



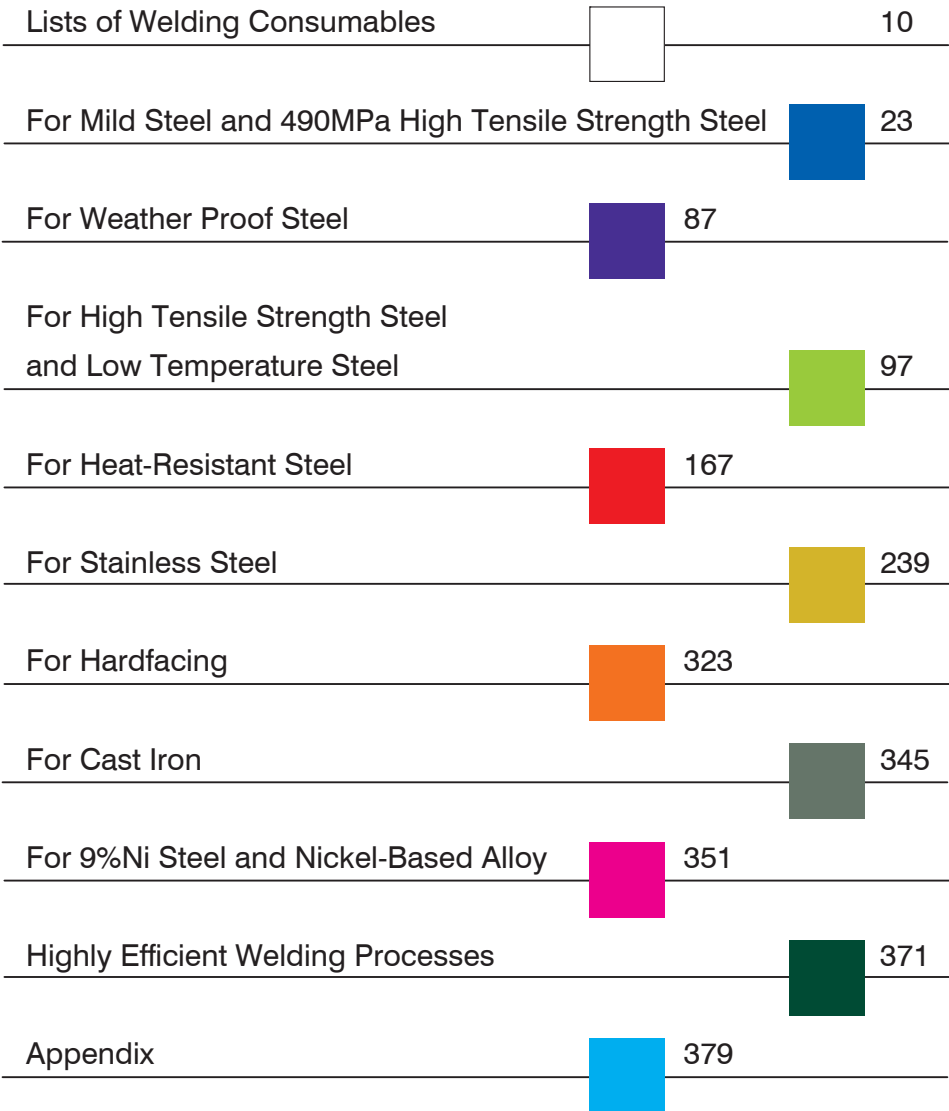
KOBELCO

WELDING HANDBOOK

KOBE STEEL, LTD.

WELDING BUSINESS

Overall Index



• For your further information of welding consumable specifications, classifications, approvals and packages, please contact the nearest Kobelco office or sales representative.

Notification

We, Welding Business of Kobe Steel, Ltd., thank you very much for your continuous patronage of our products and services. We have changed the designation system of welding consumable as described in the following from April 2008. However, the technical design of the products is not changed.

| |
|---|
| <h2>New group brand names and the corresponding products</h2> |
|---|

All KOBELCO welding consumables are designated with “Trade Designation” and are grouped into the following three new groups on the basis of the characteristics of individual products as detailed below.

(1) **FAMILIARC™** (Famili-Arc)
A coined word produced by combining “Familiar” and “Arc.”
Welding consumables grouped into this group are used for general welded structures made of mild steels and high tensile strength steels that have the tensile strength of less than 590 MPa.

(2) **TRUSTARC™** (Trust-Arc)
A coined word produced by combining “Trust” and “Arc.”
Welding consumables grouped into this group are used for such steels that require highly credible qualities as high tensile strength steels with the tensile strength of 570 MPa and higher, low temperature steels, and heat-resistant low-alloy steels.

(3) **PREMIARC™** (Premi-Arc)
A coined word produced by combining “Premium” and “Arc.”
Welding consumables grouped into this group are used for high-alloy steels, stainless steels, and nonferrous metals.

The new group brand name (referred to as “Trademark” hereinafter) is put on the head of an individual trade designation. The trade designations are made by modifying the traditional brand names in accordance with the new designation system in which the position of hyphen is reviewed so that a hyphen comes after one letter or two letters. That is, the new brand name consists of “Trademark” and “Product name” as shown in the following. We are determined to control all the trade designations so that they can clearly be identified.

Examples of new and old brand names

| Old brand name | New brand name |
|----------------|---------------------------|
| (1) B-10 | FAMILIARC™ B-10 |
| (2) MG-50 | FAMILIARC™ MG-50 |
| (3) TGS-50 | FAMILIARC™ TG-S50 |
| (4) MGS-50 | FAMILIARC™ MG-S50 |
| (5) ZERODE-44 | FAMILIARC™ Z-44 |
| (6) CMA-106N | TRUSTARC™ CM-A106N |
| (7) DW-308 | PREMIARC™ DW-308 |

The purpose of changing the designation system

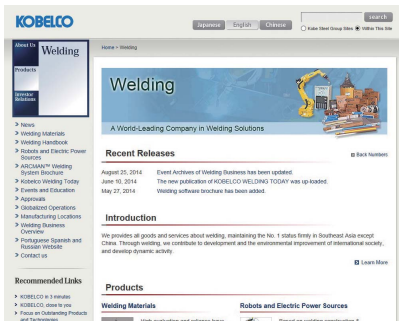
In recent years, we have found some other companies' products that have the same brand names as ours and false certificates that misrepresent our company's certificates in Japan and the Asian countries.

In order to cope with this problem, we have taken legal actions against the impostors that could be verified and have required them to change their product names. However, it is difficult in the traditional product designation system to protect all of our products from imitation. Hence, we have established the new designation system of welding consumable to ensure the trademark right in main countries and to make our products identifiable more clearly, in which the particular group brand name, "Trademark," is put on the head of an individual "Product name."

The new designation system is not only to prevent counterfeit products in Japan and overseas countries, but also to prevent our customers and users from suffering such a trouble in terms of our products.

This modification may cause customers and users to modify their relevant documents. We sincerely hope for your understanding of the abovementioned situation and for your cooperation with us.

Introduction to our Home page

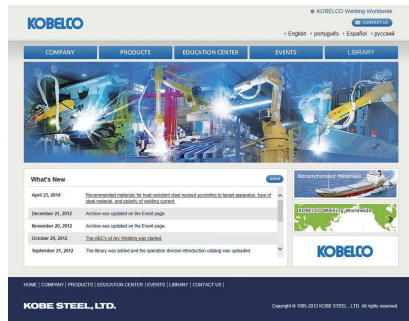


<http://www.kobelco.co.jp/english/welding>



search words

kobelco, english, welding



<http://www.kobelco-welding.jp/index>



search words

welding wire, welding robot,
kobelco

Foreword

Note the following preliminary information on use of this welding handbook.

1. Standards for welding consumables

AWS : American Welding Society
EN : European Norm

2. Classifications

Welding consumables are classified in accordance with basically the mechanical and/or chemical requirements of the standards, excluding such requirements as size, length, marking and identification manners.

3. The test conditions

- (1) Unless otherwise specified, the testing method and condition are as per AWS standard.
- (2) All mechanical and chemical data are given separately as “Typical” (one of the manufacturer’s test data) and “Guaranty” (the guaranty value).
- (3) Unless otherwise specified, all mechanical test are carried out in the as-welded condition.

4. Packaging data

Packaging data shows product length, and mass, the approximate volume.

5. Welding parameters

Welding parameters indicates the recommended current range of each welding position.

6. Approvals

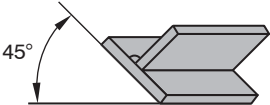
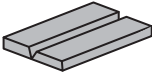
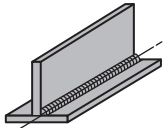
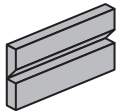
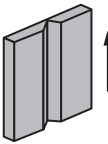
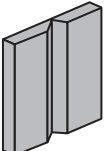
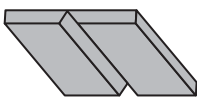
We have displayed the certification of the grade of classification society of the time in October 2014.

They may be cancelled, added, or changed and may not necessarily be applied to all the welding consumables produced at the production plants of Kobe Steel. Therefore, please contact with the International Operations Dept. of the Welding Company of Kobe Steel when you need the ship classification approval of a particular welding consumable to be used.

