



2024 Japan International Welding Show

NIPPON STEEL WELDING & ENGINEERING CO.,LTD.

WELDREAM™ Premium

WELDREAM Premium is positioned in the visionary product category that transcends customers' conventional perceptions of welding. Below, we introduce the innovative technologies and product characteristics of WELDREAM Premium.

1 “CF Wire”: An extremely low hydrogen seamless flux-cored wire



Product name: **CF Wire**

*Meaning of the name: Curb Fracture

In recent years, with a focus on redevelopment projects, the demand for large high-rise buildings has been steadily increasing. Apart from its application in high-rise buildings, construction and industrial machinery ("construction/industrial machinery") play a crucial role in national land resiliency plans and restoration projects for major disasters both in Japan and overseas, contributing significantly to building social infrastructure.

High-tensile steel is widely utilized in these sectors, with efforts being made to promote its application for weight reduction through thinning and utilization in critical components. However, welding high-tensile steel often leads to the occurrence of cold cracking (delayed cracking) in the welded area. Consequently, preventing cold cracking through "preheating" is widely adopted to facilitate the release of diffusible hydrogen before welding. Consequently, there has been a perceived issue where the growing demand for high-tensile steel coincided with an increase in welding workload. To address this issue, we have introduced "CF wire," an ultra-low hydrogen seamless flux-cored wire designed to mitigate cold cracking and streamline welding processes.

2 Features of CF wire

The most remarkable feature of CF wire is its exceptional resistance to cold cracking, surpassing that of conventional welding wires. Through our seamless technology and optimization of flux composition, CF wire has achieved an extremely low diffusible hydrogen content in the weld metal (refer to Fig. 1 [Target value: 1 mL/100 g]). The adoption of CF wire aids customers in their efforts to reduce preheat temperature and energy *costs during welding operations.

*Example: Gas, electricity, etc. for preheating

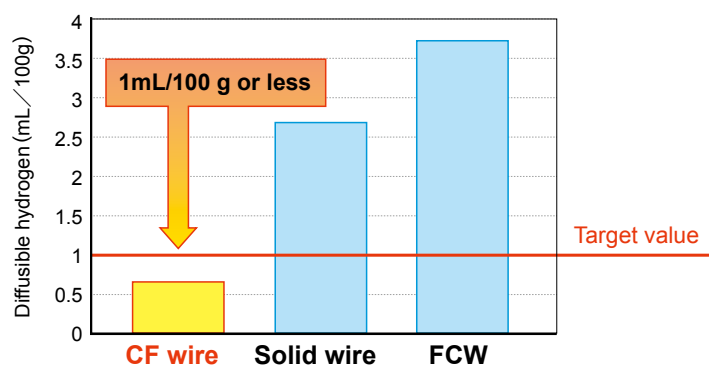


Fig. 1: Diffusible hydrogen content in CF wire

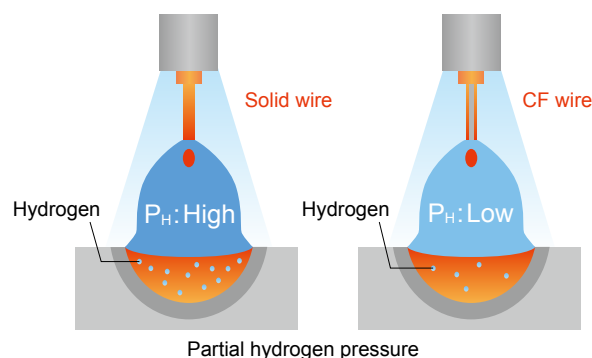


Fig. 2: Image of hydrogen reduction in CF wire

Negative Aspects of Preheating Operations

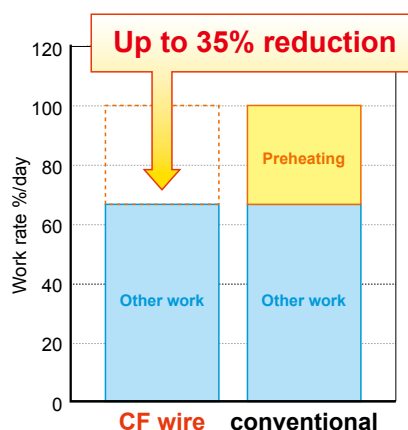
•Large workload

- Difficult to install equipment
- Preheating in a hot environment is harsh
- Time-consuming if parts are large

