistance of automotive parts under accelerated "real-life" climatic conditions. In a climate chamber, welded parts are exposed to cycles of different temperatures and humidity, while being sprayed regularly with salt solutions to accelerate metallic corrosion. It demonstrates the life expectancy of components under most severe conditions. With weld samples showing no corrosion after 26 days of testing, SM-70MT already passed beyond common automotive industry requirements, but even after 45 days not a single sample revealed any sign of corrosion.



Weld samples of conventional solid wire (left) and HYUNDAI WELDING SM-70MT after respectively 26 and 45 days of CCT testing.

Gap bridging capabilities

In car manufacturing, production efficiency is crucial and there is no opportunity to make any adjustments along the fabrication line. A welding wire such as SM-70MT, which is extremely tolerant of joint inaccuracies, will therefore help car manufacturers maintaining a high production speed.

In testing the gap bridging capability of SM-70MT, an excessive gap of 2mm was set between two plates. Subsequently, the position of the welding wire was displaced in intervals of 1mm relative to the intended welding line (point 0, 1 and 2). All three samples were high speed welded at 120 cpm. In all cases, a nice and straight weld bead was deposited, which demonstrates the excellent gap-bridging capability of SM-70MT.

1. Gap Bridging Test (Gap : 2mm (0.08in))

Touching Point Pulse / 277A / 24V / 120cm/min(47in/min) / Ar+20%CO₂ Gas

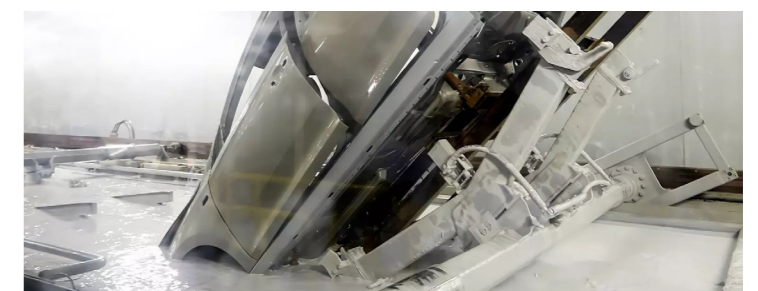
Excellent mechanical properties

Mechanical Properties of All Weld Metal						
Consumable	Shielding gas	YS MPa(lbs/in ²)	TS MPa(lbs/in ²)	EL (%)	CVN Impact Value	
					Temperature	Avg. (J)
Conventional Wire	M21	438 (63,500)	530 (76,900)	32	-20°C (0°F)	168
SM-70MT	M21	426 (61,800)	512 (74,300)	32	-50°C (-60°F)	75
	M20	545 (79,000)	606 (87,900)	28	-50°C (-60°F)	96
EN ISO 14341-B G49A 5 M21 SZ		≥390 (56,600)	490-670 (71,100-97,200)	≥18	-50°C (-60°F)	27
EN ISO 14341-B G49A 5 M20 SZ		≥390 (56,600)	490-670 (71,100-97,200)	≥18	-50°C (-60°F)	27
JIS Z 3312 G49A 5 M 0		≥390 (56,600)	490-670 (71,100-97,200)	≥18	-50°C (-60°F)	27

Diameter		1.2mm(0.045in)
Shielding Gas	M21	Ar+20%CO ₂
	M20	Ar+10%CO ₂
Amps / Volts		300 / 32
Pre-Heat		R.T.
Interpass Temp.		135-165°C (275-329°F)

SM-70MT HIGHLIGHTS

1. Ultra-low silicates and spatter providing excellent rust protection after E-coating
2. Excellent weldability and bead appearance, even at high speed welding
3. Excellent gap bridging ability
4. Excellent mechanical properties