[Ship classification societies]

ABS: American Bureau of Shipping LR: Lloyd’s Register of Shipping
DNV: Det Norske Veritas BV: Bureau Veritas NK: Nippon Kaiji Kyokai
CR: Central Research of Ships S. A. GL: Germanischer Lloyd
KR: Korean Register of Shipping CCS: China Classification Society

7. Welding position

| Illustration | AWS A3.0 | ISO 6947 |
|---|-------------|----------|
|  | 1F | PA |
|  | 1G | PA |
|  | 2F | PB |
|  | 2G | PC |
|  | 3G uphill | PF |
|  | 3G downhill | PG |
|  | 4G | PE |

Abbreviations and marks

This welding handbook uses the following abbreviations and marks if necessary.

| Abbrev. and mark | Definition | Abbrev. and mark | Definition |
|-------------------------|------------------------------------|-------------------------|----------------------------|
| AC | Alternating current or Air cooling | L | Length |
| A | Ampere | MS | Mild steel |
| AP | All positions | NR | Not required |
| AW | As-welded | Pre. H | Preheat |
| Bal | Balance | PWHT | Postweld heat treatment |
| CR | Cooling rate | RC | Redrying conditions |
| DC | Direct current | RT | Room temperature |
| DCEN | DC, electrode negative | SAW | Submerged arc welding |
| DCEP | DC, electrode positive | SG | Shielding gas |
| Dia. | Diameter | SMAW | Shielded metal arc welding |
| EGW | Electrogas arc welding | SR | Stress relief |
| EI | Elongation | SW | Solid wire |
| FCW | Flux-cored wire | TIG | Tungsten inert gas |
| FCAW | Flux Cored Arc Welding | TS | Tensile strength |
| GMAW | Gas Metal Arc Welding | V | Voltage |
| GTAW | Gas Tungsten Arc Welding | W | Width |
| H | Height | WP | Welding position |
| HAZ | Heat-affected zone | [F] | FAMILIARC™ |
| HI | Heat input | [T] | TRUSTARC™ |
| HT | High tensile | [P] | PREMIARC™ |
| Hv | Hardness (Vickers) | | |
| IPT | Interpass temperature | | |
| IV | Impact value | | |

Warning and Caution in Welding

Pay your attention to the following warnings and cautions for your safety and health during welding and related operations



WARNING

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



WARNING



Electric shock can kill.

- Do not touch live electrical parts (A stick electrode held with an electrode holder and a welding wire are electrically live).
- Wear dry, insulated gloves. Do not wear torn or wet gloves. Use an electric shock preventing device (e.g., open-circuit-voltage-reducing device) when welders or operators work in confined or high-level spaces. Use also a lifeline when welders or operators conduct welding at a high-level space.
- Follow safety practices stated in the instruction manual of welding machines before use. Do not use a welding machine the case or cover of which is removed. Welding cables must have an adequate size for the capacity expected. Welding cables must be kept in an appropriate condition and a damaged cable must be repaired or replaced with new one.



CAUTION



Flying spatter and slag can injure eyes and cause skin burns.

High temperature heat of 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 they are hot.



CAUTION



Fumes and gases generated during welding are dangerous to your health.

Welding in confined spaces is dangerous because it can be a cause to suffocation by oxygen deficient.

- 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 which cause toxication, poor health and suffocation by oxygen deficient.
- Use general ventilation during welding in a workshop. Particularly during welding in confined spaces, be sure to use adequate ventilation or respirators, and welding should be done at the presence of a trained supervisor.
- Do not conduct welding at where degreasing, solvent cleaning, spraying, or painting operations are carried out nearby. Welding work accompanied by these operations may cause generation of harmful gases.
- Use adequate ventilation or respirators with special attention during welding plated and coated steels.
- Use respirators, eye safety glasses and safety leather gloves when using welding fluxes in order to prevent you from flux dust.



CAUTION



Arc rays can injure eyes and burn skin.

- Wear hand shields with an adequate shade grade during welding operations and supervising the welding work. Select the correct shade grade for filter lenses and filter plates suitable for exact welding work by referring the standard JIS T81 41.
- Wear suitable protectors for protecting you from an arc ray; e.g., safety leather glove for welding, long sleeve shirt, foot cover, leather apron.
- Use, at need, shade curtains for welding by surrounding the welding areas in order to prevent accompanied workers from arc rays.



CAUTION



The tip of a welding wire and filler wire can injure eyes, faces, etc.

- When take off the tip of a wire fastened in the spool, be sure to hold the tip of the wire.
- When check the wire feeding condition, do not direct the welding touch to your face.



CAUTION



Fire and explosion can take place.

- Never conduct welding at areas adjacent to highly inflammable materials. Remove combustibles so that spatters cannot ignite them. If combustibles cannot be removed, cover them with a noninflammable material.
- Do not weld vessels or pipes which contain combustibles or being sealed.
- Do not put a hot weldment close to combustibles right after welding finished.
- When welding ceilings, floors, walls, remove combustibles put at the other side of them.
- Any part of a welding wire, with exception of the portion appropriately extended from the tip of the torch, must be free from touching the electrical circuit of the base metal side.
- Fasten cable joints and seal them with an insulation tape. The cable of the base metal side should be connected as close as possible to the welding portion of the work.
- Prepare fire-extinguishing equipment at where welding is carried out, in order to cope with a possible accident.



CAUTION



Falling down or dropping welding consumables can injure you.

- Wear safety shoes and pay your attention not to drop welding consumables on your body when carrying and handling them. Keep yourself in a correct posture 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 in a correct way so as not to cause falling or dropping while they are stored or carried.

Lists of Welding Consumables

| Welding Process | Product names | AWS | EN | ASME | | Page |
|--|-------------------|-----------------------|------------------------------------|-------|-------|------|
| | | | | F No. | A No. | |
| For Mild Steel and 490MPa High Tensile Strength Steel | | | | | | |
| SMAW | KOBE-6010 | A5.1 E6010 | ISO 2560-A-E 35 0 C | 3 | 1 | 32 |
| | B-33 | A5.1 E6013 | - | 2 | 1 | 33 |
| | RB-26 | A5.1 E6013 | ISO 2560-A-E 35 0 R | 2 | 1 | 34 |
| | Z-44 | A5.1 E6013 | - | 2 | 1 | 35 |
| | B-10 | A5.1 E6019 | - | 2 | 1 | 36 |
| | B-14 | A5.1 E6019 | ISO 2560-A-E 35 2 RA | 2 | 1 | 37 |
| | B-17 | A5.1 E6019 | - | 2 | 1 | 38 |
| | LB-26 | A5.1 E7016 | - | 4 | 1 | 39 |
| | LB-52 | A5.1 E7016 | ISO 2560-A-E 42 3 B | 4 | 1 | 40 |
| | LB-52A | A5.1 E7016 | - | 4 | 1 | 41 |
| | LB-52U | A5.1 E7016 | ISO 2560-A-E 42 2 B | 4 | 1 | 42 |
| | LB-57 | A5.1 E7016 | - | 4 | - | 43 |
| | LB-52-18 | A5.1 E7018 | ISO 2560-A-E 42 3 B | 4 | 1 | 44 |
| | LT-B52A | A5.1 E7018 | - | 4 | 1 | 45 |
| | KOBE-7024 | A5.1 E7024 | ISO 2560-A-E 42 0 RR | 1 | 1 | 46 |
| | LB-52T | A5.1 E7048 | - | 4 | 1 | 47 |
| | LB-78VS | A5.1 E7048 | ISO 2560-A-E 42 2 B | 4 | 1 | 48 |
| | KOBE-7010S | A5.5 E7010-P1 | ISO 2560-A-E 42 0 C | 3 | - | 49 |
| | KOBE-8010S | A5.5 E8010-P1 | ISO 2560-A-E 36 0 Z C | 3 | - | 50 |
| | LB-76 | A5.5 E7016-G | - | 4 | 1 | 51 |
| LB-88VS | A5.5 E8018-G | ISO 2560-A-E 46 2 Z B | 4 | - | 52 | |
| LB-98VS | A5.5 E9018-G | ISO 2560-A-E 50 2 Z B | 4 | - | 53 | |
| LT-B50 | - | - | - | 1 | 54 | |
| FCAW | MX-100T | A5.18 E70C-6C/6M | ISO 17632-A - T 42 2 M C/M 1 H5 | 6 | 1 | 55 |
| | MX-A100 | A5.18 E70C-6M | ISO 17632-A - T 42 4 M M 3 H5 | 6 | 1 | 56 |
| | DW-200 | A5.20 E70T-1C | - | 6 | 1 | 57 |
| | MX-100 | A5.20 E70T-1C | - | 6 | 1 | 58 |
| | MX-200 | A5.20 E70T-1C | ISO 17632-A - T 42 0 R C 3 H5 | 6 | 1 | 59 |