•Large management burden

- Strict construction management is required
- Cost of necessary materials is high
- Labor costs are high

Customer benefits from CF wire application



Preheating work can be reduced by applying CF wire.

- Faster welding
- Safe welding
- Low cost welding

3 CF wire line-up

The CF wire line-up is presented below. Please refer to the properties described for each variant and select the one that best suits your preheat reduction requirements, irrespective of the field of application.

Table1 CF wire list and product specifications


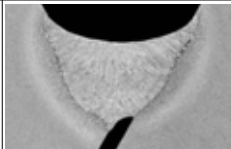



grade	Brand	Standard	Shielding gas	Applicable position	Size mm	Example of application
780 MPa	SF-80CF	JIS Z3313 T780T1-1CA-N4M2-UH5 AWS A5.29 E111T1-GC-H2	CO ₂	All positions	1.2	Horizontal welding of column joints Vertical welding of beam web
	SX-80CF	JIS Z3313 T782T15-0CA-N4C1M2-UH5 AWS A5.28 E110C-G H2		Flat Horizontal	1.2	Joint section of beam flange Corner welding part of BOX columns
490 MPa	SF-1CF	JIS Z3313 T49J0T1-1CA-UH5 AWS A5.29 E71T1-GC-H2	CO ₂	All positions	1.2 1.4	Lap fillet welding of wear resistant steel and repair welding
	SM-1A.CF	JISZ3313 T492T5-0MA-UH5 AWS A5.29 E70T5-GM-H2			1.2 1.4	
780 MPa	SX-80A.CF	JIS Z3313 T784T15-0MAG-UH5 AWS A5.28 E110C-G H2	Ar+CO ₂	Flat Horizontal	1.2	Welding of crane jibs and earth-moving machine buckets
980 MPa	SX-100A.CF	—			1.2	



4 Cold cracking resistance and weld metal properties of CF wire

The Cold cracking resistance of CF wire has been confirmed through tests specified by JIS, all of which have yielded positive results with no instances of cold cracking.

Table2 Example of the evaluation of cold cracking resistance for CF wire

There was no cold cracking when welded in low temperature condition. *					
Wire	SX-80CF	SF-80CF	SF-1CF	SX-80A.CF	SX-100A.CF
Base metal	BT-HT™630C-ES	BT-HT™630C-ES	ABREX™ 500	WEL-TEN™ 780E	WEL-TEN™ 980E
Welding condition (temperature)	0°C	5°C	5°C	0°C	0°C
Preheat	none	none	none	none	none
Sheet thickness	100mm	100mm	40mm	22mm	16mm
Cross section Photo					

* Based on JIS Z3158 y-type weld cracking test (cross-sectional cracking rate and root cracking rate are all 0%)
 ABREX and WEL-TEN are the trademarks of NIPPON STEEL CORPORATION.
 BT-HT is a product name of NIPPON STEEL CORPORATION's thick plate

Table3 Mechanical properties of deposited metal and diffusible hydrogen content of CF wire

Brand name	Mechanical properties of deposited metal (Typical)*				Diffusible hydrogen content** (ml/100g) (Typical)
	Yield point/0.2% proof stress (MPa)	Tensile strength (MPa)	Elongation (%)	Impact value (J)	
SF-80CF	741	824	20	0°C : 89	0.62
SX-80CF	771	823	21	− 20°C : 80	0.33
SF-1CF	513	566	25	0 °C : 110	0.55
SM-1A.CF	487	563	27	− 20 °C : 158	0.15
SX-80A.CF	797	889	20	− 40 °C : 82	0.32
SX-100A.CF	981	1082	16	− 40 °C : 40	0.52

* Based on JIS Z3133 **Based on JIS Z3118
 Diffusible hydrogen content in the table does not guarantee actual operation (factory or field work).

