WELDREAM®

PRODUCT CATALOG

NIPPON STEEL WELDING & ENGINEERING CO.,LTD.

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■ Please note the following points in the use of this catalog.

1. Classification numbers either by JIS (Japanese Industrial Standards) or AWS (American Welding Society) are given to the products except for some types which are classified into neither of them.
   There are three different ways in which the classification numbers are given depending on the extent that the products meet the classifications.

   (1) The classification number without an mark;
   (i.e. JIS Z 3211 E4319)

   It means that the product meets the classification requirements and that JIS Mark is usable on the product based on the JIS mark system.

   (2) The classification number with the mark " ☆ ";
   (i.e. ☆JIS Z 3214 E49J03-NCCAU, ☆AWS 5.1 E7016)

   It means that the product meets the classification requirements but that the JIS Mark system and AWS are not authentication to the classification.

   (3) The classification number with the mark" ★ ";
   (i.e. ★AWS A5.1 E7016)

   It means that the product meets most of the classification requirements. However, there is for example a partial deviation in chemical composition.

2. The symbols of welding consumables are determined as following from the initial letter of the welding process.

   (1) FCAW: Flux Cored Arc Welding (flux cored wires)

   (2) SMAW: Shielded Metal Arc Welding (covered arc welding electrodes)

   (3) SAW: Submerged Arc Welding (fluxes, wires, cut wires and backing materials)

   (4) GMAW: Gas Metal Arc Welding (solid wires)

   (5) GTAW: Gas Tungsten Arc Welding (rods and solid wires)

   (6) ESW: Electroslag Welding (solid wires and fluxes)

   (7) EGW: Electrogas Welding (flux core wires and backing materials)

3. The definition of the "Weld Metal" described in this catalog is a weld metal which has not been diluted by base metal except in the case of SAW.

4. Besides the products listed in this catalog, we will make every effort to manufacture welding consumables and/or machinery tailored to customers' requirements.

5. The status of our ship approvals may change from time to time. Your kind confirmation for up-to-date information will be appreciated.

6. The specifications of the products included in this catalog are subject to change without prior notice.

The 8th edition Apr. 2019

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2) 570~950MPa High Tensile Strength Steel

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10) Special Alloy

Welding method	Brand Name	Specification		Page
		JIS	AWS	
Covered Arc Welding Electrodes	YAWATA WELD B(M)	☆Z 3225 D9Ni-1	☆A5.11 ENiCrFe-4	230
	NITTETSU WELD 196	☆Z 3225 D9Ni-2	☆A5.11 ENiMo-9	231
	YAWATA WELD B	☆Z 3224 E Ni 6133	☆A5.11 ENiCrFe-2	232
	YAWATA WELD 182	☆Z 3224 E Ni 6182	☆A5.11 ENiCrFe-3	232
	NITTETSU WELD 112AC	☆Z 3224 E Ni 6625	☆A5.11 ENiCrMo-3	232
Submerged Arc Welding Materials	NITTETSU FLUX 10H× NITTETSU FILLER 196	☆Z 3333 FS9Ni-H YS9Ni	★A5.14 ERNiMo-9	234
Gas Tungsten Arc Welding Wires	YT-NIC	☆Z 3334 SNi2061	☆A5.14 ERNi-1	236
	YAWATA FILLER 82	☆Z 3334 SNi6082	☆A5.14 ERNiCr-3	236
	NITTETSU FILLER 196	☆Z 3332 YG-T9Ni-2	☆A5.14 ERNiMo-9	236
	YT-NC718	☆Z 3334 SNi7718	☆A5.14 ERNiFeCr-2	236
	NITTETSU FILLER 625	☆Z 3334 SNi6625	☆A5.14 ERNiCrMo-3	236
	YT-HSTC2	☆Z 3334 SNi6276	☆A5.14 ERNiCrMo-4	236
	YT-NC622	☆Z 3334 SNi6622	☆A5.14 ERNiCrMo-10	236
	YT-NC617	☆Z 3334 SNi 6617	☆A5.14 ERNiCrCoMo-1	236

11) Surfacing·Cast Iron

Welding method	Brand Name	Specification		Page
		JIS	AWS	
Covered Arc Welding Electrodes	H-250B	☆Z 3251 DF2A-250-R	—	240
	H-250C	☆Z 3251 DF2A-250-B	—	240
	H-300C	☆Z 3251 DF2A-300-B	—	240
	H-350C	☆Z 3251 DF2A-350-B	—	240
	H-500	☆Z 3251 DF2B-500-B	—	240
	H-600	☆Z 3251 DF2B-600-B	—	242
	H-700	☆Z 3251 DF2B-700-B	—	242
	H-750	☆Z 3251 DF3C-700-B	—	242
	H-800	☆Z 3251 DF3C-700-B	—	242
	H-13Cr	☆Z 3251 DF4B-350-B	—	242
	H-13M	☆Z 3251 DFMA-250-B	—	244
	H-13MN	☆Z 3251 DFMA-250-B	—	244
	H-13CrM	—	—	244
	H-MCr	☆Z 3251 DFME-250-B	—	244
	H-11Cr	☆Z 3251 DF4A-500-B	—	244
	H-30Cr	☆Z 3251 DFCrA-700-BR	—	246
	H-30CrM	☆Z 3251 DFCrA-700-BR	—	246
	C-1N	☆Z 3252 ECNi-CI	★A5.15 ENi-CI	248
	C-5N	☆Z 3252 ECNiFe-CI	☆A5.15 ENiFe-CI	248
Flux Cored Arc Welding Wires	FCM-132M	Z 3326 YF4A-G-400		250
	FCM-134	Z 3326 YF4A-G-400		250
	FCM-134M	Z 3326 YF4A-G-400		250

12) Electroslag Welding Materials

Welding method	Brand Name	Specification		Page
		JIS	AWS	
Electroslag Welding Materials	YM-55S×YF-15I	☆Z 3353 YES501-S/FES-Z	—	252
	YM-60E×YF-15I	☆Z 3353 YES602-S/FES-Z	—	252

13) Electrogas Welding Materials

Welding method	Brand Name	Specification		Page
		JIS	AWS	
Electrogas Welding Materials	EG-1	☆Z 3319 YFEG-21C	—	256
	EG-3	—	☆A5.26 EG72T-G	256
	EG-60	☆Z 3319 YFEG-32C	—	256

14) High Efficiency Welding Process

Welding method	Application	Page
SUBNAP WELDING PROCESS	High Quality and Low Cost Welding Process for Heavy Steel Plates	260
CUT WIRE SUBMERGED ARC WELDING PROCESS	High Efficiency Submerged Arc Welding Process	262
ONE-SIDE WELDING PROCESS	One-Side Welding Process to Shorten Welding Time Using Various Kind of Backing Materials and Fluxs	264
SB-41	1.It is small and light and consequently is easily set up by sticking adhesive face of aluminium foil to steel plate. 2.It can be used by cutting to the desired length and bending up or down since solid fluxes are tile-like and flexible. 3.It can be used for uranami (sound penetration bead) welding with a wide range of welding conditions since solid fluxes have high fire resistance. 4.Inventory control is easy since it rarely absorb moisture and, therefore, redrying is not necessary.	266
SOFT BACKING SUBMERGED ARC WELDING PROCESS	One-side welding where backing jigs cannot be used like welding of curved plates in shipbuilding and site welding of bridges.	268
FLUX COPPER BACKING SUBMERGED ARC WELDING PROCESS	Welding of large plates for ships, bridges and structures.	270

15) Welding Machine and Equipment

Machine and Equipment	Brand Name	Application	Page
Simplified Travelling Carriage with Various Models	—	Fillet Welding	274
CARRYBOY Series(Simplified traveling carriage)	CARRYBOY ACE	Horizontal Fillet Welding	276
CARRYBOY Series(Simplified traveling carriage)	NS Carry Auto III	Horizontal Fillet Welding	277
CARRYBOY Series(Simplified traveling carriage)	CARRYBOY K	Flat and horizontal Fillet Welding	278
Versatile Arc Welding Equipment	SY-mini	All position Welding	280
Portable Type Arc Welding Robot	NAVI-21	All position Welding	281
SESNET Welder	SESNET-W II	Vertical Butt Joint on Electroslag Welding	282
Electrogas Welding Machine	VEGA-A	Vertical Butt welding	284
High Heat Input Submerged Arc Welding Equipment	—	Welding of Box column corner joints	288
Diaphragm Welding Equipment	—	Welding of Box column diaphragms	289
PANEL LINE PRODUCTION FACILITY	—	Production line of parallel block used in shipbuilding.	290

Machine and Equipment	Brand Name	Application	Page
Multi-electrode Automatic Welding Equipment	—	Horizontal Fillet Welding of longitudinals and stiffeners	293
One-Side SAW Welding Equipment	—	Joining of large steel plates	294
High Speed FCuB Welding Equipment	NH-HISAW	Joining of large steel plates	295
FULL DIGITAL PLASMA WELDING MACHINE	NW-150AH-III NW-350AH-III	Welding of various metals	296
TWO ELECTRODES PLASMA ARC WELDING MACHINE	—	W-PLASMA Welding Welding of various metals	298
PLASMA WELDING MACHINE FOR GALVANIZED STEEL SHEET	—	DS PLASMA Welding Galvanized steel sheet	299
PLASMA TRANSFERRED ARC (PTA) WELDING Equipment	—	Surfacing welding	300
Circumferential Fillet Welding Equipment	—	Welding of automotive parts, etc	301
Pipe Overlap Fillet Welding Equipment	—	Welding of electromagnetic valves,sensor parts,etc	302
Flat Plate Butt Welding Equipment	—	Butt welding of flat plates	303
Simplified Plasma Seam Welding System	—	Seam Welding of flat plates and pipes	304
Pipe Welding Equipment	—	Seam Welding of various pipes	305
Clamp Seam Welding System (6.2m type)	—	Welding of box corner sections	306

16) Approval List of Welding Materials

Warning for Safety in Welding

⚠WARNING	· Be sure to follow the safety practices stated in the following in order to protect welders, operators and accompanied workers from a serious accident resulting in injury or death.

· Be sure to follow the safety practices stated in the following when you use welding consumables.
· Be sure to follow the safety practices stated in the instruction manual when you use welding equipment.

⚠WARNING	· Electric shock can kill.

· Do not touch live electrical parts. (A covered electrode held with an electrode holder and a wire in welding are electrically live.)
· Wear dry, insulated gloves. Do not wear teared and wet gloves.
Use an electric shock prevenling device (open-circuil-voltage-reducing device) when welders or operalors work in confined or high-level paces. Use also a lileline when a welder or operator conducts welding at a highlevel spaces.
· Follow the safety practice stated in the instruction manual of the welding machine before you use. Do not use a welding machine case or cover of which is removed. welding cables must be of a size adequale for the capacity expected. Welding cables must be maintained, and a damaged cable must be repaired or replaced new.

- Fumes and gases generated in welding. can be dangerous to your health.
- Welding in conlined spaces can be dangerous to suffocation because of oxygen deficient atmospheres.

- Keep your head out of the source of fumes or gases to prevent you from directly breathing high density fumes or gases.
- Use local exhaust ventilation, or wear respirators in order to prevent you from breathing fumes and toxic gases
- Use general ventilation for welding in the workshop. Particularly in welding in confined spaces, be sure to use adequate ventilation, or wear respirators in the presence of a trained supervisor.
- Do not weld where operations of degreasing, cleaning, spraying, and painting are present nearby. Welding work close to these operations may cause a generation of harmful gases.
- Use adequate ventilation or respirators with special attention in welding plated and coated steel.
- Use respirators, eye safety glasses and safety leather gloves when handling welding fluxes in order to prevent you from the flux dust.

- Arc rays can injure eyes and burn skin.

- Wear hand shields with an adequate grade of shade in welding and in supervising the welding work. Select the correct grade of shade for filter lenses and filter plates suitable for exact welding work by referring to the standard of JIS T8141.
- Wear protectors suitable for preventing you from the arc rays such as safety leather gloves for welding, long sleeve shirts, foot covers, leather aprons, etc.
- Use, at need, shade curtains for welding by surrounding the welding areas in order to prevent accompanied workers from the arc rays.

- Fire and explosion can take place.

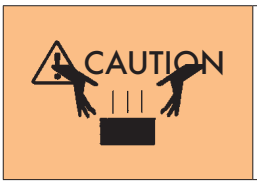
- Never weld at areas adjacent to highly inflammable materials. Remove combustibles so that spatter cannot ignite them. If combustibles cannot be removed, cover them with a noninflammable material.
- Do not weld a vessel or pipe which contains combustibles or being sealed.
- Do not put a hot weldment close to combustibles right after welding finished.
- When welding cellings, floors, walls, etc. remove combustibles at the other side of them.
- Any part of welding wire, with exception of wire extended at the tip of the torch, must be free from touching on the electrical circuit of the base metal side.
- Fasten the cable joints and seal them in a insulation tape. The cable for the base metal side should be connected closer to the part of welding.
- Be ready to cope with a possible accident by equipping fire-extingushing equipment adjacent to the welding areas.

- Flying spatters and slags can injure eyes and cause skin burns.
- High temperature heat in welding can cause skin burns.

- Wear safety glasses, safety leather gloves for welding, long sleeve shirts, foot covers, leather aprons, etc.
- Do not touch weldments while hot.

· The tips of the welding wires and filler wires can injure eyes, faces, etc.

· Do not loose your hold on the tip of the wire when take off the tip of the wire.
· Do not direct the welding torch to your face when check the wire feeding condition.



· Falling down and dropping welding consumables can injure you.

· Wear safety shoes, and pay your attention not to drop welding consumables on your body when you carry and handle them. Keep your posture correct not to cause a crick in your back while handling them.
· Follow the handling instructions shown on the surface of the pail pack wire packages when handle them.
· Pile up welding consumables so that falling down and dropping cannot take palce while being stored and carried.

Mild Steel·490~550MPa High Tensile Strength Steel

Flux Cored Arc Welding Wires
Covered Arc Welding Electrodes
Submerged Arc Welding Materials
Gas Metal Arc Welding Wires
Gas Tungsten Arc Welding Rods and Wires

SF-1

JIS Z 3313 T49J0T1-1CA-UH5
☆AWS A5.36 E71T1-C1A0-CS1

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for machinery, structures, steel frames, ships, bridges, towers, chemical engineering apparatus, rolling stock and cans.

CHARACTERISTICS

SF-1 is a rutile type seamless flux cored arc welding wire to be used with CO_2 shield gas. Arc is stable, spatters are few and bead is smooth with good shape and appearance since easily removable slag covers bead evenly. The diffusible hydrogen content is as low as that of solid wires since the wire has no seam and, consequently, weld metal shows excellent crack resistance. Welding fume is also less. It assures high welding efficiency since deposition rate is high and all-position welding is easily performed with almost the same current.

GUIDELINES FOR USAGE

1. Any welding machine for solid wire can be used as it is, but wire feed roller's pressure should be adjusted a little looser.
2. A suitable shield gas flow rate is 20~25 ℓ /min.
3. Distance between base metal and tip should be kept within 20~30mm.
4. Arc voltage should be 1 or 2 volt lower than that for conventional flux cored wires and 4 or 5 volt lower than that for solid wires.
5. SB-41, backing material, is recommended for one side welding.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S
CO_2	0.06	0.50	1.40	0.015	0.010

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
520	580	28	91

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.0	1.2	1.4	1.6
Current A	F	150~260	180~320	200~410	220~450
	H-Fil	150~260	180~320	200~410	220~450
	H	150~240	180~300	200~350	220~400
	V-up	150~200	180~260	200~280	200~280
	V-down	160~220	200~280	220~300	—
	OH	150~240	180~260	200~280	—

Approval: NK, ABS, LR, DNV, BV, GL, CR, KR, CCS, RS

SF-1E

JIS Z 3313 T492T1-1CA-UH5
☆AWS A5.36 E71T1-C1A2-CS1

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for machinery, structures, steel frames, ships, bridges, towers, rolling stock and parts which especially requires toughness.

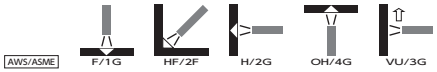
CHARACTERISTICS

NITTESU SF-1E is a rutile type seamless flux cored arc welding wire to be used with CO_2 shield gas.
It assures excellent usability with minimized spattering and beautiful bead appearance with satisfactory impact toughness in all position welding.

GUIDELINES FOR USAGE

1. If gas shild is insufficient, nitrogen in the air will be absorbed into weld metal causing deterioration of toughness. Distance between nozzle and base metal should be kept within 20mm.
2. Select optimum welding conditions, heat input for example, in accordance with plate thickness, welding position, etc.
3. For others, see GUIDELINES FOR USAGE 1~4 of SF-1.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ni
CO_2	0.06	0.50	1.29	0.014	0.005	0.30

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −20°C, J
590	610	28	93

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4
Current A	F	180~300	200~410
	H-Fil	180~300	200~410
	H	180~300	200~350
	V-up	180~260	200~280
	OH	180~300	200~300

Approval: ABS, LR, DNV, PRS

FC-1

JIS Z 3313 T49J0T1-1CA-U
☆AWS A5.36 E71T1-C1A0-CS1

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for machinery, structures, steel frames, ships, bridges, towers, chemical engineering apparatus, rolling stock and cans.

CHARACTERISTICS

FC-1 is a rutile type flux cored arc welding wire to be used with CO_2 shield gas. Arc is stable, spatters are few and bead is smooth with good shape and appearance since easily removable slag covers bead evenly. Welding fume is also less. It assures high welding efficiency since deposition rate is high and all-position welding is easily performed with almost the same current.

GUIDELINES FOR USAGE

1. Any welding machine for solid wire can be used as it is, but wire feed roller's pressure should be adjusted a little looser.
2. A suitable shield gas flow rate is 20~25ℓ/min.
3. Distance between base metal and tip should be kept within 20~30mm.
4. SB-41 series, backing material, is recommended for one side welding.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S
CO_2	0.04	0.53	1.45	0.016	0.008

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
510	570	27	100

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.0	1.2	1.4	1.6	2.0
Current A	F	90~250	120~300	150~400	200~450	300~500
	H-Fil	90~250	120~300	150~350	200~400	300~450
	H	90~230	120~280	150~320	180~350	—
	V-up	90~230	120~260	150~270	180~280	—
	V-down	120~250	160~300	220~300	250~300	—
	OH	90~230	120~260	150~270	180~280	—

Approval: NK, ABS, LR, DNV, BV, GL, CR

SF-3M

☆AWS A5.36 E71T1-C1A4-CS1

For Carbon Steel

APPLICATIONS

All position welding down to −40°C, 100%CO_2 shielding gas

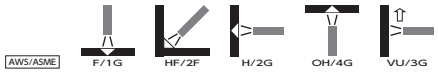
CHARACTERISTICS

SF-3M is a rutile type seamless flux cored arc welding wire to be used with CO_2 shield gas and designed for shipbuilding and offshore structure welding. Weld metal shows excellent toughness in low temperature range down to −40°C. Diffusible hydrogen content is as low as solid wire s and crack resistance is excellent. Weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with welding position, plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1-4 of SF-1

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni
0.05	0.42	1.30	0.013	0.004	0.44

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −40°C, J
545	595	28	115

■ TYPICAL WELD JOINT TEST

Base metal	Plate thickness mm	Welding position	Heat input kJ/cm	Yield strength MPa	Tensile strength MPa	Charpy 2V-notch at −40°C, J	CTOD mm,at −10°C
YS360	50	Vertical-up	22	590	655	110	0.72

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4
Current A	F, H	180~300	200~400
	H-Fil	180~300	200~400
	V-up, OH	180~260	200~280

Approval: ABS, DNV

SF-3

JIS Z 3313 T492T1-1CA-N1-UH5
☆AWS A5.36 E71T12-C1A2-CS2

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for machinery, structures, steel frames, ships, bridges, towers, rolling stock and parts which especially requires toughness.

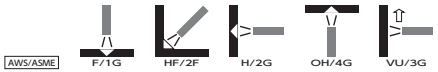
CHARACTERISTICS

SF-3 is a rutile type seamless flux cored arc welding wire to be used with CO_2 shield gas and designed for welding shipbuilding grade E steel. Weld metal shows excellent toughness in low temperature range of −20 ~ −30°C. Crack resistance and weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. If gas shield is insufficient, nitrogen in the air will be absorbed into weld metal causing deterioration of toughness. Distance between nozzle and base metal should be kept within 20mm.
2. Select optimum welding conditions, heat input for example, in accordance with plate thickness, welding position, etc.
3. SB-41, backing material, is recommended for one side welding.
4. For others, see GUIDELINES FOR USAGE 1~4 of SF-1 .

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ni
CO_2	0.05	0.42	1.30	0.013	0.004	0.44

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J	
			−30°C	−20°C
545	600	27	105	130

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4
Current A	F	180~300	200~410
	H-Fil	180~300	200~410
	H	180~300	200~350
	V-up	180~260	200~280
	OH	180~260	200~280

Approval: NK, ABS, LR, DNV, BV, CR, CCS, RS

SF-1A

JIS Z 3313 T49J0T1-1MA-UH5
☆AWS A5.36 E71T1-M21A2-CS1

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for machinery, structures, steel frames, ships, bridges, towers, chemical engineering apparatus, rolling stock and cans.

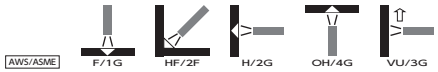
CHARACTERISTICS

SF-1A is a rutile type seamless flux cored arc welding wire to be used with Ar+CO_2 shield gas. Arc is stable, spatters are few and bead is smooth with good shape and appearance since easily removable slag covers bead evenly. The diffusible hydrogen content is as low as that of solid wires since the wire has no seam and, consequently, weld metal shows excellent crack resistance. Welding fume is also less. It assures high welding efficiency since deposition rate is high and all-position welding is easily performed with almost the same current.

GUIDELINES FOR USAGE

1. Any welding machine for solid wire can be used as it is, but wire feed roller's pressure should be adjusted a little looser.
2. A suitable shield gas flow rate is 20~25 ℓ /min.
3. Distance between base metal and tip should be kept within 20~30mm.
4. Arc voltage should be 1 or 2 volt lower than that for conventional flux cored wires and 4 or 5 volt lower than that for solid wires.
5. SB-41, backing material, is recommended for one side welding.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S
Ar+20% CO_2	0.05	0.52	1.22	0.013	0.008

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −20°C, J
530	575	25	60

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4	1.6
Current A	F	180~320	200~430	220~450
	H-Fil	180~320	200~430	220~450
	H	180~300	200~350	220~400
	V-up	180~260	200~280	200~280
	OH	180~300	200~300	—

Approval: NK, ABS, LR, DNV, BV, GL, PRS

SF-3A

JIS Z 3313 T492T1-1MA-UH5
☆AWS A5.36 E71T1-M21A4-CS1

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for machinery, structures, steel frames, ships, bridges, towers, rolling stock and parts which especially requires toughness.

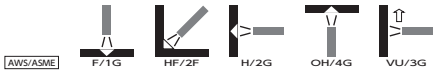
CHARACTERISTICS

SF-3A is a rutile type seamless flux cored arc welding wire to be used with Ar+CO_2 shield gas and designed for welding shipbuilding grade E steel. Weld metal shows excellent toughness in low temperature range of −20 ~ −30°C. Crack resistance and weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. If gas shield is insufficient, nitrogen in the air will be absorbed into weld metal causing deterioration of toughness. Distance between nozzle and base metal should be kept within 20mm.
2. Select optimum welding conditions, heat input for example, in accordance with plate thickness, welding position, etc.
3. SB-41, backing material, is recommended for one side welding.
4. For others, see GUIDELINES FOR USAGE 1~4 of SF-1 (Page 3–2).

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ni
Ar+20% CO_2	0.05	0.46	1.48	0.014	0.005	0.33

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J
			−40°C
600	620	25	87

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4
Current A	F	180~300	200~410
	H-Fil	180~300	200~410
	H	180~300	200~350
	V-up	180~260	200~280
	OH	180~300	200~300

Approval: NK, ABS, LR, DNV, GL, RS

SM-1

JIS Z 3313 T49J0T15-0CA-G-UH5
☆AWS A5.36 E70T15-C1A0-CS1

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for machinery, structures, steel frames, bridges, ships and rolling stock.

CHARACTERISTICS

SM-1 is seamless flux cored arc welding wire filled mainly with metallic powder and is used with CO_2 shield gas. Arc is softer and fume is less than CO_2 solid wires and high welding speed is obtainable. Continuous multi-layer welding like solid wires is possible due to the small amount of slag. The wire is fed straight and easily since it has no seam and, therefore, is suitable for high current and high efficiency automatic welding including robots.

GUIDELINES FOR USAGE

1. A high capacity welding power source of more than 600A is required for big diameter wire (2.0mm).
2. Recommended distance between tip and base metal is 20~30mm for 1.6mm diameter and 25~35mm for 2.0mm diameter.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S
CO_2	0.05	0.72	1.28	0.015	0.006

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
460	560	30	70

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4	1.6	2.0
Current (A)	F	200~320	220~450	250~550	350~650
	H-Fil	200~320	220~400	250~450	350~500

Approval: NK, ABS, LR

SM-1F

JIS Z 3313 T49J0T1-0CA-UH5
☆AWS A5.36 E70T1-C1A0-CS1

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Flat and horizontal welding of mild steel and 490MPa high tensile strength steel for ships, bridges and steel frames.

CHARACTERISTICS

SM-1F is a rutile type seamless flux cored arc welding wire filled mainly with metallic powder to be used with CO_2 shield gas. Weld metal shows excellent resistance to pitting in the welding of steel plates coated with inorganic zinc primer.

GUIDELINES FOR USAGE

1. Suitable torch angle for horizontal fillet welding is 40~50° from bottom plate and forehand angle is 5~30°.
2. Care should be given to the primer thickness.
3. For others, see GUIDELINES FOR USAGE 1~4 of SF-1 (Page 3-2).

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S
CO_2	0.05	0.53	1.50	0.016	0.011

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J	
			−20°C	0°C
510	585	26	62	85

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4	1.6
Current A	F	180~320	200~400	220~450
	H-Fil	180~320	200~350	220~450

Approval: NK, ABS, LR, DNV, BV, CR, GL, CCS, RS

FCM-1F

JIS Z 3313 T49J0T1-0CA-U
☆AWS A5.36 E70T1-C1A0-CS1

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Flat and horizontal welding of mild steel and 490MPa high tensile strength steel for ships, bridges and steel frames.

CHARACTERISTICS

FCM-1F is a rutile type flux cored arc welding wire filled mainly with metallic powder to be used with CO_2 shield gas. Weld metal shows excellent resistance to pitting in the welding of steel plates coated with inorganic zinc primer. Bead shape of fillet welding is also good.

GUIDELINES FOR USAGE

1. Suitable torch angle for horizontal fillet welding is 40~50° from bottom plate and forehand angle is 5~30°.
2. Care should be given to the primer thickness.
3. For others, see GUIDELINES FOR USAGE 1~4 of SF-1 (Page 3-2).

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S
CO_2	0.04	0.55	1.50	0.015	0.010

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
510	570	27	90

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4	1.6
Current A	F-Fil	180~320	200~400	220~450
	H-Fil	180~320	200~350	220~420

Approval: NK, ABS, LR, DNV

SM-3A

☆AWS A5.36 E71T15-M21A4-CS1

For Low Temperature Service Steel

APPLICATIONS

Seamless flux cored wire for Ar-CO2 gas shielded arc welding of low temperature service steel for offshore structures, etc.

CHARACTERISTICS

SM-3A is a seamless metal type flux cored arc welding wire to be used with Ar-20%CO_2 shielding gas for welding of flat butt and fillet joints.
It assures excellent impact toughness at low temperature down to-40°C.
It has also good usability with high efficiency, less spattering and beautiful bead appearance.
Moreover, due to its seamless surface, it provides various advantages better than conventional open-seam flux cored wires.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1~4 of SF-1.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S
Ar+20%CO_2	0.05	0.66	1.69	0.008	0.013

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J
			−40°C
540	600	29	72

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4
Current A	F	200~350	250~400
	H-Fil	200~350	250~400

Approval: ABS, LR, DNV, BV, GL

SF-3E

☆AWS A5.36 E81T1-C1A4-CS1

For Low-Ally Steel

APPLICATIONS

All position welding for YS420 down to −40°C, 100%CO_2 shielding gas

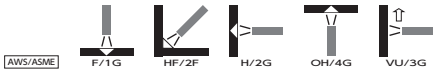
CHARACTERISTICS

SF-3E is a rutile type seamless flux cored arc welding wire to be used with CO_2 shield gas and designed for shipbuilding and offshore structure welding. Weld metal shows excellent toughness in low temperature range down to −40 °C. Diffusible hydrogen content is as low as solid wire s and crack resistance is excellent. Weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with welding position, plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1-4 of SF-1

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni
0.05	0.42	1.30	0.013	0.004	0.44

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −40°C, J
540	590	28	115

■ TYPICAL WELD JOINT TEST

Base metal	Plate thickness mm	Welding position	Heat input kJ/cm	Yield strength MPa	Tensile strength MPa	Charpy 2V-notch at −40°C, J	CTOD mm,at −10°C
YS360	50	Vertical-up	22	590	650	105	0.72

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4
Current A	F, H	180~300	200~400
	H-Fil	180~300	200~400
	V-up, OH	180~260	200~280

Approval: NK, ABS, LR, DNV

SX-26

JIS Z 3313 T49J0T15-0CA-UH5
*AWS A5.36 E70T15-C1A0-CS1

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for automobiles, rolling stock, machinery, air conditioners, tools light gauge steel, steel frames, bridges and ships.

CHARACTERISTICS

SX-26 is seamless flux cored arc welding wire filled mainly with metallic powder and is used with CO_2 shield gas. Arc is softer and fume is less and weld metal in holizontal position (2G) is bringed better than solid wires with CO_2. And penetration is gave as depth as solid wires with CO_2. Continuous multi-layer welding like solid wires is possible due to the small amount of slag.
The wire is fed straight and easily since it has no seam and, therefore, is suitable for high current and high efficiency automatic welding including robots.

GUIDELINES FOR USAGE

1. It should be been that distance between tip and base metal is 20~30mm for 1.2mm diameter and 20~35mm for 1.4mm or more diameter.
2. It should be been that flow rateof sheilding gas is 20~25L/min.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ti
0.07	0.60	1.30	0.014	0.011	0.03

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch J
			0°C
532	620	25	84

■ TYPICAL WELD JOINT TEST

Heat input kJ/cm	Inter-pass temp. °C	Joint Tensile Test		Charpy 2V-notch J	Wire Diameter mm	Base metal	Groove geometry
		Tensile Strength MPa	Location of Fracture	0°C			
30	≦ 250	539	Base tetal	93	1.4	SN490B 20mm	35° single bevel groove R.G: 8mm

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4
Current range A	F	200~380	220~450
	H	200~380	220~380
	H-Fil	200~320	220~400

Approval:

SX-55

JIS Z 3313 T550T15-0CA-UH5

For Mild Steel and 490 to 550MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490 to 550MPa high tensile strength steel for construction of Steel structural.

CHARACTERISTICS

SX-55 is seamless flux cored arc welding wire filled mainly with metallic powder and is used with CO_2 shield gas. Arc is softer and fume is less and weld metal in holizontal position (2G) is bringed better than solid wires with CO_2. And penetration is gave as depth as solid wires with CO_2. Continuous multi-layer welding like solid wires is possible due to the small amount of slag.
The wire is fed straight and easily since it has no seam and, therefore, is suitable for high current and high efficiency automatic welding including robots.
In case of welding for 490MPa high tensile strength steel, it can be applyed a administrative limited welding conditions (H/I: 40kJ/cm-I-P/Temp.: 350°C) on JASS6 of Arcitectual institute of Japan.

GUIDELINES FOR USAGE

1. It should be been that distance between tip and base metal is 20~30mm for 1.2mm diameter and 20~35mm for 1.4mm or more diameter.
2. It should be been that flow rateof sheilding gas is 20~25L/min.
3. In the welding for 520MPa steel, it can be applyed H/I≦40kJ/cm and I-P/Temp.≦ 350°C.
4. In the welding for 550MPa steel, it should be asked welding cnditions to steel supliers.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Mo
0.07	0.60	1.30	0.013	0.012	0.20

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch J
			0°C
570	639	25	121

■ TYPICAL WELD JOINT TEST

Heat input kJ/cm	Inter-pass temp. °C	Joint Tensile Test		Charpy 2V-notch J	Wire Diameter mm	Base metal	Groove geometry
		Tensile Strength MPa	Location of Fracture	0°C			
40	≦ 350	544	Base tetal	106	1.4	SN490B 20mm	35° single bevel groove R.G: 8mm

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4
Current range A	F	200~380	220~450
	H	200~380	220~380
	H-Fil	200~320	220~400

Approval:

Flux Cored Arc Welding Wires
for Mild Steel and 490~550MPa High Tensile Strength Steel

Brand Name	Shield Gas	Specification		Dia. mm	Application and Characteristics
		JIS	AWS		
SM-1S	CO_2	Z 3313 T49J0T1-0CA-UH5	☆ A5.36 E70T1-C1A0-G	1.2 1.4 1.6	Less slag quantity type seamless flux cored wire filled mainly with metallic powder. Arc is more stable than CO_2 solid wires, spatters are few and bead shape is excellent in flat butt and horizontal fillet welding.
	Welding Position	AWS/ASME F/1G HF/2F			
SM-1A	Ar + 20% CO_2	Z 3313 T49J0T15-0MA-UH5	☆ A5.36 E70T15-M21A2-CS1	1.2 1.4 1.6	Seamless flux cored wire filled mainly with metallic powder to be used with Ar+CO_2 shield gas. Arc is soft, spatters are extremely few and high efficiency welding is possible.
	Welding Position	AWS/ASME F/1G HF/2F			

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)					Typical Mechanical Properties of Weld Metal				Type of Current
C	Si	Mn	P	S	Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J	
0.05	0.52	1.56	0.015	0.009	510	590	28	98	DC (+)
0.04	0.45	1.60	0.011	0.013	480	560	30	110	DC (+)

FT-51

JIS Z 3211 E4313
☆AWS A5.1 E6013

For Mild Steel

APPLICATIONS

Welding of mild steel sheets for ships, rolling stock and structures. Applicable to welding of vertical downward and finishing of heavy structural works.

CHARACTERISTICS

FT-51 is a high titania potassium type electrode for all positions and assures easy operation even in vertical downward position. Spatters are less and bead appearance is beautiful. Welding distortion is low on a thin steel sheet, because penetration is shallow.

GUIDELINES FOR USAGE

1. If coating flux absorbs excessive moisture, arc and slag fluidity become unstable and spatters increase. And undercuts and blowholes are apt to occur. Damp electrodes should be redried at 70~120°C for 60 minutes.
2. In inclined and vertical downward positions, touch electrode tip lightly to the base metal and deposit a stringer bead with electrode slope 40~80°C.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.08	0.33	0.42	0.014	0.013

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
460	510	25	60

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.0	2.6	3.2	4.0	5.0	6.0
Length (mm)		250	350	350	400	400	400
Current A	F	30~70	50~100	60~130	110~170	150~220	200~280
	VD	30~70	50~100	60~130	110~170	150~220	—
	VU, OH	30~70	50~100	60~130	100~150	130~190	—

Approval: ABS, LR
Identification color: End-red

S-16W

JIS Z 3211 E4316
☆AWS A5.1 E7016

For uranami welding in all positions

APPLICATIONS

Uranami (sound penetration bead) welding of mild steel pipes for ships, pressure vessels and pipelines.

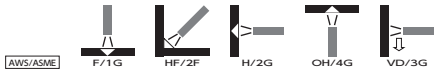
CHARACTERISTICS

S-16W is a low hydrogen type electrode for uranami welding in all positions. In low current range in root pass welding of pipes, a sound penetration bead without blowholes is obtained due to stable arc, strong arc force. And excellent slag fluidity and coverage.

GUIDELINES FOR USAGE

1. DC(-) should be used for uranami welding. However AC or DC(+) have to be used on AWS.
2. 3.2mm diameter electrode is recommended for all position welding of pipes with 6-15mm wall thickness.
3. Electrodes should be redried at 300~350°C for 60 minutes before use.
4. Arc should be started on a small plate or the side of the groove and cut after moving crater to the side of the groove
5. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.07	0.52	0.89	0.010	0.002

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −30°C, J
462	546	29	192

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)><AWS: AC or DC(+)>

Diameter (mm)		2.6	3.2	4.0
Length (mm)		350	400	400
Current A	F	70~100	100~140	150~190
	OH	60~90	80~120	110~150
	VU	60~90	80~120	110~150
	Uranami welding	40~80	60~110	80~140

Identification color: End-red, secondary-red

NITTETSU-16W

JIS Z 3211 E4316
AWS A5.5 E7016-G

For uranami welding in all positions

APPLICATIONS

Uranami (sound penetration bead) welding of mild steel pipes for ships, pressure vessels and pipelines.

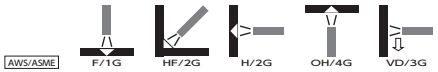
CHARACTERISTICS

NITTETSU-16W is a low hydrogen type electrode for uranami welding in all positions. In low currentrange in root pass welding of pipes, a sound penetration bead without blowholes is obtained due tostable arc, strong arc force. And excellent slag fluidity and coverage.

GUIDELINES FOR USAGE

1. DC(-) should be used for uranami welding. However AC or DC(+) have to be used on AWS.
2. 3.2mm diameter electrode is recommended for all position welding of pipes with 6-15mm wallthickness.
3. Electrodes should be redried at 300~350°C for 60 minutes before use.
4. Arc should be started on a small plate or the side of the groove and cut after moving crater to theside of the groove
5. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.11	0.87	1.02	0.014	0.002

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch J	
			at −20°C	at −40°C
499	609	32	104	56

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)><AWS: AC or DC(+)>

Diameter (mm)		2.6	3.2	4.0
Length (mm)		350	400	400
Current A	F	50~100	70~130	100~150
	OH	40~80	60~130	90~150
	VU	40~80	60~130	90~150
	Uranami welding	40~80	60~110	80~140

Identification color: End-red, secondary-red

NITTETSU-56

AWS A5.1 E7016

For 490MPa High Tensile Strength Steel and uranami welding in all positions

APPLICATIONS

Uranami (sound penetration bead) welding of 490MPa high tensile strength steel pipes for ships,pressure vessels and pipelines.

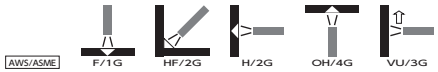
CHARACTERISTICS

NITTETSU -56 is a low hydrogen type electrode for uranami welding in all positions. In low current range in root pass welding of pipes, a sound penetration bead without blowholes is obtained due to stable arc, enough shielding effect. And excellent slag fluidity and coverage.

GUIDELINES FOR USAGE

1. DC(-) should be only used for uranami welding. However AC or DC(+) have to be used on AWS.
2. Backstep method should be applied to prevent bloeholes and pits at arc starting and arc length should be kept as short as possible during welding.
3. Electrodes should be redried at 300~350°C for 60 minutes before use.
4. Arc should be started on a small plate or the side of the groove and cut after moving crater to the side of the groove.
5. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.07	0.54	1.17	0.014	0.002

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J	
			−20°C	−40°C
480	586	37	139	79

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)><AWS: AC or DC(+)>

Diameter (mm)		2.6	3.2	4.0
Length (mm)		350	400	400
Current A	F	60~100	90~140	120~180
	OH	50~90	80~120	100~160
	VU	50~90	80~120	100~160
	Uranami welding	40~80	60~110	80~140

L-55

JIS Z 3211 E4916-U
*AWS A5.1 E7016

For 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of 490MPa high tensile strength steel for ships, structures, bridges and pressure vessels.

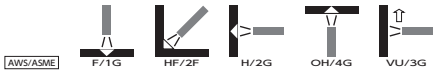
CHARACTERISTICS

L-55 is a low hydrogen type electrode for all positions. Weld metal shows excellent crack resistance, mechanical properties and X-ray quality. Vertical and overhead welding is very easy.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 300~350°C for 60 minutes before use.
2. Backstep method should be applied to prevent blowholes and pits at arc starting and arc length should be kept as short as possible during welding.
3. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.07	0.62	1.18	0.011	0.008

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −30°C, J
480	550	30	160

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.6	3.2	4.0	5.0	6.0	8.0
Length (mm)		300	400	450	450	450	450
Current A	F, H-Fil, H	60~110	70~140	120~190	190~240	250~300	340~390
	V-up,OH	60~90	60~130	90~150	130~170	—	—

Approval: NK, ABS, LR, DNV, BV
Identification color: End-light green, secondary-yellow

L-55LH

JIS Z 3211 E4916-U
*AWS A5.1 E7016

For 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of 490MPa High Tensile Strength Steel for ships, structures, bridges and pressure vessels.

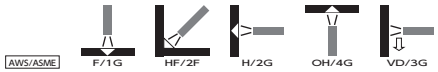
CHARACTERISTICS

L-55LH is a low hydrogen type electrode for all positions. Diffusible hydrogen in the weld metal 100 grams is 5mL below. Therefore the weld metal shows excellent crack resistance and X-ray quality. Weldability and mechanical properties are good due to arc stable. And vertical and overhead welding is very easy.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 300~350°C for 60 minutes before use.
2. Backstep method should be applied to prevent blowholes and pits at arc starting. Arc length should be kept as short as possible during welding.
3. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.07	0.61	1.12	0.014	0.001

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −30°C, J
466	577	28	141

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.6	3.2	4.0	5.0	6.0	8.0
Length (mm)		300	400	450	450	450	450
Current A	F, HF, H	60~110	70~140	120~190	190~240	250~300	340~390
	VU, OH	60~90	60~130	90~150	130~170	—	—

Identification color: End-light blue, secondary-pink

7018

JIS Z 3211 E4916
*AWS A5.1 E7018

For 490MPa high tensile strength steel

APPLICATIONS

Welding of 490MPa high tensile strength steel for ships, steel frames, bridges and pressure vessels.

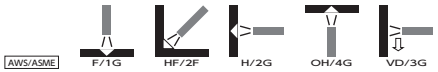
CHARACTERISTICS

7018 is an Iron powder low hydrogen type electrode containing a large amount of iron powder in coating flux. Deposited metal gives excellent mechanical properties, crack resistance and X-ray quality. Weldability is good and high welding efficiency is obtained.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 300~350°C for 60 minutes before use.
2. Backstep method should be applied to prevent blowholes and pits at arc starting and arc length should be kept as short as possible during welding.
3. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.08	0.57	0.92	0.013	0.010

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −30°C, J
460	530	31	110

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.6	3.2	4.0	5.0	6.0
Length (mm)		350	350	400	400	450
Current A	F	70~100	100~140	150~200	190~240	250~310
	VU, OH	60~90	80~120	120~160	140~180	—

Identification color: End-light yellow, secondary-green

TW-50

JIS Z 3211 E4948
*AWS A5.1 E7048

For 490MPa High Tensile Strength Steel

APPLICATIONS

Tack welding of mild steel and 490MPa high tensile strength steel for ships, structures and bridges.

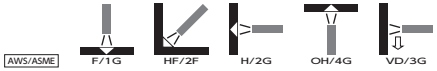
CHARACTERISTICS

TW-50 is a low hydrogen type electrode for tack welding in all positions. Crack resistance, arc restriking, slag removal and resistance to moisture absorption are excellent. Vertical downward welding is easy and assures high efficiency using the same current as flat position.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 300~350°C for 60 minutes before use.
2. Backstep method should be applied to prevent blowholes and pits at arc starting and arc length should be kept as short as possible.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.08	0.45	1.02	0.010	0.007

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −30°C, J
460	530	30	110

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.6	3.2	4.0
Length (mm)		300	350	400
Current A	F, H-Fil, H	100~130	130~160	170~220
	V-down	110~150	140~170	190~230
	OH	70~90	110~140	140~170

Approval: NK, ABS, LR, DNV, BV
Identification color: End-brown, secondary-light yellow

L-53

JIS Z 3211 E5716-U
*AWS A5.1 E7016

For 540MPa High Tensile Strength Steel

APPLICATIONS

Welding of 540MPa high tensile strength steel for pressure vessels, bridges, machineries etc.

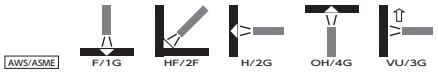
CHARACTERISTICS

L-53 is a ultra low hydrogen type electrode for all positions. Weld metal shows excellent mechanical properties even after long postweld PWHT.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 300~350°C for 60 minutes before use.
2. Backstep method should be applied to prevent blowholes and pits at arc starting and arc length should be kept as short as possible during welding.
3. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Mo
0.08	0.59	0.93	0.015	0.003	0.18

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

0.2% Proof Stress, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −20°C, J	PWHT
530	590	30	210	As-welded
460	540	32	250	620°C×15h

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0	6.0
Length (mm)		350	400	400	450
Current A	F, H-Fil, H	90~140	130~190	180~240	250~310
	V-up,OH	80~120	110~170	140~200	—

Approval:
Identification color: Light gray

Memo

Covered Arc Welding Electrodes for Mild Steel and 490~550MPa High Tensile Strength steel

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics	Typical Chemical Composition of Weld Metal (%)					Typical Mechanical Properties of Weld Metal			
	End	Secondary	JIS	AWS			C	Si	Mn	P	S	Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
S-03	Scarlet	Yellow	Z 3211 E4303	☆ A5.1 E6013	3.2 4.0 5.0 6.0	Lime-titania type electrode showing excellent weldability in vertical and overhead positions. A smooth and beautiful bead without undercuts and excessive reinforcement is obtained due to good slag fluidity and coverage.	0.08	0.12	0.42	0.018	0.012	410	470	28	110
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G									
NS-03Hi	Blue	—	Z 3211 E4303-U	☆ A5.1 E6013	2.0 2.6 3.2 4.0 5.0 6.0	Lime-titania type electrode assuring high efficiency in welding complicated structure of thin and medium thick plates. It produces a small amount of fumes and is highly resistant to moisture absorption. Arc is sharp, concentrated and easy to restrike. Slag is easy to remove. It can deposit a smooth and long bead even in inclined position.	0.07	0.17	0.39	0.015	0.009	435	490	28	100
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G									
S-03Z	Blue	Scarlet	Z 3211 E4303-U	☆ A5.1 E6013	2.0 2.6 3.2 4.0 5.0	Lime-titania type electrode for steel frames, bridges and sheet metals. Arc is soft, spatters are few, and arc restriking and slag removal are excellent in horizontal fillet welding. It can deposit a smooth and long bead.	0.07	0.19	0.41	0.018	0.014	430	460	30	110
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G									
G-200	Green	—	Z 3211 E4319-U	☆ A5.1 E6019	2.6 3.2 4.0 4.5 5.0 6.0 7.0	Ilmenite type electrode with excellent mechanical properties, crack resistance and X-ray quality. Operation is easy in all positions due to its soft arc and stable slag fluidity. It is extensively used throughout industry for all types of work.	0.07	0.08	0.46	0.015	0.012	390	450	29	−20°C 72
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G									
A-200	Purple	—	Z 3211 E4319	☆ A5.1 E6019	2.0 2.6 3.2 4.0 4.5 5.0 6.0	Ilmenite type electrode with excellent operational characteristics and weldability. Sharp arc and excellent slag coverage assure beautiful bead appearance with fine ripples and without undercuts. Operational characteristics in vertical and overhead positions excel other ilmenite electrodes.	0.08	0.12	0.40	0.019	0.011	410	460	28	−20°C 73
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G									
G-300	Scarlet	—	Z 3211 E4319	☆ A5.1 E6019	2.6 3.2 4.0 4.5 5.0 6.0 7.0	Ilmenite type electrode with excellent weldability especially in vertical upward position. Beautiful bead appearance free from defects such as incomplete penetration and undercuts is obtained since manipulation is easy due to smooth flow of slag round to the front of weld and even solidification of molten metal. Weld metal shows good impact properties and ductility.	0.08	0.13	0.53	0.018	0.010	400	460	30	−20°C 94
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G									

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Covered Arc Welding Electrodes
for Mild Steel and 490~550MPa High Tensile Strength steel

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics	Typical Chemical Composition of Weld Metal (%)					Typical Mechanical Properties of Weld Metal		
	End	Secondary	JIS	AWS			C	Si	Mn	P	S	Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
L-43LH	Silver	Indigo blue	Z 3211 E4316	—	3.2 4.0 5.0 6.0	Extra low hydrogen type electrode suitable for welding thick mild steel with high restraint where cracks tend to occur, root pass of butt joints of 490~780MPa high tensile strength steel and overhead fillet with low heat input of 490MPa high tensile strength steel due to its excellent crack resistance. Preheating temperature required to prevent cracks in the first pass welding can be decreased	0.04	0.41	0.34	0.008	0.005	400	460	33	−30°C 180
	Welding Position		AWS/ASME F/1G	HF/2F H/2G OH/4G VU/3G											
S-16	Red	Silver	Z 3211 E4316-U	☆ A5.1 E7016	2.6 3.2 4.0 5.0 6.0 8.0	Low hydrogen type electrode with excellent crack resistance, mechanical properties and X-ray quality. Operation is easy in all positions due to its stable arc and wide welding current range. It is extensively used throughout industry for all types of work.	0.07	0.58	1.10	0.011	0.008	460	540	32	−30°C 180
	Welding Position		AWS/ASME F/1G	HF/2F H/2G OH/4G VU/3G											
S-16LH	Red	Orange	Z 3211 E4916	☆ A5.1 E7016	3.2 4.0 5.0 6.0	Low hydrogen type electrode having excellent crack resistance. Diffusible hydrogen content is extremely low and the strength of weld metal is slightly lower than the other low hydrogen type electrodes. It is suitable, therefore, for welding those plates which have high restraint and are apt to crack.	0.05	0.48	0.64	0.012	0.007	440	510	32	−30°C 200
	Welding Position		AWS/ASME F/1G	HF/2F H/2G OH/4G VU/3G											
S-16V	Red	Blue	Z 3211 E4340-U	☆ A5.1 E7048	3.2 4.0 4.5 5.0 5.5 6.0	Low hydrogen type electrode for vertical downward butt and fillet welding. Welding efficiency is twice as high as vertical upward welding since high current is used. Weld metal shows high crack resistance and excellent mechanical properties and, therefore, it is applicable for various types of steel. Electrodes are used with vertical downward gravity welders and assure high efficiency.	0.08	0.53	0.84	0.014	0.011	440	540	31	170
	Welding Position		AWS/ASME VD/3G												

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Covered Arc Welding Electrodes
for Mild Steel and 490~550MPa High Tensile Strength Steel

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics	Typical Chemical Composition of Weld Metal (%)					Typical Mechanical Properties of Weld Metal			
	End	Secondary	JIS	AWS			C	Si	Mn	P	S	Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
EX-55	Green	Purple	Z 3211 E4916-U	☆ A5.1 E7016	3.2 4.0 5.0 6.0 7.0	Low hydrogen type electrode which produces an extremely small amount of fumes. Weldability and X-ray properties are excellent and extremely low diffusible hydrogen content of weld metal assures excellent crack resistance and mechanical properties.	0.08	0.60	1.10	0.010	0.005	510	570	31	−30°C 160
	Welding Position		AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G											
EX-50F	Blue	Pink	Z 3211 E4940-G	☆ A5.1 E7024	4.0 4.5 5.0 5.5 6.0 6.4	Iron powder titania type electrode which produces an extremely small amount of fumes. It is used for plates with carbon equivalent (C+1/6Mn+1/5Cr+1/5Mo+1/5V+1/15Ni+1/15Cu) less than 0.36% and thickness up to 25 mm, and gives a beautiful bead of equal leg length and free from undercuts. Slag is easy to remove and weld metal is not susceptible to primer. It also is suitable for gravity welding.	0.07	0.39	0.76	0.017	0.010	460	520	27	88
	Welding Position		AWS/ASME	F/1G HF/2F											
M-50G	Light green	—	Z 3211 E4940-G	★ A5.1 E7024	3.2 4.0 4.5 5.0 5.5 6.0	Iron powder titania type electrode for weiding 490MPa high tensile strength steel up to 12.7 mm thick. It assures a beautiful bead of equal leg length and free from undercuts. Spatters are few and slag is easy to remove. It is not susceptible to primer and can deposit a long bead. It also is suitable for gravity welding.	0.07	0.37	0.90	0.016	0.010	470	540	30	100
	Welding Position		AWS/ASME	F/1G HF/2F											
LM-55G	Light green	Purple	—	☆ A5.1 E7028	5.0 5.5 6.0 6.4 7.0 8.0	Iron powder low hydrogen type electrode for flat and horizontal fillet welding. It assures beautiful, flat bead free from undercuts and of equal leg length. Weld metal shows excellent mechanical properties and crack resistance. It also is suitable for gravity Welding.	0.06	0.20	1.19	0.014	0.010	460	530	29	120
	Welding Position		AWS/ASME	F/1G HF/2F											

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

YF-15 × Y-D
YF-15 × Y-CM

☆JIS Z 3183 S50J2-H
☆AWS A5.17 F7A4-EH14
F7P4-EH14
☆JIS Z 3183 S50J2-H
☆AWS A5.23 F8A2-EG-A3
F7P2-EG-A3

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Flat butt and fillet welding of steel frames, bridges, machinery and storage tanks. The combination with Y-D wire is used for mild steel and 490MPa high tensile strength steel and Y-CM for 490MPa high tensile strength steel.