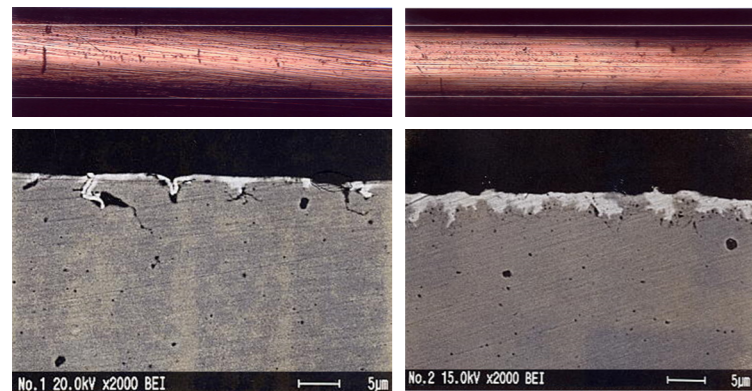
SOLID WIRES RE-INVENTED



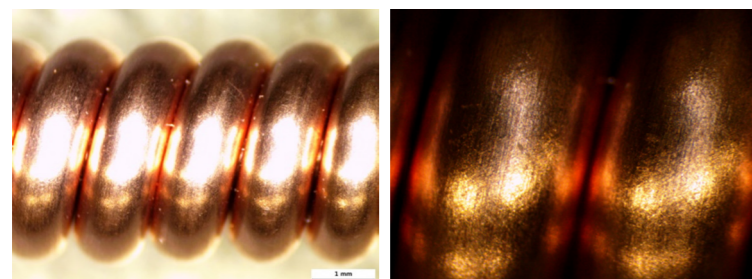
Gas shielded metal arc welding (GMAW or MIG/MAG) is the most commonly applied welding process in the automotive industry. It is especially used for the joining of thin plate material at high welding speed, often in a single run and mainly in automated production lines. Robotic welding is frequently applied and is characterised by repeated starts and stops of the welding process. A problem-free and stable GMAW process is essential for uninterrupted welding and for the quality of the weldments. The main challenge is the avoidance of spatter and post weld cleaning.

For these demanding applications, HYUNDAI WELDING introduces E-Line – a unique electrically copper-coated 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 automotive welding applications 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 is cleaned again - gives improved glide in liner and contact tip with minimal voltage/current fluctuations and thereby a superior arc stability. This brings advantages with all arc types used in the automotive industry – short arc, pulse arc and spray arc – in terms of a consistent nice weld appearance with minimal spatter 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 with many starts and stops.

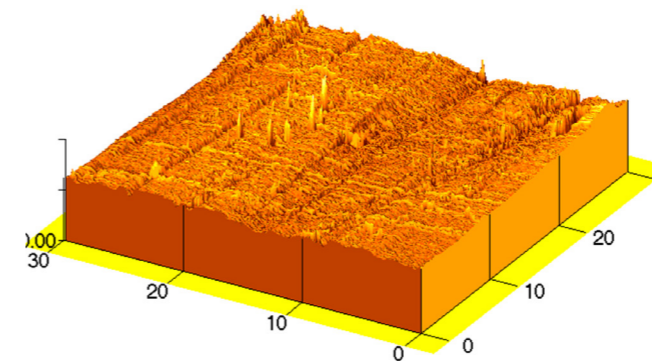


Note: Chemically, with copper sulphate coated wire (left) and electrically coated wire (E-Line). The copper coating of E-Line wires fills up the natural imperfections from the drawing process and adheres better to the wire surface.

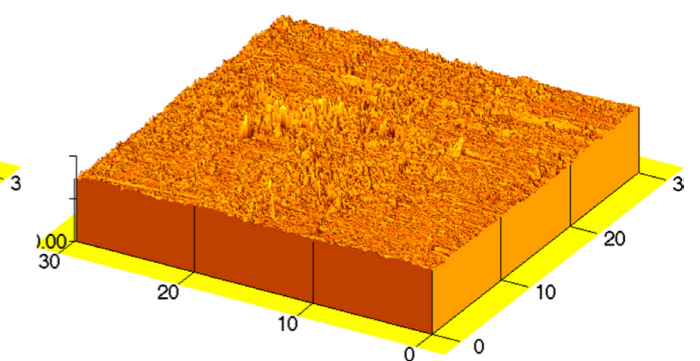


Note: Electrically copper-coated wire after extreme deformation showing perfect adhesion of copper on the E-Line surface. It reduces the risk of liner clogging by copper flaking. Visually the colour is brighter than chemically copper coating.

Chemically coated wire

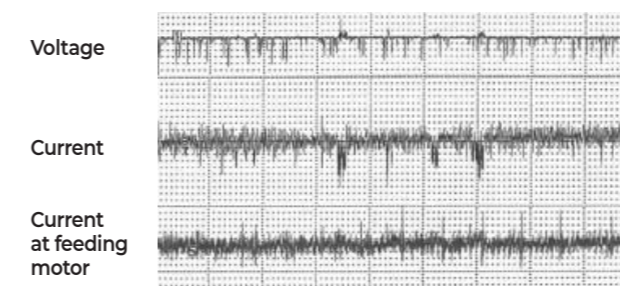


E-Line wire

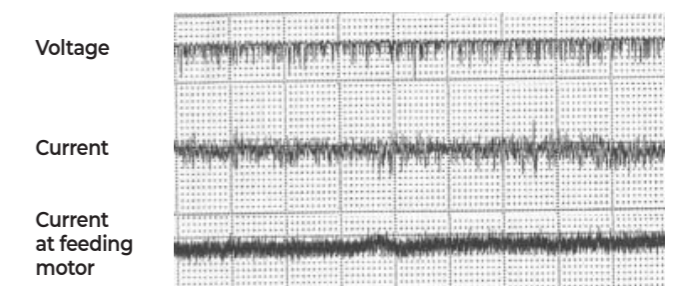


Note: Surface roughness of chemically coated solid wire (left) and E-Line wire measured over 4 mm wire length.