| Welding Process | Product names | AWS | EN | ASME | | Page |
|-----------------|----------------------|-------------------------------|------------------------------------|-------|-------|------|
| | | | | F No. | A No. | |
| FCAW | MX-200H | A5.20 E70T-1C | - | 6 | 1 | 60 |
| | MX-200E | A5.20 E70T-9C | ISO 17632-A - T 42 3 R C 3 H5 | 6 | 1 | 61 |
| | MX-A200 | A5.20 E70T-1M | - | 6 | 1 | 62 |
| | DW-50 | A5.20 E71T-1C/1M, -9C/9M | ISO 17632-A - T 42 2 P C/M 1 H5 | 6 | 1 | 63 |
| | DW-100 | A5.20 E71T-1C | ISO 17632-A - T 42 0 P C 1 H10 | 6 | 1 | 64 |
| | DW-100V | A5.20 E71T-1C | - | 6 | 1 | 65 |
| | DW-100E | A5.20 E71T-9C | ISO 17632-A - T 42 2 P C 1 H10 | 6 | 1 | 66 |
| | DW-A50 | A5.20 E71T-1M | ISO 17632-A - T 42 2 P M 1 H5 | 6 | 1 | 67 |
| | DW-A51B | A5.20 E71T-5M-J | - | 6 | 1 | 68 |
| GMAW | MIX-50 | A5.18 ER70S-3 | - | 6 | 1 | 69 |
| | MG-51T | A5.18 ER70S-6 | - | 6 | 1 | 70 |
| | MG-50 | A5.18 ER70S-G | - | 6 | 1 | 71 |
| | MG-S50 | A5.18 ER70S-G | - | 6 | 1 | 72 |
| | MIX-50S | A5.18 ER70S-G | - | 6 | 1 | 73 |
| | SE-A50 | A5.18 ER70S-G | - | 6 | 1 | 74 |
| | MG-50T | - | - | - | 1 | 75 |
| | MIX-1TS | - | - | - | 1 | 76 |
| GTAW | NO65G | A5.18 ER70S-2 | - | 6 | 1 | 77 |
| | TG-S51T | A5.18 ER70S-6 | - | 6 | 1 | 78 |
| | TG-S50 | A5.18 ER70S-G | - | 6 | 1 | 79 |
| SAW | MF-53/US-36 | A5.17 F7A0-EH14 | - | 6 | - | 80 |
| | G-50/US-36 | A5.17 F7A2-EH14 | - | 6 | - | 81 |
| | G-60/US-36 | A5.17 F7A2-EH14 | - | 6 | - | 82 |
| | G-80/US-36 | A5.17 F7A2-EH14, F6P2-EH14 | - | 6 | - | 83 |
| | PF-H55E/US-36 | A5.17 F7A4-EH14 | - | 6 | 1 | 84 |
| | MF-38/US-36 | A5.17 F7A6-EH14, F7P6-EH14 | - | 6 | - | 85 |
| | MF-300/US-36 | A5.17 F7A6-EH14, F7P6-EH14 | - | 6 | - | 86 |

| Welding Process | Product names | AWS | EN | ASME | | Page |
|--|----------------------|-----------------|----------------------------------|-------|-------|------|
| | | | | F No. | A No. | |
| For Weather Proof Steel | | | | | | |
| SMAW | LB-W52 | A5.5 E7016-G | - | 4 | - | 90 |
| | LB-W52B | A5.5 E7016-G | - | 4 | - | 91 |
| FCAW | DW-588 | A5.29 E81T1-W2C | - | 6 | - | 92 |
| | DW-50W | - | - | - | - | 93 |
| GMAW | MG-W50TB | A5.28 ER80S-G | - | 6 | - | 94 |
| SAW | MF-53/US-W52B | A5.23 F7A0-EG-G | - | 6 | - | 95 |
| | MF-38/US-W52B | A5.23 F7A2-EG-G | - | 6 | - | 96 |
| For High Tensile Strength Steel and Low Temperature Steel | | | | | | |
| SMAW | LB-7018-1 | A5.1 E7018-1 | ISO 2560-A-E 42 4 B | 4 | 1 | 104 |
| | NB-3J | A5.5 E7016-C2L | - | 4 | 10 | 105 |
| | LB-62L | A5.5 E8016-C1 | - | 4 | 10 | 106 |
| | LB-65L | A5.5 E8016-C1 | - | 4 | 10 | 107 |
| | LB-52NS | A5.5 E7016-G | ISO 2560-A-E 42 6 Z B | 4 | - | 108 |
| | LB-52NSU | A5.5 E7016-G | - | 4 | - | 109 |
| | LB-55NS | A5.5 E8016-G | - | 4 | - | 110 |
| | NB-1SJ | A5.5 E8016-G | - | 4 | 10 | 111 |
| | LB-62 | A5.5 E9016-G | ISO 2560-A-E 50 3 Z B | 4 | - | 112 |
| | LB-62UL | A5.5 E9016-G | ISO 2560-A-E 50 3 Z B | 4 | - | 113 |
| | LB-62U | A5.5 E9016-G | - | 4 | - | 114 |
| | LB-67L | A5.5 E9016-G | - | 4 | 10 | 115 |
| | LB-62D | A5.5 E9018-G | - | 4 | - | 116 |
| | LB-106 | A5.5 E10016-G | - | 4 | - | 117 |
| | LB-Y75 | A5.5 E10016-G | - | 4 | - | 118 |
| | LB-70L | A5.5 E10016-G | - | 4 | - | 119 |
| | LB-116 | A5.5 E11016-G | - | 4 | 12 | 120 |
| | LB-80UL | A5.5 E11016-G | - | 4 | 12 | 121 |
| LB-88LT | A5.5 E11016-G | - | 4 | 12 | 122 | |
| LB-80L | A5.5 E11018-G H4 | - | 4 | - | 123 | |
| FCAW | MX-55LF | A5.20 E70T-9C-J | - | 6 | - | 124 |
| | DW-55E | A5.20 E71T-9C-J | ISO 17632-A - T 42 4 P C 1 H5 | 6 | - | 125 |

| Welding Process | Product names | AWS | EN | ASME | | Page |
|-----------------|------------------|--------------------|---|-------|-------|------|
| | | | | F No. | A No. | |
| FCAW | DW-A55E | A5.20 E71T-9M-J | ISO 17632-A - T 42 4 P M 1 H5 | 6 | 1 | 126 |
| | DW-A55ESR | A5.20 E71T-12M-J | ISO 17632-A - T 42 4 P M 1 H5 | 6 | 1 | 127 |
| | DW-55L | A5.29 E81T1-K2C | ISO 17632-A - T 46 6 1.5Ni P C 1 H5 | 6 | 10 | 128 |
| | DW-55LSR | A5.29 E81T1-K2C | ISO 17632-A - T 46 6 1.5Ni P C 1 H5 | 6 | 10 | 129 |
| | DW-A55L | A5.29 E81T1-K2M | ISO 17632-A - T 46 6 1.5Ni P M 1 H5 | 6 | 10 | 130 |
| | DW-A55LSR | A5.29 E81T1-Ni1M | ISO 17632-A - T 46 6 Z P M 1 H5 | 6 | 10 | 131 |
| | DW-A81Ni1 | A5.29 E81T1-Ni1M-J | ISO 17632-A - T 46 6 1Ni P M 2 H5 | 6 | 10 | 132 |
| | DW-62L | A5.29 E91T1-Ni2C-J | ISO 17632-A - T 50 6 Z P C 2 H5 | 6 | 10 | 133 |
| | DW-A62L | A5.29 E91T1-Ni2M-J | ISO 17632-A - T 50 6 Z P M 2 H5 | 6 | 10 | 134 |
| | MX-A55T | A5.28 E80C-G | - | 6 | 10 | 135 |
| | MX-A55Ni1 | A5.28 E80C-G | ISO 17632-A - T 46 6 Mn1Ni M M 3 H5 | 6 | - | 136 |
| | MX-A80L | A5.28 E110C-G H4 | ISO 18276-A - T69 6 Mn2.5Ni M M 3 H5 | 6 | - | 137 |
| | DW-50LSR | A5.29 E71T1-GC | - | 6 | - | 138 |
| | DW-A70L | A5.29 E101T1-GM | ISO 18276-A - T62 5 Mn1NiMo P M 2 H5 | 6 | - | 139 |
| | DW-A80L | A5.29 E111T1-GM-H4 | ISO 18276-A - T69 4 Z P M 2 H5 | 6 | - | 140 |
| DW-460L | - | - | - | - | 141 | |
| GMAW | MG-S50LT | A5.18 ER70S-G | - | 6 | - | 142 |
| | MG-S1N | A5.28 ER70S-G | - | 6 | 10 | 143 |
| | MG-S3N | A5.28 ER70S-G | - | 6 | - | 144 |
| | MG-60 | A5.28 ER80S-G | - | 6 | - | 145 |
| | MG-T1NS | A5.28 ER80S-G | - | 6 | 10 | 98 |
| | MG-S63B | A5.28 ER90S-G | - | 6 | - | 146 |
| | MG-70 | A5.28 ER100S-G | - | 6 | - | 147 |
| | MG-S70 | A5.28 ER100S-G | - | 6 | 12 | 148 |
| | MG-80 | A5.28 ER110S-G | - | - | - | 149 |

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| | | | | F No. | A No. | |
| GMAW | MG-S80 | A5.28 ER110S-G | - | 6 | - | 150 |
| | MG-S88A | A5.28 ER120S-G | - | 6 | - | 151 |
| GTAW | TG-S1N | A5.28 ER70S-G | - | 6 | - | 152 |
| | TG-S3N | A5.28 ER70S-G | - | 6 | 10 | 153 |
| | TG-S62 | A5.28 ER80S-G | - | 6 | 2 | 154 |
| | TG-S60A | A5.28 ER80S-G | - | 6 | - | 155 |
| | TG-S80AM | A5.28 ER110S-G | - | 6 | - | 156 |
| SAW | MF-38/US-49A | A5.17 F7A6-EH14, F7P6-EH14 | - | 6 | - | 157 |
| | PF-H55S/US-49A | A5.17 F7A6-EH14, F7P6-EH14 | - | 6 | 1 | 98 |
| | PF-H55LT/US-36 | A5.17 F7A8-EH14, F7P8-EH14 | - | 6 | - | 158 |
| | PF-H55AS/US-36J | A5.17 F7A8-EH14, F7P8-EH14 | - | 6 | 1 | 159 |
| | PF-H203/US-203E | A5.23 F7P15-ENi3-Ni3 | - | 6 | 10 | 160 |
| | MF-38/US-A4 | A5.23 F8A4-EA4-A4, F8P6-EA4-A4 | - | 6 | 2 | 161 |
| | MF-38/US-40 | A5.23 F9A6-EA3-A3, F8P6-EA3-A3 | - | 6 | - | 162 |
| | MF-38/US-49 | A5.23 F8A4-EG-A4, F8P6-EG-A4 | - | 6 | - | 163 |
| | PF-H80AK/US-80BN | A5.23 F11A4-EG-G | - | 6 | - | 164 |
| | PF-H80AS/US-80LT | A5.23 F11A10-EG-G | - | 6 | - | 165 |
| | PF-H80AK/US-80LT | A5.23 F12A10-EG-G | - | 6 | - | 166 |
| | For Heat-Resistant Steel | | | | | |
| SMAW | CM-A76 | A5.5 E7016-A1 | - | 4 | 2 | 174 |
| | CM-B95 | A5.5 E7015-B2L | - | 4 | 3 | 175 |
| | CM-A96 | A5.5 E8016-B2 | - | 4 | 3 | 176 |
| | CM-A96MB | A5.5 E8016-B2 | - | 4 | 3 | 177 |
| | CM-A96MBD | A5.5 E8016-B2 | - | 4 | 3 | 178 |
| | CM-B98 | A5.5 E8018-B2 | - | 4 | 3 | 179 |
| | CM-B105 | A5.5 E8015-B3L | - | 4 | 4 | 180 |
| | CM-A106 | A5.5 E9016-B3 | - | 4 | 4 | 181 |
| | CM-A106N | A5.5 E9016-B3 | - | 4 | 4 | 182 |