CHARACTERISTICS

The combination assures excellent impact properties, especially stable impact properties at low temperatures with YF15 × Y-CM in single-layer welding.

GUIDELINES FOR USAGE

1. An excessive amount of flux may cause disorder of bead ripples in high current welding.
2. An excessively narrow groove in multi-layer welding should be avoided since it may deteriorate slag removability.

WELDING POSITION

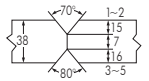
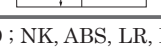
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

	Combination	C	Si	Mn	P	S	Mo	Base Metal	Plate Thickness mm	Welding Method
A	YF-15 ×Y-D	0.14	0.45	1.56	0.020	0.016	–	SM520C	38	X groove, multi-layer
B	YF-15 ×Y-CM	0.10	0.39	1.25	0.018	0.014	0.19	SM490B	13	I groove, one pass both sides

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

	Combination	Joint Tensile Test		Charpy 2 V-notch, J			Base Metal	Plate Thickness mm	Welding Method
		Tensile Strength, MPa	Location of Fracture	−40°C	−20°C	0°C			
A	YF-15 ×Y-D	560	Base metal	36	51	76	SM520C	38	X groove, multi-layer
B	YF-15 ×Y-CM	550	Base metal	41	65	84	SM490B	13	I groove, one pass both sides

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
38	4.8		1	800	36	30	Multi-layer
			2	740	36	30	
			3	940	36	30	
			4, 5	740	36	32	
13	4.8		1	650	32	60	one pass both sides
			2	750	34	60	

Approval: YF-15 × Y-D ; NK, ABS, LR, DNV, BV, CR, GL
YF-15 × Y-CM ; NK, ABS, LR, DNV, BV

YF-15B × Y-DM3

☆JIS Z 3183 S532-H
☆AWS A5.23 F7A4-EG-G
F7P4-EG-G

For 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of thick 490MPa high tensile strength steel plates to be used as welded or after post welding stress relieving annealing for ships, machinery and pressure vessels.

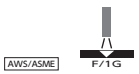
CHARACTERISTICS

Sufficient strength and stable impact values are assured even after stress relieving annealing for long hours in multi-layer welding of thick plates.

GUIDELINES FOR USAGE

1. An excessive amount of flux may cause uneven ripples in high current welding.
2. An excessively narrow groove should be avoided since it makes slag difficult to remove.

WELDING POSITION



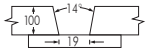
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Mo	Base Metal	Plate Thickness mm	Welding Method
0.08	0.43	1.57	0.021	0.010	0.25	SB480	100	Multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test				Charpy 2 V-notch, J		PWHT	Base Metal	Plate Thickness mm	Welding Method
Test Temperature °C	Yield Point, MPa	Tensile Strength, MPa	Elongation, %	−30°C	0°C				
R. T.	550	610	25	54	110	As welded	SB480	100	Multi-layer
R. T.	460	540	32	98	130	630°C×13h			

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
100	4.8		1~58	(L) 650 (T) 700	33 34	60	Multi-layer

Approval:

NF-1 × Y-D

*JIS Z 3183 S532-H
*AWS A5.17 F7A4-EH14
F7P2-EH14

For Narrow gap of Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Narrow gap welding and single flat butt welding of mild steel and 490MPa high tensile strength for pressure vessels, steel frames, bridges and heavy electric machinery.

CHARACTERISTICS

In use of NF-1, outstanding efficiency and economy are obtained in multi-layer (one pass one layer) narrow gap welding of thick plates. In other words, flux consumption rate is low and slag is extremely easy to remove.
Weld metal of NF-1 x Y-D shows excellent toughness. Weldability and mechanical properties are excellent also in high current welding with normal groove.

GUIDELINES FOR USAGE

An excessive amount of flux in a deep groove may cause disorder of bead ripples.

WELDING POSITION

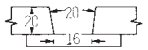
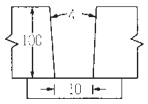
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

	C	Si	Mn	P	S	Base Metal	Plate Thickness mm	Welding Method
A	0.08	0.27	1.30	0.018	0.011	SM490B	20	multi-layer
B	0.10	0.18	1.39	0.020	0.007	A516Gr70	100	I narrow groove, multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

	Tensile Strength, MPa	Location of Fracture	Elon-gation, %	Charpy 2 V-notch, J			PWHT	Base Metal	Plate Thickness mm	Welding Method
				−40°C	−20°C	0°C				
A	490	540	32	81	140	170	As Weld	SM490B	20	multi-layer
B	490	570	30	39	130	130	625°C ×10hr	A516Gr70	100	I narrow groove, multi-layer

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry mm	Pass	Current, A	Voltage, V	Speed, cm/min	Note
20	4.8		1~11	500	36	30	Multi-layer
100	4.8		1~5	450	31	30~35	Multi-layer
			6~13	500	32	35	
			14~20	550	33	35	
			21~26	600	34	35	
			27	650	34	35	

Approval: NK, ABS, LR

NF-1 × Y-DM3

*JIS Z 3183 S58J2-H
*AWS A5.23 F8A4-EG-G
F8P2-EG-G

For Narrow gap of Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Narrow gap welding and single layer welding of 490MPa high tensile strength for pressure vessels, heavy electric machinery.

CHARACTERISTICS

Outstanding efficiency and economy are obtained in multi-layer narrow gap welding of thick plates since flux consumption rate is low and slag is extrmely easy to remove. Weld metal shows excellent toughness. Weldability and mechanical properties are excellent also in high current welding with normal groove and strength is sufficient even after stress relief annealing for long hours.

GUIDELINES FOR USAGE

An exessive amount of flux may cause disorder of bead ripples in narrow groove welding.

WELDING POSITION

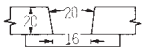
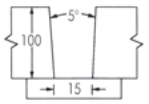
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

	C	Si	Mn	P	S	Mo	Plate Thickness mm	Base Metal	Welding Method
A	0.07	0.20	1.50	0.015	0.004	0.011	20	SM490B	multi-layer
B	0.06	0.24	1.38	0.014	0.008	0.007	100	A516Gr70	I narrow groove, multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

	Yield Point, MPa	Tensile Strength, MPa	Elon-gation, %	Charpy 2 V-notch, J			PWHT	Base Metal	Plate Thickness mm	Welding Method
				−40°C	−20°C	0°C				
A	550	600	29	37	74	140	628°C ×4hr	SM490B	20	multi-layer
B	510	590	33	64	93	150	625°C ×10hr	A516Gr70	100	I narrow groove, multi-layer

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry mm	Pass	Current, A	Voltage, V	Speed, cm/min	Note
20	4.8		1~11	500	32	30	Multi-layer
100	(L) 3.2 (T) 3.2		1~3	450	30~31	25	Multi-layer
			4~21	(L) 500	31~32	40~50	
				(T) 550	31~32		
			21~26	(L) 600	32	50	
			27	(T) 650	31		

Approval:

NF-11H × Y-D
NF-11H × Y-DM3
NF-11H × Y-E

*JIS Z 3183 S502-H/*AWS A5.17 F7A4-EH14
*AWS A5.23 F7A6-EG-G
*AWS A5.23 F8A4-EG-G

Submerged Arc Welding Consumables for Horizontal position

APPLICATIONS

NF-11H × Y-D: Horizontal welding for HT490 MPa grade steel used in large scale tank
NF-11H × Y-DM3: Horizontal welding for aluminium-killed low temperature service
NF-11H × Y-E: Horizontal welding for HT550-610 MPa grades

CHARACTERISTICS

NF-11H is a fused flux suitable to horizontal welding for a circumferential joint in a large scale of cylindrical tank.

GUIDELINES FOR USAGE

1. Flux should be dried at 200~350°C for 60 minutes or over before welding.
2. Foreign materials such as rust and oil in weld area should be completely removed to prevent weld crack and pits.
3. Welding current for 1st run should be kept less than 500 amps. and welding speed should be less than 40 cm/min.
4. Recommended welding power source is a DC with drooping characteristic.

WELDING POSITION

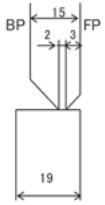
■ SIZE AND PACKAGE OF FLUX AND WIRE)

Flux		Wire	
Particle size,mesh	Unit weight,KGS	Recommended dia,mm	Unit weight,KGS
2×X200	25	3.2 or 2.4	25

■ TYPICAL PROPERTIES OF BUTT WELD METAL (Horizontal MULTI-PASS)

Wire Used	Typical chemical composition,%						Tensile Strength, MPa	Base Metal	Charpy 2 V-notch,J		
	C	Si	Mn	P	S	Mo			−46°C	−20°C	0°C
Y-D	0.08	0.41	1.84	0.021	0.008		590	HT490	69	110	150
Y-DM3	0.07	0.24	1.31	0.015	0.005	0.13	510	YP325	86	150	–
Y-E	0.09	0.29	1.63	0.023	0.005	tr.	640	HT610	60	110	150

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

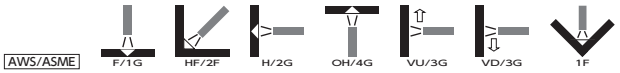
Wire Dia. mm	Groove Geometry	Pass number		Current A	Voltage V	Speed cm/min	Heat input kJ/cm	Others
3.2		BP	1	390-410	22-24	25	21-24	1)Horizontal angle of torch: 22.5 deg. 2)Wire extension: 25mm 3)Burden height of flux: 35-40 mm
			2	390-410	22-24	35	15-17	
			3	390-410	22-24	30	17-20	
			4	390-410	22-24	40-45	11-15	
		Arc-air gouging (9.5mmφ-carbon rod with 500 A-40 V-95 cm/min)						
		FP	1	440-460	22-24	40	15-17	
			2	440-460	22-24	40	15-17	
			3	440-460	22-24	40	15-17	
			4	440-460	22-24	40-45	13-17	

Memo

Submerged Arc Welding Materials
for Mild Steel and 490~550MPa High Tensile Strength Steel

Brand Name	Specification JIS	Specification AWS	Application and Characteristics	Typical Chemical of Weld C	Si	Mn	Composition Metal (%) P	S	Mo	Typical Mechanical Properties of Weld Metal Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch °C	Charpy 2 V-notch J	Remarks PWHT	Base Metal	Plate Thickness mm	Welding Method
NF-45 × Y-B	☆ Z 3183 S422-S	☆ A5.17 F6A2-EM12	High speed butt and fillet welding of medium thick and thick and thin mild steel plates. The combination is has good tolerance to scales and rust of plates and, therefore, welding defects such as pits scarcely occur.	0.08	0.37	1.14	Joint Tensile Test											
	Welding Position		AWS/ASME F/1G				0.015	0.012	—	—	470	—	0	56	As welded	SS400	20	Y groove, one pass both sides
NF-45 × Y-D	☆ Z 3183 S501-H	☆ A5.17 F7A0-EH14	High speed flat butt and fillet welding of medium and thin mild steel and 490MPa high tensile strength steel for spiral pipes, steel frames, bridges and rolling stock. The combination has good tolerance to scales and rust of plates and, therefore, welding defects such as pits and blowholes scarcely occur. Bead appearance is beautiful.	0.13	0.18	0.90	Joint Tensile Test											
							0.019	0.018	—	—	460	—	0	64	As welded	SS400	12	I groove, one pass both sides
	Welding Position		AWS/ASME F/1G	0.10	0.30	1.40	Joint Tensile Test											
							0.020	0.013	—	—	550	—	0	35	As welded	SM490B	12	I groove, one pass both sides
YF-800 × Y-D	☆ Z 3183 S501-H	☆ A5.17 F7A0-EH14	Flat and horizontal fillet welding of mild steel and 490MPa high tensile strength steel for bridges, steel frames, structures and ships. YF-800 is a pumiceous flux. Flux consumption rate is low and slag removal is excellent especially in flat and horizontal fillet welding. The combination has good tolerance to scales and rust of plates and, therefore, welding defects such as pits and blowholes scarcely occur.	0.05	0.08	1.60	0.020	0.006	—	440	540	29	−20	57	As welded	SM490A	25	Multi-layer
	Welding Position		AWS/ASME 1F H/2G															
YF-800S × Y-D	☆ Z 3183 S501-H	☆ A5.17 F7A0-EH14	Flat fillet welding of mild steel and 490MPa high tensile strength steel for construction, bridges and ships. Slag is extremely easy to remove and comes off naturally even in the welding of thin plates where normally slag is not easy to remove.	0.05	0.59	1.47	0.020	0.013	—	410	520	28	0	56	As welded	SM400A	25	Multi-layer welding with backing plate
	Welding Position		AWS/ASME 1F H/2G															
NF-60 × Y-DS	☆ Z 3183 S501-H	☆ A5.17 F7A0-EH14	High speed flat butt and fillet welding of thin and medium thickness plates of mild and 490MPa high strength steel.	0.10	0.30	1.64	0.018	0.012		—	480	—	0	45	As welded	SM400B	12	I groove, one pass both sides
	Welding Position		AWS/ASME F/1G H/2G															
NF-80 × Y-DS	☆ Z 3183 S501-H	☆ A5.17 F7A2-EH14 F6P2-EH14	Multi-layer narrow gap welding of thick plates for 490MPa high strength steel. This flux is a neutral type fused flux and shows good slag detachability.	0.07	0.40	1.45	—	—	—	430	540	28	−20	54	As welded	SM490A	100	Multi-layer
	Welding Position		AWS/ASME F/1G										0	120				
													20	140				

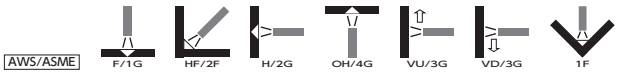
Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.



Submerged Arc Welding Materials
for Mild Steel and 490~550MPa High Tensile Strength Steel

Brand Name	Specification JIS	Specification AWS	Application and Characteristics	Typical Chemical of Weld C	Si	Mn	Composition Metal (%) P	S	Mo	Typical Mechanical Properties of Weld Metal Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch °C	Charpy 2 V-notch J	PWHT	Remarks Base Metal	Plate Thickness mm	Welding Method
YF-15A × Y-D	☆ Z 3183 S50J2-H	☆ A5.17 F7A4-EH14	Flat butt and fillet welding of mild steel and 490MPa high tensile strength steel for steel frames, bridges, pipes and ships. Bead shapes and appearance are excellent and pock marks scarcely occur in wide range of welding conditions. Slag is easy to remove in flat fillet welding. The combination is economical since wire melting rate is high and flux consumption rate is low.	0.06	0.49	1.56	0.019	0.011	—	450	530	32	−40	56	As welded	SM490B	25	Multi-layer
													−20	87				
													0	110				
				0.11	0.36	1.55	0.015	0.006	—	410	550	31	0	68	As welded	SM490B	19	X groove, one pass both sides
	Welding Position		AWS/ASME F/1G															
NF-100 × Y-DS	☆ Z 3183 S532-H	☆ A5.17 F7A6-EH14 F7P6-EH14	Welding of thick plates for 490MPa high strength steel to be used under as-welded and postweld teat treatment for structures and pressure vessels.	0.07	0.41	1.54	—	—	—	450	560	28	−40	60	As welded	SM490A	30	Multi-layer
													−20	80				
													0	130				
										400	510	36	−40	98	620°C × 5hr			
													−20	160				
													0	170				
	Welding Position		AWS/ASME F/1G															
YF-38 × Y-D	☆ Z 3183 S502-H	☆ A5.17 F7A0-EH14	High speed flat butt and fillet welding of mild steel and 490MPa high tensile strength steel for pipes, steel frames, bridges and rolling stock. High efficiency and economy are obtained due to high deposition rate and low flux consumption rate. The combination has good tolerance to rust and dust and assures beautiful bead appearance.	0.14	0.17	0.93	Joint Tensile Test											
							0.020	0.018	—	—	450	—	−20	71	As welded	SS400	9	I groove, one pass both sides
													0	76				
							Joint Tensile Test											
				0.10	0.31	1.33	0.017	0.011	—	—	550	—	−20	26	As welded	SM490B	10	I groove, one pass both sides
	Welding Position		AWS/ASME F/1G										0	45				
NF-80 × Y-CMS	☆ Z 3183 S502-H	☆ A5.23 F7A2-EA4-A2 F7P2-EA4-A2	Multi-layer narrow gap welding of thick plates for 490MPa high strength steel. In case where tensile strength is required more than 490MPa after PWHT condition the combined wire of Y-CMS is recommended.	0.07	0.34	1.30	0.019	0.010	0.45	440	560	27	−20	41	As welded	SM490A	100	Multi-layer
													0	88				
													20	93				
										430	530	29	−20	71	620 °C × 5hr			
													0	98				
													20	120				
	Welding Position		AWS/ASME F/1G															

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

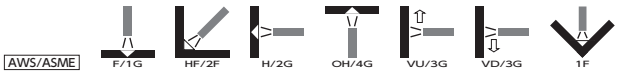


Submerged Arc Welding Materials for Mild Steel and 490~550MPa High Tensile Strength Steel

Brand Name	Specification JIS	Specification AWS	Application and Characteristics	Typical Chemical of Weld C	Si	Mn
NSH-53Z × Y-DL	☆ Z 3183 S502-H	—	Flat butt welding and fillet welding of double bevel grooves of mild steel and 490MPa high tensile strength steel for steel frames, and corner joint welding of box columns. It is possible to weld up to 60mm thick plates in one run since the flux gives a deep penetration.	0.12	0.28	1.50
	Welding Position		AWS/ASME F/1G			
NF-1 × Y-E	☆ Z 3183 S532-H	★ A5.23 F8A4-EG-G ☆ A5.23 F8P2-EG-G	Narrow gap welding and single-layer welding of 490MPa high tensile strength steel. Slag is extremely easy to remove and toughness is high. Economical welding is assured since flux consumption rate is low.	0.07	0.32	1.89
	Welding Position		AWS/ASME F/1G			

Composition Metal (%) P	S	Mo	Typical Mechanical Properties of Weld Metal Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch, °C	J	Remarks PWHT	Base Metal	Plate Thickness mm	Welding Method
0.016	0.005	—	370	530	30	0	50	As welded	SM490B	50	Y groove, one pass with backing plate.
0.011	0.004	—	480	570	28	−40	31	630 °C× 10hr	A516 Gr 70	100	I groove, narrow gap, multi-layer welding (Tandem)
						−20	76				
						0	140				

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.



YM-26

JIS Z 3312 YGW11
☆AWS A5.18 ER70S-G

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for automobiles, rolling stock, machinery, air conditioners, tools light gauge steel, steel frames, bridges and ships.

CHARACTERISTICS

YM-26 is a gas metal arc welding wire to be used with CO_2 shield gas. Arc is stable, spatters are few and weldability is excellent even in high welding current range. High efficiency is obtained since deposition rate is high and penetration is deep.

GUIDELINES FOR USAGE

1. Automatic flat and vertical welding is possibly by applying NAVI-21 process, our manpower saving automatic welding process. For vertical welding, dip transfer welding with 1.2mm diameter wire and 120-240 amperage is recommended.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ti
CO_2	0.07	0.52	1.11	0.017	0.011	0.04

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

PWHT	Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
As-welded	460	560	28	130
625°C×3hr	400	510	31	180

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.0	1.2	1.4	1.6	2.0
Current A	F	70~250	100~350	150~470	200~550	250~650
	H	70~250	100~350	150~450	200~450	—
	H-Fil	70~250	130~300	150~400	200~450	—

Approval: NK, ABS, LR, DNV, BV, CR, GL, KR

YM-28

JIS Z 3312 YGW12
☆AWS A5.18 ER70S-6

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for automobiles, rolling stock, electric appliances, machinery, air conditioners, light gauge steel, pipes, steel frames, bridges and ships.

CHARACTERISTICS

YM-28 is a gas metal arc welding wire to be used with CO_2 shield gas. Arc is stable, spatters are few and weldability is excellent even with low current under 200A. Welding of thin plates in all positions. especially in vertical downward position, is easy. Also, it shows better weldability in high speed welding of thin plates with currents of less than 300A than wires of other types. Also with Ar+CO_2 mixture gas, arc is stable, spatters are few and bead is beautiful in a wide welding current range.

GUIDELINES FOR USAGE

1. In vertical downward welding, wire should be held at an angle slightly above horizontal.
2. Optimum arc voltage should be selected in accordance with welding current to maintain stable dip transfer mode. If voltage is too high or too low, dip transfer frequency will decrease.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S
CO_2	0.08	0.60	1.10	0.014	0.010
Ar+20%CO_2	0.08	0.70	1.25	0.015	0.011

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Shield Gas	Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
CO_2	450	550	27	120
Ar+20%CO_2	480	590	27	130

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		0.9	1.0	1.2	1.4
Current A	F, H-Fil	70~200	70~250	80~350	250~550
	H	70~140	70~160	80~180	—
	OH	70~100	70~120	80~150	—
	V-up	70~140	70~160	80~180	—
	V-down	70~200	70~220	80~240	—

Approval: NK, ABS, LR, DNV, BV

YM-28Z

JIS Z 3312 G49A0C0

For Molten Galvanized Steel, Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of molten galvanized steel for light gauge steel, pipes, steel frames, rolling stock and containers, and mild steel and 490MPa steel for various structures.

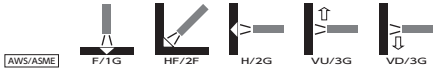
CHARACTERISTICS

YM-28Z is a gas metal arc welding wire to be used with CO_2 shield gas. In the welding of molten galvanized steel plates of 270g/m2 (Z27) galvanization level, blowholes and spatters are less and bead is sounder than conventional YGW 14 type wires. It is also used for joining steel plates without galvanization.

GUIDELINES FOR USAGE

1. Optimum arc voltage should be selected in accordance with welding current to carry out stable welding.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S
CO_2	0.05	1.04	1.38	0.005	0.010

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
460	600	30	76

■ TYPICAL WELD JOINT TEST

Joint Tensile Test		Bend Test		Base metal	Plate Thickness mm	Welding Conditions			
Tensile Strength, MPa	Location of Fracture	Face bend 180°	Root bend 180°			Shield Gas	Current A	Voltage V	Speed cm/min
460	Base metal	No defect	No defect	SGH400 Z27	3.2	CO_2	160	20	60

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		0.9	1.2
Current (A)	F, H-Fil	70~200	100~350
	H	70~140	80~180
	V-up	70~140	80~180
	V-down	70~200	80~240

Approval:

YM-28S

JIS Z 3312 YGW15
☆AWS A5.18 ER70S-G

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of mild steel and 490MPa high tensile strength steel for automobiles, rolling stock, machinery, air conditioners, tools light gauge steel, steel frames, bridges and ships.

CHARACTERISTICS

YM-28S is a gas metal arc welding wire to be used with Ar+CO_2 shield gas. Arc is stable, spatters are few, weldability is satisfactory and beautiful and flat bead is obtained in high current spray transfer welding. Welding in vertical position is easy and weld metal shows excellent toughness. It also is suitable for dip transfer welding with low current. It assures excellent weldability and properties of weld metal in pulsed arc welding.

GUIDELINES FOR USAGE

1. It be possibility applied splay arc in the high welding current range, short circuit arc in the low welding current range and pulse are welding.
2. It should be applied that the shielding gas is Ar-5~25CO_2.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.08	0.45	0.85	0.011	0.015

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch J	
			−20°C	0°C
480	570	31	130	150

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		0.9	1.0	1.2	1.4	1.6
Current range A	F, H-Fil	70~200	70~250	80~350	150~400	200~450
	V-up	70~150	70~150	80~170	—	—
	H	70~150	70~180	70~200	—	—

Approval: NK, ABS, LR, DNV GL, CR

Gas Metal Arc Welding Wires
for Mild Steel and 490~550MPa High Tensile Strength Steel

Brand Name	Shield Gas	Specification JIS	Specification AWS	Dia. mm	Application and Characteristics
YM-SCM	CO_2	Z 3312 G49A0C16	☆A5.18 ER70S-3	0.6 0.8	YM-SCM is a gas metal arc welding wire to be used for all positional welding of extremely thin steel plates for automobile and farm machineries compo-nents.
		Welding Position		AWS/ASME F/1G H/2G VU/3G	
YM-25	Ar + CO_2	Z 3312 YGW16	☆A5.18 ER70S-3	0.8 0.9 1.0 1.2	YM-25 is a gas metal arc welding wire to be used with Ar+CO_2 shield gas and is suitable for all position welding of thin plates. Arc is stable, spatters are few and bead is beautiful in dip transfer welding.
		Welding Position		AWS/ASME F/1G OH/4G VU/3G VD/3G	
YM-25S	Ar + CO_2	Z 3312 YGW16	☆A5.18 ER70S-3		YM-25S is a gas metal arc welding wire to be used with Ar+CO_2 shield gas and is suitable for all position welding of thin plates. Arc is stable, spatters are few and bead is beautiful in dip transfer welding.
		Welding Position		AWS/ASME F/1G H/2G OH/4G VU/3G	

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Type Chemical Composition of Weld Metal (%) C	Si	Mn	P	S	Typical Mechanical Properties of Weld Mrtal Yield Point, MPa	Tensile Strength, MPa	Elonga-tion, %	Charpy 2V-notch 0°C, J		Type of Current
0.10	0.52	1.05	0.016	0.012	480	560	27	69		DC (+)
Ar+20%CO_2										
0.10	0.39	0.80	0.014	0.007	420	540	32	120		DC (+)
Ar+10%CO_2										
0.09	0.39	1.06	0.014	0.007	460	550	28	150		DC (+)
CO_2										
0.10	0.22	0.62	0.015	0.009	400	500	34	140		DC (+)
Shield Gas: Ar+20%CO_2										
0.07	0.43	0.92	0.015	0.010	480	540	29	−20°C 150	As welded	DC (+)
					450	520	30	−20°C 150	620°C×1hr	

Gas Metal Arc Welding Wires
for Mild Steel and 490~550MPa High Tensile Strength Steel

Brand Name	Shield Gas	Specification JIS	Specification AWS	Dia. mm	Application and Characteristics
YM-24S	Ar + CO_2	Z 3312 G43A2M0	—	1.2	YM-24S is a gas metal arc welding wire to be used with Ar+CO_2 shield gas. Spatters are extremely few and bead is beautiful especially in high speed welding (80~150cm/min)of thin plates, 2.0~3.2mm, in combination with a power source with high pulse frequency.
		Welding Position			AWS/ASME F/1G HF/2F
YM-24T	Ar + CO_2	Z 3312 YGW16	—	1.2	YM-24T is a gas metal arc welding wire to be used with Ar+CO_2 shield gas and has favorable gap-proof performance on high-speed welding of thin steel sheets. Weldability, arc is stable, spatters are few and bead is beautiful. The best effect is obtained in combination with inverter controlled pulsed.
		Welding Position			AWS/ASME F/1G HF/2F H/2G
YM-22Z	Ar + CO_2	—	—	1.2	YM-22Z is a gas metal arc welding wire to be used with Ar+CO_2 shield gas. Blowholes and spatters are few and bead is sound in one pass fillet welding of alloified molten galvannealed steel plates of 45~60g/m^2 galvanization level. Also, high speed welding of more than 100cm/min is possible. The best effect is obtained in the combination with an inverter controlled pulsed power source.
		Welding Position			AWS/ASME F/1G HF/2F VD/3G

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Type Chemical Composition of Weld Metal (%) C	Si	Mn	P	S	Typical Mechanical Properties of Weld Mrtal Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch 0°C, J		Type of Current
Shield Gas: Ar+20%CO_2										
0.09	0.14	0.94	0.006	0.010	380	470	33	−20°C 130	140	DC (+)
Shield Gas: Ar+20%CO_2										
0.07	0.61	1.21	0.008	0.005	460	570	30	−20°C 140		DC (+)
Shield Gas: Ar+20%CO_2										
0.09	0.09	0.42	0.010	0.005	—	—	—	—		DC (+)

YT-28

☆JIS Z 3316 W49AP2U12
☆AWS A5.18 ER70S-6

For Mild Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Gas Tungsten Arc Welding of mild steel, 490MPa high tensile strength steel and aluminium-killed steel for low temperature service.

CHARACTERISTICS

YT-28 is filler rods and spool wire for GTAW (TIG welding). to be used with Ar shield gas.
The weld metal shows stable toughness at low temperature range down to −40°C.
The weld bead shape is excellent since high fluidity of molten pool and high affinity between molten pool and base metal. It also suitable for uranami (sound penetration bead) welding.
The operability is good since the surface of the filler rod is smooth.

GUIDELINES FOR USAGE

1. Arc length should be kept as short as possible during welding. However, don't contact electrode and molten pool. If electrode contacts into molten pool, the weld metal that is included tungsten should be grinded.
2. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.09	0.77	1.47	0.013	0.011

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J		PWHT
			−40°C	−20°C	
464	579	32	120	163	As weld
429	510	32	—	162	620°C×1hr

■ SIZES<DC(−)>

Diameter (mm)	1.2	1.6	2.0	2.4	3.2
Length of Filler Rod (mm)	1000	1000	1000	1000	1000
Weight of spool wire (kg)	12.5	—	—	—	—

Approval: NK, ABS
Identification color: End-blue

570~950MPa High Tensile Strength Steel

Flux Cored Arc Welding Wires
Covered Arc Welding Electrodes
Submerged Arc Welding Materials
Gas Metal Arc Welding Wires
Gas Tungsten Arc Welding Rods and Wires

SF-60/SF-60A

Z 3313 T59J1T1-1CA-N2M1-UH5 (SF-60)
☆AWS A5.36 E81T1-C1A2-K11 (SF-60)
Z 3313 T59J1T1-1MA-N2M1-UH5 (SF-60A)
☆AWS A5.36 E81T1-M21A2-K11 (SF-60A)

For 590MPa High Tensile Strength Steel

APPLICATIONS

All position welding for TS 590MPa class steel

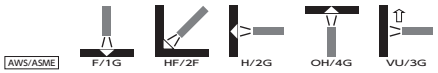
CHARACTERISTICS

SF-60 and SF-60A are rutile type seamless flux cored arc welding wires to be used with 100%CO_2 (SF-60) and Ar+20%CO_2(SF-60A) shield gas and designed for bridges, machineries and structures welding. Weld metal shows excellent toughness in low temperature range at down to −5°C. Diffusible hydrogen content is as low as solid wire s and crack resistance is excellent. Weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with welding position, plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1-4 of SF-1

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Brand name	Shielding gas	C	Si	Mn	P	S	Ni
SF-60	CO_2	0.05	0.50	1.47	0.011	0.005	0.53
SF-60A	Ar+20%CO_2	0.05	0.36	1.35	0.009	0.005	0.41

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Brand name	Shielding gas	Yield strength, MPa	Tensile strength, MPa	Elongation, %	Charpy 2V-notch at −5°C, J
SF-60	CO_2	590	620	25	100
SF-60A	Ar+20%CO_2	560	620	29	130

■ TYPICAL WELD JOINT TEST

Brand name	Shielding gas	Welding position	Heat input, kJ/cm	Joint tensile test		Charpy 2V-notch at −5°C, J
				Tensile strength, MPa	Fracture Location	
SF-60	CO_2	V-up	24.0	610	WM	81
SF-60A	Ar+20%CO_2	V-up	22.1	610	WM	130

*Base metal: SM570Q (30mm thick.)

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2
Current A	F, H, H-Fil	180~300
	V-up, OH	180~250

Approval: SF-60 ; NK

SF-70A

☆AWS A5.36 E101T1-M21A4-K2-H4

For 690MPa High Tensile Strength Steel

APPLICATIONS

Welding of YP620 steel and 690MPa high tensile strength steel (WEL-TEN 690RE, 690 and 690C etc.) of down to -40°C for offshore structures, pressure vessels, tanks, penstocks, turbine casings, crane and construction machineries.

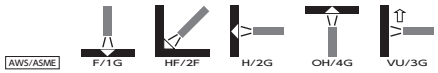
CHARACTERISTICS

SF-70A that is used with Ar+20%CO_2 shielding gas is rutile type seamless flux cored arc welding wire. Weld metal shows excellent toughness in low temperature range down to -40°C. Diffusible hydrogen content is as low as solid wires and crack resistance is excellent. Weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with welding position, plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1-4 of SF-1.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni
0.06	0.44	1.75	0.012	0.004	1.88

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength, MPa	Tensile strength, MPa	Elongation, %	Charpy 2V-notch at −40°C, J
730	765	23	88

■ TYPICAL WELD JOINT TEST

Base metal		Welding position		Joint tensile test		Charpy 2V-notch at −40°C, J
Type of Steel	Plate thickness	Welding position	Heat input, kJ/cm	Yield strength, MPa	Tensile strength, MPa	
HT780	38mm	Vertical-up	14.6	690	800	68

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)> (Shielding gas: Ar+20%CO_2)

Diameter (mm)		1.2
Current A	F, H, HF	180~300
	VU, OH	180~250

Approval: ABS, DNV

SF-80AM

☆AWS A5.36 E111T1-M21A2-K3-H4

For 780MPa High Tensile Strength Steel

APPLICATIONS

Welding of YP690 steel and 780MPa high tensile strength steel (WEL-TEN 780RE, 780E and 780C etc.) of down to -20°C for bridges, pressure vessels, tanks, penstocks, turbine casings, crane and construction machineries.

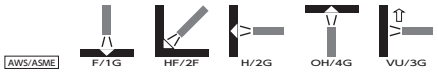
CHARACTERISTICS

SF-80AM that is used with Ar+20%CO_2 shielding gas is rutile type seamless flux cored arc welding wire. Weld metal shows excellent toughness range down to -20°C. Diffusible hydrogen content is as low as solid wires and crack resistance is excellent. Weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance withwelding position, plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1-4 of SF-1.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Mo
0.06	0.44	1.64	0.013	0.004	2.14	0.30

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −20°C, J
819	848	20	73

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2
Current A	F, H-Fil	180~300
	VU, OH	180~250

SM-80A

☆AWS A5.36 E110T15-M21A4-G-H4

For 780MPa High Tensile Strength Steel

APPLICATIONS

Welding of 780MPa high tensile strength steel for frames, bridges, pressure vessels, penstocks and offshore structures.

CHARACTERISTICS

SM-80A is a metal type seamless flux cored arc welding wire to be used with Ar+20%CO_2 shield gas. Arc is stable, spatters and slags are few and weldability is excellent in a wide current range. Bead appearance is beautiful and weld metal shows excellent toughness at low temperatures. Diffusible hydrogen content is as low as solid wires and crack resistance is excellent.

GUIDELINES FOR USAGE

1. Arc voltage should be 1 or 2 volt lower than that for conventinal flux cored wires and 4 or 5 volt lower than that for solid wires.
2. All dust and rust in groove should be completely removed.
3. Preheating at 100~150°C is required in accordance with plate thickness, restraint, heat input, etc.
4. A suitable shield gas flow rate is 20-25L/min.
5. Distance between base metal and tip should be kept within 20-30mm.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ni	Cr	Mo	Other
Ar+20%CO_2	0.05	0.37	1.38	0.013	0.005	2.51	0.48	0.42	-

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

0.2% Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −40°C, J
761	821	22	91

■ TYPICAL WELD JOINT TEST

Joint Tensile Test		Charpy 2V-notch J		Base metal	Plate Thickness mm
Tensile Strength MPa	Location of Fracture	−60°C	−40°C		
824	Base Metal	64	88	WELTEN 780E	20

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2
Current A	F, H	180~300
	H-Fil	180~300

Approval: ABS, DNV (During the proceedings)

L-60

JIS Z 3211 E5916-N1M1U
☆AWS A5.5 E8016-G

For 590MPa High Tensile Strength Steel

APPLICATIONS

Welding of SM570, SPV450 and 590MPa high tensile strength steel (WEL-TEN 590) for penstocks, storage tanks, pressure vessels, bridges, offshore structures and machinery.

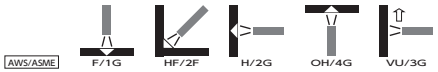
CHARACTERISTICS

L-60 is an extra low hydrogen type electrode with high resistance to moisture absorption. Weldability in all positions, mechanical properties and X-ray quality are excellent. Weld metal shows satisfactory crack resistance due to its extremely low diffusible hydrogen content.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 350~400°C for 60 minutes before use.
2. Preheating in accordance with the type of steel, plate thickness, restraint, etc., i. e. at 50~100°C for a 35mm thick plate, is necessary to prevent cracks.
3. Welding with excessively high heat input, i.e. more than 55 kJ/cm for a 35mm thick plate, should be avoided to assure strength and toughness of weld.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Mo
0.07	0.42	1.12	0.73	0.22

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −20°C, J
540	640	27	170

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0	6.0
Length (mm)		350	400	400	450
Current A	F, H-Fil	70~140	120~190	190~250	250~310
	V-up, OH	60~130	90~170	140~190	—

Approval: NK, ABS, LR, DNV, BV
Identification color: End-orange, secondary-yellow

L-60W

JIS Z 3211 E5916-N1M1
☆A5.5 E8016-G

For uranami welding in all positions of 590MPa High Tensile Strength Steel

APPLICATIONS

Uranami (sound penetration bead) welding of 590MPa high tensile strength steel pipes for ships, pressure vessels and pipelines.

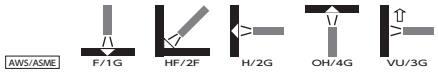
CHARACTERISTICS

L-60W is a low hydrogen type electrode for uranami welding in all positions.
In low current range in root pass welding of pipes, a sound penetration bead without blowholes is obtained due to stable arc, strong arc force. And excellent slag fluidity and coverage.

GUIDELINES FOR USAGE

1. DC(-) should be used for uranami welding. However AC or DC(+) have to be used on AWS.
2. 3.2mm diameter electrode is recommended for all position welding of pipes with 6-15mm wall thickness.
3. Electrodes should be redried at 300-350°C for 60 minutes before use.
4. Arc should be started on a small plate or the side of the groove and cut after moving crater to the side of the groove
5. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Cu	Ni	Mo
0.07	0.60	1.14	0.012	0.004	0.02	0.64	0.12

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −20°C, J
577	657	26	116

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(±)>

Diameter (mm)		2.6	3.2	4.0
Length (mm)		350	400	400
Current A	F	50~100	70~130	100~150
	OH	40~80	60~130	90~150
	VU	40~80	60~130	90~150
	Uranami welding	40~80	60~110	80~140

Approval: —
Indentification color:End-Pink, secondary-Brown

L-62CF

JIS Z 3211 E6216-N1M1
☆AWS A5.5 E9016-G

For 590MPa High Tensile Strength Steel

APPLICATIONS

Welding of SPV490 and 590MPa high tensile strength steel (WEL-TEN 610) for penstocks, storage tanks, pressure vessels, bridges, offshore structures and machinery.

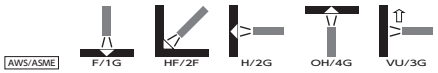
CHARACTERISTICS

L-62CF is an extra low hydrogen type electrode for all position welding of 590MPa high tensile strength steel. It is suitable for site welding of storage tanks since its coating flux is highly resistant to moisture absorption even in an atmosphere of high temperature humidity. Extremely low diffusible hydrogen content in weld metal assures excellent crack resistance.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 350~400°C for 60 minutes before use.
2. Preheating in accordance with the type of steel, plate thickness, restraint, etc., i.e. at 50~100°C for a 35mm thick plate, is necessary to prevent cracks.
3. Welding with excessively high heat input, i.e. more than 55 kJ/cm for a 35mm thick plate, should be avoided to assure strength and toughness of weld.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Mo
0.07	0.45	1.36	0.70	0.35

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −20°C, J
590	660	28	170

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0
Length (mm)		350	400	400
Current A	F, H-Fil	100~140	140~190	190~250
	V-up, OH	90~130	120~170	140~190

Approval: NK

Identification color: End-Golden blown, secondary-Green

L-60LT

JIS Z 3211 E6216-G
☆AWS A5.5 E9016-G

For 590MPa High Tensile Strength Steel

APPLICATIONS

Welding of 590MPa high tensile strength steel (N-TUF490) for low temperature service for structures to be used in frigid area, pressure vessels, storage tanks and offshore structures.

CHARACTERISTICS

L-60LT is an extra low hydrogen type electrode for all positions with high resistance to moisture absorption. Weld metal shows excellent toughness at temperatures around −50°C and CTOD (crack tip opening displacement) value.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 350~400°C for 60 minutes before use,
2. Preheating in accordance with the type of steel, plate thickness, restraint, etc., i.e. at 50~100°C for a 35mm thick plate, is necessary to prevent cracks.
3. Select the optimum heat input in accordance with the required specification of structures and plate thickness to assure desired toughness and CTOD value. Arc length should be kept as short as possible during welding.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Mo	Ti	B
0.07	0.41	1.51	0.67	0.18	0.03	0.002

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −50°C, J
600	680	26	180

■ TYPICAL CTOD VALUES OF WELD JOINT (AS WELDED)

Base Metal (Thickness)	Groove	Welding Conditions	CTOD Value, (mm) −10°C		
A537C1.2 Mod (25mm)	Y	Diameter: 4.0mm Position:V-up Heat Input: 32kJ/cm	1.17	1.11	1.26

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0
Length (mm)		350	400	400
Current A	F, H-Fil	100~140	140~190	190~250
	V-up, OH	90~130	120~170	140~190

Approval: ABS, DNV

Identification color: End-silver, secondary-brown

L-80

JIS Z 3211 E7816-N5CM3U
☆AWS A5.5 E11016-G

For 780MPa High Tensile Strength Steel

APPLICATIONS

Welding of 780MPa high tensile strength steel (WEL-TEN 780, 780C, 780P and 780E) for penstocks, pressure vessels, bridges, machinery and turbine casings.

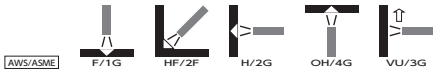
CHARACTERISTICS

L-80 is an extra low hydrogen type electrode with high resistance to moisture absorption. Weldability in all positions, mechanical properties and X-ray quality are excellent. Extremely low diffusible hydrogen content in weld metal assures satisfactory crack resistance.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 350~400°C for 60 minutes before use.
2. Preheating in accordance with the type of steel, plate thickness, restraint, etc., i.e. at 120~180°C for a 35mm thick plate is necessary to prevent cracks.
3. Welding with excessively high heat input, i.e. more than 45 kJ/cm for a 35mm thick plate, should be avoided to assure strength and toughness of weld.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Cr	Mo
0.05	0.44	1.35	2.52	0.18	0.54

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −20°C, J
740	830	22	96

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0	6.0
Length (mm)		350	400	400	400
Current A	F, H-Fil	100~140	140~190	190~250	250~310
	V-up, OH	90~130	120~170	140~190	—

Approval: NK, ABS
Identification color: End-orange, secondary-purple

L-80SN

JIS Z 3211 E7816-N9M3U
☆AWS A5.5 E11016-G

For 780MPa High Tensile Strength Steel

APPLICATIONS

Welding of 780MPa high tensile strength steel (WEL-TEN 780) for offshore structures, pressure vessels, storage tanks and structures to be used in frigid area.

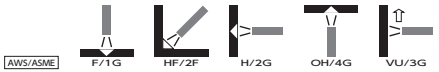
CHARACTERISTICS

L-80SN is a ultra low hydrogen type electrode with high resistance to moisture absorption. Weld metal shows excellent toughness at around −80°C. It can be used with confidence for welding extremely thick plates such as racks of offshore structures since extremely low diffusible hydrogen content in weld metal assures satisfactory crack resistance.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 350~400°C for 60 minutes before use, kept at 100~150°C and taken out only as needed.
2. Preheating in accordance with the type of steel, plate thickness, restraint, etc., i.e. at 100~150°C for a 35mm thick plate, is necessary to prevent cracks.
3. Welding with excessively high heat input, i.e. more than 40 kJ/cm for a 35 mm thick plate, should be avoided to assure strength and toughness of weld.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Mo	Diffusible Hydrogen (Gas Chromatography) mℓ/100g
0.05	0.36	1.39	4.64	0.48	1.6

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −80°C, J
760	860	20	90

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0
Length (mm)		350	400	400
Current A	F, H-Fil	100~140	140~190	190~250
	V-up, OH	90~130	120~170	140~190

Approval: ABS, LR, DNV
Identification color: End-pink, secondary-green

Covered Arc Welding Electrodes for 590~980MPa High Tensile Strength Steel

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics
	End	Secondary	JIS	AWS		
L-60S	Orange	Light blue	Z 3211 E5716-G	☆ A5.5 E8016-G	3.2 4.0 5.0 6.0	Extra low hydrogen type electrode with high resistance to moisture absorption. It assures satisfactory toughness at -45°C, weldability in all positions and X-ray quality. Crack resistance is excellent due to the extremely low diffusible hydrogen content in weld metal.
	Welding Position		AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		
L-62	Pink	White	Z 3211 E6216-G	☆ A5.5 E9016-G	3.2 4.0 5.0 6.0	Extra low hydrogen type electrode with high resistance to moisture absorption. Weldability in all positions, mechanical properties and X-ray quality are excellent. Extremely low diffusible hydrogen content in weld metal assures satisfactory crack resistance.
	Welding Position		AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		
L-74S	Orange	Red	Z 3211 E6916-G	☆ A5.5 E10016-G	3.2 4.0 5.0	Extra low hydrogen type electrode with high resistance to moisture absorption and suitable for all position welding of 685MPa. Weldability and X-ray properties are excellent and extremely low diffusible hydrogen content of weld metal assures excellent crack resistance and mechanical properties.
	Welding Position		AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		
L-80EL	Red	Pink	Z 3211 E7816-N5CM3U	☆ A5.5 E11016-G	4.0 5.0	Ultra low hydrogen type electrode with high resistance to moisture absorption. It is suitable for welding under severe conditions such as site welding of penstocks and tanks since extremely low diffusible hydrogen content in weld metal assures excellent crack resistance.
	Welding Position		AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		
L-100EL	Orange	Orange	—	—	4.0 5.0	Ultra low hydrogen type electrode with high resistance to moisture absorption and suitable for all position welding of 950MPa high tensile strength steel. Weldability and X-ray properties are excellent and extremely low diffusible hydrogen content of weld metal assures excellent crack resistance and mechanical properties.
	Welding Position		AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)						Typical Mechanical Properties of Weld Metal				Diffusible Hydrogen (Gas Chromatography) mℓ/100g
C	Si	Mn	Ni	Cr	Mo	Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J , 0°C	
0.05	0.46	1.12	1.51	—	0.20	580	650	27	−45°C 120	—
0.07	0.48	1.39	0.76	—	0.35	600	670	29	−20°C 170	—
0.05	0.37	1.01	3.28	0.23	0.34	780	840	22	−29°C 100	—
0.06	0.45	1.44	2.44	0.20	0.42	740	820	22	−20°C 120	1.4
0.06	0.25	1.67	2.01	0.89	0.75	910	990	19	−25°C 70	1.7

NF-820 × Y-DM

*JIS Z 3183 S582-H
*AWS A5.23 F8A0-EA3-A3

For 590MPa High Tensile Strength Steel

APPLICATIONS

Fillet welding of 590MPa high tensile strength steel for steel frames, bridges, pressure vessels and storage tanks.