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 |

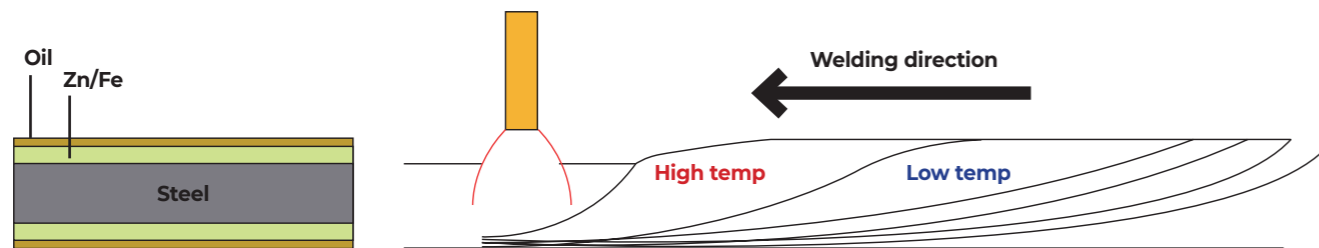
HYUNDAI WELDING E-Line Wire Range

Product Name	AWS A5.18	EN ISO 14341-A	Steel quality	Shielding gas
SM-70	ER70S-6	G 42 2 C1 3Si1 G 42 5 M21 3Si1	Pickling coated steel sheet (PO)	General purpose wire CO ₂ & Ar/CO ₂ mixed gas
SM-70S	ER70S-3	G 38 2 C1 2Si G 42 3 M21 2Si	Hot dip galvanised steel sheet (HGA)	Ar/CO ₂ mixed gas

SM-70S

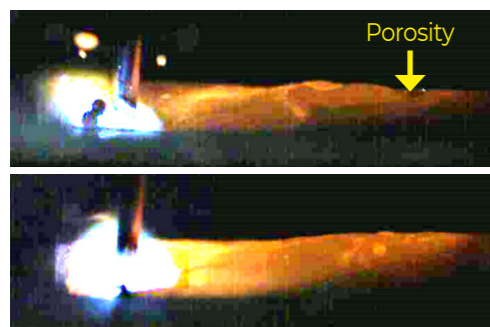


There is a trend in the automotive industry to use hot-dip galvanised alloyed steel sheet (HGA) instead of pickling coated and oiled sheet (P&O). The high strength HGA sheet offers the possibility to design lighter and, at the same time, more durable components to increase the lifespan of a car.



When welding HGA steel, the galvanised layer easily evaporates causing porosity because the vapour can not sufficiently escape and gets entrapped in the solidifying weld metal. The fact that the thin sheet is welded in the low and medium current range further increases this risk. To successfully weld HGA steel, the right set of pulse parameters need to be developed for each application, in combination with the use of a solid wire with adapted chemistry. The aim is to create a weld pool with a larger area remaining at a sufficiently high temperature to give the vapour more time to escape.

For this application, HYUNDAI WELDING has developed SM-70S. It is a solid wire from the E-Line range with excellent weldability in both short arc and pulse arc and is very suited for robotic welding. It was developed in co-operation with Hyundai Motors Automotive Steel Development and is already used by major car manufacturers as welding consumable for hot-dip galvanised steel. The figures below show recordings of weld pools from standard ER70S-6 solid wire and SM-70S with respectively pore formation and the absence of pores, confirmed by X-ray photos.



Note: Weld pool with a small area remaining at high temperature (top) and one with a larger area of high temperature. Both are welded at 180A with the same pulse parameters; the first with standard ER70S-6 solid wire, the second with SM-70S.

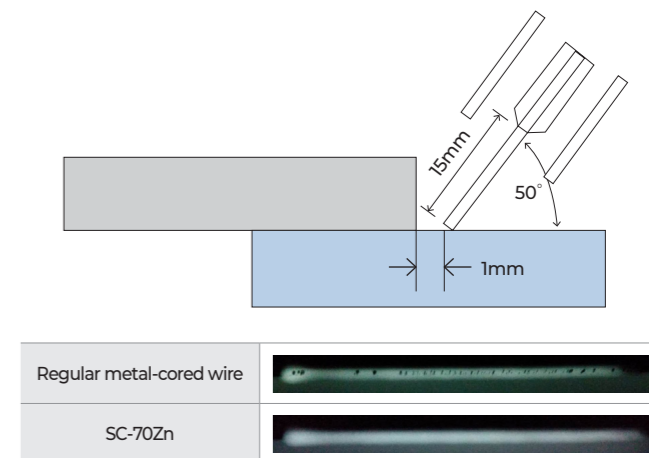
Product	Bead appearance	X-Ray performance
Standard 70S-6 wire		
SM-70S		

SC-70Zn

SC-70Zn is another product developed for the single pass welding of galvanised steels. It is a metal-cored wire with adapted chemistry which is applied in and outside the automotive industry for the welding of Zn-coated steels.