WELDREAM™ Plus

The WELDREAM Plus lineup features welding enhanced with improved weldability and mechanical properties, in addition to our popular conventional products. Below we introduce WELDREAM Plus products along with examples of their applications.

1 "NF-800R" flux for submerged arc welding that realizes highly efficient and highly functional welding

Applications Flat and horizontal fillet welding of architectural build H steel and bridge girders

Features

- Capable of handling 400-590N/mm² class steel by switching wires without the requirement no flux replacement.
- Excellent slag removability and bead shape due to melted flux.
- Achieving weld metal with high toughness. (47 J \leq at 0°C, corresponding to JIS Z 3183 S502-H and S582-H)



Table: Mechanical properties of weld metal with NF-800R

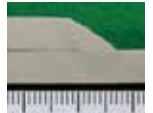
Steel type	Plate thickness (mm)	Wire (Tandem)	Heat input (kJ/cm)	YP (MPa)	TS (MPa)	vE0°C (J)
	Web x Flange					
SN490B	32×40	Y-D	76	485	620	69
TMCP385B	32×40	Y-DM	76	520	660	77

2 "NS-40Z" covered Electrode for thick hot-dip galvanized steel plate

Applications In structures exposed to corrosive environments such as deck plates, exterior walls, and roofs

Features

- Robust arc spraying and outstanding resistance to porosity, facilitating thick plating with zinc deposits of up to the level of 550 g/m².
- Continuous and highly concentrated arc even in the presence of zinc vapor, ensuring reliable penetration.
- Excellent tracking, coverage, and slag removability, resulting in aesthetically pleasing weld beads.



3 "SX-55HC" SX wire for high heat input welding

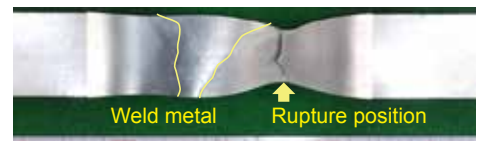
Applications Welding of beam flange joints, columns and through diaphragms where full penetration is required.

Features

- Applicable to 490N/mm² class steel sheet up to a maximum heat input of 100kJ/cm.
- Excellent weldability and mechanical properties are obtained even with high heat input welding.

Table: Weld metal properties of SX-55HC

Steel type	thickness (mm)	Heat input (kJ/cm)	YP (MPa)	TS (MPa)	vE0°C (J)
SN490B	25	100	433	582	96

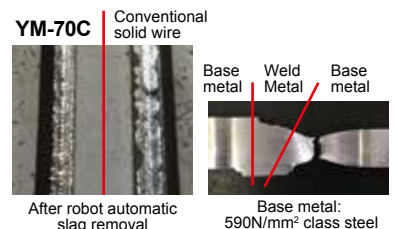


4 "YM-70CM" solid wire for robot welding, ideal for welding 590N/mm² class box column for building structure.

Applications Welding of beam flange joints, columns and through diaphragms where full penetration is required.

Features

- Good in slag removability even for high-strength materials and excellent defect resistance.
- Reliable mechanical properties certified by the Minister can be obtained.

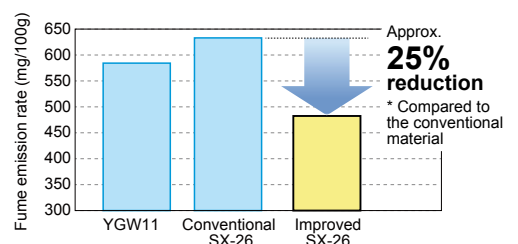


5 "SX-26" with improved low-fume emission for convenient usage

Applications Suitable for welding beam flange joints, columns and through diaphragms requiring full penetration is required.