CHARACTERISTICS

Bead appearance and slag removal are excellent in flat and horizontal fillet welding with single or double electrodes. NF-820 is a pumiceous flux and is economical due to its low consumption rate.

GUIDELINES FOR USAGE

Care should be taken to keep the flux from absorbing moisture.

WELDING POSITION

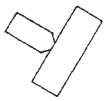
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Mo	Base Metal	Plate Thickness mm	Welding Method
0.05	0.67	1.86	0.014	0.012	0.51	WT590	25	Multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test			Charpy 2 V-notch, J		Base Metal	Plate Thickness mm	Welding Method
Yield strength, MPa	Tensile Strength, MPa	Elonga-tion, %	−20°C	−5°C			
600	670	26	58	65	WT590	25	Multi-layer

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
19	(L)4.8		1st & 2nd	800	27	60	one pass both sides
	(T)4.8			750	28		

Approval:

NB-60L × Y-DM3

*AWS A5.23 F8A8-EG-G
F8P8-EG-G

For 590MPa High Tensile Strength Steel

APPLICATIONS

Multi-layer butt welding of aluminium-killed steel for low temperature service for offshore structures, installations for low temperatures service and structures to be used in frigid areas.

CHARACTERISTICS

NB-60L is a Ti-B type bonded flux and assures excellent low temperature toughness and CTOD both as welded and after stress relief annealing.

GUIDELINES FOR USAGE

1. Satisfactory weldability and weld metal properties are obtained with heat input of less than 50kJ/cm.
2. Flux should be used as fast as possible after taking out of the can. Flux should be redried at 250~350°C for 60 minutes.

WELDING POSITION

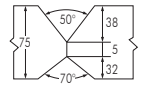
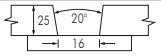
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Mo	Base Metal	Plate Thickness mm	Welding Method
0.08	0.18	1.54	0.010	0.005	0.18	YP420	25	X groove, multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test			Charpy 2 V-notch, J	PWHT	Base Metal	Plate Thick-ness mm	Welding Method
Yield Strength, MPa	Tensile Strength, MPa	Elonga-tion, %	−60°C				
560	640	32	140	As-welded	YP420	25	X groove, multi-layer
500	610	30	180	600°C×1.5hr			

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
75	4.8		1 2~13 14 15~29	600 700 600 700	27 32 28 32	30 30 30 30	Multi-layer, with back gouging
25	4.8		1~11	700	30	30	Multi-layer

Approval: LR, DNV

YF-15B × Y-DM

☆JIS Z 3183 S624-H4
☆AWS A5.23 F9A6-EA3-A3
F8P2-EA3-A3

For 590MPa High Tensile Strength Steel

APPLICATIONS

Single and multi-layer welding of 590MPa high tensile strength steel for ships, steel frames, bridges and pressure vessels.

CHARACTERISTICS

Weld metal shows excellent impact values and sufficient strength and toughness as welded and after stress relieving annealing.

GUIDELINES FOR USAGE

An excessive amount of flux in high current welding may cause uneven bead ripples.

WELDING POSITION

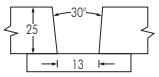
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Mo	Base Metal	Plate Thickness mm	Welding Method
0.09	0.38	1.33	0.014	0.011	0.49	WT590	25	Multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test			Charpy 2 V-notch, J		Base Metal	Plate Thickness mm	Welding Method
Yield strength, MPa	Tensile Strength, MPa	Elongation, %	−40°C	0°C			
540	630	25	41	69	WT590	25	Multi-layer

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
25	4.0		1~14	550	30	41	Multi-layer

Approval: NK, KR

NB-250H × Y-204B

☆AWS A5.23 F9A8-EG-G
F9P8-EG-G

For 590MPa Low Temperature Service

APPLICATIONS

Flat butt welding of 590MPa high tensile strength steel for low temperature service for offshore structures and structures to be used in frigid areas.

CHARACTERISTICS

NB-250H is a high basic type bonded flux and assures excellent low temperature toughness (impact and CTOD properties) both as welded and after stress relieving annealing. Slag is easy to remove even in narrow grooves.

GUIDELINES FOR USAGE

1. Satisfactory weldability and mechanical properties are obtained with heat input of less than 45kJ/cm.
2. Flux should be used as fast as possible after taking out of the can. Damp flux should be redried at 250~350°C for 60 minutes.

WELDING POSITION

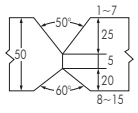
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Mo	Base Metal	Plate Thickness mm	Welding Method
0.10	0.20	1.71	0.011	0.003	0.74	0.29	HT590	50	X groove, multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test			Charpy 2 V-notch, J		CTOD mm	PWHT	Base Metal	Plate Thickness mm	Welding Method
Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	−60°C	−40°C	−10°C				
610	710	29	150	170	2.06	As-welded	HT590	50	X groove, multi-layer
590	680	30	110	140	2.99	605°C ×2.5hr	HT590	50	X groove, multi-layer

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
50	4.8		1	600	28	30	Multi-layer with gouging
			2~7	650	30	28	
			8	600	28	30	
			9~15	650	30	28	

Approval: ABS, DNV, BV

NB-250H × Y-80M

*JIS Z 3183 S804-H4
*AWS A5.23 F11A10-EG-M3

For 780MPa High Tensile Strength Steel

APPLICATIONS

Welding of 780MPa high tensile strength steel for offshore structures, pressure vessels, penstocks and bridges.

CHARACTERISTICS

NB-250H is a bonded flux designed to minimize the diffusible hydrogen content in weld metal and, therefore, crack resistance is extremely high. Impact properties are excellent at low temperature and slag is easy to remove even in narrow grooves.

GUIDELINES FOR USAGE

1. Flux should be redried at 250~350°C for 60~120 minutes before use.
2. When flux is reused, care should be taken that alien things such as rust are not mixed in with the flux.
3. Preheating at 100~150°C is required.

WELDING POSITION

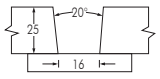
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Cr	Mo	Base Metal	Plate Thickness mm	Welding Method
0.07	0.19	1.41	2.18	0.56	0.52	WT780	25	Multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Joint Tensile Test			Charpy 2 V-notch, J		Base Metal	Plate Thickness mm	Heat Input kJ/cm	Welding Method
Yield strength, MPa	Tensile Strength, MPa	Elong-ation, %	−60°C	−40°C				
730	830	29	86	120	WT780	25	31	Multi-layer

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
25	4.0		1~9	550	31	30	Multi-layer

Approval: NK, ABS, DNV

NB-250J × Y-80J

*JIS Z 3183 S804-H4
*AWS A5.23 F11A10-EG-G

For 780MPa High Tensile Strength Steel

APPLICATIONS

Welding of 780MPa high tensile strength steel for offshore structures, pressure vessels, penstocks and bridges.

CHARACTERISTICS

NB-250J is a bonded flux designed to minimize the diffusible hydrogen content in weld metal and, therefore, crack resistance is extremely high. Impact properties are excellent at low temperature and slag is easy to remove even in narrow grooves.

GUIDELINES FOR USAGE

1. Flux should be redried at 250~350°C for 60~120 minutes before use.
2. When flux is reused, care should be taken that alien things such as rust are not mixed in with the flux.
3. Preheating at 100~150°C is required.

WELDING POSITION

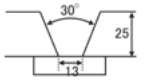
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Cr	Mo	Base Metal	Plate Thickness mm	Welding Method
0.08	0.20	1.43	2.17	0.56	0.52	WT780	25	Multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Joint Tensile Test			Charpy 2 V-notch, J		Base Metal	Plate Thickness mm	Heat Input kJ/cm	Welding Method
Yield strength, MPa	Tensile Strength, MPa	Elong-ation, %	−60°C	−40°C				
759	859	24	64	103	WT780	25	34	Multi-layer

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
25	4.0		1~8	600	28	30	Multi-layer

Approval: ABS, DNV, CCS

NB-80 × Y-80

☆JIS Z 3183 S80J4-H4
☆AWS A5.23 F12A4-EG-G

For 780MPa High Tensile Strength Steel

APPLICATIONS

Welding of 780MPa high tensile strength steel for offshore structures, pressure vessels, penstocks and bridges.
Welding of 3Ni-1.75%Cr-0.5%Mo steel such as ASTM A508 Gr.4N and A543 type B Cl.1 steel.

CHARACTERISTICS

NB-80 is a bonded flux designed to minimize the diffusible hydrogen content in weld metal and, therefore, crack resistance is extremely high. Impact properties are excellent at low temperature and slag is easy to remove even in narrow grooves.

GUIDELINES FOR USAGE

1. Flux should be redried at 300~350°C for 60~120 minutes before use.
2. When flux is reused, care should be taken that alien things such as rust are not mixed in with the flux.
3. Preheating at 100~150°C is required.

WELDING POSITION

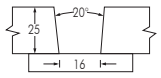
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Cr	Mo	Base Metal	Plate Thickness mm	Welding Method
0.07	0.20	1.62	2.13	0.94	0.45	WT780	25	Multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Joint Tensile Test			Charpy 2 V-notch, J				Base Metal	Plate Thick-ness mm	Heat Input kJ/cm	Welding Method	PWHT
Yield strength, MPa	Tensile Strength, MPa	Elon-gation, %	−40°C	−20°C	−29°C	0°C					
790	890	21	87	110	–	130	HT780	25	31	Multi-layer	As-welded
690	800	24	–	–	103	145	A508Gr.4l1	25	28	Multi-layer	585°C ×20h

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
25	4.0		1~9	550	31	30	Multi-layer

Approval:

Memo

Submerged Arc Welding Materials for 590~780MPa High Tensile Strength Steel

Brand Name	Specification		Application and Characteristics	Typical Chemical of Weld				
	JIS	AWS		C	Si	Mn	P	S
NF-250 × Y-204B	—	☆ A5.23 F9A6-EG-G F8P6-EG-G	Narrow gap welding of 590MPa low temperature service steel for nuclear reactor pressure vessels and structures to be used in frigid areas. Slag is extremely easy to remove and weld metal shows excellent impact value.	0.07	0.14	1.60	0.010	0.004
	Welding Position		AWS/ASME F/1G					

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Composition Metal (%)			Typical Mechanical Properties of Weld Metal					Remarks			
Ni	Cr	Mo	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch, °C	Charpy 2 V-notch, J	PWHT	Base Metal	Plate Thickness mm	Welding Method
0.94	—	0.38	—	660	28	−50	91	As welded	SPV490	40	Single, one pass one layer multi-layer
			—	640	29	−50	64	625°C× 1hr			

YM-60C

JIS Z 3312 G59JA1UC3M1T
☆AWS A5.28 ER80S-G

For 590MPa High Tensile Strength Steel

APPLICATIONS

Welding of 590MPa high tensile strength steel for steel frames, bridges, pressure vessels and penstocks.

CHARACTERISTICS

YM-60C is a gas metal arc welding wire to be used with CO_2 shield gas. Arc is stable, spatters are few and weldability is excellent even in high welding current range. High efficiency is obtained in automatic and semi-automatic welding due to high deposition rate and deep penetration. It is also applicable to OSCON process, our manpower saving automatic welding process.

GUIDELINES FOR USAGE

1. Preheating at 50~150°C is required in accordance with plate thickness, restraint, heat input, etc.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Mo
CO_2	0.07	0.38	1.38	0.011	0.012	0.35

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J	
			−20°C	−5°C
590	660	28	110	120

■ TYPICAL WELD JOINT TEST

Joint Tensile Test		Charpy 2V-notch, J		Base metal	Plate Thickness mm	Welding Method
Tensile Strength, MPa	Location of Fracture	−20°C	−5°C			
640	Base metal	60	80	590MPa high tensile strength steel	25	X groove, 3 passes both sides

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4	1.6
Current (A)	F, H-Fil	80~350	150~450	250~550
	H	100~300	150~350	–

Approval: NK, DNV

YM-60A

JIS Z 3312 G59JA1UM3M1T
☆AWS A5.28 ER80S-G

For 590MPa High Tensile Strength Steel

APPLICATIONS

Welding of 590MPa high tensile strength steel for steel frames, bridges, pressure vessels, storage tanks and penstocks.

CHARACTERISTICS

YM-60A is a gas metal arc welding wire to be used with Ar+5~25%CO_2 or Ar+2~5%O_2 shield gas. It is suitable for spray arc welding with high current and vertical butt welding with low current and high heat input. Weld metal shows excellent mechanical properties and crack resistance. Weldability is satisfactory and bead appearance is beautiful when it is used for OSCON Process, our manpower saving automatic welding process.

GUIDELINES FOR USAGE

1. Preheating at 50~150°C is required in accordance with plate thickness, restraint, heat input, etc.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Mo
Ar+20%CO_2	0.06	0.35	1.45	0.008	0.003	0.38

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J		PWHT
			−30°C	−5°C	
580	650	28	180	200	As welded
560	630	28	−40°C: 100	−0°C: 210	620°C×3hr
530	600	30	−40°C: 190	−0°C: 230	620°C×15hr

■ TYPICAL WELD JOINT TEST

Joint Tensile Test		Charpy 2V-notch, J		welding Position	Base metal	Plate Thickness mm	PWHT
Tensile Strength, MPa	Location of Fracture	−30°C	−10°C				
660	Base Metal	150	190	F	590MPa high tensile strength steel	25	As welded
670	Base Metal	140	180	V			

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4	1.6
Current (A)	F	80~350	150~450	200~550
	H-Fil	80~350	150~400	200~450

Approval: NK, ABS, DNV

YM-80C

JIS Z 3312 G78A2UCN5M3T
☆AWS A5.28 ER110S-G

For 780MPa High Tensile Strength Steel

APPLICATIONS

Welding of 780MPa high tensile strength steel for steel frames, bridges, pressure vessels and penstocks.

CHARACTERISTICS

YM-80C is a gas metal arc welding wire to be used with CO_2 shield gas. Arc is stable, spatters are few and weldability is satisfactory even in high welding current range. Bead appearance is beautiful and weld metal shows excellent toughness.

GUIDELINES FOR USAGE

1. Preheating at 120~180°C is required in accordance with plate thickness, restraint. heat input etc.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ni	Mo
CO_2	0.07	0.60	1.34	0.005	0.009	2.28	0.42

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J	
			−20°C	−0°C
720	850	21	70	80

■ TYPICAL WELD JOINT TEST

Joint Tensile Test		Charpy 2V-notch, J		Base metal	Plate Thick-ness mm	Welding Method	PWHT
Tensile Strength, MPa	Location of Fracture	−15°C	0°C				
830	Base metal	70	80	WT780	48	X groove	As Weldes
840	Base metal	60	60				625°Cx1hr

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		0.9	1.0	1.2	1.4	1.6
Current (A)	F, H-Fil	60~200	70~250	80~350	150~450	250~550

Approval: NK

YM-80A

☆AWS A5.28 ER110S-G

For 780 MPa High Tensile Strength Steel

APPLICATIONS

Welding with Ar+CO_2 mixture gas for 780 MPa high tensile strength for steel frames, bridges, penstoch, offshore

CHARACTERISTICS

YM-80A is a gas metal arc welding wire to be used with Ar+10~25% CO_2 mixtures.
This wire is available to low temperature operation up to −40°C under both as-welded and PWHT conditions.
It can be used with confidence for welding extremely thick plates such as Rack & Chord in offshore structures
since extremely low diffusible hydrogen content in deposited metal assures satisfactory crack resistance.

GUIDELINES FOR USAGE

1. Preheating is necessary according to plate thickness and its chemical composition and so on.
2. All water, rust and oil in groove should be completely removed to prevent cracks and pits.
3. In case PWHT is carried out, recommended holding temperature for PWHT is approximately 580°C.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ni	Cr	Mo
Ar+20%CO_2	0.07	0.28	1.36	0.006	0.003	2.87	0.47	0.29

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Shielding gas	Welding position	Heat input kJ/cm	Yield Strength, MPa	Tensile Strength, MPa	Elon-gation, %	Charpy 2V-notch, J		PWHT
						−40°C	−29°C	
Ar+20%CO_2	F/1G	25	760	870	22	72	—	As welded
	VU/ 3G	40	700	890	22	74	110	
	F/1G	20	760	830	25	67	—	580°C×8hrs.
			740	810	25	100	—	600°C×8hrs.

■ SIZES & RECOMMENDED CURRENT <DC(+)>

Diameter (mm)		1.2	1.4	1.6
Current Range (A)	F/1G, HF/2F	70~250	200~350	300~500
	H/2G, VU/3G	70~150	100~250	–
	OH/4G, VD/3G	70~150	100~200	–

Approval: NK, ABS, DNV

Gas Metal Arc Welding Wires for 590~980MPa High Tensile Strength Steel

Brand Name	Shield Gas	Specification JIS	Specification AWS	Dia. mm	Application and Characteristics
YM-70CS	CO_2	Z 3312 G69A2UCN1M2T	☆ A5.28 ER100S-G	1.2 1.4 1.6	Welding of 690MPa high strength steel for civil construction equipment, steel frames, bridge and pressure vessels.
	Welding Position		AWS/ASME F/1G HF/2F		
YM-70C	CO_2	Z 3312 G69A2UCN4M3T	☆ A5.28 ER100S-G	0.9 1.0 1.2 1.6	Welding of 690MPa high tensile strength steel. Good weldability with stable arc and few spatters and excellent toughness are assured even in high current welding.
	Welding Position		AWS/ASME F/1G HF/2F		
YM-70A*	Ar + 20% CO_2	Z 3312 G69A3UMN4M3T	☆ A5.28 ER100S-G	0.9 1.2 1.6	Welding of 690MPa high tensile strength steel. Arc is stable, spatters are extremely few, and beautiful bead appearance and excellent toughness are obtained in a wide current range with Ar+20%CO_2 or Ar+O_2 mixture gas.
	Welding Position		AWS/ASME F/1G HF/2F		

Note : *Mechanical properties are with Ar+CO_2 mixture gas.
Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)							Typical Mechanical Properties of Weld Metal				PWHT	Type of Current
C	Si	Mn	P	S	Ni	Mo	Yield strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J		
0.08	0.53	1.58	0.010	0.008	0.52	0.34	650	740	22	−5°C 90 −20°C 80	—	DC (+)
0.06	0.49	1.02	0.009	0.006	1.23	0.30	610	720	23	130 −20°C 100	—	DC (+)
0.06	0.47	1.32	0.010	0.005	1.92	0.44	660	740	23	−20°C 130 −40°C 90	—	DC (+)

YT-60

*JIS Z 3316 W59AP2U34M3
*AWS A5.28 ER80S-G

For Mild Steel and 590MPa High Tensile Strength Steel

APPLICATIONS

Gas Tungsten Arc Welding of mild steel, 590MPa high tensile strength steel plates. It is also suitable for uranami (Sound penetration bead) welding with back shielding.

CHARACTERISTICS

YT-60 is filler rods and spool wire for GTAW (TIG welding). to be used with Ar shield gas.
The weld metal shows stable toughness at low temperature range down to −40°C.
The weld bead shape is excellent since high fluidity of molten pool and high affinity between molten pool and base metal. It also suitable for uranami (sound penetration bead) welding.
The operability is good since the surface of the filler rod is smooth.

GUIDELINES FOR USAGE

1. Arc length should be kept as short as possible during welding. However, don't contact electrode and molten pool. If electrode contacts into molten pool, the weld metal that is included tungsten should be grinded.
2. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Mo
0.09	0.70	1.89	—	0.35

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J −40°C	PWHT
655	700	27	120	As weld
580	630	31	300	620°C×1hr

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)	1.2	1.6	2.0	2.4	3.2
Length of Filler Rod (mm)	1000	1000	1000	1000	1000
Weight of spool wire (kg)	12.5, 20	12.5	—	—	—

Identification color: Gold

YT-70

*JIS Z 3316 W69AP2UN4M3T
*AWS A5.28 ER100S-G

For 690MPa High Tensile Strength Steel

APPLICATIONS

Gas Tungsten Arc Welding of 690MPa and 100ksi high tensile strength steel for offshore structures, pressure vessels, tanks, penstocks, turbine casings, crane and construction machineries. It is also suitable for uranami (Sound penetration bead) welding with back shielding.

CHARACTERISTICS

YT-70 is filler rods and spool wire for GTAW (TIG welding) to be used with Ar shield gas.
The weld metal shows stable toughness at low temperature range down to −20°C.
The weld bead shape is excellent since high fluidity of molten pool and high affinity between molten pool and base metal. It also suitable for uranami (sound penetration bead) welding.
The operability is good since the surface of the filler rod is smooth.

GUIDELINES FOR USAGE

1. Arc length should be kept as short as possible during welding. However, don't contact electrode and molten pool. If electrode contacts into molten pool, the weld metal that is included tungsten should be grinded.
2. Preheating at 120~180°C is required in accordance with plate thickness, restraint and heat input etc.
3. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Mo
0.09	0.45	1.43	1.80	0.43

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J −20°C	PWHT
713	792	25	283	As weld
695	755	28	265	610°C×1hr

■ SIZES<AC or DC(−)>

Diameter (mm)	1.2	1.6	2.0	2.4	3.2
Length of Filler Rod (mm)	1000	1000	1000	1000	1000
Weight of spool wire (kg)	12.5, 20	—	—	—	—

Identification color: End-pink

YT-80A

☆JIS Z 3316 W78AP2UN5C1M3T
☆AWS A5.28 ER110S-G

For 780MPa High Tensile Strength Steel

APPLICATIONS

Gas Tungsten Arc Welding of 780MPa and 110ksi high tensile strength steel (WEL-TEN 780, 780C and 780E etc.) of down to -20°C for offshore structures, pressure vessels, tanks, penstocks, turbine casings, crane and construction machineries. It is also suitable for uranami (Sound penetration bead) welding with back shielding.

CHARACTERISTICS

YT-80A is filler rods and spool wire for GTAW (TIG welding) to be used with Ar shield gas.
The weld metal shows stable toughness at low temperature range down to −20°C.
The weld bead shape is excellent since high fluidity of molten pool and high affinity between molten pool and base metal. It also suitable for uranami (sound penetration bead) welding.
The operability is good since the surface of the filler rod is smooth.

GUIDELINES FOR USAGE

1. Arc length should be kept as short as possible during welding. However, don't contact electrode and molten pool. If electrode contacts into molten pool, the weld metal that is included tungsten should be grinded.
2. Preheating at 120~180°C is required in accordance with plate thickness, restraint and heat input etc.
3. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Mo	Cr
0.06	0.43	1.49	2.80	0.59	0.51

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J −20°C	PWHT
760	840	28	98	As weld

■ SIZES<AC or DC(+)>

Diameter (mm)	1.2	1.6	2.0	2.4
Length of Filler Rod (mm)	1000	1000	1000	1000
Weight of spool wire (kg)	12.5, 20	—	—	—

Identification color: End-purple

Low Temperature Service Steel

Flux Cored Arc Welding Wires
Covered Arc Welding Electrodes
Submerged Arc Welding Materials
Gas Metal Arc Welding Wires
Gas Tungsten Arc Welding Rods and Wires

SF-36F

JIS Z 3313 T496T1-0CA-N1-H5
☆AWS A5.36 E70T1-C1A8-K6

For Low Temperature Service Steel

APPLICATIONS

Flat and horizontal fillet welding of low-temperature steels to be used for marine structures, shipbuildings, LPG vessels, and others.

CHARACTERISTICS

SF-36F is a rutile-based seamless flux cored wire dedicated to flat fillet welding and horizontal fillet welding that enables stable toughness to be obtained over a low-temperature range down to around −60°C. It gives excellent porosity resistance in the fillet welding of inorganic zinc primer coated steel plates.

GUIDELINES FOR USAGE

1. It is appropriate to hold the torch for horizontal fillet welding at an angle of 40 - 50° to the lower plate and with an advance angle of about 5 - 20°.
2. Depending on the type or film pressure of the primer, good porosity resistance may not be obtained, and therefore it is required that the type and film pressure of the primer should be managed.
3. For more information, refer to the essential points of welding operations 1 - 3 (page 20) with the SF-1.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL(%)<Shield Gas:CO_2>

C	Si	Mn	P	S	Ni
0.05	0.48	1.33	0.016	0.006	0.52

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, (−60°C) J
550	580	27	68

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4	1.6
Current A	H-Fil	180~320	200~380	220~430
	F-Fil	180~320	200~380	220~430

Approval: NK, ABS, LR, DNV

SF-36E

JIS Z 3313 T496T1-1CA-N3-H5
☆AWS A5.36 E81T1-C1A8-K2-H4

For Low Temperature Service Steel

APPLICATIONS

Welding of aluminium-killed steel for low temperature service for offshore structures, ships and LPG ships.

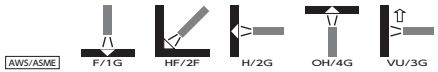
CHARACTERISTICS

SF-36E is a rutile type seamless flux cored arc welding wire to be used with CO_2 shield gas. Weld metal shows stable toughness at low temperature range down to −60°C. Arc is stable and bead appearance and shape are excellent in all positions. Diffusible hydrogen content is as low as solid wires and crack resistance is excellent.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with welding position, plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1~4 of SF-1.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ni
CO_2	0.05	0.43	1.29	0.010	0.003	1.31

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J	
			−60°C	−40°C
570	610	28	76	112

■ TYPICAL WELD JOINT TEST

Base metal	Plate Thickness mm	Shield Gas	Joint Tensile Test		Charpy 2V-notch, J	
			Tensile Strength, MPa	Location of Fracture	−60°C	−40°C
Low temperature service steel, YP410 MPa	50	CO_2	620	Base metal	60	104

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4
Current A	F, H	180~300	200~400
	OH	180~250	200~280
	H-Fil	180~300	200~400
	V-up	180~250	200~280

Approval: NK, ABS, LR, DNV, BV, RS, GL, KR

SF-3AM

☆AWS A5.36 E81T1-M21A8-Ni1-H4

For Low Temperature Service Steel

APPLICATIONS

Seamless flux cored wire for Ar+CO_2 gas shielded arc welding of low temperature service steel for offshore structures, etc.

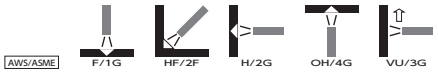
CHARACTERISTICS

SF-3AM is a rutile type seamless flux cored arc welding wire with Ar+20%CO2 shielding gas. It assures excellent impact toughness at low temperatures down to −40°C. It has also good usability in all position welding.
Moreover, due to its seamless surface, it provides various advantages better than conventional open-seam flux cored wires.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with welding position, plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1~4 of SF-1.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ni
Ar+20%CO_2	0.05	0.33	1.28	0.010	0.003	0.89

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J
			−60°C
550	610	27	95

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.4
Current A	F, H	180~300	200~400
	OH	180~250	200~280
	H-Fil	180~300	200~400
	V-up	180~250	200~280

Approval: ABS, LR, DNV, RS

SF-3AMSR

☆AWS A5.36 E71T1-M21A6-K6
E71T1-M21P6-K6

For Low-Alloy Steel, PWHT

APPLICATIONS

All position welding for YS420 down to −40°C, Ar+20%CO_2 shielding gas

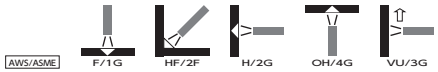
CHARACTERISTICS

SF-3AMSR is new type of seamless flux cored wire for low temperature service steel under SR, in using mixed Ar+CO_2 shielding gas.
Weld metal shows excellent toughness in low temperature range down to−40°C.
Crack resistance and weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with welding position, plate thickness and required toughness. Arc voltage should be 1 or 2 volt lower than that for conventinal flux cored wires and 4 or 5 volt lower than that for solid wires.
2. Enough care should be taken for gas shielding. A suitable shield gas flow rate is 20-25L/min.
3. Distance between base metal and tip should be kept within 20-30mm.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni
0.04	0.28	1.24	0.009	0.004	0.80

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

PWHT	Yield Strength MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −40°C, J
As welded	505	559	27	137
585°C×2.5hr	476	555	28	123

■ TYPICAL WELD JOINT TEST RESULT

Steel	Heat input kJ/cm	PWHT	Yield Strength MPa	Tensile Strength MPa	Charpy 2V-notch at −40°C, J	CTOD mm, at −10°C
EH40 (T=50mm)	505 (Vertical-up)	As welded	515	587	110	0.37, 0.43
		585°C×2.5hr	489	579	84	0.55, 0.54

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2
Current A	F, H	180~300
	H-Fil	180~300
	V-up, OH	180~250

Approval: DNV, LR

SF-47E

☆AWS A5.36 E81T1-C1A8-Ni1-H4

For Low-Alloy Steel

APPLICATIONS

All position welding for YS460 down to −60°C, 100%CO_2 shielding gas

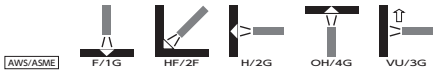
CHARACTERISTICS

SF-47E is a rutile type seamless flux cored arc welding wire to be used with CO_2 shield gas and designed for shipbuilding and offshore structure welding. Weld metal shows excellent toughness in low temperature range down to −60°C. Diffusible hydrogen content is as low as solid wire s and crack resistance is excellent. Weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with welding position, plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1-4 of SF-1

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni
0.05	0.46	1.31	0.012	0.004	0.96

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −60°C, J
545	600	28	70

■ TYPICAL WELD JOINT TEST

Base metal	Plate thickness mm	Welding position	Heat input kJ/cm	Yield Strength MPa	Tensile Strength MPa	Charpy 2V-notch at −60°C, J
YS400	100	Vertical-up	22	575	640	65

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2
Current A	F, H	180~300
	H-Fil	180~300
	V-up, OH	180~260

Approval: NK, ABS, DNV, LR

SF-50E

☆AWS A5.36 E91T9-C1A8-Ni2-H4

For Low-Alloy Steel

APPLICATIONS

All position welding for YS500 down to −60°C, 100%CO_2 shielding gas

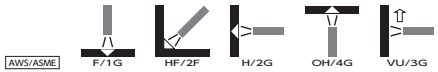
CHARACTERISTICS

SF-50E is a rutile type seamless flux cored arc welding wire to be used with CO_2 shield gas and designed for offshore structure welding. Weld metal shows excellent toughness in low temperature range down to −60°C. Diffusible hydrogen content is as low as solid wire s and crack resistance is excellent. Weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with welding position, plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1-4 of SF-1

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (mass%)

C	Si	Mn	P	S	Ni
0.04	0.25	1.21	0.012	0.003	2.30

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength MPa	Tensile Strength MPa	Elongation, %	Charpy 2V-notch at −60°C, J
563	626	25	85

■ TYPICAL WELD JOINT TEST RESULT

Base metal	Plate thickness mm	Welding position	Heat input kJ/cm	Yield Strength MPa	Tensile Strength MPa	Charpy 2V-notch at −60°C, J
YS420	100	Vertical-up	20	661	702	96

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2
Current A	F, H	180~300
	H-Fil	180~300
	V-up, OH	180~260

Approval: ABS, DNV, BV

SF-50A

☆AWS A5.36 E91T9-M21A4-K2-H4

For Low-Alloy Steel

APPLICATIONS

All position welding for YS500 down to −40°C, Ar+20%CO_2 shielding gas

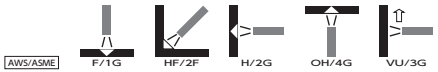
CHARACTERISTICS

SF-50A is a rutile type seamless flux cored arc welding wire to be used with Ar+20%CO_2 shield gas and designed for shipbuilding and offshore structure welding. Weld metal shows excellent toughness in low temperature range down to −40°C. Diffusible hydrogen content is as low as solid wire s and crack resistance is excellent. Weldability in all positions are excellent.

GUIDELINES FOR USAGE

1. Select optimum welding conditions and control heat input in accordance with welding position, plate thickness and required toughness.
2. Enough care should be taken for gas shielding.
3. For others, see GUIDELINES FOR USAGE 1-4 of SF-1

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni
0.06	0.49	1.21	0.015	0.004	1.68

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −40°C, J
630	680	23	100

■ TYPICAL WELD JOINT TEST

Base metal	Plate thickness mm	Welding position	Heat input kJ/cm	Yield Strength MPa	Tensile Strength MPa	Charpy 2V-notch at −40°C, J	CTOD mm,at −10°C
YS500	63.5	Vertical-up	20	595	655	98	0.27

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2
Current A	F, H	180~300
	H-Fil	180~300
	V-up, OH	180~250

Approval: LR, DNV

L-55SN

☆AWS A5.5 E7016-G

For Aluminium-killed Steel and 490MPa High Tensile Strength Steel

APPLICATIONS

Welding of ASTM A516 Gr 55~70, classification Society Standard A32, 36, D32, 36, E32, 36, JIS SLA235A, 235B, 325A (N-TUF295N, 325N, 325, 365) steel for ships, pressure vessels, storage tanks and offshore structures.

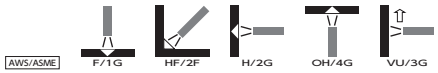
CHARACTERISTICS

L-55SN is an extra low hydrogen type electrode for all positions of aluminium-killed steel for low temperature service and 490MPa high tensile strength steel. It is suitable for welding offshore structures and structures to be used in frigid areas since weld metal shows excellent toughness even at −55 °C and CTOD (crack tip opening displacement) properties.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 350~400°C for 60 minutes before use.
2. Optimum heat input in accordance with service conditions and plate thickness of structure should be applied in order to obtain desired toughness or CTOD value. Arc length should be kept as short as possible.
3. Backstep method should be applied to prevent blowholes and pits at arc starting.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Ti	B
0.07	0.42	1.41	0.012	0.007	0.57	0.02	0.002

■ TYPICAL MECHANICAL PROPERTIES OF WELD JOINT

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J		
			−60°C	−40°C	−30°C
530	580	28	130	140	180

■ TYPICAL CTOD VALUES OF WELD METAL (AS WELDED)

Base Metal (Thickness)	Groove	Welding Conditions	CTOD Value, (mm)	
			−30°C	−10°C
BS4360-50D (25mm)	Y	Diameter: 5.0mm	0.33	1.16
		Position:V-up	1.14	1.11
		Heat Input: 40kJ/cm	0.53	1.25

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0
Length (mm)		350	400	400
Current A	F, H-Fil	100~140	140~190	190~240
	V-up, OH	80~120	110~150	150~190

Approval: NK, ABS, LR, DNV

Identification color: End-yellow, secondary-purple

N-12M

☆AWS A5.5 E8016-C1

For 610MPa High Tensile Strength Steel

DESCRIPTION

Welding of 610MPa high tensile strength steel (N-TUF490) for low temperature service steel.

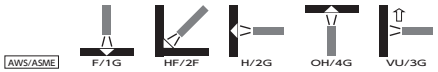
APPLICATION

N-12M is a low hydrogen type electrode for all positions. This electrode is used by direct current (DCEP) polarity. Weld metal shows excellent low temperature toughness under post weld heat treatment (PWHT).

PROCEDURE

1. Welding is operated in DCEP electrode positive polarity.
2. Electrodes should be dried at 350~400°C for 60 minutes before use.
3. Preheating in accordance with the type of steel, plate thickness, restraint, etc., i.e. at 50~100°C for a 35mm thick plate, is necessary to prevent cracks.
4. Select the optimum heat input in accordance with the required specification of structure and plate thickness to assure desired toughness.
5. Arc length should be kept as short as possible during welding.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Mo
0.07	0.36	1.15	0.011	0.002	2.59	0.12

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL (D+)

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −50°C, J	PWHT
579	659	25	161	580°C×4.5h

■ SIZE & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0
Length (mm)		350	400	400
Current A	F / H-fillet	100~140	140~190	190~250
	V-up, OH	90~130	120~170	140~190

Identification color:

N-13NM

JIS Z 3211 E4916-N7PUL

☆AWS A5.5 E7016-C2L

For 3.5%Ni Low Temperature Service Steel

DESCRIPTION

Welding of 3.5%Ni steel such as ASTM A203 Gr. D, E and JIS SL3N for pressure vessels and storage tanks.

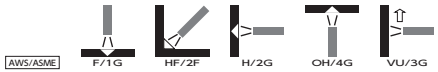
APPLICATION

N-13NM is a low hydrogen type electrode for all positions. Weld metal shows excellent low temperature toughness under postweld heat treatment (PWHT)

PROCEDURE

1. Electrodes should be redried at 350~400°C for 60 minutes before use.
2. Preheating at 60~100°C is necessary depending on plate thickness. When stress-relief annealing is required, keep temperature below 610°C and increase cooling speed as much as possible.
3. Backstep method should be applied to prevent blowholes and pits at arc starting and arc length should be kept as short as possible during welding.
4. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.
5. Keep the proper heat in put to present from the deterioration of mechanical properties.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Mo
0.03	0.24	0.82	0.010	0.008	3.44	0.10

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J		PWHT
			−105°C	−80°C	
430	530	30	98	130	610°C×2h

■ SIZE & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0
Length (mm)		350	400	400
Amp.	F, H-Fil	90−130	130−180	180−240
	V-up,OH	80−120	110−170	—

Approval:

Identification color: End-Light green, secondary-Red

Covered Arc Welding Electrodes for Low Temperature Service Steel

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics
	End	Secondary	JIS	AWS		
N-5F	Yellow	Pink	Z 3211 E4928-GAP	—	5.0 5.5 6.0 7.0 8.0	Iron powder low hydrogen type electrode for horizontal and flat fillet welding of aluminium-killed steel for low temperature service. Weld metal shows excellent toughness at −45~−60°C. Weldability is good and bead is beautiful with equal leg length and without undercuts. It also is suitable for gravity welding.
	Welding Position		AWS/ASME F/1G HF/2F			
N-11	Green	Dark brown	Z 3211 E5516-3N3APL	☆ A5.5 E8016-G	3.2 4.0 5.0 6.0	Low hydrogen type electrodes assuring excellent toughness at −45 ~ −60°C. N-11 is suitable for all position welding.
	Welding Position		AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G			
N-12	Green	Green	Z 3211 E5516-N5APL	☆ A5.5 E8016-C1	3.2 4.0 5.0 6.0	Low hydrogen type electrode for all positions. It is suitable for welding cryogenic LPG tanks since weld metal shows excellent toughness at −50~−60°C.
	Welding Position		AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G			
N-13	Green	Orange	Z 3211 E5516-N7L	☆ A5.5 E8016-C2	2.6 3.2 4.0 5.0 6.0	Low hydrogen type electrode for all positions. Weld metal shows excellent toughness even at −60~−75°C.
	Welding Position		AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G			
N-16	Blue	White	Z 3211 E5516-N13APL	☆ A5.5 E8016-G	2.6 3.2 4.0 5.0	Low hydrogen type electrode for welding 3.5% Ni steel for low temperature service in all positions. Weld metal contains 6.5%Ni and shows excellent toughness at −75~ −105°C.
	Welding Position		AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G			

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)						Typical Mechanical Properties of Weld Metal				
C	Si	Mn	P	S	Ni	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J, 0°C	PWHT
0.07	0.19	1.12	0.012	0.007	0.73	480	550	29	−60°C 68	—
0.07	0.49	1.15	0.012	0.005	1.62	540	610	29	−60°C 94 / −45°C 130	—
0.06	0.44	1.02	0.015	0.005	2.38	520	600	28	−60°C 110 / −50°C 120	—
0.05	0.42	0.46	0.010	0.008	3.35	500	580	29	−75°C 120 / −60°C 140	—
0.04	0.17	0.28	0.010	0.005	6.65	600	680	21	−105°C 110	As-welded
						580	640	26	−105°C 95	600°C ×1hr

NB-55 × Y-DS

*AWS A5.17 F7A8-EH14
F7P8-EH14

For Low Temperature Service Steel

APPLICATIONS

Multi-layer butt welding of aluminium-killed steel for low temperature service for offshore structures, installations for low temperatures service and structures to be used in frigid areas.

CHARACTERISTICS

NB-55 is a Ti-B type bonded flux and assures excellent low temperature toughness and CTOD both as welded and after stress relief annealing.

GUIDELINES FOR USAGE

1. Satisfactory weldability and weld metal properties are obtained with heat input of less than 50kJ/cm.
2. Flux should be used as fast as possible after taking out of the can. Flux should be redried at 250~350°C for 60 minutes.

WELDING POSITION

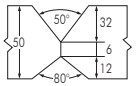
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Base Metal	Plate Thickness mm	Welding Method
0.08	0.20	1.74	0.016	0.001	KE36	50	X groove, multi-layer (POLARITY; ACEP)

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test			Charpy 2 V-notch, J			PWHT
Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	−60°C	−40°C	−29°C	
450	560	31	180	210	220	As-welded
430	520	34	120	147	190	620°C×2hr

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
100	4.0		1~4 5~16	600 600	30/33 30/33	30 30	Multi-layer, with back gouging

Approval: NK, ABS, LR, DNV, BV

NB-55E × Y-D

*AWS A5.17 F7A8-EH14

for Low Temperature Service Steel

APPLICATIONS

Single-layer welding of aluminium-killed steel for low temperature service for offshore structures, ships and LPG storage tanks.

CHARACTERISTICS

Excellent toughness is obtained in multi-layer welding with 30~100kJ/cm heat input.

GUIDELINES FOR USAGE

Flux should be used as fast as possible after taking out of the can. Flux should be redried at 250~350°C for 60 minutes.

WELDING POSITION

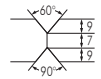
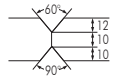
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.09	0.18	1.65	0.018	0.007

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test			Charpy 2 V-notch, J		Base Metal	Plate Thickness mm	Welding Method
Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	−60°C	−40°C			
460	560	33	170	200	EH36	32	X groove

■ TYPICAL GROOVE GEOMETRY AND WELLDING CONDITIONS

Plate Thickness mm	Wire Dia mm	Groove Geometry	Pass	Current A	Voltage V	Speed cm/min	Note
25	(L) 4.8 (T) 6.4		1	(L) 1000 (T) 900	36 40	60	One pass both sides
			2	(L) 1100 (T) 850	36 40	55	
32	(L) 4.8 (T) 6.4		1	(L) 1080 (T) 1000	36 40	45	One pass both sides
			2	(L) 1250 (T) 1100	36 40	45	

Approval: NK, ABS, LR, DNV

NB-55LS × Y-3NI

*AWS A5.23 F7A10-EG-Ni3

for Low Temperature Service Steel

APPLICATIONS

Multi-layer welding of high-toughness YP360 and YP420 class steel for offshore structures in frigid sea area.

CHARACTERISTICS

It produces Ti-B bearing weld metal having excellent low temperature toughness as impact value at −70°C and CTOD value at −50°C in as welded condition. It provides sufficient resistance for sea water corrosion.

GUIDELINES FOR USAGE

Flux should be used as fast as possible after taking out of the can. Flux should be redried at 250~350°C for 60 minutes.

WELDING POSITION

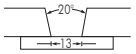
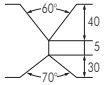
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Ti	B	Plate Thickness mm	Welding Method
0.04	0.10	1.22	2.92	0.03	0.003	25	Multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test			Charpy 2 V-notch, J			Plate Thick-ness mm	Welding Method
Yield Strength, MPa	Tensile Strength, MPa	Elonga-tion, %	−90°C	−70°C	−50°C		
520	590	29	70	130	160	25	Multi-layer

■ TYPICAL GROOVE GEOMETRY AND WELLDING CONDITIONS

Plate Thickness mm	Wire Dia mm	Groove Geometry	Pass	Current A	Volt-age V	Speed cm/min	note
25	4.8		1~8	750	33	30	Multi-layer
75	4.8		2~Final	650 (L) 1000 (T) 800	28 34 40	30 40	Multi-layer

Approval: DNV, BV

NB-55L × Y-D

*AWS A5.23 F7A8-EG-G
F7P8-EG-G

For Low Temperature Service Steel

APPLICATIONS

Multi-layer butt welding of aluminium-killed steel for low temperature service for offshore structures, installations for low temperatures service and structures to be used in frigid areas.

CHARACTERISTICS

NB-55L is a Ti-B type bonded flux and assures excellent low temperature toughness and CTOD both as welded and after stress relief annealing.

GUIDELINES FOR USAGE

1. Satisfactory weldability and weld metal properties are obtained with heat input of less than 50kJ/cm.
2. Flux should be used as fast as possible after taking out of the can. Flux should be redried at 250~350°C for 60 minutes.

WELDING POSITION

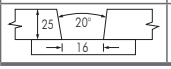
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Base Metal	Plate Thickness mm	Welding Method
0.09	0.20	1.51	0.015	0.007	SM490B	25	Multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test			Charpy 2 V-notch, J		PWHT	Base Metal	Plate Thickness mm	Welding Method
Yield Strength, MPa	Tensile Strength, MPa	Elonga-tion, %	−60°C	−40°C				
520	580	34	130	170	As-welded	SM490B	25	Multi-layer
490	570	33	100	150	600°C×1hr			

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
25	4.8		1~11	700	30	30	Multi-layer

Approval: NK, ABS, LR, DNV, GL

NB-55E × Y-DM3

☆AWS A5.23 F8A4-EG-G

for Low Temperature Service Steel

APPLICATIONS

Single-layer welding of aluminium-killed steel for low temperature service for offshore structures, ships and LPG storage tanks.

CHARACTERISTICS

Single or multi-layer welding of aluminium-killed steel for low temperature service for installations for low temperature service and structures to be used in frigid areas. Excellent toughness of −40°C is obtained in high heat input welding.

GUIDELINES FOR USAGE

Flux should be used as fast as possible after taking out of the can. Flux should be redried at 250~350°C for 60 minutes.

WELDING POSITION

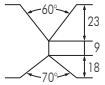
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Mo
0.10	0.24	1.63	0.010	0.003	0.09

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test			Charpy 2 V-notch, J	Base Metal	Plate Thickness mm	Welding Method
Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	−40°C			
530	650	26	140	EH36	32	One pass both sides

■ TYPICAL GROOVE GEOMETRY AND WELLDING CONDITIONS

Plate Thickness mm	Wire Dia mm	Groove Geometry	Pass		Current A	Voltage V	Speed cm/min
50	(L) 4.8 (T) 4.0		1st	1	(L) 1000 (T) 950	34 38	47
				2	(L) 1000 (T) 950	36 33	44
				3	(L) 1000 (T) 950	36 40	44
			2nd	1	(L) 1250 (T) 1000	34 33	50
				2	(L) 1000 (T) 950	38 40	46

Approval: 2 electrodes; NK, DNV

NB-60L × Y-DM3

☆AWS A5.23 F8A8-EG-G
F8P8-EG-G

For Low Temperature Service Steel

APPLICATIONS

Multi-layer butt welding of aluminium-killed steel for low temperature service for offshore structures, installations for low temperatures service and structures to be used in frigid areas.

CHARACTERISTICS

NB-60L is a Ti-B type bonded flux and assures excellent low temperature toughness and CTOD both as welded and after stress relief annealing.

GUIDELINES FOR USAGE

1. Satisfactory weldability and weld metal properties are obtained with heat input of less than 50kJ/cm.
2. Flux should be used as fast as possible after taking out of the can. Flux should be redried at 250~350°C for 60 minutes.