It brings the productivity of a metal-cored wire and has an excellent weldability, a low spatter level and a nice bead appearance. SC-70Zn eliminates the risk of rejects in automotive industry by allowing the escape of zinc vapour from weld pool.

Item	Conditions
Base metal	galvanized steel, 2.0t
Joint	Lap joint (overlapping)
Wire dia	1.2mm
CTWD (mm)	15
Shielding gas	80% Ar + 20% CO ₂
Air flow	20 L/min
Ampere	180-200A
Weld speed	60 CPM



COPPER ALLOY WIRES



HYUNDAI WELDING offers S-Line copper alloy GMAW / MIG wires for welding applications in the automotive industry. Body panels (ERCu and ERCuSi-A), frame assemblies (ERCuSi-A), bumper reinforcements (ERCuAl-A1) and brake drums (ERCuAl-A2) are the most common areas where S-Line welding wires are known for their consistent quality and high productivity. The high purity of the wires – important for X-ray proof welding - is guaranteed by strict specifications for the raw materials with a narrow chemical composition.



Body panel (ERCu and ERCuSi-A), frame assembly (ERCuSi-A), bumper reinforcement (ERCuAl-A1) and brake drum (ERCuAl-A2) are the most common usage areas of copper alloy MIG wires in automotive industry.

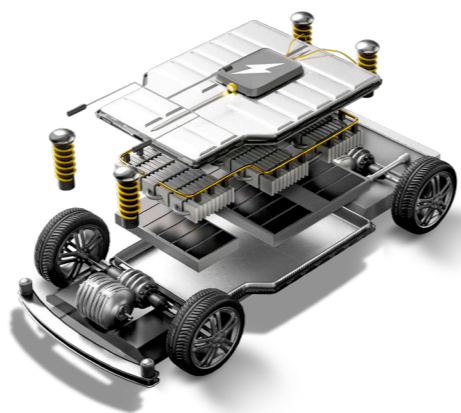
Product Name	AWS A5.7	EN ISO 24373	Typical Chemical Composition of All-Weld Metal(%)									
			Al	Si	Fe	Cu	Mn	Ni	Pb	Sn	P	Zn
SMT-Cu (S)	ERCu	SCu1898A-CuSn1MnSi	0.1 - 0.4	0.01	0.03	Rest	0.1 - 0.4	0.10	0.01	0.5 - 1.0	0.02	-
SMT-CuSi A (S)	ERCuSi-A	SCu6560-CuSi3Mn1	0.02	2.8 - 4.0	0.50	Rest	0.5 - 1.5	-	0.02	0.20	0.05	0.40
SMT-CuAl A1 (S)	ERCuAl-A1	SCu 6100-Cu Al7	6.0 - 8.5	0.20	-	Rest	-	-	0.02	-	-	0.20
SMT-CuAl A2 (S)	ERCuAl-A2	SCu6180-CuAl10Fe	8.5 - 11.0	0.10	1.50	Rest	-	-	0.02	-	-	0.02

EV BATTERY TRAYS & ALUMINIUM WELDING

Electric vehicles are incredibly complex, involving thousands of components to create a finished car. One such component that many EV manufacturers need to outsource is their battery tray.

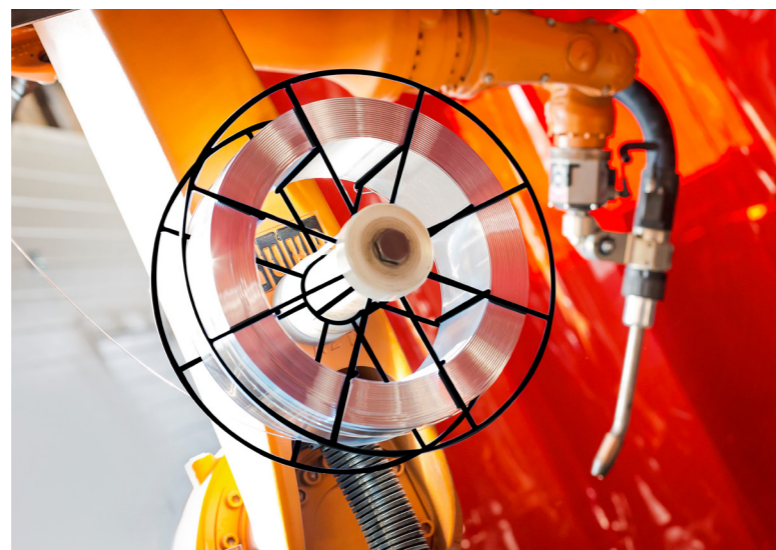
It is a critical component of an electric vehicle, helping to ensure the safe and reliable operation of the vehicle's electrical system. It helps to protect the batteries from damage due to impacts or vibration, and it also provides a secure mounting point for the batteries. This ensures that the batteries do not move or shift during operation, which can cause electrical shorts or other problems.