Features

- Generate less fumes compared to solid wire while maintaining the performance of the conventional SX-26.



WELDREAM™ Advance

Leveraging the strengths of the Nippon Steel Group, WELDREAM Advance offers an array of optimal welding materials tailored to match high-performance steel for superior quality, and workability. Below, we introduce WELDREAM Advance products are introduced below along with illustrative application examples.

1 Welding material for 780 N/mm² Class steel delivering high quality and efficiency

Our products have been utilized both domestically and internationally, encompassing submerged arc welding materials <NB-250H / Y-80M (for AC)>, <NB-250J / Y-80J (for DC)>, FCW "SF-80A" suitable for all positions, and electrode "L-80SN."

Applications

Welding of 780N/mm² class steels including offshore structures (R&C), shipbuilding (SEP ships), and building steel frames, etc.

Features

- ① Even when welding thick plate, a low defect rate with good mechanical properties and good weldability.
- ② Seamless FCW SF-80A is optimal for onsite welding because the flux does not easily absorb moisture.
- ③ Additionally, we also provide a full line-up including solid wire "YM-80C" and "YM-80A."



2 Welding material designed exclusively for CORSPACE™, a coating cycle extension steel

The coating cycle can be extended as compared to that of ordinary steel, leading to life-cycle cost reduction.

- "PX Series" (SMAW, GMAW, FCAW, SAW)

Applications

Welding structures exposed to corrosive environments prone to salt damage, including steel bridges, harbor cranes, and unloaders.

Features

- ① To inhibit the progress of corrosion in the welded part, the welding material contains a very small amount of Sn (tin), which is also present in the steel material.
- ② Because the JIS symbol is the same as that of the welding material for ordinary steel, it is possible to manage the welding work in accordance with the conventional technical standards such as road bridge specifications.
- ③ Since its launch, the product has been adopted in bridge projects by over a dozen companies.

CORSPACE Base metal strength class	SMAW	GMAW	FCAW	SAW
400N/mm ² 490N/mm ²	L-55-PX	YM-26-PX	SF-1-PX SM-1F-PX	YF-15/ Y-D-PX YF-800/ Y-D-PX
520N/mm ²	—	YM-55C-PX	—	YF-15B/ Y-DM3-PX NF-820/ Y-D-PX
570N/mm ²	L-60-PX	YM-60C-PX	SF-60-PX SM-60F-PX	YF-15B/ Y-DM-PX NF-820/ Y-DM-PX

3 Welding material exclusively for sulfuric/hydrochloric acid dew-point corrosion resistant steel S-TEN™

Welding materials are effective in sulfuric/hydrochloric acid dew-point corrosive environments and are excellent for LCC.

- "ST Series" (SMAW, FCAW, GTAW, SAW)

Applications

Exhaust gas containing sulfuric acid / hydrochloric acid is subjected to flue gas treatment, waste incineration, and power generation facilities.

Features

- ① The welded part exhibit the same level of corrosion resistance as the base metal
- ② Welding under the same conditions as that for ordinary steel is possible.

Steel type	SMAW	FCAW	GTAW	SAW
S-TEN1	ST-16M	SF-1ST	YT-1ST	Y-1ST/ NB-1ST
S-TEN2	ST-16Cr ST-03Cr	FC-23ST	—	—

4 Welding material for NSGP™ Steel, a highly corrosion-resistant steel plate for crude oil tankers that contribute to air pollution prevention by eliminating paint.

- "GP Series" (SMAW, FCAW, SAW)

Applications

Welding of NSGP steel applied to VLCC tank bottom plate and surface of upper decks (ceiling parts).