WELDING POSITION

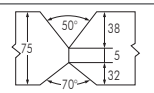
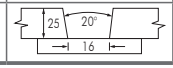
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Mo	Base Metal	Plate Thickness mm	Welding Method
0.08	0.18	1.54	0.010	0.005	0.18	YP420	25	X groove, multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Test			Charpy 2 V-notch, J −60°C	CTOD Value mm −10°C	PWHT	Base Metal	Plate Thick-ness mm	Welding Method
Yield Strength, MPa	Tensile Strength, MPa	Elonga-tion, %						
560	640	32	140	2.36	As-welded	YP420	25	X groove, multi-layer
500	610	30	180	2.80	600°C×1.5hr			

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
75	4.8		1 2~13 14 15~29	600 700 600 700	27 32 28 32	30 30 30 30	Multi-layer, with back gouging
25	4.8		1~11	700	30	30	Multi-layer

Approval: LR, DNV

Submerged Arc Welding Materials for Low Temperature Service Steel

Brand Name	Specification JIS	Specification AWS	Application and Characteristics	Typical Chemical of Weld C	Si	Mn	Composition Metal (%) P	S	Mo	Ni	Typical Mechanical Properties of Weld Metal Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, °C	J	Remarks PWHT	Base Metal	Plate Thickness mm	Welding Method
NSH-60 × Y-D	☆Z3183 S582-H	☆A5.23 F8A4-EH14-G	Multi-layer butt welding and fillet welding of up to 570 MPa tensile strength grade such as ASTM A537 Cl.2 plate or APIX65 pipe. NSH-60 is an agglomerated flux containing iron powder, and is able to make high deposition rate and deep penetration welding. Combined with a wire of Y-D, It is able to high heat input welding up to approx. 150kJ/cm.	0.08	0.41	1.84	0.016	0.008	—	—	620	650	28	−40	65	As-welded	YP420	25	Multi-layer
	Welding Position		AWS/ASME F/1G											−29	76				
														−18	88				
NF-310 × Y-E	—	☆A5.23 F8A8-EG-G F8P4-EG-G	Single and multi-layer flat butt welding of aluminium-killed steel for low temperature service for LPG storage tanks, installations for low temperature service and structures to be used in frigid areas. Weld metal shows extremely high toughness and excellent ductility. Weldability is satisfactory and slag is easy to remove.	0.09	0.27	1.36	0.016	0.009	—	—	520	590	31	−75	120	As-welded	N-TUF 325N	20	
	Welding Position		AWS/ASME F/1G											−60	140				
														−45	160				
														−30	—				
											500	570	33	−75	—	630°C× 1hr			
														−60	86				
														−45	130				
														−30	150				
NF-310 × Y-DM3	—	☆A5.23 F8A8-EG-G F8P4-EG-G	Single and multi-layer flat butt welding of aluminium-killed steel for low temperature service for LPG storage tanks, installations for low temperature service and structures to be used in frigid areas. Weld metal shows extremely high toughness and excellent ductility. Weldability is satisfactory and slag is easy to remove.	0.08	0.20	1.00	0.013	0.011	0.19	—	530	600	27	−60	100	As-welded			
	Welding Position		AWS/ASME F/1G											−45	160				
														−30	170				
											520	600	30	−60	72	630°C× 1hr			
														−45	140				
														−30	170				
NB-55E × Y-CM	—	—	Single-layer welding of aluminium-killed steel for low temperature service for offshore structures, ships and LPG storage tanks.	0.08	0.24	1.48	0.010	0.003	0.18	—	490	650	27	−60	63	—	EH36	27	One pass both sides
	Welding Position		AWS/ASME F/1G											−40	120				
NB-55 × Y-CMS	—	☆A5.23 F8A8-EA4-A4 F8P8-EA4-A4	Multi-layer welding of aluminium-killed steel for low temperature service for offshore structures, ships and LPG storage tanks.	0.08	0.13	1.36	0.010	0.004	0.40	—	560	620	23	−60	87	As-welded	EH36	24	Multi-layer
	Welding Position		AWS/ASME F/1G											−40	120				
											530	590	25	−60	160	620°C× 2hr			
														−40	200				
NB-55 × Y-DM	—	☆A5.23 F9A8-EA3-G F9P8-EA3-G	Single-layer welding of aluminium-killed steel for low temperature service for offshore structures, ships and LPG storage tanks.	0.09	0.12	1.62	0.009	0.002	0.35	—	570	660	26	−60	62	As-welded	SPV490Q	24	Multi-layer (DC+)
	Welding Position		AWS/ASME F/1G																
											550	630	28	−60	48	620°C× 2hr			

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

YM-55H

JIS Z 3312 G55AP4C0
☆AWS A5.28 ER80S-G

For Low Temperature Service Steel

APPLICATIONS

Welding of 490MPa high tensile strength steel for alminium-killed steel of low temperature.

CHARACTERISTICS

This is a gas metal arc welding wire to be used with CO_2 Shield gas. Arc is stable.spatters are few and weldability is good even in high welding current range. It assures excellent toughness at low temperatures down to −45°C.

GUIDELINES FOR USAGE

1. Automatic welding is possibly VEGA-A process, our manpower saving automatic welding system

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Mo
0.08	0.44	1.36	0.006	0.002	–	0.18

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J	
			−40°C	−20°C
560	630	29	70	145

■ TYPICAL WELDING JOINT TEST RESULT

Joint Tensile Test		Charpy 2V-notch, J				Base metal	Plate thickness mm	Welding Method
	Location of Fracture	−60°C	−40°C	−20°C	0°C			
570	Base metal	50	90	–	–	A516Gr70	20	Two pass V-up of one side
590	Base metal	–	–	90	110	SM490B	20	One pass V-up of one side

■ SIZES<DC(+)>

Diameter (mm)		1.2	1.6
Current A	F	80~350	250~550
	H-Fill	80~350	250~550
	H	80~300	250~450

Approval: NK, LR, DNV

YM-69F

☆JIS Z 3312 G78A6UG0
☆AWS A5.28ER110S-G

For 780MPa High Tensile Strength Steel

APPLICATIONS

Welding of YP690 steel and TS780MPa high tensile strength steel (WEL-TEN 780, 780C and 780E etc.) of down to -60°C for offshore structures, pressure vessels, tanks, penstocks, turbine casings, crane and construction machineries.

CHARACTERISTICS

YM-69F that is used with Ar+CO_2 and Ar+O_2 shielding gas is a solid wire for gas metal arc welding. Weld metal of YM-69F that is used with Ar+10%CO_2 shielding gas shows excellent toughness over 69J in low temperature range down to −60°C.

GUIDELINES FOR USAGE

1. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.
2. Preheating at 100~180°C is necessary depending on plate thickness and welding conditions.
3. It should be used Ar+10%CO_2 shielding gas, if the absorbed energy is required over 69J at −60°C.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL with Ar+10%CO_2 (%)

C	Si	Mn	Ni	Cr	Mo
0.06	0.27	1.36	2.88	0.51	0.29

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL with Ar+10%CO_2

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −60°C, J
750	830	20	100

■ TYPICAL WELD JOINT TEST

Base metal		Welding conditions			Joint tensile test			Charpy 2V-notch at −60°C, J
Type of Steel	Plate Thickness	Welding position	Heat input kJ/cm	Groove geometry	Yield Strength, MPa	Tensile Strength, MPa	Location of Fracture	
WT780	20	Flat	18	V groove, Multi-layer and back gouging	–	810	Base Metal	91
		Vertical-up	17		815	910	–	100

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)> (Shielding gas: Ar+10%CO_2)

Diameter (mm)		1.2
Current A	F, H	180~320
	VU, OH	100~200
	H	100~250
	VD	100~250

Approval: ABS, DNV

Gas Metal Arc Welding Wires for Low Temperture Service Steel

Brand Name	Shield Gas	Specification JIS	Specification AWS	Dia. mm	Application and Characteristics
YM-28E	Ar + 10% CO_2	Z 3312 G49AP3UM12	☆A5.18 ER70S-G	0.9 1.0 1.2 1.6	YM-28E is a gas metal arc welding wire to be used with Ar+5~25%CO_2 shield gas. Weldability is satisfactory and bead appearance is beautiful in both dip transfer and spray arc welding. Weld metal shows excellent mechanical properties and toughness. Ar+10%CO_2 is used for welding aluminium-killed steel for low temperature service.
	Welding Position		AWS/ASME	F/1G	HF/2F
YM-36E	Ar + 20% CO_2	Z 3312 G49AP6M17	☆A5.18 ER70S-G	1.2 1.6	YM-36E is a Ti-B type gas metal arc welding wire to be used with Ar+5~25%CO_2 shield gas. Weldability is satisfactory and bead appearance is beautiful in both dip transfer and spray arc welding. It assures excellent toughness and CTOD values at low temperatures down to −60°C in a wide heat input range.
	Welding Position		AWS/ASME	F/1G	HF/2F
YM-1N	Ar + 10% CO_2	Z 3312 G57AP6MN2M1T	☆A5.28 ER80S-G	1.2 1.6	YM-1N is a gas metal arc welding wire to be used with Ar+5~20%CO_2 shield gas. Weldability is satisfactory in spray arc and pulsed arc welding. Weld metal shows excellent toughness in a wide heat input range from low to comparatively high. High efficiency and quality are obtained in the welding of aluminium steel to be used around −45°C when it is used for OSCON process, our manpower saving automatic welding process.
	Welding Position		AWS/ASME	F/1G	HF/2F
YM-3N	Ar + 10% CO_2	Z 3312 G49AP6UMN7	☆A5.28 ER80S-G	1.2 1.6	YM-3N is a gas metal arc welding wire to be used with Ar+5~20%CO_2 shield gas. Weldability is satisfactory and bead appearance is beautiful in both dip transfer and spray arc welding. Weld metal shows excellent toughness at low temperatures like −60°C ~ −75°C.
	Welding Position		AWS/ASME	F/1G	HF/2F

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%) C	Si	Mn	P	S	Ni	Mo	Typical Mechanical Properties of Weld Mrtal Yield Strength, MPa	Tensile Strength, MPa	Elon-gation, %	Charpy 2V-notch J		Type of Current
0.07	0.61	1.21	0.008	0.005	—	—	460	570	30	−30°C 140		DC(+)
0.05	0.33	1.20	0.004	0.002	—	—	500	540	30	−60°C 70	−40°C 220	DC(+)
0.05	0.39	1.10	0.007	0.005	0.98	0.22	530	590	28	−60°C 100	−30°C 130	DC(+)
0.04	0.30	0.70	0.006	0.004	3.56	—	540	610	27	−75°C 150	−40°C 200	DC(+)

YT-28E

☆JIS Z 3316 W49AP4U12
☆AWS A5.18 ER70S-G

For Low Temperature Service Steels

APPLICATIONS

Gas Tungsten Arc Welding of mild steel, 490MPa high tensile strength steel and aluminium-killed steel for low temperature service.

CHARACTERISTICS

YT-28E is filler rods for GTAW (TIG welding) to be used with Ar shielding gas.
The weld metal shows stable toughness at low temperature range down to −40°C.
The weld bead shape is excellent since high fluidity of molten pool and high affinity between molten pool and base metal. It also suitable for uranami (sound penetration bead) welding.
The operability is good since the surface of the filler rod is smooth.

GUIDELINES FOR USAGE

1. Arc length should be kept as short as possible during welding. However, don't contact electrode and molten pool. If electrode contacts into molten pool, the weld metal that is included tungsten should be grinded.
2. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S
0.07	0.60	1.45	0.010	0.005

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −40°C, J	PWHT
440	550	34	170	As weld

■ SIZES<DC(−)>

Diameter (mm)	1.2	1.6	2.0	2.4	3.2
Length of Filler Rod (mm)	1000	1000	1000	1000	1000

Identification color: End-yellow

Heat Resisting Steel

Covered Arc Welding Electrodes
Submerged Arc Welding Materials
Gas Metal Arc Welding Wires
Gas Tungsten Arc Welding Rods and Wires

N-0S

☆AWS A5.5 E7016-A1

For 0.5%Mo Heat Resisting Steel

APPLICATIONS

Welding of piping steel (STPA12, A335-P1), boiler and heat exchanger tubes (STBA12, A209-T1), rolled steel ,(A204-A, B, C), cast steel (A217-WC1) and forged steel (A182-F1, A336-F1) .

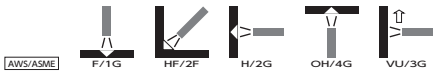
CHARACTERISTICS

N-0S is a extra low hydrogen type electrode with a 0.5% Mo steel core wire and is suitable for welding C-Mo steel to be used at high temperatures up to 500°C.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 350~400°C for 60 minutes before use.
2. Preheating at 100~200°C and postheating at 600~650°C are required.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Mo
0.06	0.51	0.60	0.012	0.006	0.52

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	PWHT
480	560	32	620°C×1h

■ TYPICAL CREEP-RUPTURE STRENGTH OF WELD METAL

1,000h Creep-rupture Strength MPa		PWHT
500°C	550°C	
265	165	720°C×1h

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.6	3.2	4.0	5.0	6.0
Length (mm)		300	350	400	400	400
Current A	F	60~90	90~140	140~190	190~240	240~300
	V-up, OH	50~80	80~120	110~150	140~180	—

Approval:

Identification color: End-green, secondary-light yellow

N-1S/CM-1A

☆AWS A5.5 E8016-B2

For 1.25%Cr-0.5%Mo Heat Resisting Steel

APPLICATIONS

Welding of piping steel (STPA22, 23, A335-P11, P12), boiler and heat exchanger, tubes (STBA22, 23, A199-T11, A213-T11, T12), rolled steel (SCMV2, 3, A387Gr11, 12), cast steel (A217-WC6) and forged steel (A 182-F11, F12, A336-F12).

CHARACTERISTICS

N-1S and CM-1A are low hydrogen type electrodes for 1~1.50%Cr-0.5%Mo steel in all posirions. The welding metals require postheating at 620~720°C and are able to used at high temperatures up to 550°C.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 350~400°C for 60 minutes before use.
2. Preheating at 150~300°C and postheating at 620~720°C are required.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Brand name	C	Si	Mn	P	S	Cr	Mo
N-1S	0.06	0.45	0.60	0.013	0.006	1.26	0.51
CM-1A	0.08	0.31	0.72	0.007	0.006	1.30	0.46

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Brand name	Test Temperature °C	Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −18°C, J	PWHT
N-1S	R.T.	570	660	27	—	690°C×1hr
CM-1A	R.T.	440	565	29	240	690°C×6hr
	485	335	430	23	—	

■ TYPICAL CREEP-RUPTURE STRENGTH OF WELD METAL

Brand name	1,000h Creep-rupture Strength, MPa		PWHT
	550°C	600°C	
N-1S	170	92	720°C×1hr

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)	N-1S	2.6	3.2	4.0	5.0	6.0
	CM-1A	—	—			
Length (mm)		300	350	400	400	450
Current A	F	60~90	90~140	140~190	190~240	240~300
	VU, OH	50~80	80~120	110~150	140~180	—

Identification color of N-1S: End-white, secondary-light yellow

Identification color of CM-1A: End-white

N-2S/CM-2A

☆AWS A5.5 E9016-B3

For 2.25%Cr-0.5%Mo Heat Resisting Steel

APPLICATIONS

Welding of piping steel (STPA24, A335-P22), boiler and heat exchanger tubes (STBA24, A199-T22, A213-T22), rolled steel (SCMV4, A387Gr22, 22L), cast steel (A217-WC9) and forged steel (A182-F22, A336-F22).

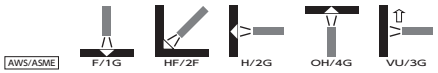
CHARACTERISTICS

N-2S and CM-2A are low hydrogen type electrodes for 2.25%Cr-1%Mo steel in all posirions. The welding metals require postheating at 680~730°C and show extremely high creep-rupture strength at 550~600°C. In addition CM-2A is designed for the excellent notch toughness and low temper embrittlement.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 350~400°C for 60 minutes before use.
2. Preheating at 200~300°C and postheating at 680~730°C are required.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Brand name	C	Si	Mn	P	S	Cr	Mo
N-2S	0.06	0.57	0.58	0.010	0.006	2.29	1.00
CM-2A	0.09	0.23	0.65	0.007	0.005	2.32	1.06

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Brand name	Test Temperature °C	Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −40°C, J	PWHT
N-2S	R.T.	590	690	24	—	690°C×1hr
CM-2A	R.T.	485	630	30	SR: 120, SR+SC: 91	690°C×8hr
	454	375	490	17	—	

■ TYPICAL CREEP-RUPTURE STRENGTH OF WELD METAL

Brand name	1,000h Creep-rupture Strength, MPa	PWHT
	468°C	
N-2S	290	690°C×12hr

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)	N-2S	2.6	3.2	4.0	5.0	6.0
	CM-2A	—				
Length (mm)		300	350	400	400	450
Current A	F	60~90	90~140	140~190	190~240	240~300
	VU, OH	50~80	80~120	110~150	140~180	—

Identification color of N-1S: End-red, secondary-light yellow
Identification color of CM-2A: End-yellow

Memo

Covered Arc Welding Electrodes for Heat Resisting Steel

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics
	End	Secondary	JIS	AWS		
N-2SM	Yellow	Blue	—	☆A5.5 E9016-B3	3.2 4.0 5.0	Extra low hydrogen type electrode with a 2.25%Cr-1%Mo core wire. Weld metal rarely embrittles during service.
	Welding Position		AWS/ASME F/1G	HF/2F	H/2G	OH/4G VU/3G
N-3	Green	Black	—	☆A5.5 E9016-G	2.6 3.2 4.0 5.0 6.0	Extra low hydrogen type 1.7%Mn-0.7%Ni-0.4%Mo low alloy steel electrode. It is suitable for welding ASTM A533-B steel which is used for pressure vessels for nuclear reactor container.
	Welding Position		AWS/ASME F/1G	HF/2F	H/2G	OH/4G VU/3G
N-P31	Light green	—	—	☆A5.5 E9016-G	3.2 4.0 5.0 6.0	Low hydrogen type electrode suitable for ASTM A533 Type B, C class 1 steel.
	Welding Position		AWS/ASME F/1G	HF/2F	H/2G	OH/4G VU/3G
N-P32	Light blue	—	—	☆A5.5 E9016-G	3.2 4.0 5.0 6.0	Low hydrogen type electrode suitable for ASTM A533 Type B, C class 2 steel.
	Welding Position		AWS/ASME F/1G	HF/2F	H/2G	OH/4G VU/3G

Note : SC means Socal step cooling.

Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)									Test temperature °C	Typical Mechanical Properties of Weld Metal				
C	Si	Mn	P	S	Ni	Cr	Mo	V		Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J	PWHT
0.11	0.33	0.66	0.007	0.004	—	2.24	1.00	—	RT	590	680	26	−29°C 160	690°C×6hr
									454	460	530	21	−29°C 70	690°C×6hr +SC
									RT	550	650	27	−29°C 160	690°C×19.8hr
									454	420	500	20	−29°C 80	690°C×19.8hr +SC
0.05	0.24	1.72	0.005	0.004	0.82	—	0.35	—	R.T.	590	680	30	−12°C 170	625°C×1hr
										520	600	30	−12°C 180	625°C× 45hr
0.08	0.35	1.29	0.012	0.006	0.40	—	0.46	—	R.T.	580	640	24	0°C 140	620°C×2hr
									R.T.	540	610	27	0°C 150	620°C× 40hr
0.08	0.29	1.45	0.011	0.006	0.74	—	0.46	—	R.T.	620	690	23	0°C 130	610°C×2hr
									R.T.	600	660	26	0°C 140	610°C× 40hr

Note : SC means Socal step cooling.

NF-250 × Y-511

☆JIS Z 3183 S642-1CM
☆AWS A5.23 F8P2-EG-B2

For 1.25%Cr-0.5%Mo Heat Resisting Steel

APPLICATIONS

Narrow gap welding of 1~1.25%Cr-0.5%Mo heat resisting steel for boiler drums, main steam tubes, superheated steam tubes and chemical engineering apparatus.

CHARACTERISTICS

Slag is extremely easy to remove in one-layer one-pass or one-layer two-pass multi-layer narrow gap welding. NF-250 is a high basic type flux and chemical composition rarely changes even in multi-layer welding. Weld metal shows excellent toughness.

GUIDELINES FOR USAGE

1. Flux should be redried at 350~400°C for 60 minutes before use.
2. Preheating of 150~250°C and postheating of 600~720°C are required.
3. Welding conditions should be carefully set up since excessive heat input and arc voltage against a given groove width may cause undercuts.

WELDING POSITION

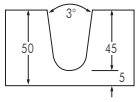
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Cr	Mo	Base Metal	Plate Thickness mm	Welding Method	Groove
0.10	0.29	0.75	0.010	0.004	1.35	0.49	A387Gr11	50	3.2mm, tandem multi-layer	7R 3° U groove

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elong-ation, %	Charpy 2 V-notch at −20°C, J	PWHT	Base Metal	Plate Thickness mm	Welding Method	Groove
600	27	150	650°C×4h	A387Gr11	50	3.2mm, tandem one-layer one-pass multi-layer	7R 3° U groove
540	29	100	680°C×12h				

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
50	(L) 3.2 (T) 3.2		1~2	450	26	25	Tandem multi-layer
			3~13	(L) 450 (T) 450	26 26	50	
			14	(L) 450 (T) 450	26 26	45	

Approval:

NB-250M × Y-521H

☆JIS Z 3183 S642-2CM
☆AWS A5.23 F9P2-EG-B3

For 2.25%Cr-1%Mo Heat Resisting Steel

APPLICATIONS

Multi-layer welding of extremely thick 2.25%Cr-1%Mo heat resisting steel for petroleum refining apparatus and chemical plants.

CHARACTERISTICS

NB-250M is a high basic type flux of low hydrogen content and, therefore, susceptibility to cracking caused by hydrogen is low. Weld metal shows excellent low temperature toughness and resistance to embrittlement during service.

GUIDELINES FOR USAGE

1. Flux should be redried at 200-350°C for 60 minutes before use.
2. Preheating at 150-250°C, interpass temperatures and post heating at 680-730 °C are required.
3. Satisfactory weldability and weld metal properties are obtained with heat input of less than 40kJ/cm.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Cr	Mo	Base Metal	Plate Thickness mm	Welding Method
0.13	0.15	0.71	0.009	0.003	2.21	0.97	A387 Gr22	38	4.0mm,single narrow gap

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Test Temp. °C	Tensile Strength, MPa	Elonga-tion, %	PWHT	Charpy 2 V-notch at −45°C, J	PWHT	Base Metal	Plate Thickness mm	Welding Method
R. T.	660	25	SR	150	690°C×4h	A387 Gr22	38	4.0mm, single narrow gap
454	510	20	SR+SC	110				
R. T.	590	32	SR	180	700°C×4h			
454	450	23	SR+SC	120				

Note : SC means Socal step cooling.
Approval:

NB-2CM × Y-521

☆JIS Z 3183 S642-2CM
☆AWS A5.23 F9P2-EB3-B3

For 2.25%Cr-1%Mo Heat Resisting Steel

APPLICATIONS

Multi-layer welding of 2.25%Cr-1%Mo heat resisting steel for boiler drums and pressure vessels.

CHARACTERISTICS

Slag is extremely easy to remove in one-layer two-pass malti-layer narrow gap welding. Obtained weld metal shows excellent toughness and low temper-embrittlement.

GUIDELINES FOR USAGE

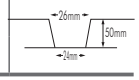
1. Flux should be redried at 350~400°C for 60 minutes before use.
2. Preheating of 150~250°C and postheating of 680~720°C are required.
3. Welding conditions should be carefully set up since excessive heat input and arc voltage against a given groove width may cause undercuts.

WELDING POSITION

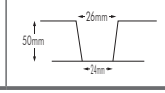
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Cr	Mo	Base Metal	Plate Thickness mm	Welding Method
0.13	0.16	0.85	0.009	0.002	2.27	0.98	A387Gr22	50	4.0mm, tandem one-layer two-pass

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elong-ation, %	Charpy 2 V-notch at −40°C, J	PWHT	Base Metal	Plate Thickness mm	Welding Method	Groove
640	25	180	690°C×7h	A387Gr22	50	4.0mm, tandem one-layer two-pass multi-layer	
590	30	195	690°C×26h				

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
50	(L) 4.0 (T) 4.0		all	(L) 560/570 (T) 560/570	30/32 31/33	57	Tandem multi-layer

Approval:

NF-250 × Y-204

☆JIS Z 3183 S642-MN
☆AWS A5.23 F9P6-EG-G

For 1.3%Mn-0.5%Mo and 1.3%Mn-0.5%Mo-0.5%Ni Heat Resisting Steel

APPLICATIONS

Narrow gap welding of ASTM A302B and A533B steel for nuclear reactor pressure vessels.

CHARACTERISTICS

Slag is extremely easy to remove in narrow gap welding. NF-250 is a high basic type flux and chemical composition rarely changes even in multi-layer welding. Weld metal shows excellent toughness.

GUIDELINES FOR USAGE

Welding conditions should be carefully set up since excessive heat input and arc voltage against a given groove width may cause undercuts.

WELDING POSITION

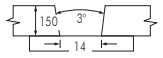
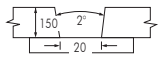
■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Mo	Base Metal	Plate Thickness mm	Welding Method
0.07	0.18	1.76	0.011	0.002	0.67	0.45	A533B	150	3.2mm, tandem multi-layer

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Test Temp. °C	Tensile Strength, MPa	Elon-gation, %	Charpy 2 V-notch, J		PWHT	Base Metal	Plate Thickness mm	Welding Method
			−27°C	−17°C				
R. T.	630	29	140	150	630°C×45h	A533B	150	3.2mm, tandem multi-layer. Heat input: 28~35kJ/cm
350	560	23						
R. T.	600	30	200	210	630°C×45h	A533B	150	4.0mm, tandem multi-layer. Heat input: 32~37kJ/cm
350	550	27						

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Plate Thickness mm	Wire Dia. mm	Groove Geometry	Pass	Current, A	Voltage, V	Speed, cm/min	Note
150	(L) 3.2 (T) 3.2		1	500	27	25	Tandem multi-layer
			2~43	(L) 450	27	40~50	
				(T) 450	25		
150	(L) 4.0 (T) 4.0		1~2	500	27	25	Tandem multi-layer
			3~61	(L) 550	29	50	
				(T) 550	27		

Approval:

Submerged Arc Welding Materials for Heat Resisting Steel

Brand Name	Specification		Application and Characteristics	Typical Chemical of Weld		
	JIS	AWS		C	Si	Mn
NF-1 × Y-DM	☆Z 3183 S624-H4	☆A5.23 F9A2-EA3-A3 F9P0-EA3-A3	Multi-layer narrow gap welding of ASTM A204 and A299 steel for boilers and pressure vessels. The combination is suitable for narrow gap welding since slag is extremely easy to remove and flux consumption rate is low. Weld metal shows high toughness and excellent weldability and joint properties are assured even in high current welding.	0.10	0.18	1.39
	Welding Position		AWS/ASME F/1G			
NB-1CM × Y-511S	☆Z 3183 S642-1CM	☆A5.23 F9P2-EB2-B2	Multi-layer narrow gap welding of 1~1.25%Cr-0.5%Mo heat resisting steel for boiler drums and pressure vessels.	0.09	0.27	1.17
	Welding Position		AWS/ASME F/1G			

Composition Metal (%)					Typical Mechanical Properties of Weld Metal					Remarks			
P	S	Mo	Cr	Ni	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch, °C	Charpy 2 V-notch, J	PWHT	Base Metal	Plate Thickness	Welding Method
0.016	0.005	0.52	—	—	640	670	27	−20	73	625°C ×3.5hr	A204C	50	I narrow groove, multi-layer (tandem)
								0	110				
0.008	0.002	0.54	1.39	—	430	580	28	−18	201	690°C× 3.5hr	A387 Gr11	25	Multi-layer (tandem)
					410	530	29	−18	220	690°C× 20.5hr			

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

YM-505

*JIS Z 3317 G49C3M3T
*AWS A5.28 ER80S-G

For 0.5%Mo Heat Resisting steel

APPLICATIONS

Welding with CO_2 gas for 0.5% Mo Steels such as piping steel (STPA12, A335-P1), boiler and heat exchanger tubes (STBA12, A209-T1), rooled steel (A204-A, B and C), cast steel (A217-WC1) and forged steel (A182-F1, A336-F1).

CHARACTERISTICS

YM-505 can be welded with CO_2 gas shielding. Arc is stable, spatters are few and bead appearance is good. Preheating at 100~200°C and postheating at 620~720°C are required. This product is used at higt temperatures up to 500°C and is not suitable for low temperature operation.

GUIDELINES FOR USAGE

1. Preheating and PWHT should be carried out accrding to the specification such as ASME and so on.
2. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%,*ppm)

Brand name	Shielding gas	C	Si	Mn	P	S	Cr	Mo	Sb	Sn	As	X-bar*
YM-505	CO_2	0.07	0.46	1.07	0.004	0.005	–	0.49	–	–	–	–

*Note; X-bar=(10×%P+5×%Sb+4×%Sn+%As)×100

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Brand name	Shielding gas	Yield Strength, MPa	Tensile Strength, MPa	Elon-gation, %	Charpy 2V-notch at –10°C, J	PWHT
YM-505	CO_2	630	670	26	110	as weld
		610	680	27	95	620°C×1.0hrs.

■ SIZES & RECOMMENDED CURRENT <DC(+)>

Diameter (mm)		1.0	1.2	1.6
Current Range (A)	F/1G, HF/2F	70~250	200~350	300~500
	H/2G, VU/3G	70~150	100~250	—
	OH/4G, VD/3G	70~150	100~200	—

YM-511/YM-511A

*JIS Z 3317 G55C1CMT1
*AWS A5.28 ER80S-G
*JIS Z 3317 G55M1CMT
*AWS A5.28 ER80S-G

For 1~1.25%Cr-0.5%Mo Heat Resisting Steels

APPLICATIONS

YM-511: Welding with CO_2 gas for 1~1.5%Cr-0.5%Mo Steels such as ASTM A335 P11/12 boiler tube.
YM-521A: Welding with Ar+CO_2 mixture gas for 1~1.25%Cr-0.5%Mo Steels such as ASTM A387 Gr.12 or A335 P11/12

CHARACTERISTICS

YM-511 can be welded with CO_2 gas shielding. Arc is stable and bead appearance is good. And, this product is not suitable for low temperature operation.
YM-511A shoud be with shielding gas of Ar+5~25%CO_2 mixtures. This product is suitable for ASTM A387 Gr.11 & Gr.12 as well as T12 boiler tube. And, it is available to low temperature operation up to −18°C, further it meets the requirement of X-bar and temper embrittlment as per API 934-A(Step Cooling test) under PWHT conditions of 691°C×2~20 hours.

GUIDELINES FOR USAGE

1. Preheating and PWHT should be carried out accrding to the specification such as ASME and so on.
2. All water, rust and oil in groove should be completely removed to prevent cracks and pits.
3. From the above reason, provide a windbreak apparatus, especially in case shielded by Ar+5~25% CO_2 mixtures.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%,*ppm)

Brand name	Shielding gas	C	Si	Mn	P	S	Cr	Mo	Sb	Sn	As	X-bar*
YM-511	CO_2	0.07	0.38	1.00	0.014	0.009	1.05	0.5	–	–	–	—
YM-511A	Ar+20%CO_2	0.06	0.35	0.78	0.005	0.002	1.28	0.54	0.001	0.001	0.002	6.1

*Note; X-bar=(10×%P+5×%Sb+4×%Sn+%As)×100

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Brand name	Shielding gas	Yield Strength, MPa	Tensile Strength, MPa	Elon-gation, %	Charpy 2V-notch, J		PWHT
					-23°C	0°C	
YM-511	CO_2	—	670	36	—	160	720°C×1hr.
YM-511A	Ar+20%CO_2	450	560	29	74	—	691°C×3.5hrs.
		450	450	32	74	—	691°C×24.5hrs.

■ SIZES & RECOMMENDED CURRENT <DC(+)>

Diameter (mm)		1.0	1.2	1.6
Current Range (A)	F/1G, HF/2F	70~250	200~350	300~500
	H/2G, VU/3G	70~150	100~250	—
	OH/4G, VD/3G	70~150	100~200	—

YM-521/YM-521A

☆JIS Z 3317 G62C2C1M3
☆AWS A5.28 ER90S-G
☆JIS Z 3317 G62M2C1M2
☆AWS A5.28 ER90S-G

For 2.25%Cr-1%Mo Heat Resisting Steels

APPLICATIONS

YM-521: Welding with CO_2 gas for 2.25%Cr-1%Mo Steels such as ASTM A335 P22 boiler tube.
YM-521A: Welding with Ar+CO_2 gas for 2.25%Cr-1%Mo Steels such as ASTM A387 Gr.22 or A335 P22.

CHARACTERISTICS

YM-521 can be welded with CO_2 gas shielding. Arc is stable and bead appearance is good. And, this product is not suitable for low temperature operation.
YM-521A shoud be with shielding gas of Ar+5~25%CO_2 mixtures. This product is suitable for ASTM A387 Gr.22 as well as T22 boiler tube. And, it is available to low temperature operation up to −29°C, further it meets the requirement of X-bar and temper embrittlment as per API 934-A(Step Cooling test) under PWHT conditions of 691°C×5~34 hours.

GUIDELINES FOR USAGE

1. Preheating and PWHT should be carried out acrding to the specification such as ASME and so on.
2. All water, rust and oil in groove should be completely removed to prevent cracks and pits.
3. From the above reason, provide a windbreak apparatus, especially shielded by Ar+5~25% CO_2 mixtures.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%,*ppm)

Trade name	Shielding gas	C	Si	Mn	P	S	Cr	Mo	Sb	Sn	As	X-bar*
YM-521	CO_2	0.06	0.59	1.30	0.013	0.009	2.40	0.92	–	–	–	—
YM-521A	Ar+20%CO_2	0.11	0.19	0.67	0.006	0.002	2.38	1.02	0.001	0.001	0.002	7.1

*Note; X-bar=(10×%P+5×%Sb+4×%Sn+%As)×100

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Trade name	Shielding gas	Yield Strength, MPa	Tensile Strength, MPa	Elon-gation, %	Charpy 2V-notch, J		PWHT
					-29°C	0°C	
YM-521	CO_2	—	670	25	—	110	700°C×1hr.
YM-521A	Ar+20%CO_2	490	630	29	103	—	691°C×5.5hrs.
		390	590	31	102	—	691°C×33.5hrs.

■ SIZES & RECOMMENDED CURRENT <DC(+)>

Diameter (mm)		1.0	1.2	1.6
Current Range (A)	F/1G, HF/2F	70~250	200~350	300~500
	H/2G, VU/3G	70~150	100~250	—
	OH/4G, VD/3G	70~150	100~200	—

YT-505/YT-511/YT-521

☆JIS Z 3317 W55G
☆AWS A5.28 ER80S-G
☆JIS Z 3317 W551CMT
☆AWS A5.28 ER90S-G
☆JIS Z 3317 W622C1M2
☆AWS A5.28 ER90S-G

For 0.5% Mo, 1~1.25%Cr-0.5%Mo and 2.25%Cr-1%Mo Heat Resisting Steels

APPLICATIONS

YT-505: Welding of 0.5% Mo steels such as ASTM A204 Gr. A-C or A335 P1 boiler tube.
YT-511: Welding of 1~1.25%Cr-0.5%Mo Steels such as ASTM A387 Gr.11 or A335 P11/12
YT-521: Welding of 2.25%Cr-1%Mo Steels such as ASTM A387 Gr.22 or A335 P22.

CHARACTERISTICS

YT-505, YT-511 and YT-521 are filler rods and spool wire for GTAW (TIG welding)
to be used with Ar shield gas. Those products show good welding performance in Uranami welding (penetration bead welding).

GUIDELINES FOR USAGE

1. Preheating and PWHT should be carried out acrding to the specification such as ASME and so on.
2. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.
3. When uranami welding, it is recommended 100% Ar gas backings.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Trade name	Shielding gas	C	Si	Mn	P	S	Cr	Mo	Sb	Sn	As	X-bar*
YT-505	100%Ar	0.09	0.02	1.74	0.013	0.004	–	0.46	–	–	–	—
YT-511	100%Ar	0.1	0.22	0.84	0.005	0.002	1.43	0.51	0.001	0.001	0.002	6.1
YT-521	100%Ar	0.12	0.08	0.76	0.005	0.004	2.35	0.98	0.001	0.001	0.002	6.1

*Note; X-bar=(10×%P+5×%Sb+4×%Sn+%As)×100

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Trade name	Shielding gas	Yield Strength, MPa	Tensile Strength, MPa	Elon-gation, %	Charpy 2V-notch, J		PWHT
YT-505	100%Ar	590	670	33	277 (−50°C)	280 (−36°C)	590°C×2.2hrs.
		520	600	31	279 (−50°C)	279 (−36°C)	645°C×9hrs.
YT-511	100%Ar	490	630	28	208 (−23°C)	231 (−12°C)	691°C×3.5hr
		390	590	32	234 (−23°C)	278 (−12°C)	691°C×24.5hrs.
YT-521	100%Ar	500	650	29	–	279 (−29°C)	691°C×5.5hr
		490	630	29	246 (−50°C)	266 (−29°C)	691°C×33.5hrs.

■ SIZES<DC(−)>

Diameter (mm)	0.8	1.0	1.2	1.6	2.0	2.4	3.2
Length of Filler Rod (mm)	—	100%	1000	1000	1000	1000	1000
Weight of spool wire (kg)	12.5	12.5	12.5	100%	100%	100%	100%

Memo

Boiler Tube/Pipe

Covered Arc Welding Electrodes
Gas Tungsten Arc Welding Rods and Wires

Covered Arc Welding Electrodes for Boiler Tube/Pipe

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics
	End	Secondary	JIS	AWS		
N-0S	Green	Light yellow	—	☆ A5.5 E7016-A1	2.6 3.2 4.0 5.0 6.0	N-0S is a extra low hydrogen type electrode with a 0.5% Mo steel core wire and is suitable for welding C-Mo steel to be used at high temperatures up to 500°C.
Welding Position			AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		
N-1S	White	Light yellow	—	☆ A5.5 E8016-B2	2.6 3.2 4.0 5.0 6.0	N-1S is a extra low hydrogen type electrode with a 1.25%Cr-0.5% Mo steel core wire and is suitable for welding 1~1.50%Cr-0.5%Mo steel to be used at high temperatures up to 550°C.
Welding Position			AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		
N-2S	Red	Light yellow	—	☆ A5.5 E9016-B3	2.6 3.2 4.0 5.0 6.0	N-2S is an extra low hydrogen type electrode with a 2.25%Cr-1%Mo steel core wire and is suitable for welding 2.25%Cr-1%Mo steel to be used at high temperatures up to 600°C. Weld Metal shows extremely high creep-rupture strength at 550-600°C.
Welding Position			AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		
N-HCM2S	Red	—	—	—	2.6 3.2 4.0	Low hydrogen type electrode suitable for HCM2S(2.25%Cr-1.6%W-Mo-Nb-V) steel such as ASTM T23/P23.
Welding Position			AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		
N-HCM12A	Cream	—	—	—	2.6 3.2 4.0 5.0	Low hydrogen type electrode suitable for HCM12A steel (11%Cr-2%W-0.4%Mo-Cu-Nb-V) such as ASTM T122/P122.
Welding Position			AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)						Typical Mechanical Properties of Weld Metal				PWHT
C	Si	Mn	P	S	Others	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J	
0.06	0.51	0.60	0.012	0.006	Mo: 0.52	480	560	32	—	620°C×1h
0.06	0.45	0.60	0.013	0.006	Cr: 1.26 Mo: 0.51	570	660	27	—	690°C×1h
0.06	0.57	0.58	0.010	0.006	Cr: 2.29 Mo: 1.00	590	690	24	—	690°C×1h
0.06	0.41	0.80	0.004	0.002	Cr : 2.25 Mo : 0.10 Ni : 0.99 W : 1.6 Nb : 0.04 V : 0.3	875	980	21	28	As welded
						625	755	20	120	715°C×1h
0.08	0.25	0.84	0.004	0.001	Cr : 10.5 Mo : 0.20 Ni : 0.80 W : 1.4 Nb : 0.03 V : 0.18 Cu : 1.4	665	810	23	54	740°C×5h

Gas Tungsten Arc Welding Rods and Wires for Boiler Tube/Pipe

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics	Typical Chemical Composition of Weld Metal (%)						Typical Mechanical Properties of Weld Metal				PWHT
	End	Secondary	JIS	AWS			C	Si	Mn	P	S	Others	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J	
YT-HCM2S	—	—	☆ Z 3317 W57 -2CMWV-Ni	—	1.0 1.2 1.6 2.0 2.4	Welding of HCM2S (2.25%Cr-1.6%W-Mo-Nb-V) such as ASTM T23/P23	0.05	0.38	0.85	0.004	0.004	Cr : 2.25 Mo : 0.10 Ni : 0.80 W : 1.6 Nb : 0.04 V : 0.25	780	860	21	70	As welded
YT-9ST	—	—	☆ Z 3317 W62 -9C1MV1	A5.28 ER90S-G	1.2 1.6 2.0 2.4	Welding of Mod. 9%Cr-1%Mo (9%Cr-1%Mo-Nb-V) such as ASTM T91/P91	0.07	0.08	1.05	0.008	0.005	Cr : 8.84 Mo : 1.01 Ni : 0.29 Nb : 0.05 V : 0.25	580	710	25	—	740°C× 8.4h
YT-HCM12A	—	—	☆ Z 3317 W69 -10CMWV-Cu	—	1.0 1.2 1.6 2.0 2.4	Welding of HCM12A (11%Cr-2%W-0.4%Mo-Cu-Nb-V) such as ASTM T122/P122	0.08	0.35	0.52	0.010	0.002	Cr : 10.4 Mo : 0.30 Ni : 1.10 W : 1.60 Nb : 0.05 V : 0.2 Cu : 1.4	660	790	24	110	740°C× 0.5h
YT-304H T-304H	—	—	—	—	1.0 1.2 1.6 2.0 2.4	Welding of SUPER304H (18%Cr-9%Ni-3Cu-N)	0.10	0.23	3.2	0.002	0.004	Cr : 18.4 Mo : 0.85 Ni : 16.1 Cu : 3.0 Nb : 0.6 N : 0.20	500	660	35	—	As welded
YT-HR3C T-HR3C	—	—	—	—	1.0 1.2 1.6 2.0 2.4	Welding of HR3C (25%Cr-20%Ni-Nb-N) such as SA213 TP310HCbN	0.06	0.30	1.51	0.003	0.005	Cr : 27.0 Mo : 0.91 Ni : 20.1 Cu : 2.94 Nb : 0.45 N : 0.31	480	710	35	—	As welded

Memo

Atmospheric Corrosion Resisting Steel

Flux Cored Arc Welding Wires
Covered Arc Welding Electrodes
Submerged Arc Welding Materials
Gas Metal Arc Welding Wires
Gas Tungsten Arc Welding Rods and Wires

SF-50W

JIS Z 3320 T49J0T1-1CA-NCC1-UH5
☆AWS A5.36 E71T1-C1A0-G

For 400~490MPa Atmospheric Corrosion Resisting Steel

APPLICATIONS

Welding of 400~490MPa atmospheric corrosion resisting steel (W specification) such as SMA400W and 490W for steel frames and bridges.

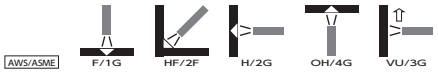
CHARACTERISTICS

SF-50W is a rutile type seamless flux cored arc welding wire to be used with CO_2 shield gas. Diffusible hydrogen content is extremely low and, consequently, weld metal shows excellent crack resistance. Weldability is excellent, and, especially in horizontal fillet welding, bead is beautiful and slag is easy to remove.

GUIDELINES FOR USAGE

1. Preheating at 50~150°C is required depending on plate thickness, restraint, surface condition of base metal, heat input, etc.
2. All water, rust and oil in groove should be removed.
3. Select optimum welding conditions, heat input for example, in accordance with welding positions.
4. For others, see GUIDELINES FOR USAGE 1~4 of SF-1.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Cu	Ni	Cr
CO_2	0.04	0.35	0.80	0.015	0.008	0.34	0.44	0.47

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
500	580	26	100

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.6
Current A	F	180~300	220~450
	H-Fil	180~300	220~450
	V-up	180~250	200~280

Approval:

SF-60W

JIS Z 3320 T57J1T1-1CA-NCC1-UH5
☆AWS A5.36 E81T1-C1A0-W2

For Atmospheric Corrosion Resisting Steel

APPLICATIONS

Welding of 590MPa atmospheric corrosion resisting steel (W specification) such as SMA570W and 570W for steel brames and bridges.

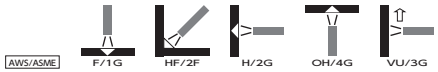
CHARACTERISTICS

Rutile type seamless flux cored wire for welding 590MPa atmospheric corrosion resisting steel. The diffusible hydrogen content is extremely low and, consequently, crack resistance is high. Spatters are few and weldability is excellent.

GUIDELINES FOR USAGE

1. Preheating at 50~150°C is required depending on plate thickness, restraint, surface condition of base metal, heat input, etc.
2. All water, rust and oil in groove should be removed.
3. Select optimum welding conditions, heat input for example, in accordance with welding positions.
4. For others, see GUIDELINES FOR USAGE 1~4 of SF-1 .

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Cu	Ni	Cr
0.05	0.50	1.18	0.012	0.005	0.42	0.61	0.51

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −5°C, J
630	685	22	115

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2	1.6
Current A	F	180~300	220~450
	H-Fil	180~300	220~450
	V-up	180~250	200~280

Approval:

Covered Arc Welding Electrodes for Atmospheric Corrosion Resisting Steel

Brand Name	Identification Color		Specification		Dia. mm	Base metal	Application and Characteristics
	End	Secondary	JIS	AWS			
CT-03Cr	Red	Black	☆Z 3214 E49J03-NCCAU	–	2.6 3.2 4.0	W	Lime-titania type electrode for welding of ASTM A242 steel thinner than 9 mm and finish welding of thick plates. Weldability is excellent in all positions.
	Welding Position		AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G				
CT-16Cr	White	Yellow	☆Z 3214 E49J16-NCCAU	☆A5.5 E7016-G	2.6 3.2 4.0 5.0 6.0	W	Extra low hydrogen type electrode for welding of medium and thick plates in all positions. Crack resistance and mechanical properties are excellent.
	Welding Position		AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G				
CT-16VCr	Silver	Blue	–	☆A5.5 E7016-G	3.2 4.0 5.0	W	Extra low hydrogen type electrode for vertical downhand welding of fillet and butt joints. Weld metal shows excellent crack resistance and mechanical properties. High welding efficiency is assured since high current can be used.
	Welding Position		AWS/ASME VD/3G				
CT-26MCr	Blue	White	–	–	4.0 4.5 5.0 5.5 6.0	W	Iron powder titania type electrode for flat and horizontal fillet welding. Spatters are few and bead shape is beautiful with equal leg length and without undercuts. It also is suitable for gravity welding.
	Welding Position		AWS/ASME F/1G HF/2F				
CT-60Cr	Scarlet	Light yellow	☆Z 3214 E57J16-NCC1AU	☆A5.5 E8016-G	3.2 4.0 5.0 6.0	W P	Extra low hydrogen type electrode for welding of ASTM A242 and A588 steel in all positions. It assures excellent weldability, X-ray properties, crack resistance and mechanical properties.
	Welding Position		AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G				

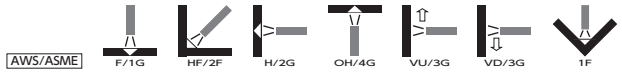
Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)						Typical Mechanical Properties of Weld Metal			
C	Si	Mn	Cu	Cr	Ni	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
0.05	0.16	0.41	0.32	0.48	0.15	500	570	29	110
0.04	0.37	0.62	0.35	0.50	0.14	500	560	30	240
0.06	0.41	0.72	0.32	0.47	0.13	520	570	29	160
0.07	0.31	0.85	0.33	0.48	0.14	470	550	30	110
0.07	0.38	0.67	0.44	0.56	0.62	520	610	25	−18°C 180

Submerged Arc Welding Materials for Atmospheric Corrosion Resisting Steel

Brand Name	Specification		Base metal	Application and Characteristics	Typical Chemical of Weld					Composition Metal (%)			Typical Mechanical Properties of Weld Metal					Remarks		
	JIS	AWS			C	Si	Mn	P	S	Cu	Ni	Cr	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch, °C	Charpy 2 V-notch, J	Base Metal	Plate Thickness mm	Welding Method
NF-820 × Y-CNCW	☆Z 3183 S50J2-AW1	☆A5.23 F7A0-EG-G	W	Fillet and butt welding of including MISA Welding Process, of mild steel and 490MPa atmospheric corrosion resisting steel.	0.05	0.66	1.57	0.011	0.006	0.35	0.14	0.56	490	570	27	0	76	SMA 490BW	20	Multi-layer
	Welding Position		AWS/ASME 1F HF/2F																	
YF-15B × Y-CNCW	☆Z 3183 S50J2-AW1	☆A5.23 F7A4-EG-G	W	Flat filler and butt welding of mild steel and 490MPa atmospheric corrosion resisting steel.	0.07	0.45	1.31	0.014	0.007	0.37	0.11	0.55	510	600	27	−20	85	SMA 490BW	20	Multi-layer
	Welding Position		AWS/ASME F/1G													0	120			
NF-310 × Y-CNCW	☆Z 3183 S50J2-AW1	☆A5.23 F7A4-EG-G	W	Single and multi-layer welding of mild steel and 490MPa atmospheric corrosion resisting steel requiring low temperature toughness. Ti-B type weld metal shows excellent low temperature toughness.	0.08	0.22	0.89	0.007	0.008	0.37	0.12	0.59	560	600	28	−60	130	SMA 490BW	20	Multi-layer
	Welding Position		AWS/ASME F/1G													−40	150			
																−20	170			
NF-820 × Y-60W	☆Z 3183 S582-AW1	☆A5.23 F8A0-EG-G	W	Fillet welding, including MISA Welding Process, of 590MPa atmospheric corrosion resisting steel.	0.06	0.60	1.67	0.012	0.008	0.37	0.10	0.56	540	640	25	−5	66	SMA 570W	20	Multi-layer
	Welding Position		AWS/ASME 1F HF/2F																	
YF-15B × Y-60W	☆Z 3183 S58J2-AW1	☆A5.23 F8A2-EG-G	W	Flat fillet and butt welding of 590MPa atmospheric corrosion resisting steel.	0.08	0.45	1.43	0.018	0.009	0.37	0.10	0.57	520	630	29	−5	88	SMA 570W	20	Multi-layer
	Welding Position		AWS/ASME F/1G																	

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.