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| | | | | F No. | A No. | |
| SMAW | CM-A106ND | A5.5 E9016-B3 | - | 4 | 4 | 183 |
| | CM-B108 | A5.5 E9018-B3 | - | 4 | 4 | 184 |
| | CM-5 | A5.5 E8016-B6 | - | 4 | 4 | 185 |
| | CM-9 | A5.5 E8016-B8 | - | 4 | 5 | 186 |
| | CM-95B9 | - | - | 4 | 5 | 187 |
| | CM-96B9 | - | - | 4 | 5 | 188 |
| | BL-96 | A5.5 E9016-G | - | 4 | - | 189 |
| | CM-A106H | A5.5 E9016-G | - | - | 4 | 190 |
| | CM-A106HD | A5.5 E9016-G | - | - | 4 | 191 |
| | CM-9Cb | A5.5 E9016-G | - | 4 | - | 192 |
| | CR-12S | A5.5 E9016-G | - | - | - | 193 |
| CM-2CW | A5.5 E9016-G | - | 4 | - | 194 | |
| GMAW | MG-S5CM | A5.28 ER80S-B6 | - | 6 | 4 | 195 |
| | MG-S9CM | A5.28 ER80S-B8 | - | 6 | 5 | 196 |
| | MG-S56 | A5.28 ER80S-G | - | 6 | - | 197 |
| | MG-SM | A5.28 ER80S-G | - | 6 | 2 | 198 |
| | MG-S1CM | A5.28 ER80S-G | - | 6 | 3 | 199 |
| | MG-S2CM | A5.28 ER90S-G | - | 6 | 4 | 200 |
| | MG-S2CMS | A5.28 ER90S-G | - | 6 | 4 | 201 |
| | MG-S2CW | A5.28 ER90S-G | - | 6 | - | 202 |
| | MG-S9Cb | A5.28 ER90S-G | - | 6 | - | 203 |
| MG-S12CRS | A5.28 ER90S-G | - | - | - | 204 | |
| GTAW | TG-S70SA1 | A5.28 ER70S-A1 | - | 6 | 2 | 205 |
| | TG-S80B2 | A5.28 ER80S-B2 | - | 6 | 3 | 206 |
| | TG-S90B3 | A5.28 ER90S-B3 | - | 6 | 4 | 207 |
| | TG-S5CM | A5.28 ER80S-B6 | - | 6 | 4 | 208 |
| | TG-S9CM | A5.28 ER80S-B8 | - | 6 | 5 | 209 |
| | TG-S90B9 | A5.28 ER90S-B9 | - | 6 | 5 | 210 |
| | TG-SM | A5.28 ER80S-G | - | 6 | 2 | 211 |
| | TG-S56 | A5.28 ER80S-G | - | 6 | 11 | 212 |
| | TG-S63S | A5.28 ER90S-G | - | 6 | 12 | 213 |
| | TG-S1CM | A5.28 ER80S-G | - | 6 | 3 | 214 |

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| GTAW | TG-S1CML | A5.28 ER80S-G | - | 6 | 3 | 215 |
| | TG-S2CM | A5.28 ER90S-G | - | 6 | 4 | 216 |
| | TG-S2CML | A5.28 ER80S-G | - | 6 | 4 | 217 |
| | TG-S2CMH | A5.28 ER90S-G | - | - | 4 | 218 |
| | TG-S9Cb | A5.28 ER90S-G | - | 6 | 5 | 219 |
| | TG-S12CRS | A5.28 ER90S-G | - | - | - | 220 |
| | TG-S2CW | A5.28 ER80S-G | - | 6 | - | 221 |
| SAW | MF-38/US-40 | A5.23 F8P6-EA3-A3, F9A6-EA3-A3 | - | 6 | - | 222 |
| | MF-38/US-A4 | A5.23 F8P6-EA4-A4, F8A4-EA4-A4 | - | 6 | 2 | 223 |
| | PF-90B9/US-90B9 | A5.23 F9PZ-EB91-B91 | - | 6 | - | 224 |
| | MF-38/US-49 | A5.23 F8P6-EG-A4, F8A4-EG-A4 | - | 6 | - | 225 |
| | MF-27/US-56B | A5.23 F9P4-EG-G | - | 6 | - | 226 |
| | PF-200/US-56B | A5.23 F9P4-EG-G | - | 6 | - | 227 |
| | PF-200/US-511N | A5.23 F8P2-EG-B2 | - | 6 | 3 | 228 |
| | PF-200D/US-511ND | A5.23 F8P2-EG-B2 | - | 6 | 3 | 229 |
| | PF-200/US-521S | A5.23 F9P2-EG-B3 | - | 6 | 4 | 230 |
| | PF-200D/US-521S | A5.23 F9P2-EG-B3 | - | 6 | 4 | 231 |
| | PF-200S/US-502 | A5.23 F7P2-EG-B6 | - | 6 | 4 | 232 |
| | PF-200S/US-9Cb | A5.23 F10PZ-EG-G | - | 6 | - | 233 |
| | PF-500/US-521H | A5.23 F9P2-EG-G | - | - | 4 | 234 |
| | PF-500D/US-521HD | A5.23 F9P2-EG-G | - | - | 4 | 235 |
| | MF-29A/US-2CW | - | - | - | - | 236 |
| PF-200S/US-12CRSD | - | - | - | - | 237 | |
| For Stainless Steel | | | | | | |
| SMAW | NC-38 | A5.4 E308-16 | - | 5 | 8 | 248 |
| | NC-38H | A5.4 E308H-16 | - | 5 | 8 | 249 |
| | NC-38L | A5.4 E308L-16 | - | 5 | 8 | 250 |
| | NC-38LT | A5.4 E308L-16 | - | 5 | 8 | 251 |
| | NC-39 | A5.4 E309-16 | - | 5 | 8 | 252 |
| | NC-39L | A5.4 E309L-16 | - | 5 | 8 | 253 |
| | NC-39MoL | A5.4 E309LMo-16 | - | 5 | 8 | 254 |

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| SMAW | NC-30 | A5.4 E310-16 | - | 5 | 9 | 240 |
| | NC-32 | A5.4 E312-16 | - | 5 | - | 255 |
| | NC-36 | A5.4 E316-16 | - | 5 | 8 | 256 |
| | NC-36L | A5.4 E316L-16 | - | 5 | 8 | 257 |
| | NC-36LT | A5.4 E316L-16 | - | 5 | 8 | 258 |
| | NC-317L | A5.4 E317L-16 | - | 5 | 8 | 259 |
| | NC-37 | A5.4 E347-16 | - | 5 | 8 | 260 |
| | NC-37L | A5.4 E347-16 | - | 5 | 8 | 261 |
| | CR-40Cb | A5.4 E409Nb-16 | - | - | 7 | 262 |
| | CR-40 | A5.4 E410-16 | - | 4 | 6 | 263 |
| | NC-2209 | A5.4 E2209-16 | - | 5 | 8 | 264 |
| | NC-2594 | A5.4 E2594-16 | - | 5 | 8 | 265 |
| NC-316MF | - | - | - | - | 266 | |
| FCAW | DW-308H | A5.22 E308HT1-1/4 | - | 6 | 8 | 267 |
| | DW-308L | A5.22 E308LT0-1/4 | ISO 17633-A-T 19 9 L R C/M 3 | 6 | 8 | 268 |
| | DW-308LT | A5.22 E308LT0-1/4 | - | 6 | 8 | 269 |
| | DW-308LH | A5.22 E308LT1-1/4 | - | 6 | 8 | 270 |
| | DW-308LP | A5.22 E308LT1-1/4 | ISO 17633-A-T 19 9 L P C/M 1 | 6 | 8 | 271 |
| | DW-308 | A5.22 E308T0-1/4 | ISO 17633-A-T Z 19 9 R C/M 3 | 6 | 8 | 272 |
| | DW-309MoL | A5.22 E309LMoT0-1/4 | ISO 17633-A-T 23 12 2 L R C/M 3 | 6 | 8 | 273 |
| | DW-309MoLP | A5.22 E309LMoT1-1/4 | ISO 17633-A-T 23 12 2 L R C/M 1 | 6 | 8 | 274 |
| | DW-309L | A5.22 E309LT0-1/4 | ISO 17633-A-T 23 12 L R C/M 3 | 6 | 8 | 275 |
| | DW-309LH | A5.22 E309LT1-1/4 | - | 6 | 8 | 276 |
| | DW-309LP | A5.22 E309LT1-1/4 | ISO 17633-A-T 23 12 L P C/M 1 | 6 | 8 | 277 |
| | DW-309 | A5.22 E309T0-1/4 | ISO 17633-A-T Z 23 12 R C/M 3 | 6 | 8 | 278 |
| | DW-310 | A5.22 E310T0-1/4 | - | 6 | 9 | 279 |
| | DW-312 | A5.22 E312T0-1 | - | 6 | - | 280 |