Features

- ① Weld metals inhibit corrosion and thinning caused by heavy oil. The developed welding material that matches the NSGP steel because conventional welding materials cause significant corrosion and thinning in the welded part.
- ② Certification for each ship classification (NK, ABS, LR, DNV)

5 Welding material for duplex stainless steel contributing to strengthening national land resilience and reducing life cycle cost.

In addition to the FCW "FC-2120" dedicated for (SUS821L1), we provide an extensive line-up of products for various duplex stainless steels, from lean to super.

Applications

Construction of chemical tankers, sluice gates, seawater pumps, and scrubbers.

Features

- ① The corrosion resistance of the welded part is equivalent to that of the base metal
- ② The tensile strength of the weld metal is higher than that of Type 308, enabling the weight reduction of the structures.



CORSPACE, S-TEN and NSGP are the trademarks of NIPPON STEEL CORPORATION.

Intending to achieve carbon neutrality ("CN") by 2050, WELDREAM CN offers high-performance products that support the transition to and growing demand for environmentally friendly energy, thus advancing towards a sustainable society.

1 Welding material for 7-9% nickel steel, contributing to the expanded use of LNG

Liquefied natural gas ("LNG") is recognized as a crucial energy source supporting the transitional phase until carbon neutrality (CN) is achieved. Since 1969, we have supplied welding materials for LNG tank construction, including covered arc welding rods, TIG welding wires, and submerged arc welding materials, accumulating valuable application insights. Recently, we have expanded our lineup to include the FC-9NI flux-cored wire for gas-shielded arc welding, further enhancing the quality and efficiency of LNG tank construction processes.

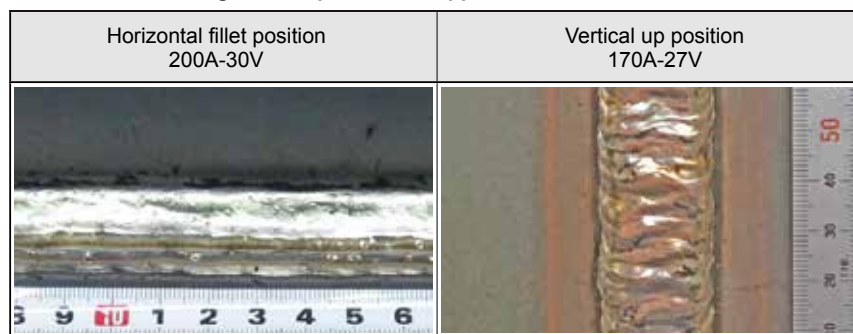
Table 1: List of welding materials for LNG tanks

Welding method	Brand	Size	Approval of classification society	AWS standard	JIS
FCAW	FC-9NI	1.2φ	NK LR ABS DNV CCS	A5.34 ENiGT1-1	—
SMAW	YAWATA™ WELD B (M)	3.2φ 4.0φ 5.0φ	NK LR ABS DNV BV	A5.11 ENiCrFe-4	Z3225 D9Ni-1
SMAW	NITTETSU™ WELD 196	3.2φ 4.0φ 5.0φ	NK LR ABS DNV BV	A5.11 ENiMo-9	Z3225 D9Ni-2
SAW	NITTETSU™ FLUX 10H /NITTETSU™ FILLER 196	500μm ~ 1.40mm 2.4φ	NK LR ABS DNV BV	A5.14 ERNiMo-9MOD	Z3333 FS9Ni-H YS9Ni
GTAW	NITTETSU™ FILLER 196	1.6φ 2.4φ	NK	A5.14 ERNiMo-9	Z3332 YGT9Ni-2

Table 2: Example of mechanical properties of weld metal (Shield gas: CO₂)

Brand	0.2% proof stress (MPa)	Tensile strength (MPa)	Elongation (%)	vE-196°C (J)
FC-9NI	445	699	47	88
Reference NK KSWL92G (C)-YP430M-TS690M	430 or more	690 or more	25 or more	27 or more

Fig.1: Example of bead appearance of FC-9NI



2 SF-309SD/FC-309SD, welding material exclusively for NIPPON STEEL High corrosion resistant coated steel plate series

SF-309SD/FC-309SD is a flux-cored wire designed exclusively for use with NIPPON STEEL'S High corrosion resistant coated steel. This wire contributes to reducing the life cycle cost by maintaining the corrosion resistance of weld metal during welding, thereby lessening the labor-intensive touch-up required for post-weld plating coating.