Gas Metal Arc Welding Wires for Atmospheric Corrosion Resisting Steel

Brand Name	Shield Gas	Specification JIS	Specification AWS	Dia. mm	Application and Characteristics
YM-55W	CO_2	☆Z 3315 G49JA0UC1-NCCJ	☆A5.28 ER80S-G	0.9 1.2 1.6	Welding of mild steel and 400~490MPa atmospheric corrosion resisting steel (W specification) for various structural works. YM-55W is a gas metal arc welding wire for all positions to be used with CO_2 shield gas. Arc is stable, spatters are few and weldability is good in wide current range.
	Welding Position	AWS/ASME F/1G	HF/2F	H/2G	VD/3G
YM-60W	CO_2	☆Z 3315 G57JA1UC1-NCCJ	☆A5.28 ER80S-G	0.9 1.2 1.6	Welding of 570MPa atmospheric corrosion resisting steel (W specification) for various constructions. YM-60W is a gas metal arc welding wire for all positions to be used with CO_2 shield gas. Arc is stable, spatter are few and weldability is good in wide current range.
	Welding Position	AWS/ASME F/1G	HF/2F	H/2G	VD/3G
FGC-55	CO_2	☆Z 3315 G49A0UC1-CCJ	☆A5.28 ER80S-G	1.0 1.2 1.6	Welding of 400~490MPa atmospheric corrosion resisting steel (P specifications) and sulfuric acid corrosion resisting steel (S-TEN1) for various structural works. FGC-55 is a gas metal arc welding wire for all positions.
	Welding Position	AWS/ASME F/1G	HF/2F	H/2G	VD/3G

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%) C	Si	Mn	P	S	Cu	Cr	Ni	Typical Mechanical Properties of Weld Metal Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J	Type of Current
0.06	0.48	1.05	0.006	0.008	0.50	0.61	0.21	580	630	27	90	DC(+)
0.07	0.38	0.83	0.016	0.005	0.58	0.50	0.46	540	640	26	−5°C 110	DC(+)
0.08	0.36	0.98	0.016	0.005	0.35	0.48	—	460	570	25	180	DC(+)

Memo

Sulphuric Acid Corrosion Resisting Steel

Flux Cored Arc Welding Wires
Covered Arc Welding Electrodes
Submerged Arc Welding Materials
Gas Metal Arc Welding Wires
Gas Tungsten Arc Welding Rods and Wires

SF-1ST

☆AWS A5.36 E81T1-C1AZ-G

High corrosion-resistance equipment to S-TEN 1

APPLICATIONS

High corrosion resisting low alloy steel S-TEN 1 for use in flue-gas treatment equipment at thermal power stations and waste incineration plants, and chloride acid washing tanks.

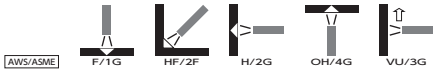
CHARACTERISTICS

Corrosion resistance of the weld metal is as high as that of the base metal, thus reducing concern of corrosion to a minimum. It is attributed to the alloying composition control technology, which was applied to S-TEN 1 and has also been used in the development of the welding materials to secure high corrosion-resistance.
The weld metal gives not only remarkably higher hydrochloric-acid dew-point corrosion resistance but also improved sulfuric-acid dew-point corrosion resistance, as compared with that of the conventional welding materials

GUIDELINES FOR USAGE

1. Any welding machine for solid wire can be used as it is, but wire feed roller's pressure should be adjusted a little looser.
2. A suitable shield gas flow rate is 20~25 ℓ /min.
3. Distance between base metal and tip should be kept within 20~30mm.
4. Arc voltage should be 1 or 2 volt lower than that for conventional flux cored wires and 4 or 5 volt lower than that for solid wires.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Cu	Sb
CO_2	0.05	0.60	1.41	0.012	0.013	0.39	0.10

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
580	640	27	47

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2
Current A	F	180~320
	H-Fil	180~320
	H	180~300
	V-up	180~260
	OH	180~260

Approval:

FC-23ST

for Sulphuric Acid Corrosion Resisting Steel

APPLICATIONS

Rutile type flux cored wire for welding S-TEN2, sulphuric acid corrosion resisting steel. Spatters are few and weldability is excellent.

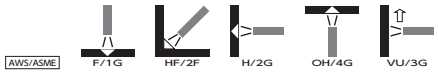
CHARACTERISTICS

Rutile type flux cored wire for welding S-TEN2, sulphuric acid corrosion resisting steel. Spatters are few and weldability is excellent.

GUIDELINES FOR USAGE

1. Any welding machine for solid wire can be used as it is, but wire feed roller's pressure should be adjusted a little looser.
2. A suitable shield gas flow rate is 20~25ℓ/min.
3. Distance between base metal and tip should be kept within 20~30mm.
4. Arc voltage should be 1 or 2 volt lower than that for conventional flux cored wires and 4 or 5 volt lower than that for solid wires.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Cu	Cr
CO_2	0.04	0.36	0.97	0.018	0.014	0.35	0.77

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
530	600	25	62

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.2
Current A	F	180~320
	H-Fil	180~320
	H	180~300
	V-up	180~260
	OH	180~260

Approval:

ST-16M

JIS Z 3211 E4916-G
☆AWS A5.5 E7016-G

High corrosion-resistance equivalent to S-TEN1

APPLICATIONS

Corrosion resisting low alloy steel for use in flue-gas treatment equipment at thermal power stations and waste incineration plants, and chloride acid washing tanks.

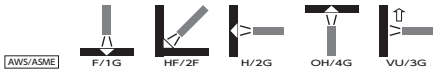
CHARACTERISTICS

Corrosion resistance of the weld metal is as high as that of the base metal, thus reducing concern of corrosion to a minimum. It is attributed to the alloying composition control technology, which was applied to S-TEN 1 and has also been used in the development of the welding materials to secure high corrosion-resistance.
The weld metal gives not only remarkably higher hydrochloric-acid dew-point corrosion resistance but also improved sulfuric-acid dew-point corrosion resistance, as compared with that of the conventional welding materials.

GUIDELINES FOR USAGE

1. Electrode should be redried at 300~350°C for 60 minutes before use.
2. Backstep method should be applied to prevent blowholes and pit at arc starting and arc length should be kept as short as possible during welding.
3. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Cu	Sb
0.04	0.62	0.50	0.009	0.004	0.42	0.08

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V notch at 0°C, J
470	570	29	170

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.6	3.2	4.0	5.0
Length (mm)		350	350	400	400
Current A	F	70~100	100~140	150~200	190~250
	V-up, OH	60~90	80~110	120~160	140~180

Approval:
Identification color: End-yellow, secondary-light blue

Memo

Covered Arc Welding Electrodes for Sulfuric Acid Corrosion Resisting Steel

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics
	End	Secondary	JIS	AWS		
ST-03Cr	White	Blue	Z 3211 E4903-G	—	2.6 3.2 4.0	Lime-titania type electrode for welding of S-TEN 2 steel in all positions. Weld metal contains Cu and Cr, and shows high corrosion resistance to sulfur dew point, sea water and polluted water. Excellent weldability makes it suitable for welding thin plates of less than 9 mm and finish welding of thick plates.
	Welding Position		AWS/ASME F/1G	HF/2F	H/2G	OH/4G VU/3G
ST-16Cr	Light yellow	Orange	Z 3211 E5516-G	☆ A5.5 E7016-G	3.2 4.0 5.0	Extra low hydrogen type electrode for welding of medium and thick S-TEN 2 plates in all positions. Weld metal contains Cu and Cr, and shows high corrosion resistance to sulfur dew point, sea water and polluted water. Crack resistance and mechanical properties are excellent.
	Welding Position		AWS/ASME F/1G	HF/2F	H/2G	OH/4G VU/3G
ST-03CrA	Orange	—	Z 3211 E4903-G	—	2.6 3.2 4.0	Suitable for CR1A. Its coating is lime-titania type and the operating performance is excellent in all positions. It is also applicable for sea water corrosion resisting steel.
	Welding Position		AWS/ASME F/1G	HF/2F	H/2G	OH/4G VU/3G
ST-16CrA	Green	—	Z 3211 E4916-G	☆ A5.5 E7016-G	3.2 4.0	Suitable for CR1A. Its coating is low hydrogen type and crack-resistance of weld metal and mechanical properties are excellent.
	Welding Position		AWS/ASME F/1G	HF/2F	H/2G	OH/4G VU/3G

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)					Typical Mechanical Properties of Weld Metal			
C	Si	Mn	Cu	Cr	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
0.06	0.15	0.56	0.23	0.79	460	530	26	110
0.05	0.50	0.48	0.20	0.73	480	570	27	200
0.08	0.24	0.66	0.22	1.23	500	570	25	59
0.07	0.38	0.69	0.23	1.18	570	620	26	180

SMAW
7

Submaged Arc Welding Meterial for Sulphuric Acid Corrosion Resisting Steel

Brand Name	Specification		Application and Characteristics
	JIS	AWS	
NB-1ST × Y-1ST	—	—	Corrosion resistance of the weld metal is as high as that of the base metal, thus reducing concern of corrosion to a minimum. It is attributed to the alloying composition control technology, which was applied to S-TEN 1 and has also been used in the development of the welding materials to secure high corrosion-resistance.
	Welding Position		AWS/ASME F/1G

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)							Typical Mechanical Properties of Weld Metal					Remarks		
C	Si	Mn	P	S	Cu	Sb	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch °C	Charpy 2V-notch J	Base Metal	Plate Thickness mm	Welding Method
0.03	0.34	1.13	0.007	0.011	0.19	0.09	450	530	31	0	141	S-TEN1	19	Multi layer

Gas Metal Arc Welding Wires for Sulphuric Acid Corroison Resisting Steel

Brand Name	Shield Gas	Specification		Dia. mm	Application and Characteristics
		JIS	AWS		
YM-W4	CO_2	—	—	0.9 1.2	Welding of sulphuric acid corrosion resisting steel.
	Welding Position	AWS/ASME	F/1G	HF/2F	H/2G VD/3G

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)								Typical Mechanical Properties of Weld Metal				Type of Current
C	Si	Mn	P	S	Cu	Cr	Ni	Yield Strength, MPa	Tensile Strength, MPa	Elon-gation, %	Charpy 0°C, J	
0.08	0.44	0.89	0.012	0.006	0.45	0.91	—	570	620	24	60 −20°C 50	DC (+)

GMAW
7

YT-1ST

For high corrosion-resistance equipment to S-TEN 1

APPLICATIONS

Gas Tungsten Arc Welding of high corrosion resisting low alloy steel S-TEN 1 for use in air preheaters, flue-gas treatment equipments, flues and smokestacks at waste incineration plants, thermal power stations and chloride acid washing tanks.

CHARACTERISTICS

Corrosion resistance of the weld metal is as high as that of the base metal, thus reducing concern of corrosion to a minimum. It is attributed to the alloying composition control technology, which was applied to S-TEN 1 and has also been used in the development of the welding materials to secure high corrosionresistance.
The weld metal gives not only remarkably higher hydrochloric-acid dewpoint corrosion resistance but also improved sulfuric-acid dew-point corrosion resistance, as compared with that of the conventional welding materials.
The weldability is excellent similar to mild steel welding.

GUIDELINES FOR USAGE

1. Arc length should be kept as short as possible during welding. However, don't contact electrode and molten pool. If electrode contacts into molten pool, the weld metal that is included tungsten should be grinded.
2. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Sb	Cu
0.01	0.29	1.33	0.10	0.32

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J	PWHT
400	480	39	280	As weld

■ SIZES<DC(−)>

Diameter (mm)	1.0	1.2	1.6	2.0	2.4
Length of Filler Rod (mm)	—	1000	1000	1000	1000
Weight of spool wire (kg)	10	—	—	—	—

Identification color: End-non

YT-W4

For Sulphuric Acid Corroison Resisting steel

APPLICATIONS

Gas Tungsten Arc Welding of sulphuric Acid Corroison Resisting steel.

CHARACTERISTICS

YT-W4 is filler rod and wire for GTAW (TIG welding) of sulphuric Acid Corroison Resisting steel.
The weldability is excellent similar to mild steel welding.

GUIDELINES FOR USAGE

1. Arc length should be kept as short as possible during welding. However, don't contact electrode and molten pool. If electrode contacts into molten pool, the weld metal that is included tungsten should be grinded.
2. All water, rust and oil in groove should be completely removed to prevent cracks and blowholes.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Cr	Cu
0.06	0.54	1.05	0.73	0.35

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J		PWHT
			−20°C	0°C	
510	580	26	150	71	As weld

■ SIZES<DC(−)>

Diameter (mm)	1.0	1.2	1.6	2.0	2.4	3.2
Length of Filler Rod (mm)	—	—	1000	1000	1000	1000
Weight of spool wire (kg)	10	10	—	—	—	—

Identification color: End-orange

Memo

Sea Water Corrosion Resisting Steel

Flux Cored Arc Welding Wires
Covered Arc Welding Electrodes
Submerged Arc Welding Materials
Gas Metal Arc Welding Wires
Gas Tungsten Arc Welding Rods and Wires

Flux Cored Arc Welding Wires for Sea Water Corrosion Resisting Steel

Brand Name	Shield Gas	Specification JIS	Specification AWS	Dia. mm	Application and Characteristics
SF-55RS	CO_2	—	☆A5.36 E81T1-C1A0-G	1.2	Rutile type seamless flux cored wire for welding MARILOY S400, S490, G400 and G490, sea water corrosion resisting steel. Diffusible hydrogen content is extremely low and crack resistance is high. Weldability is excellent in all positions.
	Welding Position	AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G			

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)								Typical Mechanical Properties of Weld Metal				Type of Current
C	Si	Mn	P	S	Cu	Mo	Cr	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch, J	
0.04	0.34	1.07	0.017	0.007	0.33	0.09	0.86	580	640	26	0°C 54	DC (+)

Covered Arc Welding Electrodes for Sea Water Corrosion Resisting Steel

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics
	End	Secondary	JIS	AWS		
RS-55	Blue	—	Z 3211 T4916-G	☆A5.5 E8016-G	3.2 4.0 5.0 6.0	Low hydrogen type electrode for welding of sea water corrosion resisting steel (MARILOY S400, S490) in all positions. Weld metal contains Cr and shows high resistance to sea water corrosion. Crack resistance and mechanical properties are also excellent.
	Welding Position		AWS/ASME	F/1G HF/2F H/2G OH/4G VU/3G		

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)						Typical Mechanical Properties of Weld Metal			
C	Si	Mn	Cu	Cr	Mo	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
0.05	0.53	0.57	—	1.00	—	500	590	26	220

Gas Metal Arc Welding Wires for Sea Water Corrosion Resisting Steel

Brand Name	Shield Gas	Specification JIS	Specification AWS	Dia. mm	Application and Characteristics
YM-W4	CO_2	—	—	0.9 1.2	Welding of 400~490MPa sea water corrosion resisting steel
	Welding Position	AWS/ASME	F/1G	HF/2F	H/2G VD/3G
YM-55RSA	Ar+ 20%CO_2	—	—	1.2	Welding of 400~490MPa sea water corrosion resisting steel
	Welding Position	AWS/ASME	F/1G	HF/2F	H/2G VD/3G

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%) C	Si	Mn	P	S	Cu	Cr	Ni	Typical Mechanical Properties of Weld Metal Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J	Type of Current
0.08	0.44	0.89	0.012	0.006	0.45	0.91	—	570	620	24	60 –20°C 50	DC (+)
0.06	0.34	1.07	0.010	0.006	0.23	1.09	—	460	550	28	190	DC (+)

Gas Tungsten Arc Welding Rods and Wires for Sea Water Corrosion Resisting Steel

Brand Name	Shield Gas	Specification		Dia.	Application and Characteristics	Typical Chemical Composition of Weld Metal (%)					Typical Mechanical Properties of Weld Metal			
		JIS	AWS	mm		C	Si	Mn	Cr	Cu	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 0°C, J
YT-W4	Ar	—	—	1.2 1.6 2.0 2.4 ×1000	Welding of sea water corrosion resisting steel and salpharic acid corrosion resisting steel	0.06	0.54	1.05	0.73	0.35	510	580	26	150 –20°C 71
YT-55RS	Ar	—	—	2.4 ×1000	Welding of sea water corrosion resisting steel (MARILOY S400 and S490).	0.04	0.31	1.05	1.16	0.11	480	540	27	—

Memo

Stainless Steel

Flux Cored Arc Welding Wires
Covered Arc Welding Electrodes
Submerged Arc Welding Materials
Gas Metal Arc Welding Wires
Gas Tungsten Arc Welding Rods and Wires

SF-308L

JIS Z 3323 TS308L-FB0
☆AWS A5.22 E308LT0-1

For Low Carbon 18% Cr-8% Ni Stainless Steel

APPLICATIONS

Welding of low carbon 18%Cr-8%Ni stainless steel for chemical apparatus, containers and plants.

CHARACTERISTICS

SF-308L is a seamless flux cored arc welding wire to be used with CO_2 or Ar+ more than 20%CO_2 shield gas. Spatters are few, slag is easy to remove and bead appearance and shape are excellent. It is highly resistant to moisture absorption and wire feeding is smooth since the wire has no seam. High welding efficiency is assured in flat and horizontal fillet positions.

GUIDELINES FOR USAGE

1. Distance between base metal and tip should be kept within the range of 15~25mm.
2. Shield gas flow rate should be kept within 20~25ℓ/min.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ni	Cr
CO_2	0.033	0.59	1.51	0.024	0.008	10.7	19.9

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elongation, %
550	41

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)	0.8	0.9	1.2	1.6
Current (A)	50~150	70~170	100~250	200~350

Approval: NK, ABS, LR, DNV, BV, RS

SF-309L

JIS Z 3323 TS309L-FB0
☆AWS A5.22 E309LT0-1

For Dissimilar Metals such as Stainless Steel and Mild Steel

APPLICATIONS

18%Cr-8%Ni clad steel and parts of hardenable steel of which heat treatment after welding is impossible or which require low carbon weld metal.

CHARACTERISTICS

SF-309L is a seamless flux cored arc welding wire to be used with CO_2 or Ar+ more than 20%CO_2 shield gas. Spatters are few, slag is easy to remove and bead appearance and shape are excellent. It is highly resistant to moisture absorption and wire feeding is smooth since the wire has no seam. High welding efficiency is assured in flat and horizontal fillet positions.

GUIDELINES FOR USAGE

1. Distance between base metal and tip should be kept within the range of 15~25mm.
2. Shield gas flow rate should be kept within 20~25ℓ/min.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shield Gas	C	Si	Mn	P	S	Ni	Cr
CO_2	0.034	0.65	1.54	0.023	0.009	12.7	24.4

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elongation, %
590	31

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)	0.8	0.9	1.2	1.6
Current (A)	50~150	70~170	100~250	200~350

Approval: NK, ABS, LR, DNV, BV, RS

SF-N309L

JIS Z 3323 TS309L-FN0
☆AWS A5.22 E309LT0-3

For Dissimilar Metals such as Stainless Steel and Mild Steel -Self-Shielded type-

APPLICATIONS

Welding of dissimilar metal such as type 304L to carbon steel, welding the clad side of type 304L clad steels and cladding (surfacing) of stainless steel to carbon steel.

CHARACTERISTICS

SF-N309L is a Self-Shielded seamless flux cored arc welding wire of type 309L stainless steel. Shielding gas is unnecessary and welding cost is reducible. It is a few spatters, easily removable slag and a smooth bead appearance. In addition, X-ray quality and Mechanical properties of weld metal is excellent.

GUIDELINES FOR USAGE

1. Distance between base metal and tip should be kept within the range of 20~30mm.
2. All water, rust and oil in groove should be completely removed to prevent welding porosity in weld metal.
3. In the welding of dissimilar metals, excessive dilution deteriorates crack and corrosion resistance. Should be been careful the penetration to base metal.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shielding gas	C	Si	Mn	Ni	Cr
None	0.03	0.65	1.50	12.6	24.3

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Shielding gas	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −20°C, J
None	515	661	32	37

■ TYPICAL MECHANICAL PROPERTIES OF WELD JOINT

Shielding gas	Tensile Strength, MPa	Location of Fracture	Charpy 2V-notch at −20°C, J
None	507	Base metal	42

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)	1.2
Current (A)	100~250

Approval: ABS

SF-316L

☆JIS Z 3323 TS316L-FB0
☆AWS A5.22 E316LT0-1

For Low Carbon 18% Cr-12% Ni-2%Mo Stainless Steel

APPLICATIONS

Welding of low carbon 18%Cr-8%Ni stainless steel for chemical engineering and power plants.

CHARACTERISTICS

SF-316L is a seamless flux cored arc welding wire to be used with CO_2 or Ar+ more than 20%CO_2 shield gas. Spatters are few, slag is easy to remove and bead appearance and shape are excellent. It is highly resistant to moisture absorption and wire feeding is smooth since the wire has no seam. High welding efficiency is assured in flat and horizontal fillet positions. 18%Cr-12%Ni-2%Mo weld metal contains an adequate amount of ferrite and shows excellent resistance to hot cracking.

GUIDELINES FOR USAGE

1. Distance between base metal and tip should be kept within the range of 15~25mm.
2. Shield gas flow rate should be kept within 20~25ℓ/min.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Shielding gas	C	Si	Mn	P	S	Ni	Cr	Cr
CO_2	0.033	0.65	1.48	0.025	0.007	12.1	19.6	2.34

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elongation, %
570	34

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)	0.8	0.9	1.2	1.6
Current (A)	50~150	70~170	100~250	200~350

Approval: NK, ABS, LR, DNV

Flux Cored Arc Welding Wires for Stainless Steel

Brand Name	Specification		Dia. mm	Application and Characteristics	Typical chemical compositions of weld metal (%)							Typical mechanical properties of weld metal	
	JIS	AWS			C	Si	Mn	Ni	Cr	Mo	Other	TS, MPa	El, %
SF-308	Z 3323 TS308-FB0	☆A5.22 E308T0-1	0.9 1.2 1.6	Welding of SUS304	0.06	0.53	1.49	9.3	19.4	—	—	600	35
	Welding Position	AWS/ASME F/1G HF/2F											
SF-308LP	Z 3323 TS308L-FB1	☆A5.22 E308LT1-1	1.2	Positional Welding of SUS304L	0.03	0.52	1.49	10.3	20.5	—	—	560	38
	Welding Position	AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G											
SF-309LP	Z 3323 TS309L-FB1	☆A5.22 E309LT1-1	1.2	All-possition type. Welding of low-C 22%Cr-12Ni stainless steel and dissimilar metals	0.03	0.57	1.53	12.3	24.2	—	—	570	33
	Welding Position	AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G											
SF-309MoL	Z 3323 TS309LMo-FB0	☆A5.22 E309LMoT0-1	0.9 1.2 1.6	Welding of dissimilar metals such as 18%Cr-12%Ni-2%Mo stainless steel to mild steel	0.035	0.62	1.49	13.1	23.7	2.38	—	740	29
	Welding Position	AWS/ASME F/1G HF/2F											
SF-309MoLP	Z 3323 TS309LMo-FB1	☆A5.22 E309LMoT1-1	1.2	All-possition type. Welding of dissimilar metals such as 18%Cr-12%Ni-2%Mo stainless steel to mild steel	0.03	0.51	1.02	12.9	24.0	2.25	—	670	29
	Welding Position	AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G											
SF-316LP	Z 3323 TS316L-FB1	☆A5.22 E316LT1-1	1.2	Positional welding of SUS316L	0.03	0.58	1.10	12.3	19.2	2.30	—	570	35
	Welding Position	AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G											
SF-317L	Z 3323 TS317L-FB0	☆A5.22 E317LT0-1	1.2	Welding of SUS317L	0.03	0.65	0.93	13.3	19.7	3.32	—	600	30
	Welding Position	AWS/ASME F/1G HF/2F											

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Flux Cored Arc Welding Wires for Stainless Steel

Brand Name	Specification		Dia. mm	Application and Characteristics	Typical chemical compositions of weld metal (%)							Typical mechanical properties of weld metal	
	JIS	AWS			C	Si	Mn	Ni	Cr	Mo	Other	TS, MPa	El, %
SF-2120	—	—	1.2	UNS S82122, S32101 Lean Duplex stainless steel	0.04	0.61	1.02	10.1	26.8	0.93	N: 0.10	790	26
	Welding Position	AWS/ASME F/1G HF/2F H/2G VU/3G											
SF-DP8	Z3323 TS2209-FB0	☆A5.22 E2209T0-1	1.2	Welding of JIS SUS329J3L, and UNS S31803	0.03	0.44	1.14	8.80	23.5	3.05	N: 0.13	808	24.1
	Welding Position	AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G											
SF-DP3	Z 3323 TS329J4L-FB0	—	1.2 1.6	Welding of SUS329J4L or UNS S39226 Duplex Stainless steel	0.04	0.64	1.00	10.4	25.6	2.82	Cu: 0.41 W: 0.25 N: 0.13	845	25
	Welding Position	AWS/ASME F/1G HF/2F											
SF-DP3W	—	☆A5.22 E2594T0-1	1.2 1.6	Welding of SUS329J4L or UNS S32750 Duplex Stainless steel	0.03	0.60	1.12	9.5	26.0	3.67	Cu: 0.41 W: 0.97 N: 0.22	910	24
	Welding Position	AWS/ASME F/1G HF/2F											
FCM-430NL	—	—	1.0 1.2	Welding of SUS430 or SUS405	0.03	0.40	0.24	—	17.9	—	Nb: 0.50	520	28
	Welding Position	AWS/ASME F/1G HF/2F											

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

S-308·R

JIS Z 3221ES308-16
☆AWS A5.4 E308-16

For 18%Cr-8%Ni Stainless steel

APPLICATIONS

Welding of 18%Cr-8%Ni austenitic stainless steel for chemical apparatus, containers and plants,

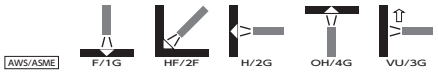
CHARACTERISTICS

S-308·R is a lime-titania type stainless steel electrode depositing 19%Cr-9%Ni metal. Slag is easy to remove, arc is stable, spatters are few and bead appearance is beautiful.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 150~250°C for 60 minutes before use.
2. Dirt such as oil, grease and dust should be completely removed from groove.
3. Excessively wide weaving may cause welding defects. Keep weaving width to less than 2.5 times electrode diameter. Arc length should be kept as short as possible.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr
0.05	0.36	1.35	0.020	0.008	9.8	19.2

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elongation, %	Creep-rupture Strength (as welded,650°C×1,000h), MPa
610	42	130

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current A	F	45~65	55~95	75~125	100~160	150~220
	V-up, OH	40~60	50~85	65~105	85~135	—

Approval: NK
Identification color: End-yellow, secondary-yellow

S-308L·R

JIS Z 3221 ES308L-16
☆AWS A5.4 E308L-16

For Low Carbon 18%Cr - 8%Ni Stainless Steel

APPLICATIONS

Welding of SUS304L type austenitic stainless steel.

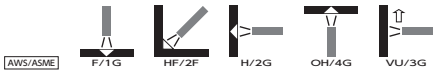
CHARACTERISTICS

S-308L·R is a Low Carbon-19%Cr-9%Ni covered electrode

GUIDELINES FOR USAGE

1. Welding is operated in either AC or DC electrode positive polarity.
2. Electrodes should be dried at 150~250°C for 60 minutes before use.
3. Dirt such as oil, grease and dust should be completely removed from groove.
4. Preheat is not necessary, interpass temperature should be less than 150°C
5. Excessively wide weaving may cause welding defects. Keep weaving width to less than 2.5 times electrode diameter. Arc length should be kept as short as possible.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Other
0.03	0.28	1.55	0.034	0.007	9.80	19.00	0.02	0.02	—

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

0.2% Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
385	548	47	95

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current A	F / H-fillet	45~50	55~70	80~100	110~140	140~170
	V-up, OH	35~45	45~65	70~80	100~130	—

Approval: NK
Identification color: End-Red

S-309·R

JIS Z 3221ES309-16
☆AWS A5.4 E309-16

For 22%Cr-12%Ni Staintess Steel and Dissimilar Metal

APPLICATIONS

Welding of 22%Cr-12%Ni stainless steel, dissimilar metals such as 18% Cr-8%Ni stainless steel to mild steel or low alloy steel, 18%Cr-8%Ni stainless clad steel, and the parts of hardenable steel for which post-heat treatment is impossible, for petroleum, chemical and textile industries.

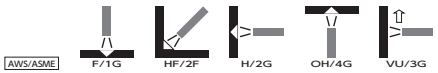
CHARACTERISTICS

S-309·R is a lime-titania type stainless steel electrode. 25% Cr-12% Ni weld metal shows extremely high crack resistance due to its high ferrite content.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 150~250°C for 60 minutes before use.
2. Dirt such as oil, grease and dust should be completely removed from groove.
3. Excessively wide weaving may cause welding defects. Keep weaving width to less than 2.5 times electrode diameter. Arc length should be kept as short as possible.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr
0.06	0.33	1.51	0.020	0.006	13.2	24.2

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elongation, %	Creep-rupture Strength (as welded,650°C×1,000h), MPa
590	37	120

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current A	F	45~65	55~95	710~125	100~160	150~220
	V-up, OH	40~60	50~85	65~105	85~135	—

Approval: NK
Identification color: End-black

S-309L·R

JIS Z 3221 ES309L-16
☆AWS A5.4 E309L-16

For Dissimilar Metal such as Stainless Steel and Mild Steel

APPLICATIONS

Welding of clad side of SUS304 class clad steel.
Welding of dissimilar metal such as SUS304 type stainless steel.

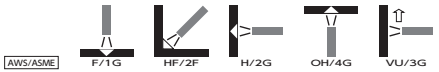
CHARACTERISTICS

S-309L·R is a Low Carbon-24%Cr-13%Ni covered electrode

GUIDELINES FOR USAGE

1. Welding is operated in either AC or DC electrode positive polarity.
2. Electrodes should be dried at 150~250°C for 60 minutes before use.
3. Dirt such as oil, grease and dust should be completely removed from groove.
4. Preheat is not necessary, interpass temperature should be less than 150°C
5. Excessively wide weaving may cause welding defects. Keep weaving width to less than 2.5 times electrode diameter. Arc length should be kept as short as possible.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Other
0.03	0.37	1.52	0.020	0.008	13.0	24.4	0.09	0.09	—

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

0.2% Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
445	582	36	88

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0
Length (mm)		350	350	350
Current A	F / H-fillet	80~100	110~140	140~170
	V-up, OH	70~80	100~130	—

Approval: NK
Indentification color : End-yellow green, secondary-blue

S-309ML·R

JIS Z 3221 ES309LMo-16
*AWS A5.4 E309LMo-16

For Dissimilar Metal such as SUS316L type Stainless Steel and Mild Steel

APPLICATIONS

Welding of clad side of SUS316L class clad steel.
Welding of dissimilar metal such as SUS316L type stainless steel.

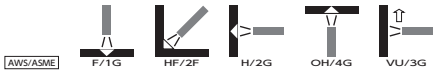
CHARACTERISTICS

S-309ML·R is a Low Carbon-23%Cr-13%Ni-2%Mo covered electrode

GUIDELINES FOR USAGE

1. Welding is operated in either AC or DC electrode positive polarity.
2. Electrodes should be dried at 150~250°C for 60 minutes before use.
3. Dirt such as oil, grease and dust should be completely removed from groove.
4. Preheat is not necessary, interpass temperature should be less than 150°C
5. Excessively wide weaving may cause welding defects. Keep weaving width to less than 2.5 times electrode diameter. Arc length should be kept as short as possible.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr	Mo	Other
0.03	0.32	1.80	0.024	0.013	13.2	22.7	2.40	—

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elongation, %
600	34

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.6	3.2	4.0	5.0
Length (mm)		300	350	350	350
Current A	F / H-fillet	55~70	80~100	110~140	140~170
	V-up, OH	45~60	70~80	100~130	—

Approval: NK, DNV
Indentification color : End-Silver, secondary-red

S-316L·R

JIS Z 3221 ES316L-16
*AWS A5.4 E316L-16

For Low Carbon 18%Cr - 12%Ni - 2%Mo Stainless Steel

APPLICATIONS

Welding of SUS316L type austenitic stainless steel.

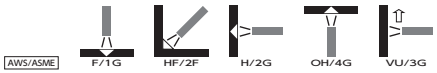
CHARACTERISTICS

S-316L·R is a Low Carbon-18%Cr-12%Ni-2%Mo covered electrode

GUIDELINES FOR USAGE

1) Welding is operated in either AC or DC electrode positive polarity.
2) Electrodes should be dried at 150~250°C for 60 minutes before use.
3) Dirt such as oil, grease and dust should be completely removed from groove.
4) Preheat is not necessary, interpass temperature should be less than 150°C
5) Excessively wide weaving may cause welding defects. Keep weaving width to less than 2.5 times electrode diameter. Arc length should be kept as short as possible.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr	Cu	Mo	Other
0.03	0.46	1.42	0.026	0.011	12.40	19.30	0.02	2.12	—

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

0.2% Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 0°C, J
436	580	38	98

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current A	F / H-fillet	40~50	55~70	80~100	110~140	140~170
	V-up, OH	35~45	45~65	70~80	100~130	—

Approval: NK
Indentification color : End-green

Covered Arc Welding Electrodes for Stainless Steel

Brand Name	Specification		Dia. mm	Application and Characteristics	Typical chemical compositions of weld metal (%)							Typical mechanical properties of weld metal	
	JIS	AWS			C	Si	Mn	Ni	Cr	Mo	Other	TS, MPa	El, %
S-309M・R	Z 3221 ES-309Mo-16	☆A5.4 E309Mo-16	2.6 3.2 4.0 5.0	Welding of dissimilar metals such as 18%Cr-12%Ni-2%Mo stainless steel to mild steel	0.08	0.41	1.68	13.2	24.1	2.51	—	650	34
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G							
S-310・R	Z 3221 ES310-16	☆A5.4 E310-16	2.0 2.6 3.2 4.0 5.0	Welding of SUS310	0.07	0.41	1.93	21.3	26.0	—	—	570	36
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G							
S-316・R	Z 3221 ES316-16	☆A5.4 E316-16	2.0 2.6 3.2 4.0 5.0	Welding of SUS316	0.05	0.33	1.48	12.9	18.3	2.35	—	590	37
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G							
S-316LN・R	—	—	2.6 3.2 4.0 5.0	Welding of SUS316LN	0.023	0.38	1.54	11.9	19.2	2.3	N: 0.15	610	39
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G							
S-316CL・R	Z 3221 ES316LCu-16	—	2.6 3.2 4.0 5.0	Welding of SUS316J1L	0.03	0.33	1.61	13.7	18.5	2.40	Cu: 1.60	570	36
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G							
S-317L・R	Z 3221 ES317L-16	☆A5.4 E317L-16	2.6 3.2 4.0 5.0	Welding of SUS317L	0.034	0.46	1.77	13.2	19.7	3.26	—	610	35
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G							
S-347・R	Z 3221 ES347-16	☆A5.4 E347-16	2.6 3.2 4.0 5.0	Welding of SUS321 or 347	0.05	0.37	1.58	9.7	20.4	—	Nb: 0.68	670	38
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G							
S-347L・R	Z 3221 ES347L-16	☆A5.4 E347-16	2.6 3.2 4.0 5.0	Welding of low-C type for SUS347	0.026	0.78	1.61	10.2	19.3	—	Nb: 0.40	590	39
Welding Position	AWS/ASME	F/1G	HF/2F	H/2G	OH/4G	VU/3G							

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Covered Arc Welding Electrodes for Stainless Steel

Brand Name	Specification		Dia. mm	Application and Characteristics	Typical chemical compositions of weld metal (%)							Typical mechanical properties of weld metal	
	JIS	AWS			C	Si	Mn	Ni	Cr	Mo	Other	TS, MPa	El, %
S-347AP・R	—	—	2.6 3.2 4.0 5.0	Welding of pipe for 347AP	0.05	0.56	1.40	9.57	19.72	—	Nb: 0.34 N: 0.10	670	38
Welding Position	AWS/ASME F/1G	HF/2F	H/2G	OH/4G	VU/3G								
S-170	—	—	2.6 3.2 4.0 5.0	Welding of NSSC170, YUS170	0.04	0.69	1.73	14.5	24.8	0.75	N: 0.28	760	36
Welding Position	AWS/ASME F/1G	HF/2F	H/2G	OH/4G	VU/3G								
S-2120・R	—	—	3.2 4.0	UNS S82122, S32101 Lean Duplex Stainless steel	0.03	0.31	0.78	9.1	25.5	0.67	N: 0.14	800	26
Welding Position	AWS/ASME F/1G	HF/2F	H/2G	VU/3G									
S-DP8	Z 3221 ES2209-16	☆A5.4 E2209-16	2.6 3.2 4.0	Welding of SUS329J3L for duplex stainless steel	0.027	0.83	0.87	8.47	22.21	3.21	N: 0.12	830	28
Welding Position	AWS/ASME F/1G	HF/2F	H/2G	OH/4G	VU/3G								
S-DP3	Z 3221 ES329J4L-16	—	2.6 3.2 4.0	Welding of SUS329J4L for duplex stainless steel	0.035	0.42	0.80	8.8	25.37	3.14	Cu: 0.49 W: 0.28 N: 0.15	850	20
Welding Position	AWS/ASME F/1G	HF/2F	H/2G	OH/4G	VU/3G								
S-DP3W	—	—	2.6 3.2 4.0	Welding of DP3W for super duplex stainless steel	0.035	0.34	0.78	8.8	25.35	3.07	Cu: 0.46 W: 2.07 N: 0.25	960	23
Welding Position	AWS/ASME F/1G	HF/2F											
S-410Nb	Z 3221 ES409Nb-16	☆A5.4 E419Nb-16	2.6 3.2 4.0 5.0	Welding of SUS403, 405 and 410	0.06	0.38	0.40	—	13.2	—	Nb: 0.87	520*	28*
Welding Position	AWS/ASME F/1G	HF/2F	H/2G	OH/4G	VU/3G								
S-430Nb	Z 3221 ES430Nb-16	★A5.4 E430-16	2.6 3.2 4.0 5.0	Welding of SUS430	0.07	0.38	0.56	—	16.8	—	Nb: 0.85	530*	29*
Welding Position	AWS/ASME F/1G	HF/2F	H/2G	OH/4G	VU/3G								

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Note : *PWHT conditions
S-410Nb PWHT: 850°C×2h; S-430Nb PWHT; 770°C×2h

Submerged Arc Welding Materials for Stainless Steel

Brand Name	Specification		Application and Characteristics
	JIS	AWS	
Y-308 × BF-300M	☆Z 3324 YWS308	☆A5.9 ER308	Welding of SUS304
	Welding Position	AWS/ASME F/1G HF/2F	
Y-308L × BF-300M	☆Z 3324 YWS308L	☆A5.9 ER308L	Welding of SUS304L
	Welding Position	AWS/ASME F/1G HF/2F	
Y-304N × BF-308N2	—	—	Welding of SUS304N2
	Welding Position	AWS/ASME F/1G HF/2F	
Y-309 × BF-300M	☆Z 3324 YWS309	☆A5.9 ER309	25% Cr-12% Ni weld metal shows extremely high crack resistance due to its high ferrite content.
	Welding Position	AWS/ASME F/1G HF/2F	
Y-309 × BF-300F	☆Z 3324 YWS309	☆A5.9 ER309	
	Welding Position	AWS/ASME F/1G HF/2F	
Y-316 × BF-300M	☆Z 3324 YWS316	☆A5.9 ER316	Welding of SUS316
Y-316 × BF-300F	Welding Position	AWS/ASME F/1G HF/2F	
Y-316L × BF-300M	☆Z 3324 YWS316L	☆A5.9 ER316L	Welding of SUS316L
Y-316L × BF-300F	Welding Position	AWS/ASME F/1G HF/2F	
Y-316L × BF-29T	—	☆A5.9 ER316L	Welding of SUS316L
	Welding Position	AWS/ASME F/1G	
Y-347 × BF-300M	☆Z 3324 YWS347	☆A5.9 ER347	Welding of SUS347
	Welding Position	AWS/ASME F/1G HF/2F	
Y-170 × BF-300M	—	—	Welding of YUS170
	Welding Position	AWS/ASME F/1G HF/2F	

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical chemical compositions of weld metal (%)							Typical mechanical properties of weld metal	
C	Si	Mn	Ni	Cr	Mo	Other	TS, MPa	El, %
0.05	0.48	1.95	9.4	20.4	—	—	570	45
0.03	0.47	1.93	10.8	19.7	—	—	550	41
0.07	0.85	3.20	8.0	22.7	—	Nb: 0.09 N: 0.18	715	37
0.06	0.45	1.64	13.5	24.0	—	—	590	38
0.06	0.49	1.46	9.8	21.7	—	—	640	44
0.05	0.55	1.68	12.6	19.8	2.25	—	600	butt weld
0.03	0.53	1.60	13.3	19.7	2.29	—	570	40
0.033	0.46	1.50	12.6	20.6	2.68	N: 0.117	720	28
0.05	0.55	1.82	10.1	19.9	—	Nb: 0.65	590	38
0.05	0.99	1.68	12.6	25.4	0.81	N: 0.28	740	51

SAW 9

Submerged Arc Welding Materials for Stainless Steel

Brand Name	Specification		Application and Characteristics
	JIS	AWS	
Y-DP8 × BF-30	—	—	Welding of SUS329J3L
	Welding Position	AWS/ASME F/1G HF/2F	
Y-DP3 × BF-30	—	—	Welding of SUS329J4L or NAR-DP3
	Welding Position	AWS/ASME F/1G HF/2F	
Y-410 × BF-300M	☆Z 3324 YWS410	☆A5.9 ER410	Welding of SUS410
	Welding Position	AWS/ASME F/1G HF/2F	

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical chemical compositions of weld metal (%)							Typical mechanical properties of weld metal	
C	Si	Mn	Ni	Cr	Mo	Other	TS, MPa	El, %
0.035	0.63	0.81	8.2	22.43	3.05	N: 0.11	790	30
0.029	0.50	0.68	8.78	24.90	2.99	Cu: 0.47 W: 0.28 N: 0.14	800	28
0.04	0.56	0.83	—	13.4	—	—	490*	32*

Note : *PWHT condition; Y-410 × BF300M; 730°C×2h

SAW 9

YM-308

☆JIS Z 3321 YS308
☆AWS A5.9 ER308

For 18%Cr-8%Ni Stainless Steel

APPLICATIONS

Welding of 18%Cr-8%Ni Stainless Steel for chemical engineering and food processing apparatus.

CHARACTERISTICS

YM-308 is a gas metal arc welding wire to be used with Ar+0.5~2%O_2 shield gas. Arc is stable, bead appearance is beautiful with outstanding edge wetting and weldability is satisfactory. 19%Cr-9%Ni weld metal contains an adequate amount of ferrite and shows excellent resistance to hot cracking.

GUIDELINES FOR USAGE

When high X-ray quality is required, stable spray transfer mode should be maintained with low current and slow welding speed using a pulsed arc power source.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr
0.04	0.34	1.92	0.019	0.002	9.6	19.9

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elongation, %
620	42

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)	1.0	1.2	1.6
Current (A)	70~300	100~350	120~350

Approval:

YM-309

☆JIS Z 3321 YS309
☆AWS A5.9 ER309

For 22%Cr-12%Ni Stainless Steel and Dissimilar Metal

APPLICATIONS

Welding of 22%Cr-12%Ni stainless steel for petroleum, chemical engineering and textile industries, 18%Cr-8%Ni stainless clad steel and dissimilar metals such as mild steel to stainless steel.

CHARACTERISTICS

YM-309 is a gas metal arc welding wire to be used with Ar+0.5~2%O_2 shield gas. Arc is stable, bead appearance is beautiful with outstanding edge wetting and weldability is satisfactory. 24%Cr-13%Ni weld metal contains an adequate amount of ferrite and shows excellent resistance to hot cracking.

GUIDELINES FOR USAGE

1. When high X-ray quality is required, stable spray transfer mode should be maintained with low current and slow welding speed using a pulsed arc power source.
2. In the welding of dissimilar metals, excessive dilution deteriorates crack and corrosion resistance. Care should be taken for the penetration to base metal.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr
0.05	0.35	1.74	0.021	0.007	13.3	23.6

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elongation, %
620	32

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)	1.0	1.2	1.6
Current (A)	70~300	100~350	120~350

Approval:

YM-316

*JIS Z 3321 YS316
*AWS A5.9 ER316

For 18%Cr-12%Ni-2%Mo Stainless steel

APPLICATIONS

Welding of 18%Cr-12%Ni-2%Mo Stainless Steel for chemical engineering and power plants.

CHARACTERISTICS

YM-316 is a gas metal arc welding wire to be used with Ar+0.5~2%O_2 shield gas. Arc is stable, bead appearance is beautiful with outstanding edge wetting and weldability is satisfactory. 18%Cr-12%Ni-2%Mo weld metal contains an adequate amount of ferrite and shows excellent resistance to hot cracking.

GUIDELINES FOR USAGE

When high X-ray quality is required, stable spray transfer mode should be maintained with low current and slow welding speed using a pulsed arc power source.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr	Mo
0.04	0.40	1.48	0.020	0.019	13.5	18.8	2.70

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Tensile Strength, MPa	Elongation, %
580	32

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)	1.0	1.2	1.6
Current (A)	70~300	100~350	120~350

Approval:

Memo

Gas Metal Arc Welding wires for Stainless Steel

Brand Name	Specification		Dia. mm	Application and Characteristics	Typical chemical compositions of weld metal (%)							Typical mechanical properties of weld metal		
	JIS	AWS			C	Si	Mn	Ni	Cr	Mo	Other	TS, MPa	El, %	PWHT
YM-308L	☆Z 3321 YS308L	☆A5.9 ER308L	1.0 1.2 1.6	Weld metal shows excellent impact values and sufficient strngth and toughness as welded and after stress relieving annealing.	0.025	0.32	1.63	10.3	20.7	—	—	600	43	—
	Welding Position	AWS/ASME F/1G HF/2F												
YM-308LSi	☆Z 3321 YS308L-Si	☆A5.9 ER308LSi	1.0 1.2 1.6	Weld metal shows excellent impact values and sufficient strngth and toughness as welded and after stress relieving annealing.	0.023	0.79	1.96	9.8	19.7	—	—	560	40	—
	Welding Position	AWS/ASME F/1G HF/2F												
YM-308UL	☆Z 3321 YS308L	☆A5.9 ER308L	1.0 1.2 1.6	Welding of ultra low C type for SUS304L	0.016	0.42	1.51	10.3	20.5	—	—	520	55	—
	Welding Position	AWS/ASME F/1G HF/2F												
YM-309L	☆Z 3321 YS309L	☆A5.9 ER309L	1.0 1.2 1.6	Low C type of YM-309	0.014	0.37	1.78	13.7	23.2	—	—	580	36	—
	Welding Position	AWS/ASME F/1G HF/2F												
YM-309LSi	☆Z 3321 YS309L-Si	☆A5.9 ER309LSi	1.0 1.2 1.6	Low C and high Si type of YM-309	0.022	0.82	1.81	13.0	23.7	—	—	600	33	—
	Welding Position	AWS/ASME F/1G HF/2F												
YM-309Mo	☆Z 3321 YS309Mo	☆A5.9 ER309Mo	1.0 1.2 1.6	Welding of dissimilar metals such as 18%Cr-12%Ni-2%Mo stainless steel to mild steel	0.10	0.38	2.13	13.7	23.2	2.2	—	640	38	—
	Welding Position	AWS/ASME F/1G HF/2F												
YM-309MoL	☆Z 3321 YS309LMo	☆A5.9 ER309LMo	1.0 1.2 1.6	Welding of dissimilar metals such as 18%Cr-12%Ni-2%Mo stainless steel to mild steel	0.010	0.35	1.67	13.9	23.7	2.2	—	630	39	—
	Welding Position	AWS/ASME F/1G HF/2F												
YM-310	☆Z 3321 YS310	☆A5.9 ER310	1.0 1.2 1.6	Welding of SUS310	0.05	0.33	1.52	21.4	26.1	—	—	590	41	—
	Welding Position	AWS/ASME F/1G HF/2F												
YM-316L	☆Z 3321 YS316L	☆A5.9 ER316L	1.0 1.2 1.6	Welding of SUS316L	0.025	0.39	1.58	12.7	19.2	2.3	—	570	43	—
	Welding Position	AWS/ASME F/1G HF/2F												

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Gas Metal Arc Welding wires for Stainless Steel

Brand Name	Specification		Dia. mm	Application and Characteristics	Typical chemical compositions of weld metal (%)							Typical mechanical properties of weld metal		
	JIS	AWS			C	Si	Mn	Ni	Cr	Mo	Other	TS, MPa	El, %	PWHT
YM-316LSi	☆Z 3321 YS316L-Si	☆A5.9 ER316LSi	1.0 1.2 1.6	High Si type of YM-316L	0.015	0.73	1.79	12.0	19.3	2.4	—	580	44	—
Welding Position	AWS/ASME F/1G HF/2F													
YM-316UL	☆Z 3321 YS316L	☆A5.9 ER316L	1.0 1.2 1.6	Ultra low C type of YM-316L	0.015	0.49	1.32	12.8	18.9	2.6	—	540	50	—
Welding Position	AWS/ASME F/1G HF/2F													
YM-317L	☆Z 3321 YS317L	☆A5.9 ER317L	1.0 1.2 1.6	Welding of SUS317L	0.023	0.40	1.55	14.3	19.8	3.4	—	630	38	—
Welding Position	AWS/ASME F/1G HF/2F													
YM-347	☆Z 3321 YS347	☆A5.9 ER347	1.0 1.2 1.6	Welding of SUS321 and SUS347	0.05	0.34	1.50	10.1	19.0	—	Nb: 0.69	630	40	—
Welding Position	AWS/ASME F/1G HF/2F													
YM-347L	☆Z 3321 YS347L	☆A5.9 ER347	1.0 1.2 1.6	Low C type of YM-347	0.030	0.35	1.46	9.5	19.0	—	Nb: 0.65	610	42	—
Welding Position	AWS/ASME F/1G HF/2F													
YM-190	—	—	0.8 1.0 1.2	Welding of NSSC190 and YUS190 (SUS444)	0.009	0.10	0.16	—	18.8	1.97	Ti: 0.12 Nb: 0.30	480	13	—
Welding Position	AWS/ASME F/1G HF/2F													
YM-410	☆Z 3321 YS410	☆A5.9 ER410	1.2 1.6	Welding of SUS410	0.05	0.36	0.30	—	12.8	—	—	570	33	850°C×2h
Welding Position	AWS/ASME F/1G HF/2F													
YM-430L	☆Z 3321 YS430	☆A5.9 ER430	1.2 1.6	Welding of SUS430 and SUS405	0.020	0.32	0.28	—	16.2	—	—	540	26	760°C×2h
Welding Position	AWS/ASME F/1G HF/2F													
YM-160	☆Z 3321 YS430L-Nb	—	1.0 1.2 1.6	Welding of SUS430 and SUS405	0.010	0.28	0.24	—	16.0	—	Nb: 0.43 Cu: 0.3	470	25	770°C×2h
Welding Position	AWS/ASME F/1G HF/2F													

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

YT-308L

☆JIS Z 3321 YS308L
☆AWS A5.9 ER308L

For Low Carbon 18%Cr-8%Ni Stainless Steel

APPLICATIONS

Welding of SUS304L type austenitic stainless steel.