Aluminium usage for battery trays improve the performance, efficiency, and sustainability of electric vehicles. It fulfils essential requirements such as structural rigidity, mechanical strength, thermal resistance and good heat transfer and crash safety. Design criteria of battery trays can differ with respect to impact & fire resistance, durability, thermal management and space & weight optimization. At end of life, 96% of the aluminium used in cars is recycled.



Superior Quality from S-Line Aluminum Wires

The welding of main parts such as the tray housing and battery frame consumes 100 to 200g of aluminium GMAW / MIG wire (ER5183 and ER4043) per tray for a standard passenger car. Process stability is one of the most important criteria for successful welding, in which the quality of the welding wire plays a key role. The new HYUNDAI WELDING S-Line range of aluminium wires provides a new level of wire surface cleanliness and finish. This is essential in the avoidance of wire feeding problems and related arc instability, as too often encountered in aluminium welding.

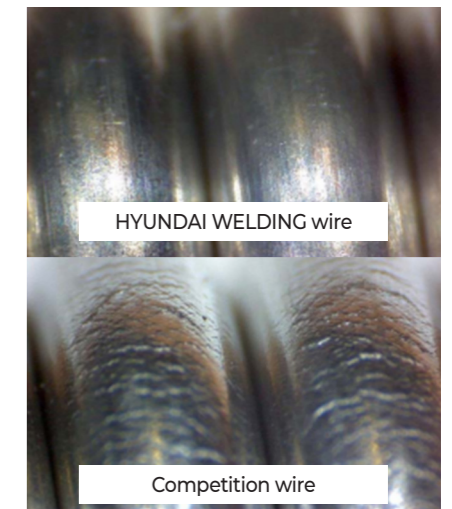


Stable wire feeding results in a high weld quality and nice appearance as well as optimal productivity. The efficiency of the process is further enhanced by smart packaging solutions with dependable wire pay-off, reducing downtime for wire exchange and feeding problems.

S-LINE

Surface Finish & Feedability

The quality of the surface of welding wires is very important for problem-free welding with a high productivity. The amount and structure of the aluminium oxides on the wire surface is essential. A high quality aluminium welding wire has a thin, homogeneous oxide layer that adheres well to the wire surface. With an irregular, non-homogeneous oxide layer, oxide particles are likely to shave off and will gradually clog liner and contact tip. If liners and tips are not renewed frequently, this will sooner or later result in feeding irregularities and arc instability and lead to irregular welds and even to porosity. HYUNDAI WELDING aluminium wires have a perfect surface quality and stand for long periods of problem-free welding and longer intervals between maintenance of the welding equipment.



Cleanliness of Wire Surface

Another surface quality aspect is the cleanliness of the wire. Contaminants from the wire drawing process on the surface need to be removed meticulously in order not to evaporate during welding and act as a source of porosity and X-Ray test failures.



Chemical Composition & Mechanical Properties

Tightly controlled chemical composition is the basis for consistent mechanical properties (tensile strength, yield strength and elongation).