Table 3: Example of salt water spray test results for galvanized steel sheet joints

Steel plate	High corrosion resistant coated steel		
Welding material	YGW12	YGW12	FC-309SD
Touch-up	N/A	Applied	N/A
Salt water spray Test Test time 1000 hours	Rust on weld metal	Spot rust on weld metal	No rust on weld metal

Table 4: Example of mechanical properties of weld metal (Shield gas: CO₂)

Brand	0.2% proof stress (MPa)	Tensile Strength (MPa)	Elongation (%)	vE0°C (J)
FC-309SD	629	715	18	34

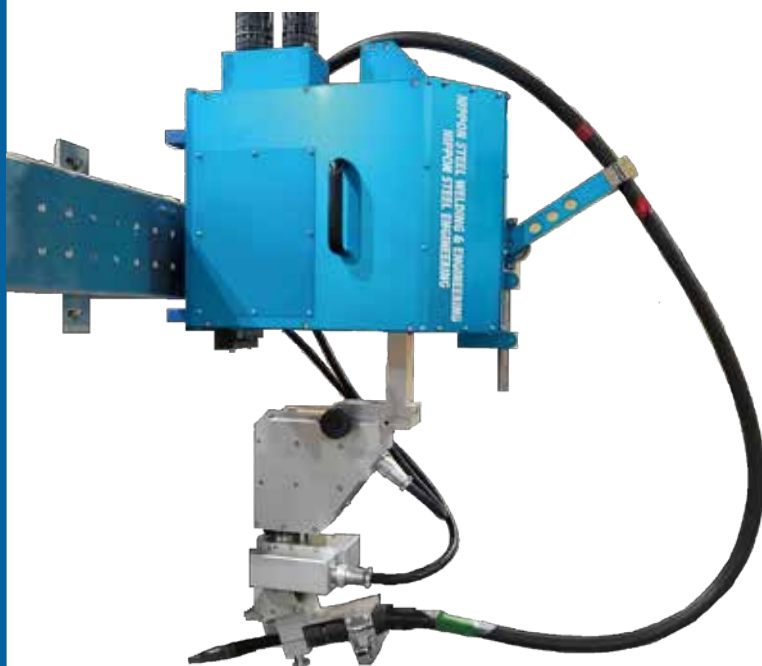
Portable 5-axis robot for on-site welding of building steel frames

Outline

In the on-site welding of steel frame construction, securing welding workers has become increasingly challenging due to a shortage of welding operators and a decline in skilled welders resulting from an aging workforce. To address these issues and strive for "manpower saving" and "assurance of welding quality" through the automation of on-site welding, we have collaborated with "NIPPON STEEL ENGINEERING CO., LTD." to develop Portable 5-axis robot. This innovative solution is the world's first portable orthogonal-type 5-axis robot with image-sensing capabilities, previously showcased as a reference in the 2022 International Welding Show. In this study, we present Portable 5-axis robot as a mass-produced model, featuring enhancements in rigidity and a revised body structure.

Features

- ① Adoption of 5-axis control enabling automatic avoidance function of erection pieces and ensuring optimal bead formation.
- ② Increased mechanical rigidity minimizing unstable movement of the torch tip.
- ③ Image sensing using a line laser and camera enabling high-precision, short-term measurement of groove shape.
- ④ Automatic calculation of the stacking method (welding conditions, aiming position, etc.) suitable for our welding materials (YM and SX) based on groove shape.
- ⑤ Maximum cable length of 100 m reducing transportation and setup labor for the robot.
- ⑥ Standard wireless operations with a tablet terminal and wired operations with a pendant box.