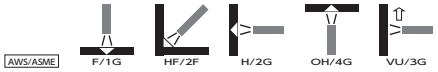
CHARACTERISTICS

YT-308L is a Low Carbon-20%Cr-10%Ni wire rod for GTAW

GUIDELINES FOR USAGE

1. Pure Argon gas is used for shielding.
2. Remove grease and oil from weld zone.
3. Avoid excessive heat input in order to obtaining good corrosion resistance with welds.
4. Preheat is not necessary, and interpass temperature should be less than 150°C.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr	Other
0.02	0.40	1.65	0.023	0.000	9.74	19.30	—

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

0.2% Yield Point, MPa	Tensile Strength, MPa	Elongation, %
420	563	43

■ SIZES

Diameter (mm)	1.2, 1.6, 2.0, 2.4
Current (A)	1000

Approval: NK, LR

YT-309L

☆JIS Z 3321 YS309L
☆AWS A5.9 ER309L

For Dissimilar Metal such as Stainless Steel and Mild Steel

APPLICATIONS

Welding of clad side of SUS304 class clad steel.
Welding of dissimilar metal such as SUS304 type stainless steel.

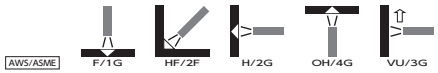
CHARACTERISTICS

YT-309L is a Low Carbon-24%Cr-13%Ni wire rod for GTAW

GUIDELINES FOR USAGE

1. Pure Argon gas is used for shielding
2. Remove grease and oil from weld zone.
3. Avoid excessive heat input in order to obtaining good corrosion resistance with welds.
4. Preheat is not necessary, and interpass temperature should be less than 150°C.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Other
0.01	0.45	1.62	0.024	0.002	13.7	23.1	0.05	0.08	—

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

0.2% Yield Point, MPa	Tensile Strength, MPa	Elongation, %
380	585	41

■ SIZES

Diameter (mm)	1.2, 1.6, 2.0, 2.4
Current (A)	1000

Approval:

YT-309MoL

☆JIS Z 3321 YS309LMo
☆AWS A5.9 ER309LMo

For Dissimilar Metal such as SUS316L type Stainless Steel and Mild Steel

APPLICATIONS

Welding of clad side of SUS316L class clad steel.
Welding of dissimilar metal such as SUS316L type stainless steel.

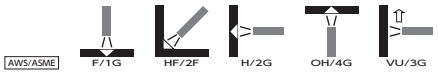
CHARACTERISTICS

YT-309MoL is a Low Carbon-23%Cr-13%Ni-2%Mo wire rod for GTAW

GUIDELINES FOR USAGE

1. Pure Argon gas is used for shielding.
2. Remove grease and oil from weld zone.
3. Avoid excessive heat input in order to obtaining good corrosion resistance with welds.
4. Preheat is not necessary, and interpass temperature should be less than 150°C.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Cr	Mo	Other
0.017	0.45	1.52	13.6	23.0	2.1	—

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

0.2% Yield Point, MPa	Tensile Strength, MPa	Elongation, %
—	670	34

■ SIZES

Diameter (mm)	1.2, 1.6, 2.0, 2.4
Current (A)	1000

Approval: NK

YT-316L

☆JIS Z 3321 YS316L
☆AWS A5.9 ER316L

For Low Carbon 18%Cr - 12%Ni - 2%Mo Stainless Steel

APPLICATIONS

Welding of SUS316L type austenitic stainless steel.

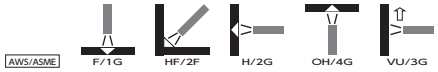
CHARACTERISTICS

YT-316L is a Low Carbon-18%Cr-12%Ni-2%Mo wire rod for GTAW

GUIDELINES FOR USAGE

1. Pure Argon gas is used for shielding.
2. Remove grease and oil from weld zone.
3. Avoid excessive heat input in order to obtaining good corrosion resistance with welds.
4. Preheat is not necessary, and interpass temperature should be less than 150°C.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	Ni	Cr	Mo	Other
0.023	0.40	1.52	12.1	18.3	2.4	—

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

0.2% Yield Point, MPa	Tensile Strength, MPa	Elongation, %
—	590	37

■ SIZES

Diameter (mm)	1.2, 1.6, 2.0, 2.4
Current (A)	1000

Approval: NK, LR

Gas Tungsten Arc Welding Rods and Wires for Stainless Steel

Brand Name	Specification		Dia. mm	Application and Characteristics	Typical chemical compositions of weld metal (%)							Typical mechanical properties of weld metal	
	JIS	AWS			C	Si	Mn	Ni	Cr	Mo	Other	TS, MPa	El, %
YT-308	☆Z 3321 YS308	☆A5.9 ER308	1.2 1.6 2.0 2.4	Welding of SUS304	0.05	0.35	1.62	10.0	20.2	—	—	650	40
YT-308UL	☆Z 3321 YS308L	☆A5.9 ER308L	1.2 1.6 2.0 2.4	Ultra Low C type of YT-308L	0.013	0.51	1.42	10.0	20.5	—	—	510	58
YT-309	☆Z 3321 YS309	☆A5.9 ER309	1.2 1.6 2.0 2.4	Welding of 22%Cr-12%Ni stainless steel (SUS309S), clad side of 18%Cr-8%Ni stainless clad steel and dissimilar joints of stainless steel and mild steel.	0.05	0.40	1.65	12.4	23.8	—	—	600	43
YT-309Mo	☆Z 3321 YS309Mo	☆A5.9 ER309Mo	1.2 1.6 2.0 2.4	Welding of dissimilar metals such as 18%Cr-12%Ni-2%Mo stainless steel to mild steel	0.11	0.38	2.31	13.9	23.4	2.2	—	680	33
YT-310	☆Z 3321 YS310	★A5.9 ER310	1.2 1.6 2.0 2.4	Welding of SUS310	0.04	0.35	1.56	21.5	26.9	—	—	600	43
YT-316	☆Z 3321 YS316	☆A5.9 ER316	1.2 1.6 2.0 2.4	Welding of SUS316	0.04	0.35	1.52	12.2	19.0	2.5	—	620	31
YT-316UL	☆Z 3321 YS316L	☆A5.9 ER316L	1.2 1.6 2.0 2.4	Ultra Low C type of YT-316L	0.015	0.55	1.51	12.6	19.0	2.5	—	530	49
YT-317L	☆Z 3321 YS317L	☆A5.9 ER317L	1.2 1.6 2.0 2.4	Welding of SUS317L	0.014	0.41	1.77	14.1	18.7	3.5	—	520	55
YT-320	—	☆A5.9 ER320LR	1.2 1.6 2.0 2.4	Welding of Alloy 20Cb3	0.004	0.08	1.71	33.6	20.5	2.5	Nb: 0.2 Cu: 3.5	520	55
YT-347	☆Z 3321 YS347	☆A5.9 ER347	1.2 1.6 2.0 2.4	Welding of SUS321 and SUS347	0.02	0.43	1.79	9.7	19.4	—	Nb: 0.74	670	46
YT-347AP	—	—	1.2 1.6 2.0 2.4	Welding of 347AP pipe	0.027	0.35	1.47	9.4	20.6	—	Nb: 0.44 N: 0.19	690	36

Gas Tungsten Arc Welding Rods and Wires for Stainless Steel

Brand Name	Specification		Dia. mm	Application and Characteristics	Typical chemical compositions of weld metal (%)							Typical mechanical properties of weld metal	
	JIS	AWS			C	Si	Mn	Ni	Cr	Mo	Other	TS, MPa	El, %
YT-DP8	☆Z 3321 YS2209	☆A5.9 ER2209	1.2 1.6 2.0 2.4	Welding of SUS329J3L and UNS S31803	0.007	0.41	1.61	8.4	22.1	3.26	N: 0.10	780	35
YT-DP3	—	—	1.2 1.6 2.0 2.4	Welding of SUS329J4L	0.010	0.37	0.78	9.3	25.3	3.03	W: 0.27 Cu: 0.4 N: 0.17	830	29
YT-DP3W	—	—	1.0 1.2 1.6 2.0 2.4	Welding of Super Duplex Stainless Steel (DP3W tube, NAR-DP3W)	0.017	0.42	0.53	9.2	25.7	3.07	W: 2.11 Cu: 0.5 N: 0.28	890	29
YT-410	☆Z 3321 YS410	☆A5.9 ER410	1.2 1.6 2.0 2.4	Welding of SUS410	0.06	0.38	0.30	—	12.9	—	—	520	33
YT-430	☆Z 3321 YS430	☆A5.9 ER430	1.2 1.6 2.0 2.4	Welding of SUS430	0.05	0.33	0.37	—	16.8	—	—	530	28
YT-430L	☆Z 3321 YS430L	☆A5.9 ER430			0.01	0.39	0.49	—	16.8	—	—	520	30
YT-190	—	—	1.2 1.6 2.0 2.4	Welding of NSSC 190 and YUS190 (190Cr-2Mo-Ti, Nb)	0.008	0.09	0.16	—	19.2	1.93	Nb: 0.30 N: 0.011 Ti: 0.13	480	12
YT-444	—	—	1.2 1.6 2.0 2.4	Welding of SUS444	0.004	0.02	0.06	0.5	19.0	2.14	Nb: 0.29 N: 0.005 O: 0.002	500	28

Memo

Special Alloy

Covered Arc Welding Electrodes
Submerged Arc Welding Materials
Gas Tungsten Arc Welding Rods and Wires

YAWATA WELD B (M)

JIS Z 3225 D9Ni-1
☆AWS A5.11 ENiCrFe-4

For 9%Ni Steel

APPLICATIONS

Welding of 9%Ni steel for cryogenic storage tanks for LNG, Liquified nitrogen, etc.

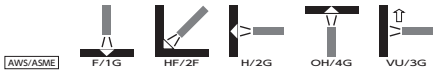
CHARACTERISTICS

YAWATA WELD B(M) is an Inconel type electrode corresponding to INCO-WELD B and is a modified version of YAWATA WELD B for higher strength. Weld metal shows excellent strength and toughness at extremely low temperatures and meets the specifications of API and NV for the welding of 9%Ni steel. With AC, it permits easy operation free from arc blow.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 300~350°C for 60 minutes before use.
2. Arc length should be kept as short as possible.
3. Crater treatment or grinding off of crater is required.

WELDING POSITION



■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Cu	Fe	Ni	Cr	Nb	Mo
0.09	0.24	3.27	0.008	0.003	0.02	10.4	65.1	15.0	1.56	2.32

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −196°C, J
420	700	40	76

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0
Length (mm)		350	350	350
Current A	F	80~100	110~140	140~180
	V-up, OH	70~90	100~130	—

Approval: NK, LR, DNV, CCS
Identification color: End-Purple, secondary-White

NITTETSU WELD 196

JIS Z 3225 D9Ni-2
☆AWS A5.11 ENiMo-9

For 9%Ni Steel

APPLICATIONS

Welding of 9%Ni steel for cryogenic storage tanks for LNG, Liquified nitrogen, etc.

CHARACTERISTICS

WELD 196 is a Hastelloy type electrode. Weld metal shows excellent strength and toughness at extremely low temperatures and meets the specifications of API and NV for the welding of 9%Ni steel.

GUIDELINES FOR USAGE

1. Electrodes should be redried at 300~350°C for 60 minutes before use.
2. Arc length should be kept as short as possible.
3. Crater treatment or grinding off of crater is required.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Fe	Ni	Mo	W
0.04	0.35	0.30	0.003	0.002	2.66	73.5	19.2	2.78

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at −196°C, J
440	720	51	98

■ SIZES & RECOMMENDED CURRENT RANGE<AC or DC(+)>

Diameter (mm)		3.2	4.0	5.0
Length (mm)		300	350	350
Current A	F	80~100	110~140	140~180
	V-up, OH	70~90	100~130	—

Approval: LR, CCS
Identification color: End-brown, secondary-white

Covered Arc Welding Electrodes for Nickel and Nickel Alloy

Brand Name	Specification JIS	Specification AWS	Dia. mm	Application and Characteristics	Typical Chemical Compositions of Weld Metal (%) C	Si	Mn	Fe	Ni	Cr	Nb	Mo	Other	Typical Mechanical Properties of Weld Metal YS, MPa	TS, MPa	El, %	Charpy 2V-notch, J
YAWATA WELD B	Z 3224 ENi6133	☆A5.11 ENiCrFe-2	2.6 3.2 4.0 5.0	YAWATA WELD B is an Inconel type electrode which is a modified version of INCO-WELD A, by The International Nickel Company, Inc., for AC use. Weld metal shows excellent resistance to heat, corrosion and oxidization as well as remarkable toughness at extremely low temperatures. In the welding of dissimilar metals, carbon migration and embrittlement are lower than stainless steel electrodes and coefficient of heat expansion is between those of carbon steel and austenitic stainless steel.	0.06	0.30	2.91	10.1	68.5	16.65	1.69	0.76	Cu: 0.06	380	650	40	−196°C 93
Welding Position			AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G														
YAWATA WELD 182	☆Z 3224 ENi6182	☆A5.11 ENiCrFe-3	2.6 3.2 4.0 5.0	YAWATA WELD 182 is an Inconel type electrode of which weld metal has the same properties as that of INCONEL Welding Electrode 182. It is suitable for welding and surfacing extremely thick plates for nuclear reactor vessels since a slightly high titanium content in weld metal checks the occurrence of blowholes. For the weldment to be used at high temperatures more than 1,000°F(538°C), YAWATA WELD B is recommended because it assures higher strength at high temperatures than YAWATA WELD 182.	0.08	0.52	6.85	7.30	68.4	14.2	1.66	—	Cu: 0.14 Ti: 0.53 Co: 0.03	440	660	44	0°C 130
Welding Position			AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G														
NITTETSU WELD 112 AC	Z 3224 ENi6625	☆A5.11 ENiCrMo-3	2.6 3.2 4.0 5.0	High strength Inconel type electrode for AC welding of high Ni alloys such as Inconel 625 and dissimilar metals of various alloys. Weld metal shows high resistance to heat, oxidation and corrosion as well as remarkably high strength.	0.06	0.38	0.46	4.95	59.2	21.8	3.40	8.90	—	490	790	43	—
Welding Position			AWS/ASME F/1G HF/2F H/2G OH/4G VU/3G														

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

NITTETSU FLUX 10H × NITTETSU FILLER 196

☆JIS Z 3333 FS9Ni-H YS9Ni
☆AWS A5.14 ERNiMo-9

For 9%Ni Steel

APPLICATIONS

Horizontal butt welding of 9%Ni steel for cryogenic storage tanks for LNG, liquefied nitrogen, etc.

CHARACTERISTICS

Hastelloy type weld metal shows high strength and excellent toughness at extremely low temperatures, and meets the requirements of API and NV for 9%Ni steel. Crack resistance is better than INCONEL type wires. Slag is easy to remove, bead appearance and X-ray properties are excellent.

GUIDELINES FOR USAGE

1. Flux should be redried at 300~350°C for 120 minutes before use.
2. DC (+) should be used.

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

C	Si	Mn	P	S	Fe	Ni	Mo	W	Al	Base Metal	Plate Thickness mm	Welding Method
0.04	0.45	0.62	0.002	0.001	2.03	73.8	19.8	2.58	0.27	9%Ni steel	19	Flat, Padding

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch at −196°C, J	Base Metal	Plate Thickness mm	Welding Method
410	710	50	110	9%Ni steel	19	Flat

■ TYPICAL WELD JOINT TEST

Tensile Test of Weld Metal			Joint Tensile Test		Charpy 2 V-notch at −196°C, J	Base Metal	Plate Thickness mm	Welding Method
Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Tensile Strength, MPa	Location of Fracture				
420	690	43	740	Weld metal + Base metal	130	9%Ni steel	30	Horizontal Butt

■ TYPICAL GROOVE GEOMETRY AND WELDING CONDITIONS

Welding Method	Wire Dia. mm	Current, A	Voltage, V	Speed, cm/min	Wire Extension
Horizontal Butt	1.6	200~280	27±2	20~60	25 ± 5
	2.4	300~380	26±2	30~70	25 ± 5

Approval: NK, LR, DNV, BV, CCS

Memo

Gas Tungsten Arc Welding Rods and Wires for Nickel and Nickel Alloy

Brand Name	Specification		Dia. mm	Application and Characteristics
	JIS	AWS		
YT-NIC	☆Z 3334 SNi2061	☆A5.14 ERNi-1	1.2 1.6 2.0 2.4	Welding for pure Nickel and dissimilar joint
YAWATA FILLER 82	☆Z 3334 SNi6082	☆A5.14 ERNiCr-3	1.2 1.6 2.0 2.4	Welding of Inconel 600 and Incoloy 800 requiring resistance to heat, oxidation and corrosion, and various combinations of dissimilar metals such as carbon steel, stainless steel and Ni alloys. Weld metal shows properties similar to INCONEL Filler Metal 82. In the welding of dissimilar metals, crack resistance is excellent since the coefficient of heat expansion is between those of carbon steel and austenitic stainless steel.
NITTETSU FILLER 196	☆Z3332 YGT9Ni-2	☆A5.14 ERNiMo-9	1.2 1.6 2.0 2.4	Welding of 9%Ni steel to be used at extremely low temperatures for storage tanks for LNG and liquefied nitrogen gas and LNG tankers. Weld metal shows high strength and excellent toughness at extremely low temperatures, and meets the requirements of API and NV. Crack resistance is also excellent.
YT-NC718	☆Z 3334 SNi7718	☆A5.14 ERNiFeCr-2	1.2 1.6 2.0 2.4	Welding of Inconel 718
NITTETSU FILLER 625	☆Z 3334 SNi6625	☆A5.14 ERNiCrMo-3	1.2 1.6 2.0 2.4	Welding of Inconel 625, 601 and Incoloy 825 requiring resistance to heat, oxidation and corrosion, and Incoloy 825 to various kinds of dissimilar metals. It is also used for surfacing of carbon steel. Weld metal has properties similar to INCONEL Filler Metal 625 and shows excellent resistance to heat, oxidation and corrosion as well as high fatigue strength.
YT-HSTC2	☆Z 3334 SNi6276	☆A5.14 ERNiCrMo-4	1.2 1.6 2.0 2.4	Welding of Hastelloy C276
YT-NC622	☆Z 3334 SNi6022	☆A5.14 ERNiCrMo-10	1.2 1.6 2.0 2.4	Welding of Hastelloy C22
YT-NC617	☆Z 3334 SNi6617	☆A5.14 ERNiCrCoMo-1	1.2 1.6 2.0 2.4	Welding of Inconel 617

Typical Chemical Compositions of Weld Metal (%)								Typical Mechanical Properties of Weld Metal			
C	Si	Mn	Ni	Cr	Mo	Fe	Other	YS, MPa	TS, MPa	El, %	Charpy 2V-notch at 0°C, J
0.001	0.35	0.33	96.0	—	—	0.05	Ti: 2.51 Al: 0.15	230	460	41	—
0.03	0.11	3.05	72.7	19.7	—	1.50	Co: 0.01 Ti: 0.35 Nb: 2.68	410	680	47	150
0.02	0.01	0.03	74.7	—	20.2	1.04	Cu: 0.75 W: 2.96	420	720	46	−196°C 160
0.028	0.08	0.08	53.8	18.0	3.1	—	Nb: 5.2 Cu: 0.10 Al: 0.45 B: 0.001	520	850	28	—
0.02	0.20	0.08	61.6	21.8	8.96	2.84	Nb: 3.55 Ti: 0.27 Al: 0.18	600	790	46	—
0.017	0.01	0.52	55.4	14.8	15.2	5.5	Co: 1.9 Cu: 0.05 W: 3.8 V: 0.2	550	770	40	—
0.009	0.05	0.22	57.5	20.6	14.0	2.3	Co: 0.09 W: 3.3 V: 0.01	550	790	40	—
0.08	0.11	0.13	52.8	21.3	9.4	0.5	Ti: 0.3	520	840	28	—

Memo

Surfacing•Cast Iron

Covered Arc Welding Electrodes

Covered Arc Welding Electrodes for Surfacing

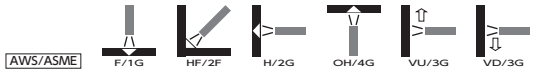
Brand Name	Identification Color		Specification	Dia. mm	Application and Characteristics	Typical Chemical Composition of Weld Metal (%)							Typical Hardness of Weld Metal (HV)		
	End	Secondary	JIS			C	Si	Mn	Cr	Mo	V	Others	As Welded	After work-hardened	PWHT
H-250B	Light blue	Red	☆Z 3251 DF2A-250-R	4.0 5.0 6.0	It is a high titanium oxide type electrode being used widely for surfacingof shafts, gears and crane wheels. Weldability is excellent and bead apearance is beautiful. Weld metal has the hardness of about 250 Vickers and is easily machined.	0.12	0.43	0.52	0.81	—	—	—	240	—	—
Welding Position			AWS/ASME F/1G HF/2F H/2G VU/3G												
H-250C	Light blue	black	☆Z 3251 DF2A-250-B	3.2 4.0 5.0 6.0	Surfacing of shafts, rollers, couplings and crane wheels. H-250C is a low hydrogen type electrode with excellent weldability. It is suitable for surfacing worn machine parts since weld metal has the hardness of about 250 Vickers as welded and is easily machined. It also is suitable for depositing buffer layer in multi-1ayer welding due to its high crack resistance.	0.13	0.27	0.94	0.65	—	—	—	250	—	500°C 230
Welding Position			AWS/ASME F/1G HF/2F H/2G VU/3G												
H-300C	Light blue	Orange	☆Z 3251 DF2A-300-B	4.0 5.0 6.0	Surfacing of shafts, rollers, spindles, gears and crane wheels H-300C is a low hydrogen type electrode for surfacing machine parts, and carbon steel and cast steel of poor weldability. Weld metal has the hardness of about 300 Vickers as welded and is easily machined. Weldability is excellent.	0.18	0.83	1.55	0.60	—	—	—	310	—	500°C 285
Welding Position			AWS/ASME F/1G HF/2F H/2G VU/3G												
H-350C	Light blue	White	☆Z 3251 DF2A-350-B	4.0 5.0 6.0 7.0	Surfacing of shafts, rollers, and bulldozer idlers and sprockets. H-350C is a low hydrogen type electrode for surfacing worn machine parts subjected to high stress abrasion by metal to metal sliding or rolling. Weld metal of about 350 Vickers hardness as welded provides reasonable abrasion resistance and is machinable in general.	0.16	0.43	1.32	1.55	—	—	—	355	—	500°C 335
Welding Position			AWS/ASME F/1G HF/2F H/2G VU/3G												
H-500	Reddish	Blue	☆Z 3251 DF2B-500-B	3.2 4.0 5.0 6.0	Surfacing of track links, bulldozer idlers and bucket lips. H-500 is a low hydrogen type electrode for surfacing machine parts which are subjected to metal to metal abrasion or earth and sand abrasion and are used without machining. Weld metal of about 500 Vickers hardness and martensitic structure provides reasonable toughness and stress resistance to some extent.	0.34	0.76	1.13	3.06	0.44	—	—	535	—	500°C 495
Welding Position			AWS/ASME F/1G HF/2F VU/3G												

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Covered Arc Welding Electrodes for Surfacing

Brand Name	Identification Color		Specification	Dia. mm	Application and Characteristics	Typical Chemical Composition of Weld Metal (%)							Typical Hardness of Weld Metal (HV)		
	End	Secondary	JIS			C	Si	Mn	Cr	Mo	V	Others	As Welded	After work-hardened	PWHT
H-600	Reddish brown	Pink	☆Z 3251 DF2B-600-B	4.0 5.0 6.0	Surfacing of track rollers, crusher teeth, mill hammers and bucket lips. H-600 is a low hydrogen type electrode for surfacing worn parts of civil engineering, construction and mining machinery to be used without machining. Weld metal of about 600 Vickers hardness and martensitic structure provides high toughness in spite of high hardness and excellent abrasion resistance to midium impact.	0.45	0.50	1.15	3.95	0.60	—	—	625	—	500°C 605
Welding Position			AWS/ASME	F/1G	HF/2F VU/3G										
H-700	Black	—	☆Z 3251 DF2B-700-B	4.0 5.0 6.0 7.0	Surfacing of mixers, screw conveyers and casings. H-700 is a low hydrogen type electrode for surfacing machine parts which are subjected to heavy impact. Weld metal of about 700 Vickers hardness and martensitic structure provides extremely high abrasion resistance.	0.64	0.90	1.23	2.58	—	0.72	—	710	—	—
Welding Position			AWS/ASME	F/1G	HF/2F VU/3G										
H-750	Reddish brown	Yellow	☆Z 3251 DF3C-700-B	4.0 5.0 6.0	It is a low hydrogen type electrode for surfacing civil engineering and construction machine parts which are not subjected to heavy impact. Weld metal of about 750 Vickers hardness and martensitic structure provides stably high hardness and abrasion resistance. Weldability is excellent.	0.69	0.99	0.35	5.83	—	1.71	—	765	—	—
Welding Position			AWS/ASME	F/1G	HF/2F VU/3G										
H-800	Reddish brown	Purple	☆Z 3251 DF3C-700-B	4.0 5.0 6.0	Surfacing of dredger pump mouths, impellers, liners and cutter knives. H-800 is a low hydrogen type electrode to give extremely hard weld metal due to dispersedly precipitated borides and carbides. Although it is not suitable for impact abrasion since weld metal tends to crack, it shows excellent resistance to earth and sand abrasion.	0.82	1.28	1.10	8.26	0.52	—	B: 0.45	815	—	—
Welding Position			AWS/ASME	F/1G	HF/2F										
H-13Cr	Reddish brown	Black	☆Z 3251 DF4B-350-B	4.0 5.0	Surfacing of hammer mills. roll crushers. hot trimming dies, roll dies and forging benches subjected to high temperature abrasion. Weld metal has chmeical composition similar to tool steel SKD11 and the hardness of about 350 Vickers as welded and 500-600 Vickers after work hardened. It also is suitable for parts subjected to medium impact abrasion at high temperatures since weld metal is resistant to comparatively high heat.	1.21	0.34	0.30	13.3	0.50	—	—	360	520	—
Welding Position			AWS/ASME	F/1G	HF/2F										

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.



Covered Arc Welding Electrodes for Surfacing

Brand Name	Identification Color		Specification	Dia. mm	Application and Characteristics
	End	Secondary	JIS		
H-13M	Reddish brown	Brown	☆Z 3251 DFMA-250-B	4.0 5.0 6.0	Filling up cavities of high manganese cast steel and surfacing of parts subjected to impact abrasion such as boring mills. Weld metal of austenitic structure has chemical composition similar to high manganese cast steel SCMnH2 and the hardness of about 250-300 Vickers as welded. Hardness goes up to 450-550 Vickers after work hardened and improves abrasion resistance remarkably.
	Welding Position		AWS/ASME	F/1G	HF/2F
H-13MN	Reddish brown	White	☆Z 3251 DFMB-250-B	4.0 5.0	Filling up cavities of high manganese cast steel and surfacing of parts subjected to impact abrasion such as boring mills. Weld metal has the hardness of about 200~250 Vickers as welded and is work hardened to 450~550 Vickers, like H-13CrM, but toughness and crack resistance are better since it contains Ni.
	Welding Position		AWS/ASME	F/1G	HF/2F
H-13CrM	Reddish brown	Brown	—	4.0 5.0	Surfacing of hot roll dies, tongue punches and hot shears subjected to impact abrasion at high temperataures. Weld metal of austenitic structure with finely precipitated carbide has high hardness at temperatures of more than 600°C showing high resistance to abrasion under high temperatures.
	Welding Position		AWS/ASME	F/1G	HF/2F VU/3G
H-MCr	Light brown	—	☆Z 3251 DFME-250-B	4.0 5.0 6.0	Joining of high manganese steel and carbon steel and surfacing of hot shears, forging molds, hot rolls and dies subjected to impact abrasion at high temperatures. Weld metal of Mn-Cr type austenitic structure is hardened by impact and shows excellent toughness and resistance to abrasion under high temperatures and impact.
	Welding Position		AWS/ASME	F/1G	HF/2F
H-11Cr	Blue	—	☆Z 3251 DF4A-500-B	3.2 4.0 5.0	Surfacing of hot shears, press dies, tongue punches, hydraulic turbine liners, and dredger pump casings and liners subjected to abrasion under high temperatures. Weld metal of austenitic structure a welded shows resistance to abrasion under comparatively high temperatures.
	Welding Position		AWS/ASME	F/1G	HF/2F

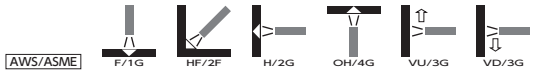
Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)							Typical Hardness of Weld Metal (HV)		
C	Si	Mn	Cr	Mo	V	Others	As Welded	After work-hardened	PWHT
0.49	0.16	13.9	—	—	—	—	280	540	—
0.90	0.26	12.61	—	—	—	Ni: 5.60	235	510	—
0.19	0.51	12.16	13.71	1.56	1.13	Ni: 2.45 W: 3.45	295	—	700°C 160
0.11	0.58	15.55	15.11	—	—	Ni: 2.45	215	490	—
0.21	0.40	1.26	11.85	—	—	—	540	—	—

Covered Arc Welding Electrodes for Surfacing

Brand Name	Identification Color		Specification	Dia. mm	Application and Characteristics
	End	Secondary	JIS		
H-30Cr	Reddish brown	Gray	☆Z 3251 DFCrA -700-BR	4.0 5.0	Surfacing of coal crushers, mixer blades, mixer arms, sand pump casings, impellers and boring tools subjected to heavy earth and sand abrasion. Weld metal of martensitic type high chromium iron is very hard due to the precipitation of chrome carbide, and shows extremely high resistance, although cracks occur, to low stress abrasion of earth and sand.
	Welding Position		AWS/ASME	F/1G	HF/2F
H-30CrM	Reddish brown	—	☆Z 3251 DFCrA -700-BR	4.0 5.0	Surfacing of mixer blades, sand blast blades, bell hoppers, impeller breakers, pump casings, impellers and sintered ore chuting boards subject to heavy earth and sand abrasion and ore abrasion under high temperatures. Weld metal of austenitic type high chromium iron containing 5% manganese in addition to chrome carbide shows excellent resistance to abrasion under high temperatures because thermal change of hardness is smaller than taht of H-30Cr.
	Welding Position		AWS/ASME	F/1G	HF/2F

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.



Typical Chemical Composition of Weld Metal (%)							Typical Hardness of Weld Metal (HV)		
C	Si	Mn	Cr	Mo	V	Others	As Welded	After work-hardened	PWHT
3.55	0.96	110	31.90	—	—	—	705	—	—
3.62	0.48	5.91	31.80	—	—	—	620	—	—

SMAW
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Covered Arc Welding Electrodes for Cast Iron

Brand Name	Identification Color		Specification		Dia. mm	Application and Characteristics
	End	Secondary	JIS	AWS		
C-1N	Gold	Red	☆Z3252 ECNi-CI	★A5.15 ENi-CI	3.2 4.0 5.0	Welding and filling up of cavities of cast iron products. C-1N is a graphite type electrode with a pure nickel core wire. Weld metal is not so hard and is easily machined. Arc is stable and slag is easy to remove. No preheating is required in general.
	Welding Position		AWS/ASME	F/1G	HF/2F	
C-5N	Gold	Light purple	☆Z3252 ECNiFe-CI	☆A5.15 ENiFe-CI	3.2 4.0 5.0	Welding of normal cast irons and ductile cast irons. C-5N is a graphite type electrode. With Fe-Ni wire. Weld metal shows excellent mechanical properties and crack resistance.
	Welding Position		AWS/ASME	F/1G	HF/2F	

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

Typical Chemical Composition of Weld Metal (%)					
C	Si	Mn	P	S	Ni
1.00	0.71	1.14	0.002	0.001	95.8
0.90	0.35	0.56	0.005	0.004	55.1

FCM-132M FCM-134 FCM-134M

☆JIS Z 3326 YF4A-G-400
☆JIS Z 3326 YF4A-G-400
☆JIS Z 3326 YF4A-G-400

For Hardfacing

APPLICATIONS

These metal-based flux cored wires provide highly efficient hardfacing and repair welding. FCM-132M, FCM-134, and FCM-134M wires with shielding gas such as Ar or Ar-20%CO_2 respectively produce 13Cr-2Ni-1 Mo-based, 13Cr-4Ni-based, and 13Cr-4Ni-1Mo based deposited metal.

CHARACTERISTICS

Hardfacing and repair welding on turbine runners, turbine blades, valves, valve seats, rolls, rollers, etc.

GUIDELINES FOR USAGE

1. NSSW FCM-132M, NSSW FCM-134, and NSSW FCM-134M wires are used with Ar or 80%+20% CO_2 as the shielding gas.
2. As a general , it is required preheating at a temperature higher than 150 to 300°C and slow cooling after welding.

WELDING POSITION

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

Brand name	C	Si	Mn	Ni	Cr	Mo
FCM-132M	0.07	0.40	0.74	2.09	12.7	1.06
FCM-134	0.07	0.38	0.57	3.96	12.5	–
FCM-134M	0.06	0.36	0.56	3.88	11.6	0.98

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

Brand name	Tensile Strength, MPa	Elongation, %	Charpy 2V-notch at 20°C, J	Typical Hardness of Weld Metal (Hv)	
				As Weld	PWHT 600°Cx2.5h
FCM-132M	900	17	22	420	290
FCM-134	900	16	18	420	300
FCM-134M	910	17	33	400	305

■ SIZES & RECOMMENDED CURRENT RANGE<DC(+)>

Diameter (mm)		1.6
Current A	F	200~350

Electroslag Welding Materials -SESNET WELDING-

Electroslag Welding Materials for SESNET WELDING PROCESS

Brand Name	Specification		Application and Characteristics	Typical Chemical Composition of Deosited Metal %							Typical Mechanical Properties of Weld Metal				Remarks
	JIS	AWS		C	Si	Mn	Ni	P	S	Mo	Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch at 0°C, J	
YM-55S × YF-15I	☆Z 3353 YES501-S/ FES-Z	—	Welding of 490MPa high tensile strength steel for diaphragm of steel frames in SESNET welding process.	0.11	0.20	1.45	—	0.010	0.004	0.13	400	560	30	54	SN490B 40 mm 1 electrode
YM-60E × YF-15I	☆Z 3353 YES602-S/ FES-Z	—	Welding of 590MPa high tensile strength steel for diaphragm of steel frames in SESNET welding process.	0.09	0.34	1.29	1.02	—	—	0.29	460	690	25	80	SM570Q 50 mm 1 electrode

ESW 12

Memo

Electrogas Welding Materials -VEGA WELDING-

Flux Cored Arc Welding Wires

Flux Cored Arc Welding Wires for Electrogas Welding -VEGA WELDING-

Brand Name	Shield Gas	Specification JIS	Specification AWS	Dia. mm	Application and Characteristics	Typical Chemical Composition of Weld Metal (%) C	Si	Mn	P	S	Mo	Ni	Typical Mechanical Properties of Weld Metal Yield Strength, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch at 0°C, J	Type of Current
EG-1	CO_2	☆Z 3319 YFEG-21C	—	1.6	VEGA welding wire to be used with CO_2 shield gas for mild steel and 490MPa high tensile strength steel. Arc is stable and bead appearance is beautiful.	0.08	0.29	1.49	0.014	0.015	0.24	–	470	640	28	59	DC (+)
	Welding Position		AWS/ASME VU/3G														
EG-3	CO_2	—	☆A5.26 EG72T-G	1.6	VEGA welding wire to be used with CO_2 shield gas for mild steel and 490MPa high tensile strength steel. It can be used also for shipbuilding grade E steel since weld metal shows excellent mechanical properties.	0.04	0.35	1.54	0.012	0.016	0.14	0.64	509	606	25	−20°C 99	DC (+)
	Welding Position		AWS/ASME VU/3G														
EG-60	CO_2	☆Z 3319 YFEG-32C	—	1.6	VEGA welding wire to be used with CO_2 gas shield for 590MPa high tensile strength steel.	0.10	0.34	1.68	0.014	0.012	0.11	–	495	650	29	−20°C 89	DC (+)
	Welding Position		AWS/ASME VU/3G														

Note : Figure of illustration relating to the symbol of welding position in the table mentioned above.

EGW
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Memo

High Efficiency Welding Process

SUBNAP WELDING PROCESS

High Quality and Low Cost Welding Process for Heavy Steel Plates

SUBNAP Welding Process is a narrow gap submerged arc welding process for the heavy plates and has the following characteristics.

CHARACTERISTICS

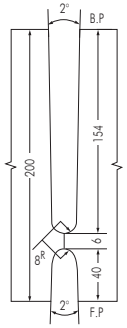
1. It is possible to shorten welding time, save welding materials and greatly reduce welding costs.
2. Any submerged arc welding machine and power source at hand can be used by just changing the nozzle to a long tip of 8~10mm diameter or a rectangular cross sectional nozzle of 8~10mm width covered by heat proof insulating tape or a tube.
3. Mechanical properties of weld metal are the same or better than those of conventional submerged arc welding process.
4. High efficiency and better bead appearance are obtained by applying tandem welding with a short distance between electrodes of 7~13mm.
5. Gas cut grooves can be welded.

■ WELDING MATERIALS

Base metal	Wire	Flux	Characteristics of Flux
ASTM A516 Gr60, 65, 70	Y-D	NF-1	Neutral type fused flux High wire melting speed
ASTM A516 Gr70 ASTM A537 Cℓ1 ASTM A299	Y-E Y-DM3		
ASTM A533B, A302B	Y-204	NF-250 NF-250* NF-250	Basic type fused flux
ASTM A387Gr11, 12, Cℓ1, Cℓ2	Y-511		
ASTM A387Gr22, Cℓ1, Cℓ2	Y-521		
	Y-521H	NB-250M	
SUS304, SUS304L	Y-308	BF-350	Basic type bonded flux
	Y-308L		

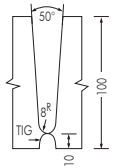
* Ⓜ Type

■ STANDARD WELDING CONDITIONS FOR ONE-LAYER TWO-PASS SUBNAP WELDING PROCESS

Groove Geometry mm	Number of Electrode	Wire Dia. mm	Layer		Elec-trode	Welding Conditions Current A	Voltage V	Speed cm/min
	AC Single	4.0	B.P	1 (1-pass)	Single	500	27 (32)	25
				2 → Final (2-pass)		600	28 (33)	30
			F.P	1 (1-pass)		500	27 (32)	25
				2 → Final (2-pass)		600	28 (33)	30
	AC·AC Tandem	3.2	B.P	1 (1-pass)	Single	500	27 (32)	25
				2 → Final (2-pass)	L	500	27 (29)	50 (55)
					T	500	27 (29)	
			F.P	1 (1-pass)	Single	500	27 (32)	25
				2 → Final (2-pass)	L	500	27 (29)	50 (55)
					T	500	27 (29)	

Note: 1. Voltage and speed in ( ) are for NF-1 and others for NF-250.
2. Distance between electrodes for tandem welding is 10mm.
3. Suitable wire center position for two-pass welding is 5~6mm from groove side wall.

■ STANDARD WELDING CONDITIONS FOR STAINLESS STEEL SUBNAP WELDING PROCESS

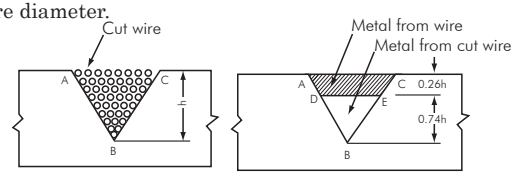
Groove Geometry mm	Wire Dia. mm	Layer	Welding Conditions Pass	Current A	Voltage V	Speed cm/min
	4.0	1-layer 2-pass	1	450	32	45
			2~3	500	32	40
			4 → Final	550	32	35

Note: Flux; BF-350

CUT WIRE SUBMERGED ARC WELDING PROCESS

High Efficiency Submerged Arc Welding Using Cut Wire

Cut Wire Submerged Arc Welding Process is to carry out submerged arc welding with high efficiency by filling the groove with "cut wire", fine wires of the same chemical composition as submerged arc welding wire chopped to almost the same length as wire diameter.

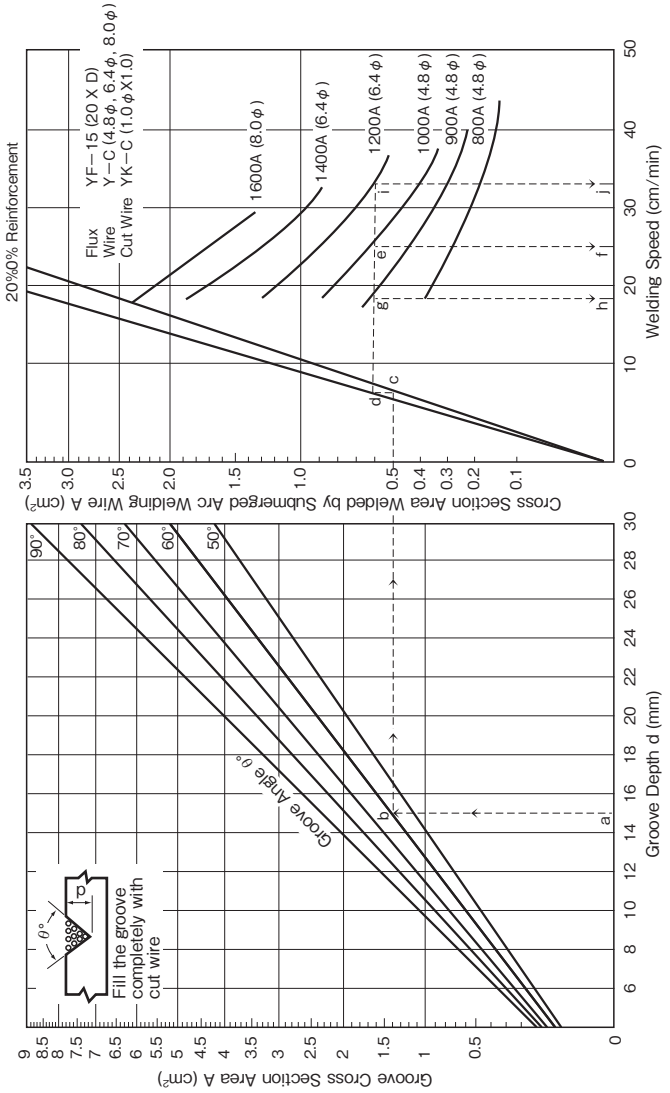


■ TYPE OF CUT WIRES

Brand Name	Typical Chemical Composition (%)						Flux to be used (mesh)
	C	Si	Mn	P	S	Others	
YK-C	0.11	0.01	1.43	0.013	0.015	—	YF-15A (20×D)
YK-D	0.13	0.01	1.87	0.010	0.014	—	YF-15A (20×D) NB-55E (12×100)
YK-CM	0.08	0.01	1.67	0.012	0.014	Mo:0.51	YF-15 (20×D)
YK-CNC	0.11	0.07	1.69	0.011	0.002	Cu:0.23 Ni:0.10 Cr:0.45	YF-15B (20×D)
YK-3NI	0.04	0.02	1.20	0.007	0.003	Ni:2.98	NB-55LM

CHARACTERISTICS

1. More than double amount of weld metal compared with conventional submerged arc welding is obtained and it is especially suitable for welding thick plates.
2. Heat affected zone of the base metal is small and consequently deterioration of toughness is limited.
3. Beautiful bead with large leg length is obtained in flat fillet welding and slag is easy to remove.
4. Hot temperature cracking can be prevented in the welding of high carbon steel since dilution rate of base metal is low.
5. Arc is stable and bead is beautiful even in high current welding.



NOMOGRAPH TO SELECT WELDING CONDITIONS

ONE-SIDE WELDING PROCESS

One-side Welding Process to Shorten Welding Time　Using Various Kinds of Backing Materials

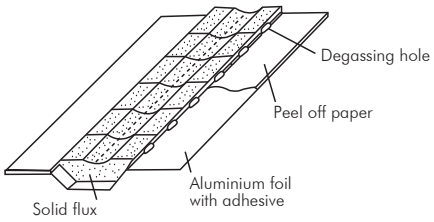
Welding Process		Backing Materials and Flux
Gas shield arc welding [Flux cored arc welding wires and Gas metal arc welding wires]		SB-41
Submerged arc welding	Soft Backing Process	SB-51
	Flux Copper Backing Process (FCuB Process)	Surface flux NSH-50M NSH-55EM Backing flux NSH-1RM

Memo

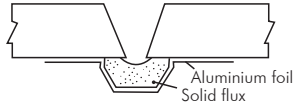
SB-41

Backing Material for Gas Shield Arc One-side Welding

SB-41 is a backing material having a structure of tile-like solid flux blocks which are stuck onto aluminium foil in succession.



<Structure of SB-41>



<How to use SB-41>

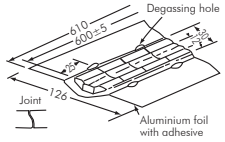
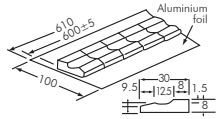
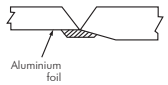
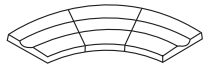
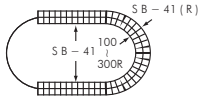
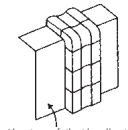
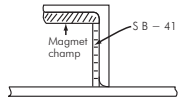
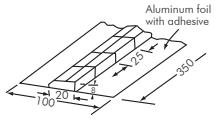
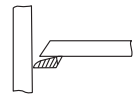
■ RECOMMENDED WELDING WIRES

Flux cored arc welding wires	SF-1, SF-3, etc.
Gas metal arc welding wires	YM-26, YM-28, etc.

APPLICATIONS

1. It is small and light and consequently is easily set up by sticking adhesive face of aluminium foil to steel plate.
2. It can be used by cutting to the desired length and bending up or down since solid fluxes are tile-like and flexible.
3. It can be used for uranami (sound penetration bead) welding with a wide range of welding conditions since solid fluxes have high fire resistance.
4. Inventory control is easy since it rarely absorb moisture and, therefore, redrying is not necessary.

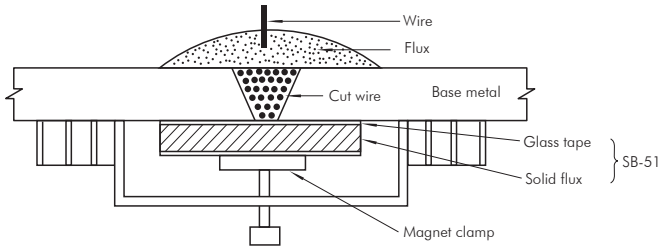
■ SIZE AND SHAPE

Type	Width × Length (Groove Depth × Width)	Applicable Wire: Flux Cored Wire	Applicable Wire: Solid Wire	Purpose	Shape	How to Use
Standard	30×600 (1.2×12)	○	○	General purpose		
B	26×600 (0.8×9)		○	General purpose		
GA	30×600 (1.2×12)	○	○	General purpose	The same as above ● With glass tape	The same as above
H	30×150R (1.5×12)	○		Different plate thickness		
R	30×100R 30×150R 30×200R 30×250R 30×300R (1.5×14)	○		Circular Plates		
LL	30×87×18R (1.2×12)	○		L longitudinals		
K	20×350	○		T joints		

Backing Materials
14

SOFT BACKING SUBMERGED ARC WELDING PROCESS

Soft Backing Process is to carry out one-side submerged arc welding by fitting SB-51, portable and light backing material, to a steel plate using magnet clamps as shown in the figure. Welding is carried out by filling the groove with cut wires in order to minimize the influence of groove gap fluctuation onto the shape of reverse head.



APPLICATIONS

One-side welding where backing jigs cannot be used like welding of curved plates in shipbuilding and site welding of bridges.

CHARACTERISTICS

1. Glass tape assures excellent adhesiveness to base metal and an even reverse bead.
2. It can be attached by magnet clamps since little push-up strength is required.
3. An even reverse bead shape similar to other parts is obtained at joining parts of backing materials.
4. The concurrent use of cut wire makes it unsusceptible to the fluctuation of groove gap and assures high efficiency.