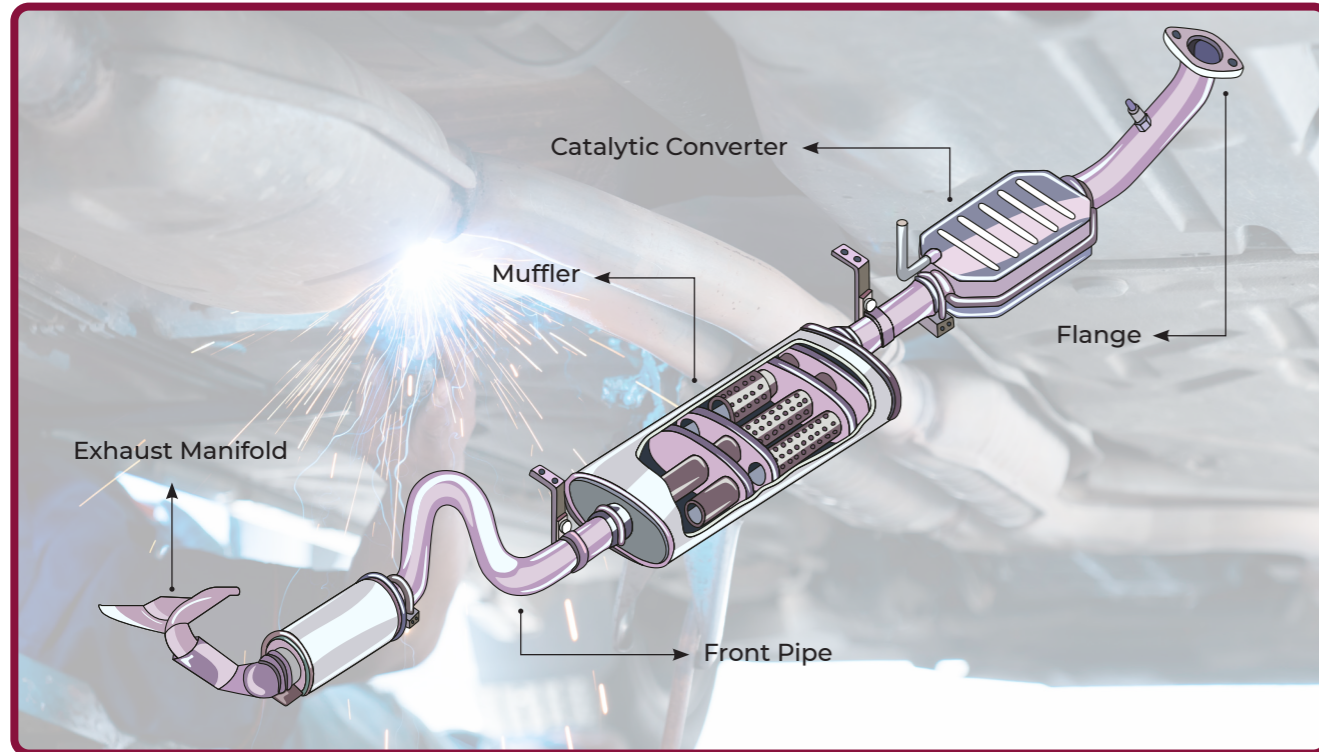


Convenient & Robust Packaging

Next to high quality spools with different aluminium wire contents, HYUNDAI WELDING also offers rigid cardboard drums with a dimension of $\varnothing 520 \times 780$ mm and a filling content of 80 kg of welding wire. In comparison with e.g. 7 kg spools, the number of stops of a welding station needed for the exchange of empty spools is reduced by more than a factor 10 by using the drums. Downtime of a welding station accounts for a proportional loss of production and includes the effort to repair work pieces that remain unfinished in the station. The somewhat higher kg price of wire in bulk drums is therefore in many cases overwhelmingly compensated by substantial savings through gains in production output.



METAL CORED WIRES FOR FERRITIC STAINLESS STEEL



Metal-cored wires for ferritic stainless steel are widely used for welding automotive exhaust systems in cars. HYUNDAI WELDING cored wires for the automotive industry are specifically designed to weld manifolds, mufflers, converters, and other components. These metal-cored wires excel in the welding of these components and show very good capability to bridge gaps. The hot end of exhaust systems include the exhaust manifold, front pipe, and catalytic converter, and the cold end consists of the center pipe, muffler, and tail pipe. The material used in mufflers differs by manufacturer, so the cored wire should be used according to the components' type of stainless steel. Austenitic wire SW-309LNS Cored is used for welding dissimilar connections between stainless steel and non/low alloyed carbon steel. The remaining ferritic wires are all used for type 400 series group of stainless steels, such as types 409, 430, 436, and 439. HYUNDAI WELDING's wires for automobiles naturally have a long history, as its Motor Group is a global leader in the automotive industry.



Applications	Product
· Welding of dissimilar metals (stainless and carbon alloy steel)	SW-309LNS Cored (Austenitic)
· Type 409 stainless	SF-409Ti
· Type 409 and 430 stainless	SF-430
· Type 409 and 430 stainless · Applied for exhaust manifolds at high temperature	SF-430Nb
· Type 409, 430, 436 stainless	SF-436
· Type 409, 430, 436, 439 stainless	SC-439Ti Cored

GMAW/MIG and Flux Cored Wires - Spools

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



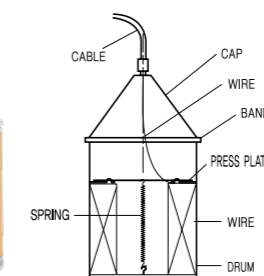
HYUNDAI WELDING's Ball pac® is a new and improved version of our original Pail pack. Our patented 'marble' system, acts as a 'non-static' resistance on top of the wire. Please see page 24 for detailed information.

ECO PLUS



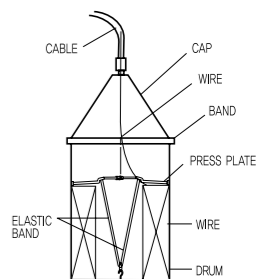
The ECO PLUS drums are made of 100% recyclable cardboard. Please see page 24 for detailed information.

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.