Mass-production portable 5-axis robot

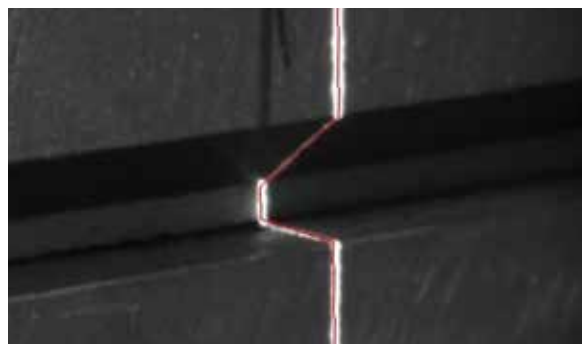


Image processing measurement by laser and camera

Bead appearance by optimal stacking method combined with SX-55 $\Phi 1.2\text{mm}$



Column welding straight section



Column welding corner

High efficiency vertical electroslag automatic welder with 2 electrodes

Outline

Our High efficiency vertical electroslag arc welding machine have been utilized as 1-pass vertical automatic welders in various applications such as stockpile tanks and ship hull plates. However, using electroslag arc welding requires additional measures to manage spatter, fumes, and provide wind protection against shielding gas during on-site welding operations. To address these challenges, we have developed and will showcase a new 2-electrode electroslag welder designed for extended lengths. The 2-electrode electroslag welder utilizes the technology cultivated by our existing electroslag welders.

Features

- 1 The adoption of a 2-electrode welding method, along with an oscillating stroke set to 80 mm, enables automatic welding of extra-thick steel sheets.
- 2 The two-electrode welding method facilitates highly efficient automatic vertical welding.
- 3 Stable long vertical automatic welding is achieved by leveraging the features of our electroslag arc welding machine and electroslag welder.
- 4 Minimal spatter or fumes generation enhances the working environment, whereas the elimination of spatter removal work improves workability.
- 5 A graphic display panel and numerical input of specific welding conditions allow for reproducible automatic welding.
- 6 The integration of PLC for control equipment facilitates the collection of welding data.
- 7 The absence of shield gas (CO₂) enhances wind resistance and contributes to carbon neutrality.
- 8 We are developing welding materials specifically for Our Welding Machine to further enhance efficiency.



YM-55HF $\phi 1.6\text{mm}$



Control panel



Face side bead



Reverse side bead

High-power Argon-Hydrogen Plasma Cutting/Gouging Equipment

Outline

Our Plasma Unit provides an argon-hydrogen plasma cutting and gouging equipment that can be used in building storage tanks for LNG, liquefied hydrogen, etc., which are major targets in line with the global trend towards carbon neutrality. The main features and applications are as follows.

Features

- 1 Performs both plasma cutting and gouging.
- 2 Check condition settings and equipment status appear on a touchscreen panel.
- 3 Main arc ignition characteristics are significantly improved over previous models.
- 4 Comes with interfaces to external devices as a standard feature.
- 5 Simple torch structure facilitates maintenance.
- 6 Less wear and tear on electrodes and tips, allowing cutting and gouging over longer periods of time.