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| | | | | F No. | A No. | |
| FCAW | DW-316L | A5.22 E316LT0-1/4 | ISO 17633-A-T Z 19 12 3 R C/M 3 | 6 | 8 | 281 |
| | DW-316LT | A5.22 E316LT1-1/4 | - | 6 | 8 | 282 |
| | DW-316LH | A5.22 E316LT1-1/4 | - | 6 | 8 | 283 |
| | DW-316LP | A5.22 E316LT1-1/4 | ISO 17633-A-T 19 12 3 L P C/M 1 | 6 | 8 | 284 |
| | DW-316H | A5.22 E316T1-1/4 | - | 6 | 8 | 285 |
| | DW-317L | A5.22 E317LT0-1/4 | - | 6 | 8 | 286 |
| | DW-317LP | A5.22 E317LT1-1/4 | - | 6 | 8 | 287 |
| | DW-347 | A5.22 E347T0-1/4 | - | 6 | 8 | 288 |
| | DW-347H | A5.22 E347T1-1/4 | - | 6 | 8 | 289 |
| | DW-2209 | A5.22 E2209T1-1/4 | - | 6 | 8 | 290 |
| | DW-2307 | A5.22 E2307T1-1/4 | - | - | - | 291 |
| | DW-2594 | A5.22 E2594T1-1/4 | - | 6 | 8 | 292 |
| | DW-410Cb | A5.22 E409NbT0-1 | - | 6 | 7 | 293 |
| | MX-A410NiMo | A5.22 EC410NiMo | - | - | - | 294 |
| | MX-A430M | - | - | - | 7 | 295 |
| | TG-X308L | A5.22 R308LT1-5 | - | 6 | 8 | 296 |
| TG-X309L | A5.22 R309LT1-5 | - | 6 | 8 | 297 | |
| TG-X316L | A5.22 R316LT1-5 | - | 6 | 8 | 298 | |
| TG-X347 | A5.22 R347T1-5 | - | 6 | 8 | 299 | |
| GMAW | MG-S308 | A5.9 ER308 | - | 6 | 8 | 300 |
| | MG-S308LS | A5.9 ER308LSi | - | 6 | 8 | 301 |
| | MG-S309 | A5.9 ER309 | - | 6 | 8 | 302 |
| | MG-S309LS | A5.9 ER309LSi | - | 6 | 8 | 303 |
| | MG-S316LS | A5.9 ER316LSi | - | 6 | 8 | 304 |
| | MG-S430NbS | - | - | - | - | 305 |
| GTAW | TG-S308 | A5.9 ER308 | - | 6 | 8 | 306 |
| | TG-S308L | A5.9 ER308L | - | 6 | 8 | 307 |
| | TG-S309 | A5.9 ER309 | - | 6 | 8 | 308 |
| | TG-S309L | A5.9 ER309L | - | 6 | 8 | 309 |
| | TG-S309MoL | A5.9 ER309LMo | - | 6 | 8 | 310 |
| | TG-S310 | A5.9 ER310 | - | 6 | 9 | 311 |

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| | | | | F No. | A No. | |
| GTAW | TG-S316 | A5.9 ER316 | - | 6 | 8 | 312 |
| | TG-S316L | A5.9 ER316L | - | 6 | 8 | 313 |
| | TG-S317L | A5.9 ER317L | - | 6 | 8 | 314 |
| | TG-S347 | A5.9 ER347 | - | 6 | 8 | 315 |
| | TG-S410 | A5.9 ER410 | - | 6 | 6 | 316 |
| | TG-S2209 | A5.9 ER2209 | - | - | - | 317 |
| | TG-S2594 | A5.9 ER2594 | - | - | - | 318 |
| | TG-S310MF | - | - | - | - | 319 |
| | TG-S410Cb | - | - | - | 7 | 320 |
| | NO4051 | - | - | - | - | 321 |
| For Hardfacing | | | | | | |
| SMAW | HF-240 | - | - | - | - | 328 |
| | HF-260 | - | - | - | - | 328 |
| | HF-330 | - | - | - | - | 328 |
| | HF-350 | - | - | - | - | 328 |
| | HF-450 | - | - | - | - | 330 |
| | HF-500 | - | - | - | - | 330 |
| | HF-600 | - | - | - | - | 330 |
| | HF-650 | - | - | - | - | 330 |
| | HF-700 | - | - | - | - | 332 |
| | HF-800K | - | - | - | - | 332 |
| | HF-950 | - | - | - | - | 332 |
| | HF-11 | - | - | - | - | 334 |
| | HF-12 | - | - | - | - | 334 |
| | HF-13 | - | - | - | - | 334 |
| | HF-16 | - | - | - | - | 334 |
| HF-30 | - | - | - | - | 334 | |
| FCAW | DW-H250 | - | - | - | - | 336 |
| | DW-H350 | - | - | - | - | 336 |
| | DW-H450 | - | - | - | - | 336 |
| | DW-H600 | - | - | - | - | 336 |
| | DW-H700 | - | - | - | - | 336 |

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| FCAW | DW-H800 | - | - | - | - | 336 |
| | DW-H11 | - | - | - | - | 338 |
| | DW-H16 | - | - | - | - | 338 |
| | DW-H30 | - | - | - | - | 338 |
| | DW-H30MV | - | - | - | - | 338 |
| SAW | G-50/US-H250N | - | - | - | - | 340 |
| | G-50/US-H350N | - | - | - | - | 340 |
| | G-50/US-H400N | - | - | - | - | 340 |
| | G-50/US-H450N | - | - | - | - | 340 |
| | G-50/US-H500N | - | - | - | - | 342 |
| | MF-30/US-H550N | - | - | - | - | 342 |
| | MF-30/US-H600N | - | - | - | - | 342 |
| For Cast Iron | | | | | | |
| SMAW | CI-A1 | A5.15 ENi-CI | - | - | - | 348 |
| | CI-A2 | A5.15 ENiFe-CI | - | - | - | 348 |
| | CI-A3 | A5.15 Est | - | - | - | 348 |
| For 9%Ni Steel and Nickel-Based Alloy | | | | | | |
| SMAW | NI-C70A | A5.11 ENiCrFe-1 | - | 43 | - | 356 |
| | NI-C703D | A5.11 ENiCrFe-3 | - | 43 | - | 357 |
| | NI-C70S | A5.11 ENiCrFe-9 | - | 43 | - | 358 |
| | NI-C1S | A5.11 ENiMo-8 | - | 44 | - | 359 |
| | NI-C625 | - | - | - | - | 360 |
| | ME-L34 | - | - | - | - | 361 |
| FCAW | DW-N82 | A5.34 ENiCr3T0-4 | - | - | - | 362 |
| | DW-N625 | A5.34 ENiCrMo3T1-1, ENiCrMo3T1-4 | - | - | - | 363 |
| | DW-NC276 | A5.34 ENiCrMo4T0-4 | - | - | - | 364 |
| | DW-N70S | - | - | - | - | 365 |
| GMAW | MG-S70NCb | A5.14 ERNiCr-3 | - | 43 | - | 366 |
| GTAW | TG-S70NCb | A5.14 ERNiCr-3 | - | 43 | - | 367 |
| | TG-SN625 | A5.14 ERNiCrMo-3 | - | 43 | - | 368 |
| | TG-S709S | A5.14 ERNiMo-8 | - | 44 | - | 369 |
| SAW | PF-N4/US-709S | A5.14 ERNiMo-8 | - | 44 | - | 370 |

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| FCB™ | PF-I55E/US-36/ PF-I50R (MF-1R) | - | - | - | - | 372 |
| FA-B | MF-38/US-36/ RR-2/FA-B1 | - | - | - | - | 374 |
| | MF-38/US-49/ RR-2/FA-B1 | - | - | - | - | 374 |
| | PF-I52E/US-36/ RR-2/FA-B1 | - | - | - | - | 374 |
| EGW | DW-S43G | A5.26 EG70T-2 | - | 6 | - | 376 |
| | DW-S1LG | - | - | - | - | 376 |
| | DW-S60G | - | - | - | - | 376 |

For Mild Steel and 490MPa High Tensile Strength Steel

Welding Consumables for

SMAW

FCAW

GMAW

GTAW

SAW

SMAW

A guide for selecting the type of stick electrode ⁽¹⁾

| Type of covering and AWS classification | High titania potassium | Low hydrogen potassium | Iron oxide titania potassium | High cellulose sodium | Iron-powder titania |
|---|------------------------|------------------------|------------------------------|-----------------------|---------------------|
| | E6013 | E7016 | E6019 | E6010 | E7024 |
| Weldability | | | | | |
| ▪ Crack resistant | ○ | ◎ | ○ | ○ | △ |
| ▪ X-ray soundness | ○ | ◎ | ○ | △ | △ |
| Usability | | | | | |
| ▪ Penetration | ○ | ○ | ◎ | ◎ | △ |
| ▪ Spatter | ○ | ○ | ○ | △ | ○ |
| ▪ Suitability for thin metal | ◎ | △ | ○ | △ | ○ |

Note (1) ◎: Excellent, ○: Good, △: Fair

Tips for better welding results

- (1) Slag and fumes on tack weld beads absorb moisture; therefore, they must be removed right after tack welding to prevent adverse effects on the subsequent main welding.
- (2) When wind velocity is more than 3m/sec in field welding, use a wind screen, or nitrogen in the wind decreases X-ray soundness and impact value of the weld.
- (3) In welding medium and heavy thick mild steels by using non-low-hydrogen electrodes, keep the work at appropriate preheat and interpass temperature to remove diffusible hydrogen and thereby prevent cracking in the weld.
- (4) In order to get better impact values, it is effective to lay each weld layer as thin as possible.
- (5) Many stick electrodes can be used with both AC and DC power sources. Low-hydrogen type electrodes, however, should be tested on mechanical properties beforehand, because DC current causes a little lower strength of the weld metal.
- (6) Low-hydrogen type electrodes are more suitable for surface finishing and repair welding of gas shielded metal arc and self-shielded metal arc welded deposits in order to prevent pits and blowholes.