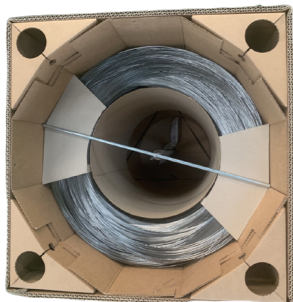
MAX PAK



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

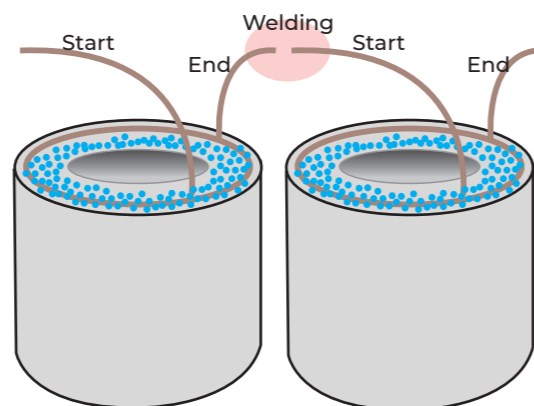
Safe Load Design Criteria

- 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
 	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
 	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

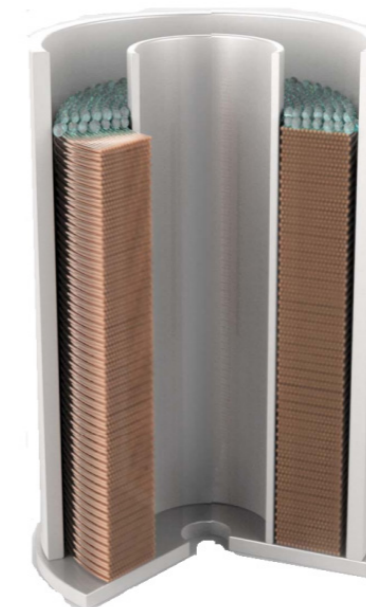
The Ball pac® minimizes friction normally resulting from twisted or tangled welding wire. This results in smooth wire feeding and stable arc, two essential elements of effective welding.

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.