■ RECOMMENDED WELDING MATERIALS

Base metal	Welding Process	Flux	Wire	Cute Wire
Mild steel	1 layer welding	YF-15A	Y-D	YK-C
	2 electrodes Multi-layer welding	NSH-50M	L : Y-C T : Y-DL	
490MPa high tensile strength steel	1 layer welding	NB-55E	Y-D	YK-D
		YF-15A	Y-D	YK-D
	2 electrodes Multi-layer welding	NSH-50M	L : Y-DL T : Y-DL	

■ TYPICAL WELDING CONDITIONS

1) ONE-LAYER WELDING (NB-55E)(AC)

Plate Thickness mm	Groove Shape	Wire Dia mm	Groove Gap mm	Cut Wire Height mm	Current A	Voltage V	Speed cm/min
8	I	4.8	0	-	800	32	45
			3	-	700	32	42
16	50°V	6.4	0	16	1100	36	30

2) MULTI-LAYER WELDING WITH TWO ELECTRODES (AC)

Plate Thick-ness mm	Groove Geometry mm	Layer	Electrode	Wire Dia mm	Cut Wire Height mm	Current A	Voltage V	Speed cm/min	Distance between Electrodes mm
16		1	L T	4.8 6.4	16	900 800	36 40	46	70
25		1	L T	4.8 4.8	15	980 700	34 38	34	70
		2	L T	4.8 4.8	0	750 700	36 38	36	30

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

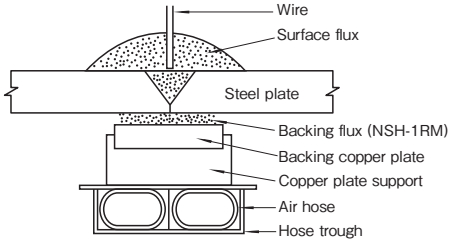
	C	Si	Mn	P	S	Base Metal	Plate Thickness mm	Welding Method	Flux
1)	0.14	0.25	0.96	0.014	0.005	KD	16	1 layer welding	NB-55E
2)	0.12	0.31	1.35	0.020	0.008	K32D	25	2 electrodes, 2 layers welding	NSH-50M

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

	Yield Point, MPa	Tensile Strength, MPa	Elonga-tion, %	Charpy 2 V-notch at 0°C, J	Base Metal	Plate Thickness mm	Welding Method	Flux
1)	330	460	39	130	KD	16	1 layer welding	NB-55E
2)	430	540	31	88	K32D	25	2 electrodes, 2 layers welding	NSH-50M

FLUX COPPER BACKING SUBMERGED ARC WELDING PROCESS

Flux Copper Backing Process is a high efficiency automatic welding process to carry out one-side submerged arc welding by spreading backing flux (NSH-1RM) to the thickness of a few millimeters on backing copper plates, as shown in the figure, and sticking the copper plate closely to the reverse surface of the groove using a pushing up device. High speed and high efficiency welding is achieved by using a pushing up device. High speed and high efficiency welding is achieved by using a systematized welding apparatus.
Especially, NH-HISAW Process with 4 electrodes can increase welding speed as much as 2.5 times high as conventional submerged arc welding process.



APPLICATIONS

Welding of large plates for ships, bridges and structures.

CHARACTERISTICS

1. High current can be used since reverse bead height tends to be even due to the copper plate under backing flux layer and fluctuation of reverse bead shape is small.
2. Highly efficient and economic welding is possible by systematizing welding apparatus.
3. NSH-50M, surface flux, can be used for both mild steel and 490MPa high tensile strength steel.

■ One-side SAW Welding Material

Base metal	Wire	Surface Flux	Backing Flux
Mild Steel and 490MPa high tensile strength Steel	Y-DL	NSH-50M	NSH-1RM
490MPa Grade E high tensile strength Steel	Y-DM3 Y-DL	NSH-55EM	NSH-1RM
Low temperature Service Steel	Y-3NI	NSH-55L	NSH-1RM

■ TYPICAL WELDING CONDITIONS (3 ELECTRODES)

Flux	Plate Thickness mm	Groove Geometry mm	Electrode	Wire Dia. mm	Electrode Tilt Angle	Current A	Voltage V	Speed cm/min	Distance Between Electrodes mm	Backing Flux Height mm
NSH-50M or NSH-55EXM × NSH-1RM	16	60° 3	L	4.8	−15	1250	35	83	35	5~6
			T_1	4.8	0	1000	40			
			T_2	6.4	5	850	45		120	
	20	50° 3	L	4.8	−15	1350	36	68	35	5~6
			T_1	4.8	0	1100	40			
			T_2	6.4	5	900	45		120	
	25	50° 5	L	4.8	−15	1450	36	56	35	5~6
			T_1	4.8	0	1250	40			
			T_2	6.4	5	1000	45		120	
	36	45° 6	L	4.8	−15	1450	35	37	35	5~6
			T_1	4.8	0	1250	40			
			T_2	6.4	5	1250	45		120	

Note: NSH-55M is used for three-electrode welding in principle.

■ TYPICAL WELDING CONDITIONS (4 ELECTRODES)

Flux	Plate Thickness mm	Groove Geometry mm	Electrode	Wire Dia. mm	Electrode Tilt Angle	Current A	Voltage V	Speed cm/min	Distance Between Electrodes mm	Backing Flux Height mm
NSH-50M × NSH-1RM	16	50° 3	L	4.8	−15	1700	35	150	30	5~6
			T_1	6.4	0	1300	40		200	
			T_2	6.4	−5	750	40		30	
			T_3	6.4	10	700	45			
	20	50° 5	L	4.8	−15	1700	35	100	30	5~6
			T_1	6.4	0	1400	40		200	
			T_2	6.4	−5	750	40		30	
			T_3	6.4	10	750	45			
	25		L	4.8	−15	1700	35	90	30	5~6
			T_1	6.4	0	1400	40		200	
			T_2	6.4	−5	1050	40		30	
			T_3	6.4	10	950	45			
	36	45° 6	L	4.8	−15	1700	35	55	30	5~6
			T_1	6.4	0	1400	40		200	
			T_2	6.4	−5	1300	40		30	
			T_3	6.4	10	1200	45			

■ TYPICAL CHEMICAL COMPOSITION OF WELD METAL (%)

1) NSH-50M × NSH-1RM × Y-DL/Y-DL/Y-DL (3 ELECTRODES)

C	Si	Mn	P	S	Base Metal	Plate Thickness mm	Welding Method
0.13	0.23	1.17	0.018	0.004	KD36	20	3 electrodes, one-side welding

2) NSH-55EM × NSH-1RM × Y-DM3/Y-DL/ Y-DL (3 ELECTRODES)

C	Si	Mn	P	S	Base Metal	Plate Thickness mm	Welding Method
0.09	0.18	1.32	0.018	0.005	KE40	20	3 electrodes, one-side welding

3) NSH-50M × NSH-1RM × Y-DL/Y-DL/Y-DL/Y-DL (4 ELECTRODES)

C	Si	Mn	P	S	Base Metal	Plate Thickness mm	Welding Method
0.12	0.20	1.15	0.019	0.005	KD36	20	4 electrodes, one-side welding

■ TYPICAL MECHANICAL PROPERTIES OF WELD METAL

1) NSH-50M × NSH-1RM × Y-DL/Y-DL/Y-DL (3 ELECTRODES)

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch at 0°C, J	Base Metal	Plate Thickness mm	Welding Method
460	550	27	135	KD36	20	3 electrodes, one-side welding

2) NSH-55EM × NSH-1RM × Y-DM3/Y-DL/ Y-DL (3 ELECTRODES)

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch at −20°C, J	Base Metal	Plate Thickness mm	Welding Method
490	570	25	120	KE40	20	3 electrodes, one-side welding

3) NSH-50M × NSH-1RM × Y-DL/Y-DL/Y-DL/Y-DL (4 ELECTRODES)

Yield Point, MPa	Tensile Strength, MPa	Elongation, %	Charpy 2 V-notch at −20°C, J	Base Metal	Plate Thickness mm	Welding Method
470	550	26	120	KD36	20	4 electrodes, one-side welding

Welding Machine and Equipment Plasma Machine and Equipment

Fillet Welding

Simplified Travelling Carriage with Various Models

It is necessary to support the weight of the welding torch and maintain wire target position correctly in order to obtain an excellent welding bead in semiautomatic welding. This requires a skilled welder, Carriage hold the welding torch for welding operators and carry out stable welding by travelling and tracking vertical plate by itself. It solves at a stroke, therefore, the problems of welding fatigue and skill required for high quality welding. Carriage are small and convenient welding carriages and there are various types for different purposes and applications. One operator can handle several machines at a time increasing operational efficiency per operator.

APPLICATIONS

Automatization of welding of ships, steel frames, bridges, etc.

CHARACTERISTICS

1. Putting stress on portability. Travelling is stable in horizontal fillet welding of even inclined or curved plates since, while the four-wheel carriages travel.
2. Little skilled welding technique is required since they travel stably tracking along the vertical plate.
3. They are small, light and easy to handle and, therefore, can be used for a wide range of applications.
4. Due to an automatic stop mechanism, one operator can handle several Carriage simultaneously assuring high efficiency and labor saving.

■ RECOMMENDED WELDING WIRES

Base metal	Brand Name	Type of Wire
Mild Steel and 490MPa High Tensile Strength Steel	SF-1 SF-1F SM-1F	Seamless Flux Cored Arc Welding Wire
	YM-26 YM-28	Gas Metal Arc Welding Wire

■ TYPICAL FILLET WELDING CONDITIONS OF SF-1

Position	Wire Dia. mm	Leg Length mm	Welding Conditions		
			Current A	Voltage V	Speed cm/min
Horizontal fillet	1.2	4	220	27	70
		6	270	29	50
		8	300	30	35
	1.4	4	260	28	70
		6	320	31	50
		8	350	33	35
	1.6	4	300	29	80
		6	350	32	50
		8	400	34	35
Flat fillet	1.2	6	280	29	50
	1.2	8	280	29	40
	1.4	14	380	38	20~23

Welding Machine and Equipment
15

Carry Boy • Ace

Multipurpose welding torch Carry for fillet welding.

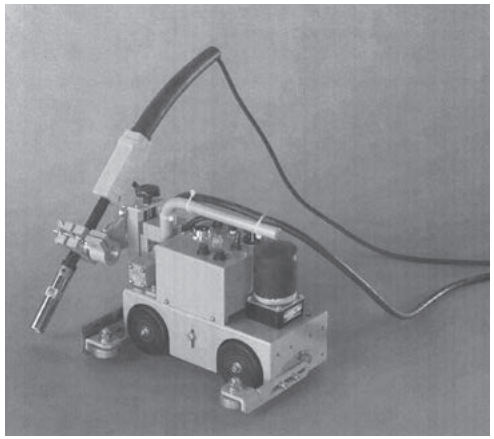
FEATURES

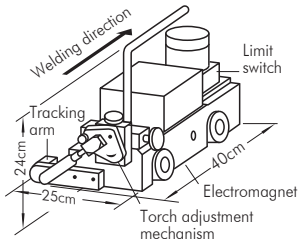
1. Strong electromagnetic attraction provides high pulling power and stable traveling performance even on inclines.
2. A multipurpose semi-automatic welding torch can be attached.
3. The wire aiming position can be freely adjusted up/down, front/back, torch angle, forward/return angles, etc.
4. The range of the aiming position can be unlimited by replacing the parts of the torch handle and following arm

■ Standard specifications

Applicable position	Horizontal fillet welding, Flat fillet welding
Weight	Approx.12kg
Drive system	Rubber carried 4-wheel drive combined with electromagnetic absorption
Torch setting adjustment	Vertical: 40mm, horizontal: 35mm; forward/reverse: ±5°
Torch angle adjustment	30° to 50°
Automatic stop function	Limit switch for forward direction
Traveling speed range	10 to 120cm/min
Operation functions	Power switch, carriage traveling dimensions switch, Start/stop switch, travel/welding switch, traveling speed adjustment switch, welding switch
Input voltage	AC100V±10% 50/60Hz
External dimensions(mm)	250(W)×400(L)×240(H)

*There are two different torch models in symmetrical shapes. One for welding at right side of the main unit, one for welding at left side.(the photo shows a left-side model)





NS Carry Auto Super IR

Planned to be released

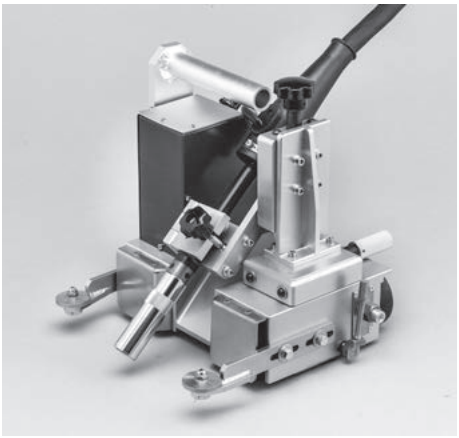
Compact, lightweight carriage for fillet welding

FEATURES

1. Simple dolly with excellent cost performance(in-house comparison)
2. Compact and lightweight(Approx.8kg)
3. High pulling power is achieved using the strong permanent magnet
4. Welding position can be easily set

■ Standard Specifications

Applicable position	Horizontal fillet welding
Weight	Approx.8kg
Drive system	4 rubber wheel drive with built-in permanent magnets and ON/OFF function
Torch setting adjustment	Vertical: 40mm, horizontal: 40mm
Torch angle adjustment	45°±5°
Automatic stop function	Limit switch for both directions
Traveling speed range	13 to 90cm/min
Operation functions	Start/stop switch, travel/welding change-over switch, right/left travel direction selector switch, speed adjustment knob
Input voltage	AC100V±10% 50/60Hz
External dimensions(mm)	291±15(W)×266(L)×274(H)



Carry Boy • K

Welding machine for fillet welding of cross pillars.

FEATURES

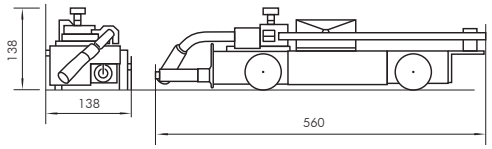
1. Compact design, can fit into a 150×150mm square space
2. Compact and lightweight(Approx.8kg), to reach the welding location.
3. Stable traveling has been achieved by the electromagnetic wheels.

■ Standard specifications

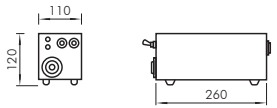
Applicable position	Horizontal fillet welding
Weight	Approx.8kg
Drive system	4-wheel drive(electromagnetic front wheels)
Torch setting adjustment	Left/right adjustment: ±10mm
Welding torch	500A, 60%; wire thickness: φ1.2mm
Automatic stop function	Limit switch for forward direction
Traveling speed range	10 to 100cm/min
Operation functions	Welding switch, traveling speed adjustment
Input voltage	AC100V±10% 50/60Hz
External dimensions(mm)	138(W)×560(L)×138(H)
Welding length	6m

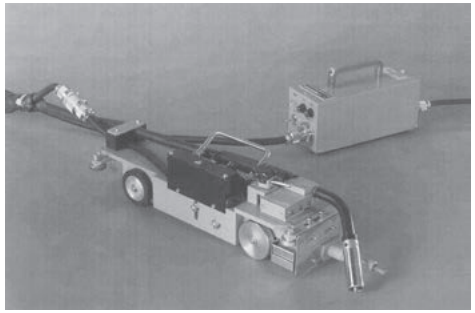
*There are two different torch models in symmetrical shapes. One for welding at right side of the main unit, one for welding at left side.(the photo shows a left-side model)

Carriage (left handed)



Control box





Memo

SY-mini

Compact automatic welding carriage

FEATURES

1. Lightweight(Approx.9kg), compact design facilitates transport and welding preparations.
2. Weaving function exhibits power for multi-pass welding for various positions.
3. Supports various types of welding such as butt welding and filet welding.

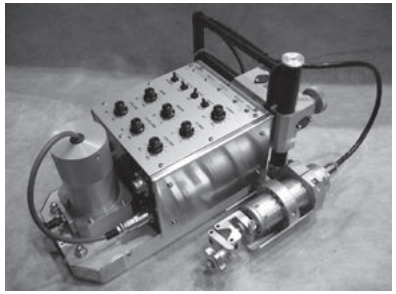
■ Standard specifications

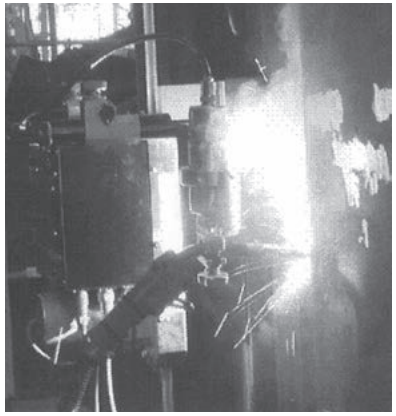
Traveling carriage unit

Input voltage	AC100V±10% 50/60Hz
Traveling method	Hugging rail/rack & pinion/clutch
Traveling speed range	0 to 50cm/min
Speed adjustment	Volume knob control
Connection with welding machine	Equipped(torch switch connection)
Clutch mechanism	Equipped(hand push travel enabled when clutch switching)
Traveling rail	1.5m/each
External dimensions(mm)	368(W)×401(L)×218(H)
Weight	Approx.9kg

Weaving unit(including torch slider)

Weaving motion	Swinging
Weaving speed	Volume adjustment(50°/sec)
Weaving angle	Volume adjustment(±9°)
Stop position	Both ends, center
Stopping time	0 to 2.0sec.
Tob/bottom stroke	100mm(rack direction manual)
Left/right stroke	90mm(rack direction manual)
Rotation axis	End of 2 axes(manually radius set)





<Vertical up welding with SY-mini>

NAVI 21

Compact arc welding robot that contributes to enhancement of welding quality

FEATURES

1. Being able to record the welding seam in the memory saves site when setting the rail and stabilizes the target position while welding.
2. Offers table quality of finish and start ends by automatic welding of teaching/memorized intervals and automatic stop.
3. Offers stable welding quality by merit of colorful welding function.
4. Enables real time work conditions revision while welding.

■ Standard specifications

Welding robot main unit

Axis configuration	3 orthogonal axes
Axis motor type	Stepping motor
Stroke forward/reverse	100mm
vertical	80mm(also manual 50mm)
travel axis	20,000mm
External dimensions(mm)	200(W)×550(L)×265(H)
Weight	11kg

Control unit

Input voltage	AC100V±15% or AC200V±15% 50/60Hz
No. of teaching points	max.50
No. of control axes/route control	3 axes/linear interpolation
Modes	Round trip/one-way, automatic/manual stop
Welding conditions Setting of voltage/current	Setting by knob of operation pendant
Setting of work conditions	Weaving width□0 to 40mm, both ends stop time(max. 9.9sec),
(weaving conditions, etc.)	welding speed(0 to 150cm/min), software weaving for forward/reverse vertical axes
Real time revision items	Current/voltage/traveling speed/torch target position weaving conditions
External dimensions(mm)	210(W)×463(L)×300(H)
Weight	11kg
Control cable length	25m

<Image photos of automatic welding with rail>

SESNET-WII

High Efficiency Electroslag Welding Machine Utilizing Non-consumable Nozzle

SESNET (Simplified Electroslag Non-consumable Elevating Tip) is a simplified electroslag welding machine with a non-consumable nozzle and a nozzle elevating mechanism. Welding performance and operation efficiency are greatly improved in butt welding of comparatively thin and short T joints by the combined use of a fine diameter solid wire.

APPLICATION

Vertical welding of diaphragms and connection joints of steel frames, bridges and longitudinals of ships.

FEATURES

1. High-efficiency, water supply type electro-slag welding machine with non-consumable hose.
2. The weaving equipment can weld 19-65mm thick plates.
3. Non-consumable nozzle rises automatically as welding progresses, thereby enabled unmonitored welding after start.

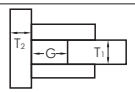
■ MODEL

Model	Number of Electrodes	Machine Weight	Recommended Power Source
SESNET-WII	1	17kg approx.	600A (DC)

■ RECOMMENDED WELDING MATERIALS

Base metal	Wire	Flux
Mild steel and 490, 590MPa high tensile strength steel	YM-55A (1.6 ϕ) YM-55S (1.6 ϕ) YM-60E (1.6 ϕ)	YF-15I

■ TYPICAL WELDING CONDITIONS

Groove Geometry	Plate Thickness, mm T_1	Plate Thickness, mm T_1	Gap (G) mm	Current A	Voltage V	Wire Feed Speed m/min	Welding Speed mm/min
	20	20	25	380	46	8.5	34
	50	60	25	380	52	8.5	14
	60	100	25	380	54	8.5	12~14

■ Standard Specifications *Upgraded function

Nozzle raising drive unit

input voltage	AC100V±10% 50/60Hz
Drive system	Friction drive by rubber rollers
Drive speed	0 to 300mm/min
Angle Adjustment	±3°

*Notched rollers control nozzle slippage.
*Increased strength of the angle adjustment part stabilizes the welding aiming position.
*A speed control motor stabilizes the raising speed.

Nozzle position adjustment range

Vertical direction	200mm
Left/right direction	150mm
Front/back direction	65mm
Turning angle	200°

Weaving unit

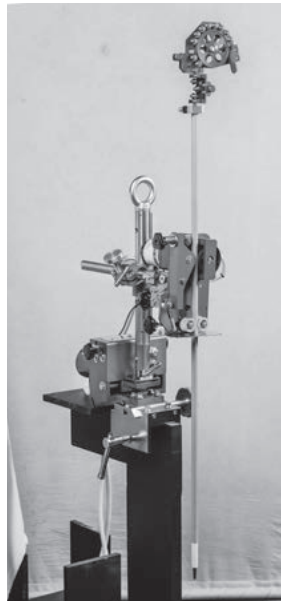
Tire tracks	Round trip simple vibration
Amplitude width	5 to 60mm
frequency	0 to 8times/min(at max. amplitude)
Stop position	Both ends of the amplitude width
Stopping time	0 to 10sec(1sec pitch)

*A speed control motor stabilizes the raising speed.
*The next setting time is shortened by the center return function.

Non-consumable nozzle

Coolant type	Water cooled
Rated current	500A
Use ratio	100%
Application wire diameter	φ1.6mm
Nozzle diameter	φ14mm
Nozzle length	1,000 to 1,600mm(welding length+350mm)

*Deflection is reduced by increased strength.
*Analog control has been improved to digital control.
*Defect detector and automatic stop function



VEGA

high-efficiency vertical automatic welding machine (Electro gas arc welding machine)

VEGA welding is a hight-efficiency one-pass vertical welding method that moves small diameter wire (1.6mm diameter) in the direction of the thickness of steel plate. The welding carrige automatically ascends while keeping a given wire extension.

FEATURES

1. Can perform single pass vertical welding of plate thickness of 12 to 28mm.
2. Weighs Approx.22kg including weaver and features easy operation to make it ideal for on-site welding.
3. Automatic welding speed control offers uniform welding bead for gap variation.
4. Because surface bead is determined by groove shape of sliding copper plates, can form pretty bead with minimal height.
5. Able to form uniform, pretty back bead using NSSW SB-60V solid backing material.

■ Standard Specifications

Traveling carriage unit

Input voltage	AC200V±10% 50/60Hz
Traveling method	Rack & pinion
Traveling speed	max.500mm/min
Traveling control	Automatic elevation control by welding current detection
Clutch mechanism	Equipped(when the clutch is released, manual push traveling is possible)
Torch setting adjustment	Vertical adjustment: ±20mm Horizontal: ±30mm Plate thickness direction: ±20mm
Traveling rail	1.5m/each
Coolant constant contact sliding sheet copper	Water cooled type
External dimensions(mm)	665(W)×360(L)×365(H)
Weight	Approx.22kg

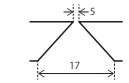
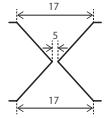
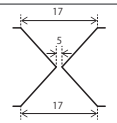
Weaving unit

Weaving type	Round trip simple vibration
Amplitude width	0 to 20mm
Stop position	Both ends of the amplitude width
Stopping time	0 or 0.1 to 3sec.

■ RECOMMENDED WELDING MATERIALS

Base metal	Wire		Backing Material	Shield Gas ℓ/mm
	Brand Name	Type of Current		
Mild steel. 490MPa high tensile strength steel	EG-1	DC (+)	Glass tape +copper plate or SB-60V	CO_2, 30
Grade E steel	EG-3			
590MPa high tensile strength steel	EG-60			

■ TYPICAL WELDING CONDITIONS

Plate Thickness mm	Groove Geometry mm		Current A	Voltage V	Speed cm/min	Heat Input kj/cm	Oscillation	
							Width mm	Frequency n/min
12.7			340	35~37	11~12	60~70	0~1	60~80
16			380	38~40	11~12	70~80	0~4	60~80
20			400	40~42	11~12	80~90	4~8	60~80
25			400	40~42	10~11	90~100	8~12	60~80
25		BP	340	35~37	12~13	55~65	0~1	60~80
		FP	330	34~36	12~13	55~65	1~3	60~80
36		BP	400	40~42	13~14	70~80	2~6	60~80
		FP	400	40~42	13~14	70~80	6~8	60~80

Two Electrode VEGA Welding Machine

High-efficiency vertical automatic welding machine (Electro-gas arc welding machine)

Two Electrode VEGA Welding Machine welding is similar to single-electrode type VEGA welding except the two electrodes are disposed across the thickness of steel plate. Flux cored wire and solid wire are used as the electrodes on cap side and root side. Compared with single-electrode method, this method permits much more efficient welding with extra-heavy steel plates ranging from 40 to 80mm in thickness, reduces man-hours,and increases the reliability of welded joints.

FEATURES

1. Vertical position single-pass welding of plates of 40 to 80mm thickness is possible.
2. Higher quality and performance, compared to single-electrode welding, is achieved.
3. Simultaneous weaving of both electrodes in the plate thickness direction stabilizes penetration.
4. Performing welding under automatic elevation control by welding current detection reduces operator monitoring time.
5. Forming uniform and beautiful penetration beads is possible using the fixed back material, NSSW SB-60VT.

■ Standard Specifications

Traveling carriage unit

Input voltage	AC100V±10% 50/60Hz
Traveling method	Rack & pinion
Traveling speed	max.500mm/min
Traveling control	Automatic elevation control by welding current detection
Clutch mechanism	Equipped(when the clutch is released, manual push traveling is possible)
Torch setting adjustment	Vertical adjustment: ±20mm Horizontal: ±30mm Plate thickness direction: ±20mm
Traveling rail	1.5m/each
Coolant constant contact sliding sheet copper	Water cooled type
External dimensions(mm)	565(W)×705(L)×405(H)
Weight	Approx.25kg

Weaving unit

Weaving type	Round trip simple vibration
Amplitude width	0 or 2 to 50mm
Stop position	Both ends of the amplitude width
Stopping time	0 or 1 to 5sec.

■ Option Specifications

Wire feeding length, digital display

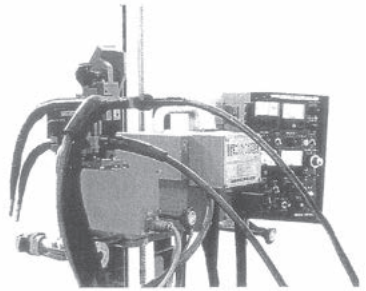
Wire feeding length	0.0 to 50.0m/min

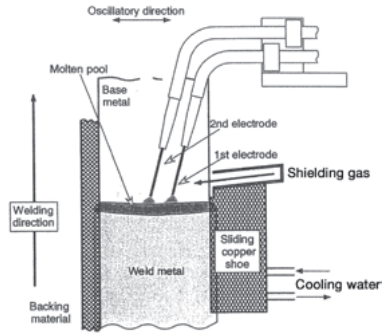
■ EXAMPLES OF WELDING CONDITION

Plate thickness mm	Brand name of wire	Electerode	Current A	Voltage V	Speed cm/min	Heat input kJ/cm	Oscillatory width mm
50	EG-3T	Cap side	390	42	6.8	282	5
	YM-55H	Root side	370	42			
60	EG-3T	Cap side	390	42	6.0	319	15
	YM-55H	Root side	370	42			
70	EG-3T	Cap side	390	42	4.5	426	25
	YM-55H	Root side	370	42			

■ RECOMMENDABLE WELDING MATERIALS

Electrode	Wire Brand name	Backing Material	Shield Gus (ℓ/min)
Cap side	EG-3T	SB-60VT	CO_2, 35~40
Root side	YM-55H		





High Heat Input Submerged are Welding Equipment

High Efficiency and High Quality Welding of Box Column Corner Joint

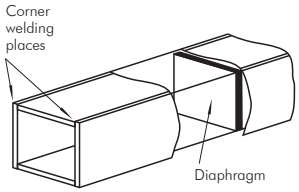
The size of box columns became larger as steel structures became taller and larger and BOX WELDER was designed to carry out the welding of the corner joints of box columns with efficiency and stable quality. The mechanism to provide especially stable welding is built into the equipment since there are connection joints which require full penetration and long welding lines in the corner welding of thick plates. Adoption of the twin-tandem process using high current assures good operational efficiency and welding joints without defects.

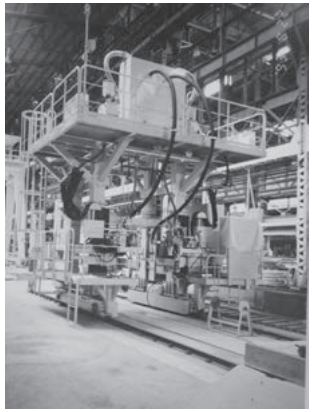
CHARACTERISTICS

1. Stable bead with deep penetration and little distortion is obtained since corners of both sides of column are welded at the same time with high current.
2. A built-in preset type welding current adjustment unit makes observation of multiple eletrodes easy.
3. Proper amount of flux is supplied to the proper place by the combined mechanism of automatic flux supply and recovery unit and a unique flux hold mechanism.
4. It is equipped with a high performance tracking device to detect groove position accurately.
5. It can be used for the welding of box columns with a wide range of size differences.

■ RECOMMENDED WELDING MATERIALS

Base metal	Wire	Flux	Remarks
Mild steel and 490MPa high tensile strength steel	Y-DL (4.8, 6.4mm)	NSH-53Z	Single-layer welding of plates up to about 50mm thick.





<External Appearance of BOX GIRDER>

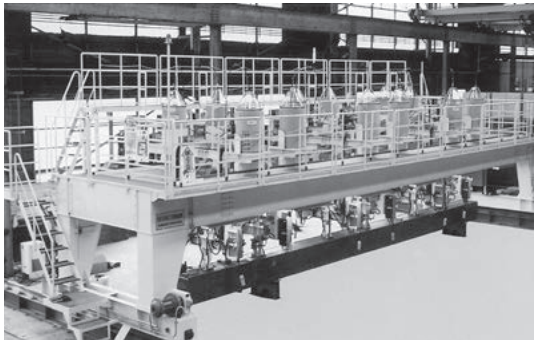
Diaphragm Welding Equipment

Electroslag Equipment for Automatizing Welding of Box Column Diaphragms

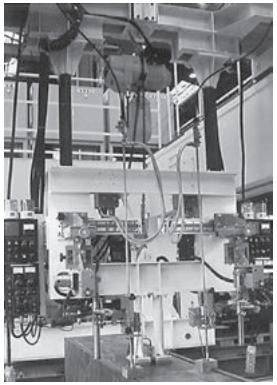
Diaphragm Welding Equipment mounts several SESNET-Ws, our unique non-consumable type electroslag welding machines, and assures increased efficiency and stable quality in the welding of diaphragms.

CHARACTERISTICS

1. Welding of both sides of diaphragm at the same time decreases distortion.
2. It is one-pass high efficiency welding using a fine diameter (1.6mm) solid wire.
3. It has an oscillation mechanism and, therefore, is applicable for a wide range of plate thicknesses (16~60mm when SESNET-W is mounted).
4. One operator can handle several equipment since arc start is easy and welding conditions are automatically controlled.



<Appratus of SESNET system>



<External appearance of Diaphragm Welding Equipment>

PANEL LINE PRODUCTION FACILITY

A panel line is a production line of parallel blocks used in shipbuilding. We, NIPPON STEEL WELDING & ENGINEERING Co., LTD., have supplied many panel line production facilities in domestic and overseas markets and are able to provide welding facilitied, welding technology and materuals. We provide our customers with a series of system engineering from welding of plates to the assembling of big structures including a layout which matches the production amount and transportation.

ONE-SIDE WELDING APPARATUS

1. It is possible to perform exellent quality welding with high efficiency providing a beautiful surface and reverse from one side. (No device for reversing large plates is necessary.) It is applicable for either three-electrode or four-electrode one-side welding apparatus.
   Applicable plate thickness: 10 ~ 40mm
   Welding length: 30m max (the longest we have supplied)
   Welding speed: 1.5m/min (four-electrode one-side welding facility at 16 t mm)
2. It is possible to weld with ease even plates with different thicknesse due to the special backing copper plates and backing mechanism.
3. Flux on the reverse side is scraped off by a scraper and automatically dumped by a conveyor.
4. Surface side flux is automatically recirculated.
5. Many methods have been developed and actually used for starting and ending treatment in the one-side welding method, such as alit-tub, cascade, gas heating at the ending point, etc., and two types of welding conditions, cascade and slit-tub methods, are preset in our one-side welding apparatus. It is possible, therefore, to carry out welding with fewer defects by selecting the appropriate method, depending on the plate thickness being welded.
6. Welding conditions for different plate thicknesses have been preset for each plate thickness and, therefore, the apparatus is easily set automatically by just accessing the plate thickness.
7. After the starting of welding, the panel line welding facility automatically carries out a series of unattended operations from the stopping of welding to the moving of the truck.
8. A platform has been installed on a gantry girder so that the changing of wire and supplying of flux can be carried out easily.

INSPECTION AND MAINTENANCE STAGE

1. An inspection and maintenance stage can be moved by rollers so that the entire reverse welding line of the one-side welding can be confirmed (in order to remove obstacles).
2. It is also equipped with a lighting unit.

LONGITUDINAL WELDING APPARATUS

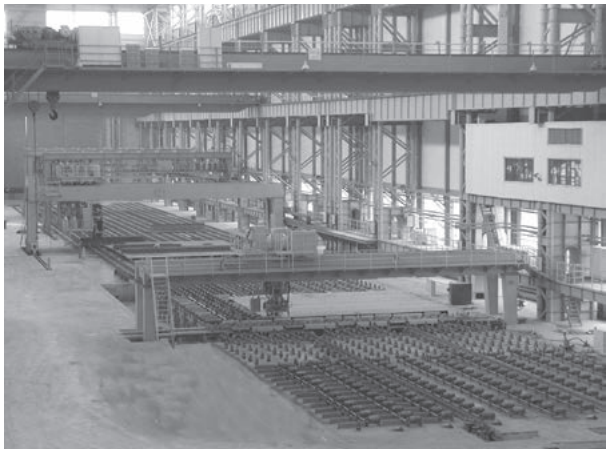
1. The twin tandem welding process (HS-MAG Process) assures high speed welding with a beautiful bead apperance.
   (A patented product of Nippon Steel & Sumikin Welding Co., Ltd.)
   Welding speed: 1.1 ~ 1.2m/min (leg length: 5 ~ 6mm)
2. Drain holes are detected by a special detector and 「ON/OFF」 of welding is automatically carried out.
3. Each of the welding machines stops welding when detecting the ending of the longitudinal.
4. The environment of the workshop is maintained clean by a fume remover.
5. Welding conditions have been preset for each leg length and are set automatically by accessing the leg lemgth.

WORKING BRIDGE

1. It is difficult to bring welding machines into a block where transverse bulkheads and girders have already been tack welded. The working bridge is a simplified apparatus to solve this problem and to improve workability.
2. No complicated handling of cables is necessary since power sources have been installed on the bridge. Also, welding current is grounded to rails.
3. The working bridge is of an L type in order to secure working places and spaces to place transverse bulkheads.

ELECTRIC CAPACITY

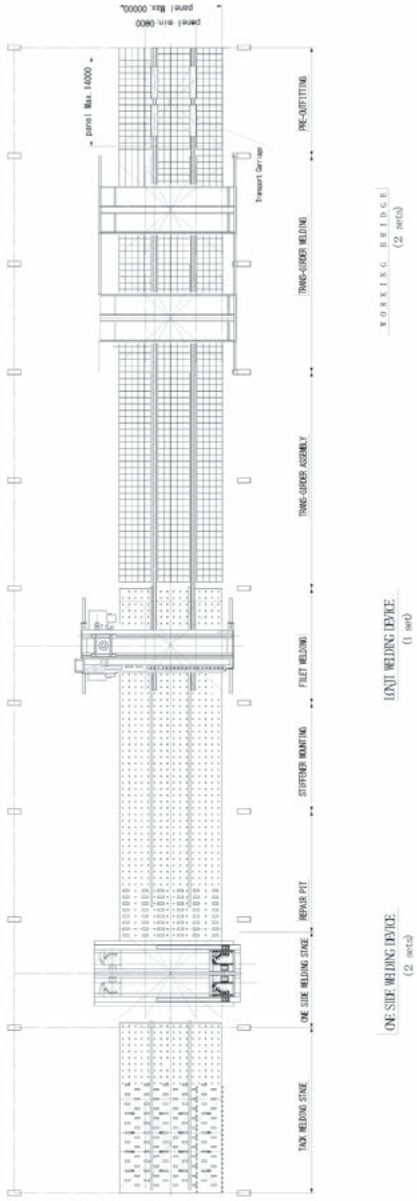
In general, electric energy used in one panel line is about 2,000 KVA (one unit with 3 electrodes for one-side welding and 16 ~ 20 selectrodes for longitudinal welding), but it increases by about 300 KVA if four electrodes are applied in one-side welding.



<Image photo of panel line>

Welding Machine and Equipment
15

<Layout of panel line>



Multi-electrode Automatic Welding Equipment

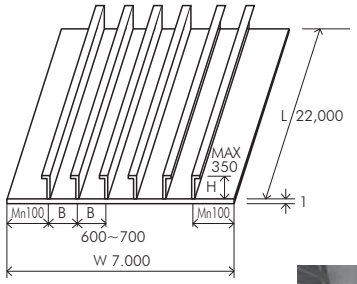
High Efficiency Horizontal Fillet Welding with Multi-electrode Welding Equipment Applying Twin-single tandem Welding Process

■ IN THE CASE OF 10/20-ELECTRODE AUTOMATIC WELDING EQUIPMENT

10-electrode Welding Equipment has five twin-single tandem welding heads and carries out the horizontal fillet welding of longitudinals or stiffeners of large structures for ship, bridges, etc.

■ SPECIFICATION

Welding process	Twin/Single tandem CO_2 horizontal fillet welding, 4.5~7.0mm leg length
Welding materials	SF-1, SM-1F, 1.6mm dia., 200kg pay-off pack with a remaining quantity detector on 1.6
Tracking	Contact type detector
Welding end detector	Optical sensor
Gantry carriage	2-motor drive method
Welding head carriage	5 units
Welding conditions setting	LCD touch switches
Error message	Message indication on the screen
Operation method	Entirely by the operational pendant at hand
Welding power source	600A (DC)



<Structure to be welded>

<External Appearance of Multi-electrode Automatic Welding Equipment>

One-side SAW Welding Equipment (FCuB)

Side Flow Magnet Type Flux Copper Backing Process

This is one-side submerged arc welding equipment for joining large steel plates. Two seams of maximum 24 meter length plates, 24.6 meters including tab plates, are welded at a time.

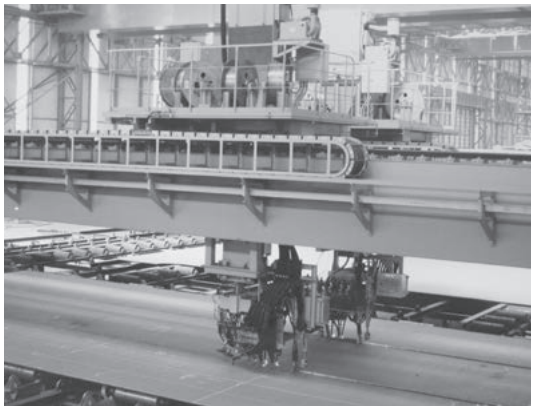
CHARACTERISTICS

1. The travelling girder is separated from the backing plate carriage and, therefore, the equipment is of very simple structure.
2. Two travelling girders, each of them equipped with 3 electrodes, weld steel plates of 10~40mm thickness, 2~5m apart and a maximum of 15mm thickness difference in one run. It is designed to make it possible to change the welding head to four electrodes.
3. Welding conditions are preset. Once welding is started by retrieving the necessary information by the plate thickness code number, the entire operation to the end of the seam proceeds without supervision.

■ RECOMMENDED WELDING MATERIALS

Base metal	Wire	Surface Flux	Backing Flux
Mild steel and 490MPa・high tensile strength steel	Y-DL	NSH-50M	NSH-1RM
490MPa Grade E high tensile strength steel	Y-DM3 Y-DL	NSH-55EM	NSH-1RM
Low Temperature service steel	Y-3NI	NSH-55L	NSH-1RM

Flux Copper Backing
Submerged Arc Welding Process.



High Speed FCuB Welding Equipment

NH-HISAW

NH-HISAW is one-side flux copper backing submerged arc welding equipment to join large steel plates with high speed. Welding speed was increased by about 2.5 times as fast as conventional flux copper backing process by the introduction of the four-electrode system. It is equipped with a device for automatic treatment at starting and finishing ends and an automatic surface flux supply unit.

APPLICATION

Joining of large plates for ships, bridges and steel structures.

CHARACTERISTICS

1. Welding speed is increased by 2.5 times as fast as conventional processes due to the unique four-electrode system. Mechanical properties of weld metal and bead appearance are excellent.
2. Operation is carried out fully automatically with optimum welding conditions to the end and, therefore, one operator can handle several NH-HISAWs simultaneously without watching them.
3. Fluctuation of welding conditions due to magnetic induction of cables, which causes problems in multi-electrode welding, has been improved.
4. It is possible to make the most of your present one-side welding equipment. Please consult with us.

■ RECOMMENDED WELDING MATERIALS

Base metal	Wire	Surface Flux	Backing Flux
Mild steel and 490MPa high tensile strength steel	Y-DL (4.8, 6.4mm)	NSH-50M	NSH-1RM

■ TYPICAL WELDING SPEED

Plate Thickness, mm	NH-HISAW, cm/min	Conventional Process, cm/min
16	150	60
20	100	58
25	90	55

■ COMPONENTS

1. Welding carriages and bobbin carriages
2. Welding operation board, control board
3. Welding power sources (system power source, etc.)
4. Wire feed units
5. Panel carriage (conveying units, backing units)
6. Magnet type weight girder
7. Flux supply units
8. Backing flux supply and recovery units

<External Appearance of High Speed FCuB Welding Equipment>

FULL DIGITAL PLASMA WELDING MACHINE

CHARACTERISTICS

1. Digital Setting of Welding Conditions
   Reproducibility of welding is improved and setting fluctuation of operators is reduced to zero by the digital setting of welding conditions. Visibility is exellent due to digital display and handling is also excellent due to large knobs.
   Welding conditions can be changed for each production item since it is possible to store up to 99 welding conditions in the internal memory.
2. Standard Featuews for Communication Function (RS232C)
   Automatic setting of welding conditions is possible using external computers, sequence, etc. Also, it is possible to readout output values such as welding currents, etc. on external equipment. This makes the storing of welding history and centralized control of welding conditions possible.
3. High Quality and High Speed Welding
   High speed, efficiency and quality welding is assured since high density plasma arc with rigidity due to inverter control and high pulse is obtainable. In addition, the control of heat input by pulse prevents undercut and burning through and assures the formation of an excellent bead.
4. Various Kinds of Torches Suitable for Production Methods and Usage
   It is possible to select the most suitable torch fit for the use from various kind of torches.
5. A Large Choice of Optional Equipment
   It is possible to make up the welding system you require utilizing various kinds of optional equipment which can be used for various objects to be welded and systems.

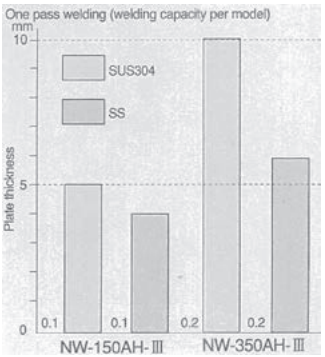
Function

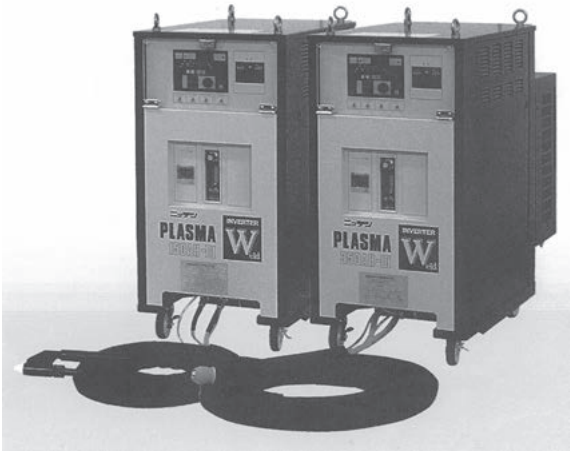
Fully Equipped with Functions Required for Automatic Welding

1. Interlock functions such as robots, automatic machines, etc. are installed standard equipment. Robots to be used with the machine must be those for plasma and TIG welding. Please contact us for details.
2. A pilot gas mass flow control unit is installed as standard equipment.
3. It is possible to have a wire feed control function built-in (optional).
4. A plasma gas control function is installed for crater treatment as standard equipment.
5. It also can be used with a primary power source of AC380/400V (a transformer for optional cooling water circulation pump).
6. It is possible to set pulse frequency from 0.5 to 999 Hz.
7. It is possible to set current patterns necessary for arc starting and crater treatment.
8. Cooling fans and cooling water circulation pumps stop operaion automatically during standby (when welding arc and pilot arc are off).
9. The following functions are equipped with to ensure the starting of welding arc.
   Control of pilot current increase
   Control of pilot gas flow rate increase
   Control of the combined use of high frequency

■ Specification

Model		NW-150AH-III	NW-350AH-III
Input voltage	V	3-phases AC 200/220V 10% 50/60 Hz	
Rated input	KVA	9.5	22.0
Output current range	A	5~150	10~350
Rated duty cycle	%	70	
Maximum no-load voltage	V	160	
Rated load voltage	V	40	
Control method		IGBT inveter control constant current system	
Cooling method		Forced air cooling	
Outside dimensions	mm	400×770×792	
Weight	kg	95	
Pulse frequency	Hz	0.5~999	
Water tank capacity	ℓ	7.6	





TWO ELECTRODES PLASMA ARC WELDING MACHINE –W-PLASMA Welding–

PRINCIPLE

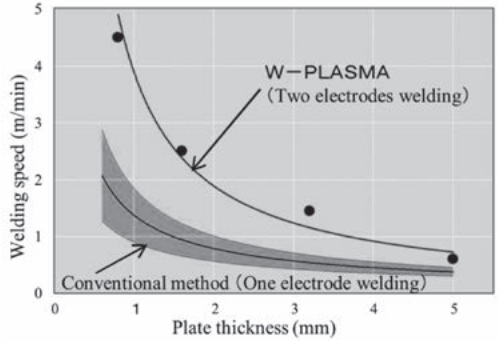
Two electrodes plasma arc welding method is how to weld by two electrodes plasma arcs. It is possible to perform welding which is free from undercuts even at high speeds, since even if undercuts generate in the preceding arc, the surface beads will be made even by the following arc.

CHARACTERISTICS

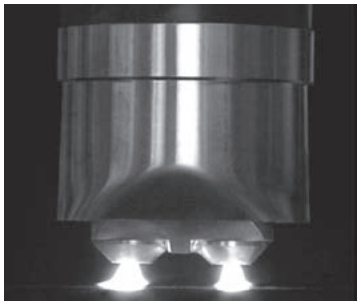
1. More than twice high speed welding has been realized compared with conventional method by two electrodes plasma welding.
2. High speed welding has been realized by striking two plasma arcs in a short distance. In addition, high quality welding can be performed by the combination with a fully digitalized plasma welding machine, .
3. Due to the unitization of welding tips, maintenance can be carried out as easily as with conventional torches.
4. The shape of the torch is simple and straight. Therefore it can easily be attached to welding jigs such as robots and so on.

■ Welding speed

Example of shaped I type butt welding for mild steel



In comparison with conventional methods, two electrodes plasma welding can obtain more than twice faster welding speed.



PLASMA WELDING MACHINE FOR GALVANIZED STEEL SHEET

(DOUBLE SHIELD GAS PLASMA WELDING MACHINE = DS PLASMA)

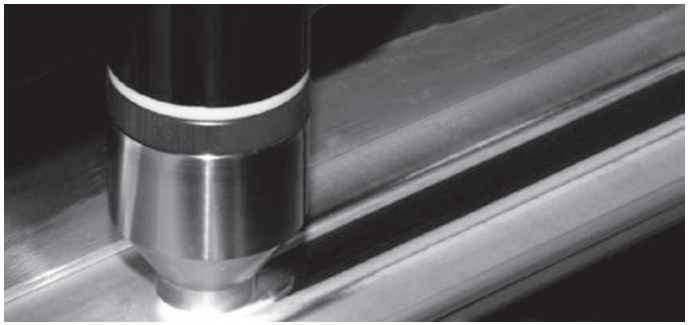
APPLICATION

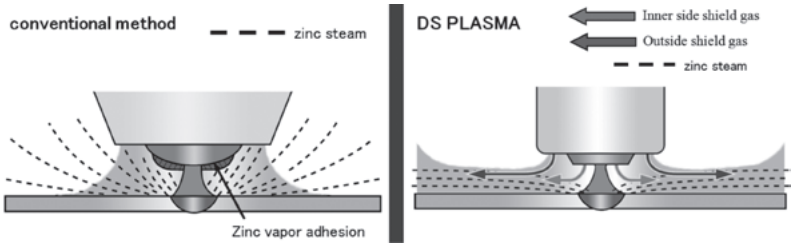
Galvanized steel sheet

CHARACTERISTICS

In case of conventional plasma welding method, it was impossible to realize stable welding for galvanized steel sheet during a long work time.That's why zinc steam from galvanized steel sheet was attached to insert tip.
This DS plasma welding method has realized stable welding during a long work time by blowing zinc steam away with double shield gas flow.
Moreover this method has also realized flat and beautiful bead appearance

- Plasma welding machine model: NW-350AH-Ⅲ-DS
- Plasma welding torch model: 107WH-DS



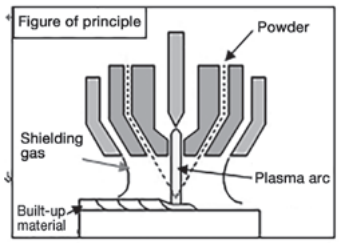


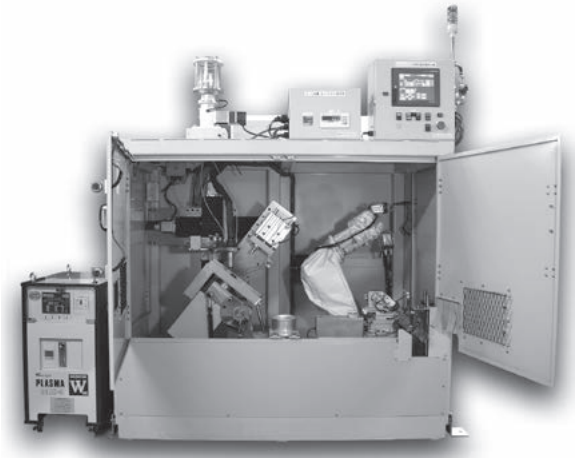
Plasma Transferred Arc Welding Equipment

Plasma transferred arc (PTA) welding is used to build up very hard material that normally cannot be molded into welding wire. The principle is to feed powder, which is build-up material as shown in the figure, into the plasma arc by carrier gas (Ar gas) to be welded and built up.
Plasma transferred arc welding has many features, such as enabling individual control of the heat source and filler metal (powder), which makes it easier to set the dilution amount and the surplus amount to the base metal, resulting in build-ups of a wide range (from thin to thick).