How to keep stick electrodes in good condition

- (1) Store stick electrodes in a warehouse where the humidity is low.
- (2) Low-hydrogen type electrodes should be stored in an oven (100-150°C) placed near the welding area after re-drying was finished so that welders can take out the electrodes little by little. This manner is good for preventing the electrodes from moisture pick up and thereby decrease the diffusible hydrogen content of the weld metal.
- (3) A change of the color of the flux coating to become darker, much more spatter, stronger arc, and irregular slag-covering are signs that the electrodes picked up moisture excessively. In such a case, re-drying is effective even for non-low-hydrogen electrodes to improve usability and X-ray soundness. But excessive drying for long hours at high temperatures deteriorates X-ray soundness of the weld metal.
- (4) Welders should bring an appropriate amount of electrodes for half-a-day use at sites in order to prevent electrodes from excessive moisture pick up.

A guide for selecting filler metals for API grade pipes ⁽¹⁾

| API 5L pipe grade | Welding pass | High cellulose electrodes | Low hydrogen electrodes | | |
|---|----------------|---------------------------|----------------------------------|--------------------------|--------------------|
| | | Downhill welding process | Downhill welding | Uphill welding | Downhill welding |
| | | | With a combination of electrodes | Low hydrogen electrodes | |
| A25 A, B X42 X46 X52 | Root | KOBE-6010 KOBE-7010S | KOBE-6010 KOBE-7010S | LB-52U | LB-78VS |
| | Hot | | | LB-52 LB-52-18 | |
| | Filler and cap | | LB-78VS | | |
| X56 | Root | KOBE-6010 KOBE-7010S | KOBE-6010 KOBE-7010S | LB-52U | LB-78VS |
| | Hot | | | LB-52 LB-52-18 | |
| | Filler and cap | | LB-78VS | | |
| X60 | Root | KOBE-6010 KOBE-7010S | KOBE-6010 KOBE-7010S | LB-52U | LB-78VS LB-88VS |
| | Hot | | | LB-52 LB-52-18 | |
| | Filler and cap | | LB-78VS LB-88VS | | |
| X65 | Root | KOBE-7010S KOBE-8010S | KOBE-7010S KOBE-8010S | LB-52U | LB-88VS |
| | Hot | | | LB-57 LB-62 LB-62D | |
| | Filler and cap | | LB-88VS | | |
| X70 | Root | KOBE-7010S KOBE-8010S | KOBE-7010S KOBE-8010S | LB-62U | LB-88VS |
| | Hot | | | LB-62 LB-62D | |
| | Filler and cap | | LB-88VS | | |
| X80 | Root | - | KOBE-7010S KOBE-8010S | LB-62U | LB-98VS |
| | Hot | | | LB-65D | |
| | Filler and cap | | LB-98VS | | |
| Weldability | | | | | |
| ▪ Stability of root pass | | ○ | ○ | ◎ | △ |
| ▪ Weld soundness | | ○ | ○ | ◎ | ○ |
| ▪ Crack resistance | | △ | ○ | ◎ | ◎ |
| Welding efficiency | | ◎ | ◎ | △ | ○ |
| Groove size tolerance | | ○ | ○ | ◎ | △ |

Note (1) ◎: Excellent, ○: Fair, △: Inferior

Tips for better welding results

1) Sizes and tolerances of welding grooves

In one-side butt welding of pipes, it is important to make sound root pass welds without incomplete joint penetration and other discontinuities. For this, it is essential to prepare welding grooves suitable for individual welding procedures. Refer to the recommended sizes and tolerances of the grooves shown in the table below.

| Type of stick electrode | Welding process | Recommendation and tolerance | Groove angle degree | Root face mm | Root gap mm | Mis-alignment mm |
|-------------------------|-----------------|------------------------------|---------------------|----------------------|----------------------|------------------------------|
| High cellulose | Downhill | Recommendation | 60-70 | 1.2-2.4 (1.2-2.0) | 1.2-2.0 | ≤ 0.8 |
| | | Tolerance | 50-75 | 0.8-2.4 | 0.8-2.4 | ≤ 1.6 |
| Low hydrogen | Uphill | Recommendation | 60-80 (70-80) | 0.4-2.0 | 2.0-3.2 (2.0-2.6) | ≤ 1.6 (≤ 0.8) |
| | | Tolerance | 55-90 | 0.4-2.4 | 1.6-3.6 | ≤ 2.0 |
| | Downhill | Recommendation | 60-80 | 1.2-2.0 | 2.6-3.4 (2.6-3.2) | ≤ 0.6 |
| | | Tolerance | 55-90 | 1.0-2.0 | 2.5-3.5 | ≤ 1.0 |

Note: Recommended ranges in parentheses are suitable for small diameter tubes with an approximate thickness of 7mm or less.

2) How to proceed root pass welding

- (1) Downhill welding should be started at the 11 to 1 o'clock position of a pipe, whereas uphill welding should be started at the 5 to 7 o'clock position in common procedures. However, welding should be started at where there is a narrower root opening.
- (2) It is recommended to strike an arc on the groove face and transfer the arc to the root of the groove, maintaining the arc in stable condition.
- (3) Joint penetration can be adjusted by controlling the shape of a keyhole molten crater by adjusting welding current, electrode holding angle, the extent of sticking an electrode into the root opening, and weaving width. Control the penetration more strictly particularly at the 12 o'clock position where reverse side bead extrusion tends to be excessive and the 6 o'clock position that tends to cause a concave reverse side beads.
- (4) Before joining beads particularly with low hydrogen electrodes, the end of the preceding bead should be tapered by grinding.
- (5) After the completion of root pass welding, remove slag and unacceptable portion of beads, and shape the beads along the entire circumference of the pipe by grinding. Particularly, where the weld surfaces contain deep undercut, the shaping should be conducted more carefully.

Types and features of flux-cored wires

There are two types of flux cored wires: DW series rutile type and MX series metal type. Both DW and MX series include a variety of wires that use either CO₂ or Ar-CO₂ admixture shielding gas. The following paragraphs describe essential characteristics of both types of flux-cored wires to provide users with a useful guide.

DW series:

DW series is the most popular type of flux-cored wire, most of which contains rutile flux. This series offers excellent weldability with good arc stability and very low spatter generation. With CO₂ or Ar-CO₂ admixture shielding gas, DW wires show good slag removability and smooth, glossy bead appearance. Because of high deposition rates, highly efficient welding can be conducted. DW series includes those suitable for out-of-position welding and those suitable for horizontal fillet welding for a variety of applications.

MX series:

MX series is metal type flux-cored wire. Due to high deposition rates, highly efficient welding can be conducted. MX wires offer excellent weldability with good arc stability and low spatter generation. With some wires, the amount of slag is as little as in gas metal arc welding with solid wires; therefore, multi-pass welding can continuously be conducted without removing the slag on each pass. A variety of MX wires are available to cover wide applications of thin plate, medium and thick plate, and primer-coated plates.

Deposition rate:

Compared at the same welding current, the deposition rates of flux-cored wires are higher by 50 - 60% relative to stick electrodes and 10 - 20% higher than solid wires. Spatter generation in use of flux-cored wires is much lower than in use of solid wires.

Tips for better welding results

In addition to the tips for gas metal arc welding with solid wires, the following tips especially for flux-cored wires are essential to use the excellent features of the wires.

- (1) Because the wire is softer than solid wire, do not excessively tighten the pressure roller of the wire feeder so as not to cause the deformation of the wire.
- (2) In flat butt welding, backhand technique is better for stable penetration. In horizontal and overhead fillet welding, forehand technique is better for flat bead appearance.
- (3) In vertical down fillet welding, the first layer run should be straight and keep the welding speed faster to avoid slag inclusions and to get better penetration. For the 2nd and subsequent layers, remove the slag of preceding beads and avoid weaving.
- (4) In one-side welding, welding parameter should carefully be selected to prevent welding defects such as hot cracking.
- (5) In horizontal fillet welding of primer-coated plates, porosity defects such as pit and gas hole are apt to occur; therefore, the selection of proper wires and welding parameters suitable for welding primer-coated plates are essential. Figure 1 shows the relationship between welding speed and the number of pits occurred in the weld metal. Figure 2 shows proper welding speeds related to fillet leg lengths.