Plasma cutting

- Applicable material: Nonferrous metals
- Applicable gas: Combinations of Ar, H₂, and N₂
- High-power plasma arc enables dross-free cutting from thin to thick plates (up to 100 mm for stainless steel)



Stainless steel cut example

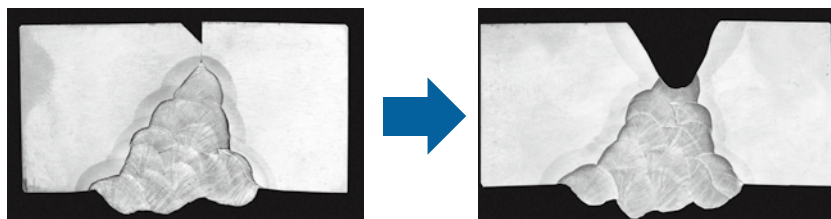


Aluminum cut example

Plasma gouging

Back chipping during full penetration welding such as SAW

- Applicable material: Various metals
- Applicable gas: Ar+H₂ or Ar
- Generates less fumes and dust with less gouging noise, and offers a smoother gouge surface finish compared to arc air gouging.
- Since no carbon rods or air are used, there is less carbon entanglement and nitride layers on gouged parts, resulting in less grinding for post-processes.



Back chipping cross section

Plasma welding resolves issues in piping welding

Outline

Since plasma welding produces fewer defects, it is often used for welding pipes that require high quality welding.

Plasma welding offers good compatibility with automatic welding equipment so it is often used in combination with automatic equipment.

Depending on the piping, plasma welders can be used with simple equipment to save cost and space instead of relying on an elaborate setup.

You can see a combination of simple equipment and our plasma welder at our JIWS booth.

Features


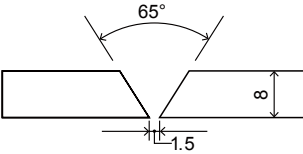
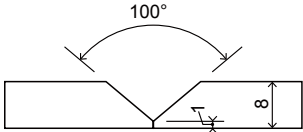
Features of plasma welding and equipment

- ① Keyhole welding, which is a feature of plasma welding, enables defect-free single-sided full-penetration welding.
- ② Capable of I-groove welding for easier groove processing (one-pass welding possible on stainless steel up to a plate thickness of 8 mm)
- ③ Better product value with clean weld beads and consistent back beads
- ④ Enables high-speed welding and low-distortion work
- ⑤ Equipment is compact and mobile; saves space
- ⑥ Preset welding conditions make it ideal for small-lot, large-variety welding machines.
- ⑦ Automatically follows pipe deformations with height tracing function (choose roller tracing or sensor tracing) (optional)
- ⑧ Remote monitor welding on a welding monitoring camera (optional)
- ⑨ Remote wire aim position adjustment (optional)
- ⑩ Remote torch height with sensor tracing adjustment (optional).



Simple pipe welding

Comparison with different welding methods (100A_SCH80 equivalent)

Welding method	Plasma	MAG	TIG (first layer only) + MAG
Groove shape			
Passes	1 pass	2 passes	4 passes
Root face	—	Approx. 1mm	1mm
Gap	0mm	1.5mm	0mm
Bead appearance	Good	Average	Good
Distortion	Good	Average	Poor
Pre-processing +welding time +post-processing	Good	Average	Average
Remarks	<ul style="list-style-type: none"> •Reliable back bead shape •Less overlay amounts required 	Difficult to manage gap	<ul style="list-style-type: none"> •Larger groove angles to achieve complete penetration •Workpiece end face requires precise machining

**Warning!**

Fumes and gas may be hazardous to your health. Please take appropriate preventive measures such as the implementation of ventilation as well as wearing a protector for breathing. Arc light is harmful to the eyes and skin. Please use appropriate shielding measures. Please do not touch anything where electricity is activated. It may cause death.

Request to Customers

- 1 Various data of distinctive features such as welding materials, deposited metal, weld metal, etc. shown in this catalog are meant to explain the representative properties and performance of the products and are not to be taken as a guarantee except those which are specified clearly as "Specification".
- 2 In regard to the properties of welded structures, please be careful since design of structures, chemical compositions of steel plates, construction method, welding conditions, ability of constructor, etc. will affect the results.
- 3 Please understand that we are not able to take responsibility for damages caused by the misuse of the technical information written in this catalog.

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