CHARACTERISTICS

1. You can control the penetration quantity into the base metal.
2. A wide range of build-ups can be achieved.
3. It is easy to control the build-up welding quantity.
4. No slag is generated in an inert gas atmosphere, and high quality build-up can be achieved.





Circumferential Fillet Welding Equipment

High Quality Plasma Welding with Little Welding Distortion

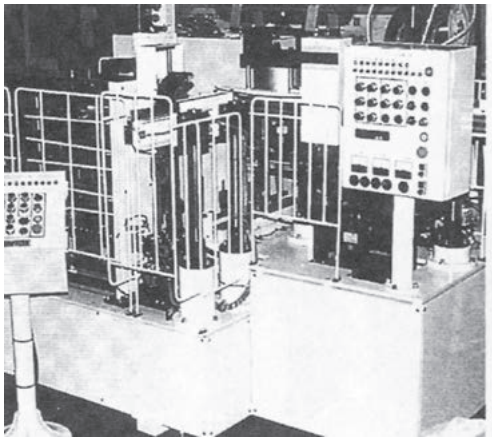
Circumferential Fillet Welding Equipment consists of a work conveying index table, a work clamp unit, a welding unit and a wire feed unit, and carries out plasma welding of a fillet joint of a gear and shaft pressed in by pressure. The fillet is welded by adding a filler wire and, therefore, any required leg length can be obtained.

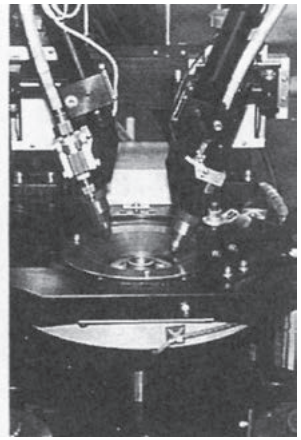
APPLICATION

Welding of various gears such as motorcycle pulleys.

CHARACTERISTICS

1. Semicircular welding by two torches facing each other drastically decreases welding distortions.
2. Welding defects such as pits and cracks do not occur since a pilot plasma arc blows off machine oil even if it is adhered to groove surface.
3. No spatters means no after treatment.
4. No defects occur at bead overlapping parts due to crater treatment.





Pipe Overlap Fillet Welding Equipment

High Quality Welding of Overlap Joints by Plasma Welding

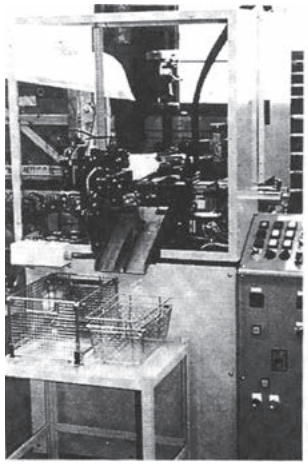
Pipe Overlap Fillet Welding Equipment consists of a work conveying unit, a welding unit and a control unit, and carries out circumferential plasma welding of an overlap fillet of a pipe pushed in to a boss. Work is conveyed by a quadrisecting index table and various sizes of pipes are produced by the one-touch exchange of a copper center pin fitted to the index table.

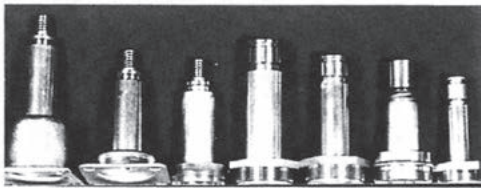
APPLICATIONS

Overlap fillet welding of various pipes.

CHARACTERISTICS

1. A welding bead without spatters is obtained since the equipment is used in the combination with a plasma welding machine.
2. It assures welding with little distortion.
3. A beautiful bead without oxidation is obtained by the after shield.
4. Wearing down of the electrode is very low making continuous operation for long hours possible and, therefore, high operation efficiency is assured.





Flat Plate Butt Welding Equipment

High Quality Welding of Seam Joints by Plasma Welding

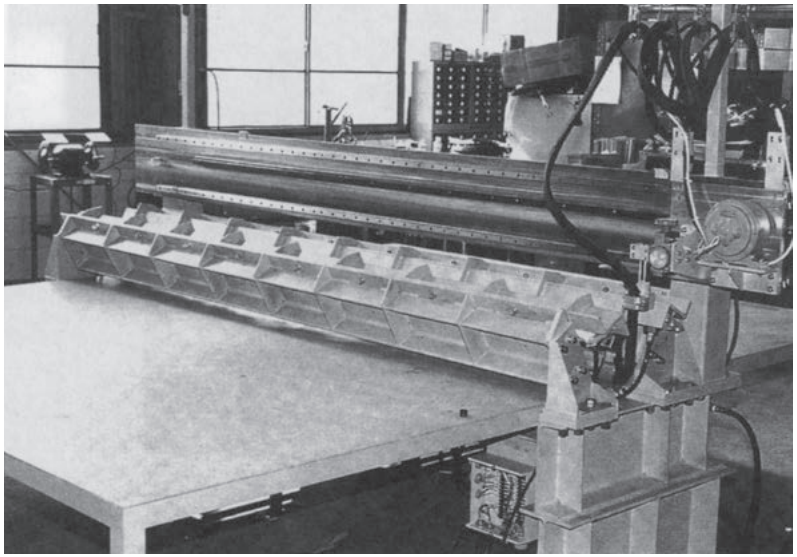
Flat Plate Butt Welding Equipment consists of a torch travelling unit, a work clamp unit and a control unit, and carries out plasma welding of butt seam of thin plates. A high quality bead with little distortion is obtained in high speed welding due to unique air clamps to restrain the work uniformly along the total length of the welding line.

APPLICATIONS

Butt welding of flat plates of various panels.

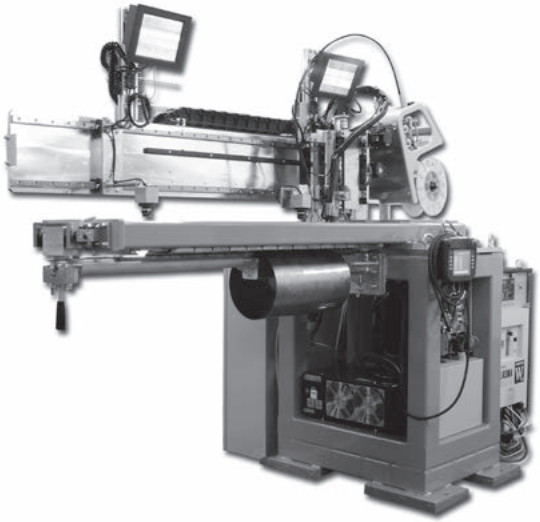
CHARACTERISTICS

1 It carries out perfect uranami (sound penetration bead) welding without spatters and with little distortion.
2. Beautiful surface and reverse beads without oxidation are obtained by after shied and back shield.
3 It can weld plates of a wide thickness range from 0.2mm to 2.0mm.
4. Maximum welding length is 3,000mm.
5. Welding of SUS and Fe type materials is possible.
6. Unique air clamps restrain even extremely thin plates perfectly and easily.



Simplified Plasma Seam Welding System

Plasma welding machines are also widely used in the tank industry (SUS, SS materials).
The key reasons why plasma welding machines are employed are their capability of single-sided single-pass full penetration welding by keyhole, and that welding distortion is small.
As a new product, we have developed and commercialized a simplified plasma seam welding device for a head plate (a conical member attached as a lid on both sides of a tank) for which automatic welding had not been possible previously.



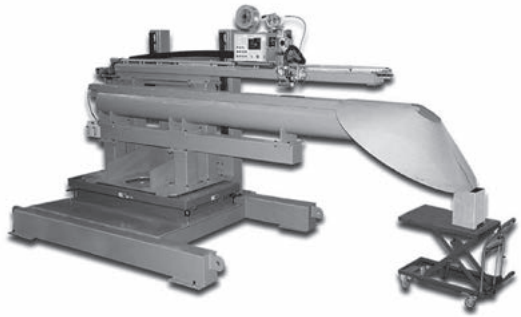
APPLICATIONS

Seam welding of inner and outer bodies of stainless pots and jars, washing machine tubs, automotive mufflers and other cylindrical objects.

CHARACTERISTICS

1. Automatic seam welding of the head plate possible
   It was structurally difficult to weld the head plate with conventional pipe seam welding equipment (clamp seamer).
   This simplified plasma seam welding device enables welding of a conical workpiece such as a head plate by adopting a structure that only needs to place (or hang) the workpiece.

2. Non-clamp welding possible
   In conventional butt welding, it is common to perform welding while the workpiece is being restrained with jigs from the front side and the opposite side, as in the clamp type shown to the right.
   In contrast, in this device, welding with non-clamping is enabled due to low strain welding by keyhole and utilization of workpiece stiffness by cylindrical forming and tack welding (however, depending on required quality, distortion removal may be necessary.)



3. Simple structure achieves low price
   Unlike a clamp seamer, this device does not require a mechanism to clamp the workpiece, so the device structure can be simplified, the device enabling to be provided at a lower price than the clamp seamer. Furthermore, the surroundings of the torch are structurally open, which is favored by customers who wish to monitor the arc condition.

4. Movable back shield mechanism (National patent number: 6376664)
   In the conventional back shield, a gap is formed between the work piece and the backing plate when back shielding is applied to a material whose curvature changes continuously such as a head plate, because of the structure that applies the backing plate to the whole welding line, making it difficult to completely protect the back bead with a shielding gas.
   This device has a backing mechanism that moves in conjunction with the torch and is in close contact with the workpiece, providing a more complete back shield effect. Furthermore, the resulting local shield reduces gas consumption as compared to the conventional methods.

Clamp Seam Welding System (6.2m type)

High Quality and High Speed Plasma Welding of Seam Joints

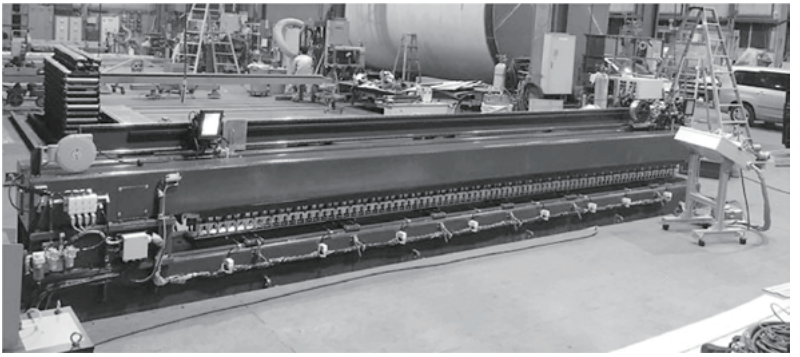
Flat Plate and Pipe Seam Welding Equipment consists of a torch travelling unit, a work clamp unit, a wire feed unit and a groove line monitor unit, and carries out the one-side keyhole welding of 1.0~8.0mm I groove joints. A high quality bead with little distortion is obtained in high welding speed due to unique air clamps to restrain the work uniformly along the total length of the welding line.

APPLICATIONS

Joining of plates for various large tanks (production of panels). Seam welding of tanks for beer, milk, lactic acid beverages, high pressure gases, etc.

CHARACTERISTICS

1. Possible to correspond to a maximum weld length of 6.2 m (conventionally 5.2 m is the maximum)
2. Possible to check arcs and grooves with a monitoring camera
   Easy to check the condition of the terminal groove adjustment in long distance welding
3. Possible to check the grooves with a camera at the time of work set for inner surface welding
4. Possible to weld the inner surface of the tank (minimum φ 1,500 mm)
5. Possible to weld dimpled plate with optional parts
6. Automatic adjustment of standoff by height copying
7. Shortened welding condition search time by pre-installation of welding basic conditions
8. Reduction in usage of back shielding gas by controlling the effective range according to welding position



Approval List of Welding Materials

1. Covered Arc Welding Materials -SMAW- (1)

Type of Steel	Brand Name	NK			ABS		
		Grade	Welding Position	Max. Dia. mm	Grade	Max.Dia. mm	
						All	F, H-Fil
For Mild Steel	G-200	KMW3	F, Vu, O	7.0	3	5.0	7.0
	A-200	KMW3	F, Vu, O	6.0	3	5.0	6.0
	G-300	KMW3	F, Vu, O	7.0	3	5.0	7.0
	S-03Z	KMW2	F, Vu, O	5.0	2	5.0	—
	NS-03Hi	KMW3	All	6.0	3	6.0	—
	FT-51	—	—	—	2	5.0	—
	S-16	KMW53H15	F, Vu, O	6.0	3Y	5.0	6.0
	S-16V	KMW53H15	F, O, H (Vd)	6.0	3Y	5.0	6.0
	EX-7	KMW2	F-Fil, H-Fil	8.0	2	—	8.0
	EX-4	KMW2	F-Fil, H-Fil	7.0	2	—	7.0
	TK-R	KMW53H10	F, Vu, Vd	4.0	—	—	—
	A-10	KMW3	All	6.0	3	6.0	—
	A-14	KMW3	All	7.0	3	7.0	—
	A-17	KMW3	All	7.0	3	7.0	—
For High Tensile Strength Steel	L-55	KMW53Y40H15	F, Vu, O	6.0	3Y, 3Y400	5.0	6.0
	L-55・PX	KMW53Y40H10	All	5.0	3Y400H10	5.0	5.0
	L-55・GP	KMW53Y40H10	All	5.0	3YH10	5.0	5.0
	7018	—	—	—	3YH10	5.0	—
	EX-55	KMW53H15	All	7.0	3Y	5.0	7.0
	TW-50	KMW53H15	All	4.0	3Y	F, O (Vd): 4.0	—
	LM-55G	KMW53H15	All	8.0	3Y	—	8.0
	EX-50F	KMW52	F-Fil, H-Fil	6.4	2Y	—	6.4
	L-60	KMW3Y50H10	F, Vu, O	6.0	AWS A5.5 E8016-G[1)]	6.0	—
	L-62CF	KMW3Y50H10	All	5.0	—	—	—
	L-74S	—	—	—	4YQ550H5	4.0	—
	L-80	AWS A5.5 E11016-G	F, Vu, O	6.0	AWS A5.5 E11016-G[1)]	4.0	6.0

Note; 1) min.AV.CVN 34J at −40°C

LR			DNV GL			BV			Others			
Grade	Welding Position	Max. Dia. mm	Grade	Welding Position	Max. Dia. mm	Grade	Welding Position	Max. Dia. mm		Grade	Welding Position	Max. Dia. mm
3m	All	7.0	3	All	7.0	3	All	7.0	—	—	—	—
3m	All	6.0	3	All	6.0	3	All	6.0	—	—	—	—
3m	All	7.0	3	All	7.0	3	All	7.0	—	—	—	—
2m	All	5.0	—	—	—	—	—	—	—	—	—	—
3m	All	6.0	3	All	6.0	—	—	—	—	—	—	—
2m	All	5.0	—	—	—	—	—	—	—	—	—	—
3Ym H15	All	6.0	3Y H10	All	6.0	3, 3YHH	All	6.0	—	—	—	—
3Ym H15	F, O, H (Vd)	6.0	3Y H10	F (Vd)	6.0	3, 3YHH	F, O (Vd)	6.0	—	—	—	—
2m, 2G	F	8.0	2	F	8.0	2	F, H	8.0	—	—	—	—
2m, 2G	F, H	7.0	2	F	7.0	2	F, H	7.0	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
3m	All	6.0	3	All	6.0	3	All	6.0	CR	3	—	—
3m	All	7.0	3	All	7.0	3	All	7.0	CR	3	—	—
3m	All	7.0	3	All	7.0	3	All	7.0	CR	3	—	—
3Y40m H15	All	6.0	3Y40 H10	All	6.0	3Y, 3Y40HH	All	6.0	—	—	—	—
—	—	—	3Y40H10	All	5.0	—	—	—	—	—	—	—
—	—	—	3Y40H10	All	5.0	—	—	—	—	—	—	—
—	—	—	3YH10	All	5.0	3YH10	All	5.0	—	—	—	—
3Ym H15	All	7.0	3Y H10	All	7.0	3, 3YHH	All	7.0	—	—	—	—
3Ym H15	All	4.0	3Y H10	All (Vd)	4.0	3, 3YHH	All	4.0	—	—	—	—
3Ym H15	All	8.0	3Y H15	All	8.0	3, 3YHH	All	8.0	—	—	—	—
3YG H15	F	8.0										
2Ym, 2YG	F	6.4	2	F, H	6.4	2Y	F, H	6.4	CR	2Y	F, H- Fil	6.4
3Ym H15	All	6.0	3Y H10	All	6.0	3Y46HH	All	6.0	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	4Y55H5	All	4.0	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—

1. Covered Arc Welding Materials -SMAW- (2)

Type of Steel	Brand Name	NK			ABS		
		Grade	Welding Position	Max. Dia. mm	Grade	Max.Dia. mm	
						All	F, H-Fil
For Low Temperature Service Steel	L-55SN	KMW53H15 KMWL3H10	All	5.0	3Y H5 +Mfr's[1]	5.0	—
	N-5F	KMWL3H15	F-Fil, H-Fil	7.0	3Y[2]	—	7.0
	L-47E	KMW63Y47H10	F, V	5.0	3Y400H10 +Mfr's[3]	5.0 (F, V)	—
	L-60LT	—	—	—	5YQ550 H5	4.0	—
For Corrosion Resisting Steel	L-80SN	—	—	—	5YQ690MW	5.0	—
	RS-55	KMW53H15	F, Vu, O	6.0	3Y	5.0	6.0
For Stainless Steel	S-308・R	KD308	F, Vu, O	5.0	—	—	—
	S-308L・R	KD308L	All	5.0	—	—	—
	S-309・R	KD309	F, Vu, O	5.0	—	—	—
	S-309L・R	KD309L	All	4.0	—	—	—
	S-309M・R	KD309Mo	F, Vu, O	5.0	—	—	—
	S-309ML・R	KD309MoL	All	5.0	—	—	—
	S-316・R	KD316	F, Vu, O	5.0	—	—	—
	S-316L・R	KD316L	F, Vu, O	5.0	—	—	—
	S-2120・R	Mfr's[4]	All	4.0	—	—	—
	S-DP8	—	—	—	—	—	—
For Special Alloy	YAWATA WELD B (M)	KMWL91	All	5.0	AWS A5.11 ENiCrFe-4[5]	5.0	—
	NITTETSU WELD 196	—	—	—	AWS A5.11 ENiMo-9[7]	5.0	—

LR			DNV GL			BV			Others			
Grade	Welding Position	Max. Dia. mm	Grade	Welding Position	Max. Dia. mm	Grade	Welding Position	Max. Dia. mm		Grade	Welding Position	Max. Dia. mm
5Y40m H15	All	5.0	5Y H5	All	5.0	—	—	—	—	—	—	—
5Y40m, 5Y40G H15	F	7.0	5Y H10 (NV2-4L) (NV4-4L)	F, H	7.0	—	—	—	—	—	—	—
3Y47H10	F, V	5.0	3Y46H10	F, V	5.0	—	—	—	—	—	—	—
—	—	—	5 Y55 H5	All	4.0	5Y50H5	All	5.0 Only	—	—	—	—
						5Y55H5	All	4.0	—	—	—	—
5Y69H5	F, V, O	5.0	5Y69 H5	All	5.0	—	—	—	CCS	5Y69	All	5.0
3Ym H15	All	6.0	3Y H10	All	6.0	—	—	—	CCS	3YH10	All	6.0
									—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	NV309MoL	All	5.0	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	Duplex	All	4.0	—	—	—	—	—	—	—
9Nim H15	All	5.0	NV9Ni H10	All	5.0	N50H5	All	5.0	CCS	9Ni H5	All	5.0
						Mfr's[6]	All	5.0	—	—	—	—
9Nim	All	5.0	NV9H5	All	5.0	N50H5	All	5.0	—	—	—	—
						Mfr's[6]	All	5.0	CCS	9Ni H5	All	5.0

Note: 1) min.AV.CVN 69J at −60°C
2) min.AV.CVN 47J at −60°C
3) T.S.: 570~720N/mm², min.Y.S.: 460N/mm², EL.: 20%, AV.CVN 64J at −20°C
4) For Stainless Steel (NSSC2120)
5) min.AV.CVN 34J at −196°C
6) AWS A5.11 ENiCrFe-4 Mod.
7) min.AV.CVN 34J at −196°C
8) AWS A5.11 ENiMo-9 Mod.

2. Gas Shielded Arc Welding Materials

1) Gas Metal Arc Welding Wires Wires -GMAW-

Type of Steel	Brand Name	NK	ABS	LR	DNV GL	BV	Others	
For Mild Steel and High Tensile Strength Steel	YM-26 / CO_2	KSW53G (C) KSW53Y40G (C)[1]	3YSA 3Y400SA[1]	3YS H15	III YMS III Y40MS[1]	SA3YM	KR	3YSG (C)
							CR	3YS
	YM-28 / CO_2	KSW53G (C)	3YSA	3YS H15	III YMS	SA3YM	—	—
	YM-28 / 85%Ar+15%CO_2	KAW53MG (M2)	3YA	3YM	III YM	A3, 3YM	—	—
	YM-28S / 80%Ar+20%CO_2	KSW53G (M2)	3YSA	3YS H15	III YMS	SA3YM	CR	3YSM
	YM-25 / 80%Ar+20%CO_2	KAW53MG (M2)	3YA	3YM H15	III YM	—	—	—
	YM-25S / 80%Ar+20%CO_2	KSW53G (M1, M2)	3YSA	3YS H5	III YMS	—	—	—
	YM-55A / 80%Ar+20%CO_2	KSW53Y40G (M2)	3YSA	3YS H15	—	—	—	—
	YM-60C / CO_2	KSW3Y46G (C)	—	—	III Y50MS	—	—	—
	YM-80C / CO_2	AWS ER110S-G Equiv.	—	—	—	—	—	—
For Low Temperature Service Steel	YM-28E / 80%Ar+20%CO_2	KSW53G (M2)	3YSA	3YS H15	III YMS	SA3M, SA3YM	—	—
	YM-55H / CO_2	KSW53Y40G (C) KSWL3G (C) KSW63Y47G (C)[1]	3Y400SA 3YSA Mfr's[2]	4Y40S H15	—	—	—	—
	YM-47E / CO_2	KSW63Y47G (C) H5	3Y400SAH5 Mfr's[3]	3Y47S H5	—	—	—	—
	YM-60A / 80%Ar+20%CO_2	KSW4Y46G (M2)	Mfr's[4]	—	IV Y46MS	—	—	—
	YM-80A / 80%Ar+20%CO_2	KSW4Y69G (M)	4YQ690SA	—	IV Y69MS	—	—	—
	YM-69F / 90%Ar+10%CO_2	—	5YQ690SA	—	V Y69MS	—	—	—
	YM-36E / 80%Ar+20%CO_2	KSWL3G (M2)	5Y400SA	5Y40S	—	—	—	—
For Stainless Steel	YM-308L / 98%Ar+2%O2	KY308L (M1)	—	304L S	VL 308L	—	KR	RY-308L (M1)
	YM-316L / 98%+2%O2	KY316L (M1)	—	316L S	VL 316L	—	KR	RY-316L (M1)

Note: 1) Flat position only
2) min.AV.CVN 47J at −40°C
3) T.S.: 570~720N/mm², min.Y.S.: 460N/mm², EL.: 20%, AV.CVN 64J at −20°C
4) min.Y.S.: 490N/mm², T.S.: 590N/mm², EL.: 20%, AV.CVN 47J at −40°C

2) Flux Cored Arc Welding Wires -FCAW- (1)

Type of Steel	Brand Name	NK	ABS	LR	DNV GL	BV	Others	
For Mild Steel and High Tensile Strength Steel	SF-1 / CO_2	KSW52G (C) H5 KSW52Y40G (C) H5	2YSA, 2Y400SA H5	2YS H5	II Y40MS H5	SA2YMH5	CCS	2S H5, 2YS H5
							KR	2YSG (C), 2SG (C)
							CR	2SM, 2YSM H5
	SF-1・EX / CO_2	KSW52G (C) H5	2YSA H5	2YS H5	II YMS H5	SA2YM H5	—	—
	SF-1V / CO_2	KSW52G (C)	—	—	II YMS	—	—	—
	SF-1A / 80%Ar+20%CO_2	KSW52G (M2) H5	3Y400SA H5	3Y40S H5	III Y40MS H5	SA3Y40 H5	PRS	3YS H5
							RINA	3YS H5
	SF-1E / CO_2	—	3Y400SA H5	3YS H5	III Y40MS H5	SA3Y40 H5	PRS	3Y40SM H5
							CCS	3Y40SM H5
	SF-1B / CO_2	—	3YSA H5	3YS H5	III YMS H5	—	CWB	E491T1-C1A3-CS1-H4
	SF-1B / 80%Ar+20%CO_2	—	3YSA H5	3YS H5	III YMS H5	—	CWB	E491T1-M21A3-CS1-H4
	SF-3 / CO_2	KSW53G (C) H5	3YSA H5, 3Y400SA H5	3YS, 3YM H5	III YMS H5	SA3YM H5	CCS	3S, 3YS H5
							RS	3YMS H5
							CR	3SM, 3YSM H5
	SF-3Y / CO_2	KSW53Y40G (C) H5	3Y400SA H5	3Y40S, 3Y40M H5	III Y40MS H5	—	—	—
	SX-3 / CO_2	KSW53Y40G (C) H5	3YSA H5, 3Y400SA H5	3Y40S H5	III Y40MS H5	SA3YM H5, SA3Y40M H5	—	—
	SF-60 / CO_2	KSW3Y46G (C) H5	—	—	—	—	—	—
	SM-1 / CO_2	KSW52G (C) H5	2YSA H10	2YS H10	—	—	—	—
	SM-1F / CO_2	KSW52Y40G (C) H5	2YSA H5, 2Y400SA H5	2YS H5	II YMS H5	SA2YM SA2Y40M H5	CCS	2S, 2YS H5
							RS	2YMS H5
							CR	2SM, 2YSM H5
							PRS	2Y40 H5
	SM-1F (×2) / CO_2	KAW52Y40G (C)	2YA, 2Y400A	2YM	II Y	A2YM, A2Y40M	—	—
	SM-1F・EX / CO_2	KSW52G (C) H5	2YSA H5	2YS H5	II YMS H5	SA2YM H5	—	—
	SM-1FDA / 80%Ar+20%CO_2	KSW52G (M2) H5 KAW52G (M2) H5	2YA H5	—	—	—	—	—
	SM-1S / CO_2	KSW52G (C) H5 KAW52Y40G (C) H5	2YSA H5, 2Y400A H5	2YS H5	II YMS H5	—	CR	2SM, 2YSM H5
	SM-3EF (×2) / CO_2	—	3Y400A	3Y40M H10	—	—	—	—
	SM-3F / CO_2	—	—	3YM	—	—	—	—
	AS-1 / CO_2	KSW52G (C)	2YSA H10	2YS H15	II YMS	—	—	—
	FC-1 / CO_2	KSW52G (C)	2YSA	2YS H15	II YMS	SA2YMH	CR	2YSM
	PL-22 / CO_2	KSW52Y40G (C)	2YSA H10, 2Y400SA H10	2YS	II Y40MS	—	—	—
	FCM-1F / CO_2	KSW52Y40G (C)	2YSA H10, 2Y400SA H10	2YS	II Y40MS	—	—	—
	FC-60 / CO_2	KSW3Y46G (C) KSW3Y50G (C)	—	—	—	—	—	—
	YM-1SA/SM-1SA/ CO_2	KAW52G (C) H5	2YA H5	—	IIY H5	—	—	—
	YM-1SA/80%Ar+20%CO_2 / SM-1SA/ CO_2	KAW52G (M2) H5 KAW52G (C) H5	2YA H5	—	IIY H5	—	—	—

Note: 1) Fillet-Weld only

2) Flux Cored Arc Welding Wires -FCAW- (2)

Type of Steel	Brand Name	NK	ABS	LR	DNV GL	BV	Others	
For Low Temperature Service Steel	SF-3M / CO_2	KSW54Y40G (C) H5	4Y400SA H5	4Y40S H5	IV Y40MS H5	—	—	—
	SF-3E / CO_2	KAW4Y42G (C) H5	4YQ420SA H5	4Y42S H5	IV Y42MS H5	—	CWB	E551T1-C1A4-CS1-H4
	SF-3A / 80%Ar+20%CO_2	KAW54MG (M2) KSW54Y40G (M2)	3YSA H5	4Y40S H5	IV Y42MS H5	—	CWB	E491T1-M21A4-CS1-H4
							PRS	4Y42S H5
							—	—
	SF-3AM / 80%Ar+20%CO_2	—	5YQ460SA H5	5Y46S H5	V Y46MS, (VL4-4L)(H5)	—	PRS	5Y46S H5
							CWB	E551T1-M21A4-Ni1-H4
	SF-3AMSR / 80%Ar+20%CO_2	—	—	4Y42S, 4Y42srS H5	IV Y42MS H5	—	—	—
	SF-36E / CO_2	KSWL3G (C) H5 KSWL3G (C) H5-TS540M	3YSA+Mfr's H5[1]	5Y40S H5	V YMS H5	SA5YM H5	KR	5YSG(C) H5
	SF-36F / CO_2	KSWL3G (C) H5	3YSA+Mfr's H5[1]	5Y40S H5	V YMS H5	—	—	—
	SF-36EA / 80%Ar+20%CO_2	—	—	5Y40S H5	V YMS NV (4-4L) (H5)	—	—	—
	SF-47E / CO_2	KSW63Y47G (C) H5 KAW63Y47MG (C) H5	5Y400SA+Mfr's H5[2]	3Y47S H5	V Y46MS H5	—	CWB	E551T1-C1A6-Ni1-H4
	SF-60L / CO_2	KSW4Y50G (C) H5	—	—	—	—	—	—
	SF-50E / CO_2	—	5YQ500SA H5	—	V Y50MS H5	SA5Y50 H5	RS	5Y50SM H5
	SF-50Y / CO_2	—	4YQ500SA H5	—	IV Y50MS H5	SA4Y50 H5	—	—
	SF-50A / 80%Ar+20%CO_2	—	4YQ500SA H5	4Y50S H5	IV Y50MS H5	—	—	—
	SF-70A / 80%Ar+20%CO_2	—	4YQ620SA H5	—	IV Y62MS H5	—	—	—
	SM-3A / 80%Ar+20%CO_2	—	4Y400SA H5	4YS H5	IV Y40MS H5	SA4Y H5	CWB	E491C-T15-M21A4-CS1-H8
	SM-47A / 80%Ar+20%CO_2	—	5YQ460SA H5	—	V Y46MS H5	—	PRS	5Y46S H5
							CWB	E550T15-M21A6-Ni1-H4
	SM-80A / 80%Ar+20%CO_2	—	4YQ690SA H5	—	IV Y69MS H5	—	—	—
For Corrosion Resisting Steel	SF-1•GP / CO_2	KSW52Y40G (C) H5	2YSA H5, 2Y400SA H5	2YS H5	–	–	—	—
	SM-1F•GP (×2) / CO_2	KAW52Y40G (C)	2YA, 2Y400A H5	2YM	—	—	—	—
	SM-1F•GP / CO_2	KSW52Y40G (C) H5	2YSA H5, 2Y400SA H5	2YS H5	—	—	—	—
	SM-1S•GP / CO_2	KSW52Y40G (C) H5 KAW52Y40MG (C) H5	2YA/2Y400A H5, 2YSA/2Y400SA H5	2YS H5	—	—	—	—
	SF-55RS / CO_2	—	2YSA H5	Mfr's[3]	II YMS H5	—	CCS	2YS H5

Note: 1) min.AV.CVN 34J at −60°C
2) T.S.: 570~720N/mm², min.Y.S.: 460N/mm², EL.: 22%
3) T.S.: 490~660N/mm², min.Y.S.: 375N/mm², EL.: 22%, AV.CVN 47J at 0°C

2) Stainless Flux Cored Arc Welding Wires-FCAW-(3)

Type of Steel	Brand Name	NK	ABS	LR	DNV GL	BV	Others	
For Stainless Steel	SF-308L / CO_2	KW308LG (C)	Mfr's[1]	304L S	VL308L	308L	RS	A-5
	SF-308LK / CO_2	—	Mfr's[2]	—	—	—	—	—
	SF-309L / CO_2	KW309LG (C)	Mfr's[3]	SS/CMn S	VL309L	309L	RS	A-9SP
	SF-309MoL / CO_2	KW309MoLG (C)-315M	Mfr's[4]	SS/CMn S	NV309MoL	309Mo	—	—
	SF-316L / CO_2	KW316LG (C)	Mfr's[5]	316L S	NV316L	—	RS	A-6
	SF-316LP / 80%Ar+20%CO_2	—	—	316L S	NV316L	—	—	—
	SF-329J3LP / CO_2	—	AWS A5.22 E2209T1-1	—	O-Duplex	—	—	—
	SF-2120 / CO_2	Mfr's[6]	—	—	—	—	—	—
	SF-DP8 / CO_2	KW2209G (C)	—	—	—	2205	—	—
	SF-N309L (FCAW and Self Shielding, not GMAW)	KW309LN	Mfr's[2]	Mfr's[7]	NV309L	309L	—	—

Note: 1) min.Y.S.: 245N/mm², T.S.: 510N/mm², EL.: 35%, AV.CVN 34J at −20°C
2) min.Y.S.: 245N/mm², T.S.: 510N/mm², EL.: 35%, AV.CVN 31J at −196°C LE:0.38mm
3) min.Y.S.: 245N/mm², T.S.: 510N/mm², EL.: 30%, AV.CVN 34J at −20°C
4) min.Y.S.: 205N/mm², T.S.: 510N/mm², EL.: 20%, AV.CVN 27J at −20°C
5) min.Y.S.: 205N/mm², T.S.: 510N/mm², EL.: 35%, AV.CVN 27J at −20°C
6) min.Y.S.: 450N/mm², T.S.: 690N/mm², EL.: 15% for Stainless Steel (NSSC2120)
7) SS/CMn, suitable for welding stainless steel Grade(s) other than the duplex types to any of the structural grades of ship steel for chemical use only.

3) Gas Tungsten Arc Welding Rods and Wires -GTAW-

Type of Steel	Brand Name	NK	ABS	LR	DNV GL	BV	Others	
For Mild Steel and High Tensile Strength Steel	YT-28 / Ar	KSWL3G (I)	4Y+Mfr's[1]	—	—	—	—	—
For Corrosion Resisting Steel	YT-55RS / Ar	KSW52G (I)	2Y	Mfr's[2]	—	—	CCS	2Y
For Stainless Steel	YT-308L / Ar	KY308L (I)	—	304L m	—	—	—	—
	YT-309MoL / Ar	KY309Mo (I)	—	—	—	—	—	—
	YT-316L / Ar	KY316L (I)	—	316L m	—	—	—	—
	YT-DP8 / Ar	KY2209 (I)	—	S31803m	—	—	—	—

Note: 1) min.AV.CVN 47J at −60°C
2) T.S.: 490~660N/mm², min.Y.S.: 375N/mm², EL.: 22%, AV.CVN 47J at 0°C

4) Electrogas Arc Welding Materials -EGW-

Grade	Brand Name	NK	ABS	LR	DNV GL	BV	Others	
For Mild Steel and High Tensile Strength Steel	EG-1 / SB-60V / CO_2	KEW52	2YA	2, 2Y[1]	—	—	—	—
	YM-55H / EG-3T / SB-60VT / CO_2	KEW53Y40	3Y400A	3Y[2], 3Y40[2]	—	—	—	—
	EG-47T (×2) / SB-60VT / CO_2	KEW63Y47	5Y470	3Y47[2]	—	—	—	—
For Low Temperature Service Steel	EG-3 / SB-60V / CO_2	KEW53Y40, KEW53	4Y400	4Y[2], 4Y40[2]	IV Y40	AV4Y40	—	—

Note: 1) Approval may be restricted for use with steel treated with aluminium.
2) Approval may be restricted for use with steel treated with niobium.

5) One-Side Gas Shielded Arc Welding Materials

Type of Steel	Brand Name	NK	ABS	LR	DNV (DNV-GL)	BV	Others	
For Mild Steel and High Tensile Strength Steel	YM-28 / SB-41 / CO_2	○	○	2YS H15	—	—	—	—
	YM-28S / SB-41 / 80%Ar+20%CO_2	○	○	2YS H15	—	—	—	—
	YM-55A / SB-41 / 80%Ar+20%CO_2	○	○	—	—	—	—	—
	YM-55H / YK-CM × CO_2	KSW53G (C)	3YSA	—	—	—	—	—
	YM-55H / YK-CM / SB-41 / CO_2	○	○	2YS H15	II Y	—	—	—
	YM-55H / YK-CM / SB-41GL / CO_2	○	○	—	II Y	—	—	—
	YM-55H / SF-1 / YK-CM / SB-41 / CO_2	KAW52SPG (C)	2Y	2YA	II Y	2Y	—	—
	YM-55H (×2) / YK-CM / SB-41 / CO_2	KAW52SPG (C)	—	—	II Y	—	—	—
	SF-1 / SB-41 / CO_2	○	○	2YS	II YMS	SA2YM H5	CR	2SM, 2YSM H5
	SF-1A / SB-41 / 80%Ar+20%CO_2	○	○	2YS, 2YM	II YMS	—	—	—
	SF-3 / SB-41 / CO_2	○	○	3YS	III YMS H5	—	CCS	3S, 3YS H5
							CR	3SM, 3YSM H5
	SF-3Y / SB-41 / CO_2	○	○	3Y40S H15	—	—	—	—
	SF-47E / SB-41 / CO_2	○	○	3Y47S, 3Y47M H5	—	—	—	—
	SM-1 / SF-1 / YK-C / SB-41 / CO_2	—	—	2A, 2YA	II YM	—	—	—
	SM-1S / SB-41 / CO_2	○	○	2YS	II YMS H5	—	CR	2SM, 2YSM H5
	FC-1 / SB-41NAS / CO_2	○	○	2YS	II YMS	—	CR	2YSM
	FC-1 / SB-41PNS / CO_2	○	○	—	II YMS	—	—	—
For Low Temperature Service Steel	YM-55H / SB-41 / CO_2	○	○	4Y40S H15	TV YMS	—	—	—
	SF-36E / SB-41 / CO_2	○	○	5Y40S H5	V YMS	—	—	—

Note; ○: It is available for One-side welding when it is done welding procedure qualification test (WPQT).
1) T.S.: 490~660N/mm², min.Y.S.: 375N/mm², EL.: 22%, AV.CVN 47J at 0°C

One-Side Gas Shielded Arc Welding Materials
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3. Submerged Arc Welding Materials -SAW-

1) Multi-layer Welding and Both Side Welding

Type of Steel	Brand Name	NK	ABS	LR	DNV GL	BV	Others	
For Mild Steel and High Tensile Strength Steel	Y-B / YF-15	KAW3TM	3TM	3TM	III TM	A3TM	—	—
	Y-CM / YF-15	KAW53TM	3YTM	3YTM	III YTM	A2YTM	—	—
	Y-CMS / NF-100	KAW53TM	—	3YTM	—	—	—	—
	Y-D / YF-15	KAW52T, 53M	2YT, 3YM	2YTM	II YT, III YM	A2YTM	CR	2YT, 3YM
	Y-D / YF-15A	KAW52TM	—	—	—	—	—	—
	Y-D / YF-800	KAW1TM, 52M	2YM	1T, 2YM	—	A2YM	—	—
	Y-D / NF-1	KAW53TM	3YTM	3YTM	—	—	—	—
	Y-D / NF-310	KAW53TM	3YTM	3YTM	III YTM	—	—	—
	Y-D / NB-55E	KAW53TM	3YTM	3YTM	III YTM	—	—	—
	Y-D (×2) / NB-55E	KAW53TM	3YTM	3YTM	III YTM	—	—	—
	Y-D (×2) / NSH-52M	KAW52TM	—	—	—	A2Y TM	—	—
	Y-DS / NF-60	KAW1M	—	—	—	—	—	—
	Y-DS / NF-100	KAW52T, KAW53M	2YTM	2YT 3YM	—	—	—	—
	Y-E / NF-1	KAW53M	—	—	—	—	—	—
	Y-DM / YF-15	KAW3Y46TM	—	—	—	—	—	—
	Y-DM / YF-15B	KAW3Y50M	—	—	—	—	KR	3Y50M
	Y-80M / YF-15B	JIS Z3183 S804-H4	—	—	—	—	KR	JIS Z 3183 S804-H4
For Low Temperature Service Steel	Y-DM3 (×2) / NB-55E	KAW54Y40TM	—	—	IV Y40TM	—	—	—
	Y-DM3 / NF-310	KAWL3TM KAWL3TM-TS540M	—	—	—	—	—	—
	Y-E / NF-310	KAWL3TM KAWL3TM-TS540M	3YTM, 3YTM+Mfr's[1]	4YT, 5Y40TM H15	V YTM (VL4-4L)	A5YTM	—	—
	Y-D / NB-55L	KAWL3M	3YM+Mfr's[2]	4Y40M H15	V YM (VL4-4L)	—	—	—
	Y-DM / NB-55	—	—	—	V YT (VL4-4L)	5YT	—	—
	Y-DS / NB-55	KAWL3M	3Y400M+Mfr's[3]	5Y40M H10	V YM (VL4-4L)	A5Y40M	—	—
	Y-3NI / NB-55LS	—	—	—	V YM (VL4-4L)	A3YM+Mfr's[4]	—	—
	Y-CMS / NB-55	KAW5Y46M	5Y400M+Mfr's[5]	5Y46M H10	V Y46M	—	—	—
	Y-DMS / NB-55	KAW4Y46M	—	—	—	—	—	—
	Y-DM3 / NB-60L	KAW63Y47M H10	3Y400M+Mfr's[6] H10	3Y47M H10	V YM (VL4-4L)	—	—	—
	Y-204B / NB-250H	—	5YQ500M H5	—	V Y50M H5	A5Y50M H5	—	—
	Y-80 / NB-80	Mfr's[7]	—	—	—	—	—	—
	Y-80M / NB-250H	KAW4Y69M, KAW4Y69H-VE47M-60T	5YQ690M	—	V Y69M	—	—	—
	Y-80J / NB-250J	KAW4Y62M H5	4.8φ:4YQ690M+Mfr's H5[9] 3.2~4.0φ:5YQ690M H5	—	IV Y69M+Mfr's[9] H5	—	CCS	4Y69M+Mfr's[9] H5
For Stainless Steel	Y-DP8 / BF-30	KD2209 TS Equiv	—	—	Mfr's[10]	A2205M	—	—
	YT-308L / BF-300M	KU308LM	—	—	—	—	—	—
For Special Alloy	NITTETSU FILLER 196 / NITTETSU FLUX 10H	KAWL91M, KAWL91M-YP400M-TS690M	Mfr's[11]	9Ni M	NV1.5Ni to NV9Ni (CVN at −196°C)	Mfr's[12] AN50 M	CCS	9Ni M

Note: 1) min.AV.CVN 30J at −60°C
2) min.AV.CVN 40J at −60°C
3) min.AV.CVN 41J at −60°C
4) min.AV.CVN 27J at −60°C
5) T.S.: 570~690N/mm², min.Y.S.: 460N/mm², EL.: 22%
6) T.S.: 570-720N/mm², min.Y.S.: 460N/mm², EL.: 20%, AV.CVN 64J at−-20°C
7) min.Y.S.: 690N/mm², T.S.: 790N/mm², EL.: 15%, AV.CVN 34J at −40°C (Each. 27J)
8) min.AV.CVN 69J at −40°C and AV.CVN 47J at −60°C
9) min.AV.CVN 47J at −60°C
10) min.Y.S.: 450N/mm², T.S.: 620N/mm², EL.: 25%, AV.CVN 27J at −20°C
11) min.Y.S.: 375N/mm², T.S.: 590N/mm² (Butt: 630MPa), EL.: 25%, AV.CVN 27J at −196°C
12) min.Y.S.: 380N/mm², T.S.: 600N/mm², EL.: 25%, AV.CVN 34J at −196°C

2) One-Side Submerge Arc Welding Materials

Type of Steel	Brand Name	NK	ABS	LR	DNV GL	BV	Others	
For Mild Steel and High Tensile Strength Stee	Y-D / NB-55E / YK-D / SB-51	KAW52SP	2Y	—	—	A2YU	—	—
	Y-DL / NSH-50M / YK-D / SB-51	KAW52MP	—	—	—	—	KR	2YMR
	Y-DL (×2) / NSH-50M / YK-D / SB-51	KAW52SP	—	—	—	—	—	—
	Y-DL (×2) / NSH-50M / NSH-1RM	KAW52SP	—	2A, 2YA	—	—	—	—
	Y-DL (×3) / NSH-50M / NSH-1RM	KAW52SP	2Y	2A, 2YA	II Y	A2YM	RS	2Y
							KR	2YSR
							CCS	2, 2Y
							RINA	2YU
	Y-DL (×4) / NSH-50M / NSH-1RM	KAW52SP	2Y	2A, 2YA	II Y	A2YU	CCS	2, 2Y
	Y-DL (×4) / NSH-50M / NSH-1RM / YK-D	KAW53SP	3Y	3YA	III Y	A3YU	—	—
	Y-DL (×2) / NSH-55ER / NSH-1RM	KAW53SP	3Y	3YA	III Y	A3YU	CCS	3Y
	Y-DL (×3) / NSH-55ER / NSH-1RM	KAW53Y40SP	3Y	3YA	III Y	A3YU	CCS	3Y
							RS	3Y
	Y-DL (×4) / NSH-55ER / NSH-1RM	KAW53SP	3Y	3YA	III Y	A3YU	CCS	3Y
	Y-DL (×4) / NSH-55ER / NSH-1RM / YK-D	KAW53Y40SP	3Y400	—	III Y40	—	—	—
	Y-DM3 / Y-DL (×2) / NSH-55EM / NSH-1RM	KAW53Y40SP	3Y400	3YA, 3Y40A	III Y40	A3Y40U	CCS	3Y, 3Y40
							RINA	3Y40U
	Y-DM3 / Y-DL (×3) / NSH-55EM / NSH-1RM	KAW53Y40SP	3Y400	—	—	—	—	—
	Y-DM3 / Y-DL (×2) / NSH-55EM / NSH-1RM / YK-CM	KAW53Y40SP	—	—	—	—	—	—
	Y-DM3 / Y-DL (×2) / NSH-55EM / NSH-1RM / YK-CM	—	—	—	—	—	CCS	3Y42

Memo

NIPPON STEEL WELDING & ENGINEERING CO.,LTD.

https://www.weld.nipponsteel.com

Head Office
Shingu Bldg., 2-4-2 Toyo, Koto-ku, Tokyo, JAPAN 135-0016
【Tel】+81-3-6388-9000 【Fax】+81-3-6388-9160
【E-mail】overseas@weld.nipponsteel.com

Narashino Plant
7-6-1, Higashinarashino, Narashino-City, Chiba, JAPAN 275-0001
【Tel】+81-47-479-1171 【Fax】+81-47-475-6430

Hikari Plant
4-2-1 Asae, Hikari-City, Yamaguchi, JAPAN 743-0021
【Tel】+81-833-71-3390 【Fax】+81-833-71-3394

R&D Division
Futtsu Research Institute
In Joining Research Laboratory Steel Research Laboratories, Technical Developm
Bureau of Nippon Steel & Sumitomo Metal Corporation, 20-1 Shintomi,
Futtsu-City, Chiba, JAPAN 293-8511
【Tel】+81-439-80-2622 【Fax】+81-439-80-2748

Narashino Operating Division
7-6-1, Higashinarashino, Narashino-City, Chiba, JAPAN 275-0001
Machinery & Engineering Unit
【Tel】+81-47-479-4111 【Fax】+81-47-479-1434

Plasma Welding Machinery Unit
【Tel】+81-47-479-4138 【Fax】+81-47-479-2968

Optical Fiber Unit
【Tel】+81-47-479-1179 【Fax】+81-47-479-4371

Shanghai Rep. Office
Room 403-39, 4th floor, KIRIN PLAZA, Lane 666, Gubei Road,
Changning District, Shanghai, 200336, CHINA
【Tel】+86-21-2216-6561

Russia Rep. Office
406, 7-K, Tallinskaya Str., St. Petersburg, RUSSIA
【Tel】+7-812-242-94-14

Subsidiary

Thailand
NIPPON STEEL WELDING (THAILAND) Co., Ltd.
Eastern Seaboard Industrial Estate Soi 3 Zone A
300/41 T. Tasit A. Pluakdaeng Rayong 21140 THAILAND
【Tel】+66-38-656-212 【Fax】+66-38-656-233

Other contact information

Korea
Seoul
B-1601, E-Staevill 323-9 Shinjung-Dong, Yangchun-Gu, Seoul, 08093, KOREA
【Tel】+82-2-2648-6578 【Fax】+82-2-2648-6579

Pusan
Room 504, Sungam B/D, 1436-2, Onchun 2-Dong, Donglae-Gu, Busan, 47734, KOREA
【Tel】+82-51-553-9650 【Fax】+82-51-556-9650