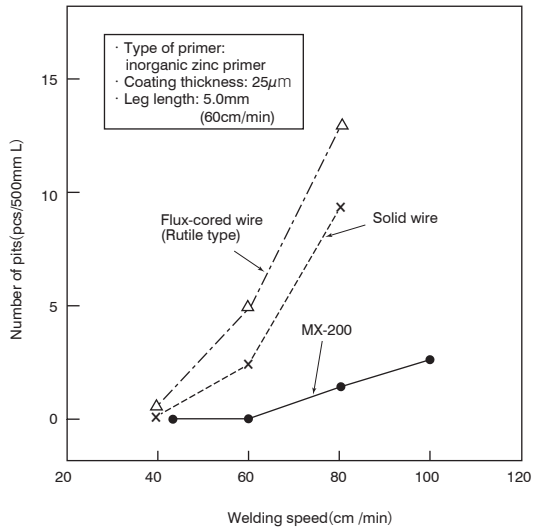


Fig.1 Porosity resistance to primer

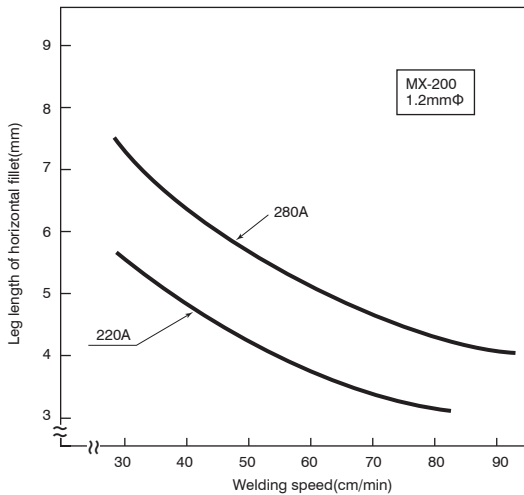


Fig.2 Horizontal fillet leg length vs. welding speed

GMAW, GTAW

Tips for better welding results in GMAW

- (1) Use a CO₂ shielding gas corresponding to ANSI/AWS A5.32/A5.32M SG-C or an equivalent CO₂ gas purified for welding.
- (2) Control the mixing ratio of Ar and CO₂ in an Ar-CO₂ admixture shielding gas because fluctuation of the mixing ratio affects the usability of a solid wire.
- (3) Adjust the shielding gas flow rate in the 20 to 25 l/min range.
- (4) Use a wind screen in welding in a windy area because a strong wind causes blowholes.
- (5) Use a proper ventilation system at where general ventilation is inadequate.
- (6) Keep the tip-to-work distance at around 15 mm with welding currents less than 250A and at around 20 to 25 mm with welding currents over 250A.
- (7) The use of an excessively low arc voltage may generate a large sound in spray arc welding with an Ar-CO₂ shielding gas. In such a case increase the arc voltage to prevent blowholes.
- (8) Torch angle, welding speed, wire diameter, and welding current markedly affect bead appearance and penetration; therefore, adjust such welding parameters according to the application.

Tips for better welding results in GTAW

- (1) Welding power source:
Use the DCEN connection with the constant current or drooping characteristic DC power source in general applications.
- (2) Shielding gas:
Use an argon gas with a high purity equivalent to that of JIS K1105, in order to prevent pits and blowholes in the weld metal and decrease consumption of the tip of a tungsten electrode. When the length of the Ar gas piping is long, use metal pipes or Teflon tubes to prevent porosity in the weld metal, because moisture can permeates into the Ar gas through the wall of a rubber hose and thereby causes porosity. Adjust the shielding gas flow rate in the 12-18 l/min range.
- (3) Tungsten electrode:
A 1-2% thoriated tungsten electrode is suitable. The tip of the tungsten electrode must be kept sharp in order to maintain the arc stable.
- (4) Tungsten electrode extension length and arc length:
In order to keep the shielding of molten weld pool in good condition, the extension of a tungsten electrode from shielding nozzle should be approx. 5 mm. Maintain the arc length at 1-3 mm. The use of an excessively long arc length can deteriorate the shielding effect and causes undercut.
- (5) Cleaning of welding groove:
Because the quality of gas tungsten arc welds is markedly affected by dirt on groove surfaces, scale, rust, water and oil must be removed before welding because they can cause pits, blowholes and unstable arcs.
- (6) Wind protection and ventilation:
Use a wind screen in a windy site to maintain the shielding gas in good condition. Use an appropriate ventilation system where welding is carried out in a confined area to prevent welders from oxygen deficiency.

Tips for better welding results in SAW

- (1) Accuracy of groove sizes:
The accuracy of root gap and groove angle affects the quality of welds much more than with other welding processes; where the accuracy is poor, burn-through, lack of penetration, excessive or insufficient reinforcement can occur.
- (2) Surface of groove:
Rust and oil in the groove shall be removed before welding to prevent pits and blowholes.
- (3) Distribution and circulation of flux:
Where a flux is supplied excessively on the base plate, the bead appearance becomes irregular particularly in use of melted fluxes. In case where a flux is used repetitively by means of a circulation system, the flux can be contaminated with scale and dust and its grain size distribution can be varied; therefore, add new flux occasionally to maintain good performances of the flux.
- (4) Grain size of flux:
Several grain sizes are available for a certain melted flux. The most proper size depends on welding currents to be used. The use of high currents with a coarse grain size flux can deteriorates bead appearance; in contrast, the use of low currents with a fine grain size flux can cause pock marks because of poor degassing.
- (5) Welding condition and penetration:
Submerged arc welding can use a wide range of parameters such as wire diameter, welding current, arc voltage and welding speed; however, erroneous setting of the parameter causes burn-through, and insufficient or excessive penetration and reinforcement. The bead shape can be affected by the travel angle of a wire; that is, where the wire is leaned to the direction of welding (backhand welding), the bead shape becomes narrower with comparatively deep penetration. In contrast, where the wire is leaned to the opposite direction of welding (forehand welding), the bead shape becomes wider with shallower penetration.

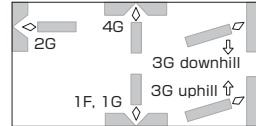
Stick electrode

- Features:**
- Suitable for butt welding of pipes
 - Excellent usability in vertical downward welding

Classification: AWS A5.1 E6010

Identification color: 1st Yellowish green, 2nd -
Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.4 | 300 | 2 | 20 | 13 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 27 | 175W, 115H, 380L |
| 4.0 | 350 | 5 | 20 | 40 | 175W, 115H, 380L |
| 4.8 | 350 | 5 | 20 | 58 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.20 |
| Si | 0.15 | 1.00 |
| Mn | 0.51 | 1.20 |
| P | 0.009 | 0.035 |
| S | 0.008 | 0.035 |
| Ni | 0.02 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | <0.01 | 0.08 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2G, 3G uphill, 3G downhill, 4G |
|------|---|
| 2.4 | 40~75 |
| 3.2 | 70~130 |
| 4.0 | 90~180 |
| 4.8 | 140~225 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 430 | 331min. |
| TS (MPa) | 510 | 414min. |
| EI on 4d (%) | 27 | 22min. |
| IV -29°C (J) | 63 | 27min. |

Stick electrode**Features:**

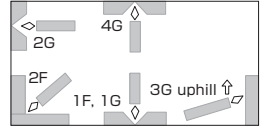
- Excellent usability in the flat and horizontal positions

Welding Positions:**Classification:**

AWS A5.1 E6013

Redrying Conditions: 70~100°Cx0.5~1h**Identification color:** 1st Pink**Polarity:**

AC, DCEP, DCEN

**Packaging data**

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.0 | 300 | 2 | 20 | 10 | 270W, 85H, 330L |
| 2.6 | 350 | 5 | 20 | 20 | 170W, 105H, 380L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 105H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 95H, 430L |
| 5.0 | 400 | 5 | 20 | 82 | 170W, 100H, 430L |
| 6.0 | 450 | 5 | 20 | 138 | 170W, 90H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.08 | 0.20 |
| Si | 0.30 | 1.00 |
| Mn | 0.33 | 1.20 |
| P | 0.013 | 0.035 |
| S | 0.009 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | 0.01 | 0.08 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.0 | 30~60 | 30~60 |
| 2.6 | 55~95 | 50~90 |
| 3.2 | 80~130 | 70~120 |
| 4.0 | 125~175 | 100~160 |
| 5.0 | 170~230 | 120~200 |
| 6.0 | 230~300 | - |

Note: ^a Single values are maximum.**All-weld mechanical properties**

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 430 | 331min. |
| TS (MPa) | 480 | 414min. |
| El on 4d (%) | 25 | 17min. |

Stick electrode

Features:

- Suitable for butt and fillet welding of thin plates
- Excellent usability in all positions including vertical downward

Classification:

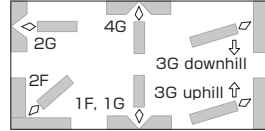
AWS A 5.1 E6013
EN ISO 2560-A-E 35 0 R

Redrying Conditions: 70~100°Cx0.5~1h

Identification color: 1st Black, 2nd -

Polarity: AC, DCEP, DCEN

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.0 | 300 | 2 | 20 | 10 | 270W, 90H, 330L |
| 2.6 | 350 | 5 | 20 | 19 | 170W, 100H, 380L |
| 3.2 | 350 | 5 | 20 | 29 | 170W, 100H, 380L |
| 4.0 | 400 | 5 | 20 | 53 | 170W, 95H, 430L |
| 5.0 | 400 | 5 | 20 | 81 | 170W, 95H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.08 | 0.20 |
| Si | 0.30 | 1.00 |
| Mn | 0.37 | 1.20 |
| P | 0.012 | 0.035 |
| S | 0.010 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | 0.02 | 0.08 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G, 3G downhill | 3G uphill, 4G |
|------|--------------------------------|---------------|
| 2.0 | 30~65 | 30~65 |
| 2.6 | 45~95 | 45~95 |
| 3.2 | 60~125 | 60~125 |
| 4.0 | 105~170 | 100~150 |
| 5.0 | 150~220 | 125~190 |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 450 | 331min. |
| TS (MPa) | 510 | 414min. |
| EI on 4d (%) | 25 | 17min. |