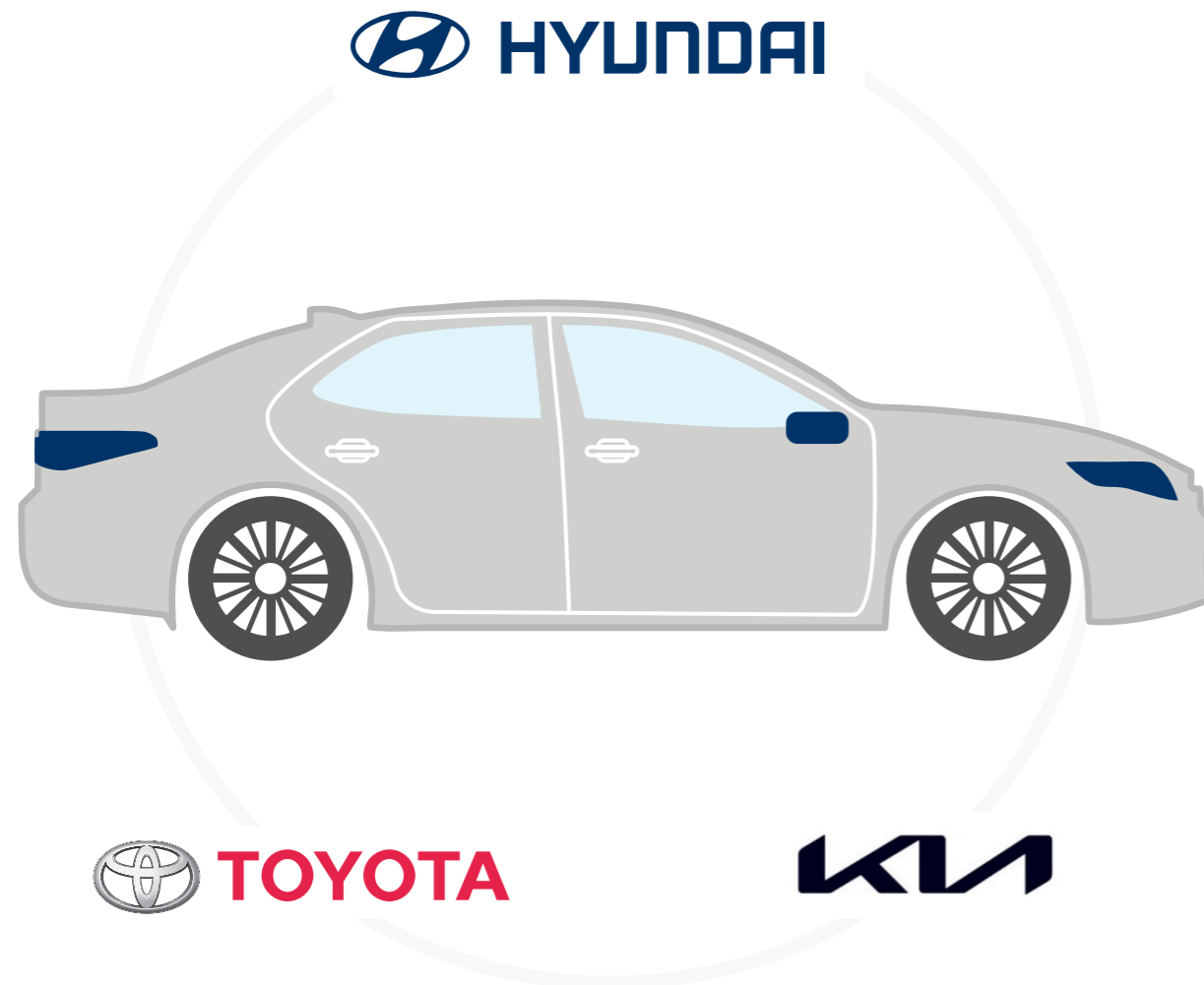
Patent & Trademark Principal Register

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)			

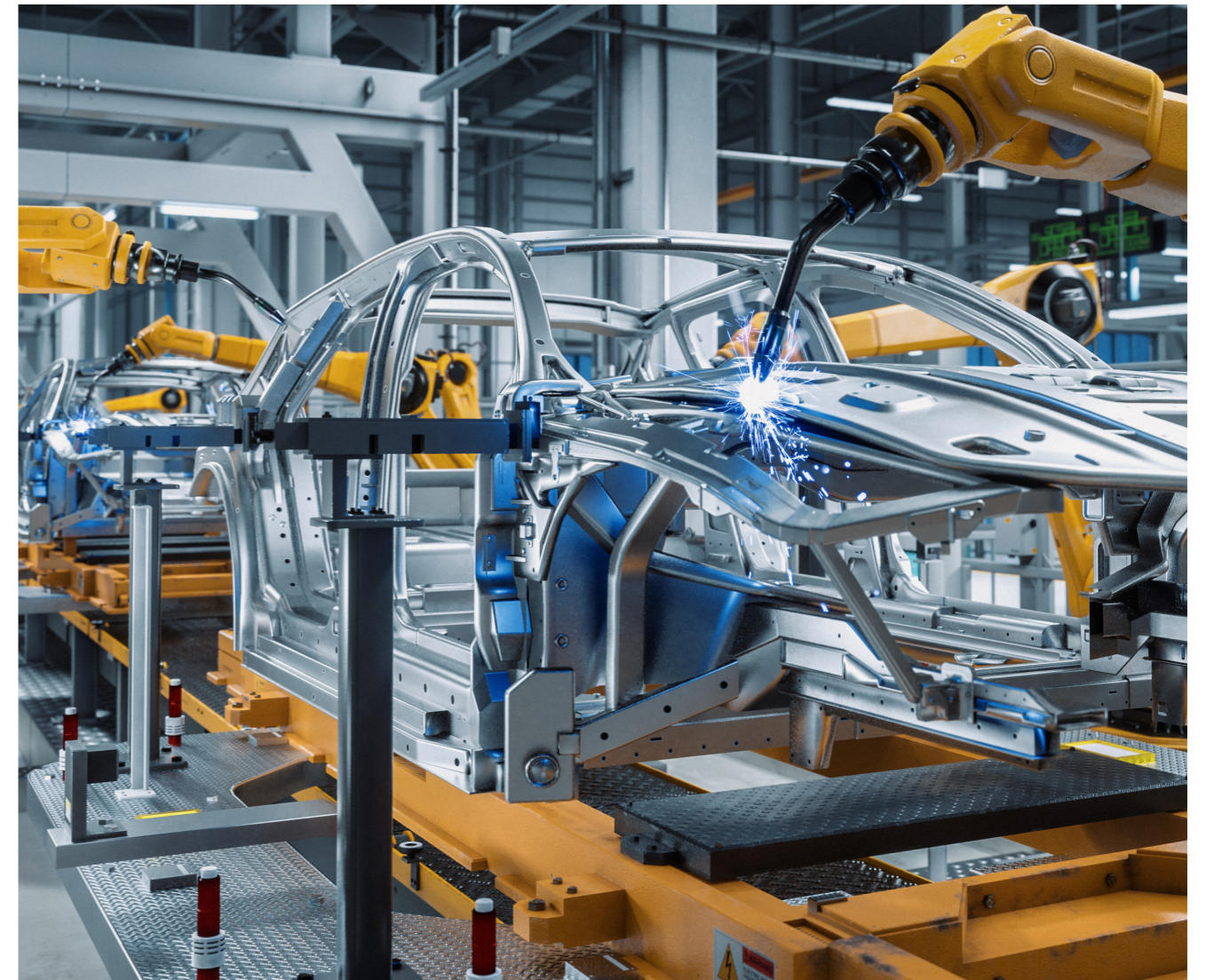
REFERENCES



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 automotive welding solutions meet customer requirements for automobile manufacturing 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 almost 50 years since its foundation in 1975.

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



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