Approvals

| | |
|------------|------|
| ABS | 2 |
| LR | 2m |
| NK | KMW2 |

Stick electrode

Features: ▪ Typical lime titania type electrode

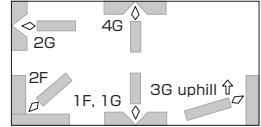
Classification: AWS A5.1 E6013

Redrying Conditions: 70~100°Cx0.5~1h

Identification color: 1st Silver gray, 2nd Blue white

Polarity: AC, DCEP, DCEN

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.0 | 300 | 2 | 20 | 11 | 270W, 85H, 330L |
| 2.6 | 350 | 5 | 20 | 22 | 170W, 105H, 380L |
| 3.2 | 350 | 5 | 20 | 34 | 170W, 105H, 380L |
| 4.0 | 450 | 5 | 20 | 64 | 170W, 90H, 480L |
| 5.0 | 450 | 5 | 20 | 98 | 170W, 90H, 480L |
| 6.0 | 450 | 5 | 20 | 142 | 170W, 90H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.08 | 0.20 |
| Si | 0.14 | 1.00 |
| Mn | 0.34 | 1.20 |
| P | 0.014 | 0.035 |
| S | 0.009 | 0.035 |
| Ni | 0.02 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.01 | 0.08 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.0 | 30~60 | 25~55 |
| 2.6 | 60~100 | 50~90 |
| 3.2 | 100~140 | 90~130 |
| 4.0 | 140~190 | 120~170 |
| 5.0 | 190~250 | 140~210 |
| 6.0 | 250~330 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 410 | 331min. |
| TS (MPa) | 460 | 414min. |
| EI on 4d (%) | 32 | 17min. |
| IV 0°C (J) | 110 | - |

Approvals

| | |
|------------|------|
| ABS | 3 |
| LR | 3m |
| DNV | 3 |
| NK | KMW3 |

Stick electrode

- Features:**
- Suitable for butt and fillet welding of thin and thick plates (up to 20mm)
 - Better usability

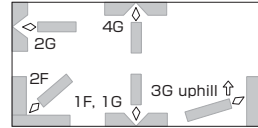
Classification: AWS A5.1 E6019

Redrying Conditions: 70~100°Cx0.5~1h

Identification color: 1st Green

Polarity: AC, DCEP, DCEN

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 19 | 170W, 100H, 380L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 105H, 380L |
| 4.0 | 400 | 5 | 20 | 56 | 170W, 95H, 430L |
| 5.0 | 400 | 5 | 20 | 84 | 170W, 95H, 430L |
| 6.0 | 450 | 5 | 20 | 136 | 170W, 90H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.10 | 0.20 |
| Si | 0.09 | 1.00 |
| Mn | 0.39 | 1.20 |
| P | 0.016 | 0.035 |
| S | 0.008 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | <0.01 | 0.08 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 40~70 |
| 3.2 | 80~130 | 60~110 |
| 4.0 | 120~180 | 100~150 |
| 5.0 | 170~250 | 130~200 |
| 6.0 | 230~300 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 400 | 331min. |
| TS (MPa) | 450 | 414min. |
| EI on 4d (%) | 30 | 22min. |
| IV -18°C (J) | 68 | 27min. |

Stick electrode**Features:**

- Suitable for butt and fillet welding of thin and medium-thick plates (up to 20mm)
- Excellent usability

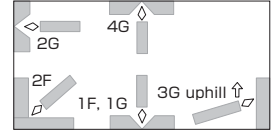
Classification:

AWS A5.1 E6019
EN ISO 2560-A-E 35 2 RA

Redrying conditions: 70~100°Cx0.5~1h

Identification color: 1st Pale brown, 2nd -

Polarity: AC, DCEP, DCEN

Welding Positions:**Packaging data**

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 20 | 170W, 120H, 380L |
| 3.2 | 400 | 5 | 20 | 35 | 170W, 120H, 430L |
| 4.0 | 450 | 5 | 20 | 62 | 170W, 120H, 480L |
| 5.0 | 450 | 5 | 20 | 94 | 170W, 120H, 480L |
| 6.0 | 450 | 5 | 20 | 141 | 170W, 120H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.10 | 0.20 |
| Si | 0.10 | 1.00 |
| Mn | 0.43 | 1.20 |
| P | 0.015 | 0.035 |
| S | 0.007 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | 0.01 | 0.08 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1G, 1F, 2G, 2F | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~90 | 45~75 |
| 3.2 | 85~140 | 60~120 |
| 4.0 | 130~190 | 100~160 |
| 5.0 | 180~260 | 135~210 |
| 6.0 | 240~310 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 410 | 331min. |
| TS (MPa) | 460 | 414min. |
| El on 4d (%) | 32 | 22min. |
| IV -18°C (J) | 82 | 27min. |

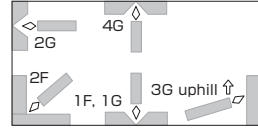
Approvals

| | |
|------------|------|
| ABS | 3 |
| LR | 3m |
| DNV | 3 |
| BV | 3 |
| NK | KMW3 |
| CR | 3 |
| GL | 3 |

Stick electrode

- Features:**
- Suitable for butt and fillet welding of thin and thick plate (up to 20mm)
 - Good mechanical properties

Welding Positions:



Classification: AWS A5.1 E6019

Redrying Conditions: 70~100°Cx0.5~1h

Identification color: 1st Yellow

Polarity: AC, DCEP, DCEN

Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 19 | 170W, 100H, 380L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 105H, 380L |
| 4.0 | 400 | 5 | 20 | 57 | 170W, 95H, 430L |
| 5.0 | 400 | 5 | 20 | 85 | 170W, 100H, 430L |
| 6.0 | 450 | 5 | 20 | 154 | 170W, 95H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.09 | 0.20 |
| Si | 0.08 | 1.00 |
| Mn | 0.60 | 1.20 |
| P | 0.012 | 0.035 |
| S | 0.006 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | <0.01 | 0.08 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 40~70 |
| 3.2 | 80~130 | 60~110 |
| 4.0 | 120~180 | 100~150 |
| 5.0 | 170~250 | 120~180 |
| 6.0 | 240~310 | 130~200 |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 420 | 331min. |
| TS (MPa) | 470 | 414min. |
| EI on 4d (%) | 31 | 22min. |
| IV -18°C (J) | 80 | 27min. |

Approvals

| | |
|------------|------|
| ABS | 3 |
| LR | 3m |
| DNV | 3 |
| BV | 3 |
| NK | KMW3 |
| GL | 3 |
| CR | 3 |

Stick electrode

Features: ▪ Low hydrogen type containing iron powder

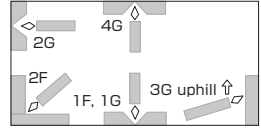
Classification: AWS A5.1 E7016

Redrying Conditions: 300~350°Cx0.5~1h

Identification color: 1st Blue white

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 20 | 170W, 110H, 380L |
| 3.2 | 350 | 5 | 20 | 34 | 170W, 115H, 380L |
| 4.0 | 400 | 5 | 20 | 60 | 170W, 110H, 430L |
| 5.0 | 450 | 5 | 20 | 106 | 170W, 110H, 480L |
| 6.0 | 450 | 5 | 20 | 150 | 170W, 110H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|---------------------------|--------------|-----------------------|
| C | 0.08 | 0.15 |
| Si | 0.50 | 0.75 |
| Mn | 1.01 | 1.60 |
| P | 0.013 | 0.035 |
| S | 0.003 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Others^b | 1.05 | 1.75 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 100~140 | 90~130 |
| 4.0 | 140~190 | 120~180 |
| 5.0 | 190~250 | 160~210 |
| 6.0 | 260~320 | - |

All-weld mechanical properties

| | Typical (AC) | | Guaranty | |
|---------------------|--------------|-------|----------|----------|
| | | | | |
| 0.2%YS (MPa) | 480 | 410 | 400min. | 340min. |
| TS (MPa) | 550 | 500 | 483min. | 450min. |
| El on 4d (%) | 33 | 34 | 22min. | 25min. |
| IV -29°C (J) | 100 | 130 | 27min. | 27min. |
| PWHT (°C×h) | AW | 620x1 | AW | 620±15x1 |

Approvals

| | |
|------------|------------|
| ABS | 3 |
| LR | 3Ym, H15 |
| DNV | 3Y, H10 |
| BV | 3, 3Y, H15 |
| NK | KMW3, H15 |
| CR | 3, 3Y, H15 |

Stick electrode

- Features:**
- Suitable for butt and fillet welding of heavy structures
 - Excellent mechanical properties

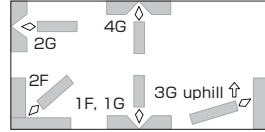
Classification: AWS A5.1 E7016
EN ISO 2560-A-E 42 3 B

Redrying Conditions: 300~350°Cx0.5~1h

Identification color: 1st Blue white, 2nd White

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 20 | 170W, 110H, 380L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 110H, 380L |
| 4.0 | 400 | 5 | 20 | 54 | 170W, 110H, 430L |
| 5.0 | 450 | 5 | 20 | 97 | 170W, 110H, 480L |
| 6.0 | 450 | 5 | 20 | 137 | 170W, 110H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|---------------------------|--------------|-----------------------|
| C | 0.08 | 0.15 |
| Si | 0.60 | 0.75 |
| Mn | 0.94 | 1.60 |
| P | 0.011 | 0.035 |
| S | 0.006 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Others^b | 0.98 | 1.75 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | 150~200 |
| 6.0 | 210~310 | - |

All-weld mechanical properties

| | Typical (AC) | | Guaranty | |
|---------------------|--------------|-------|----------|----------|
| | | | | |
| 0.2%YS (MPa) | 500 | 420 | 400min. | 350min. |
| TS (MPa) | 570 | 520 | 483min. | 460min. |
| EI on 4d (%) | 32 | 33 | 22min. | 25min. |
| IV -29°C (J) | 120 | 150 | 27min. | 27min. |
| PWHT (°C/h) | AW | 620x1 | AW | 620±15x1 |

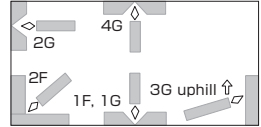
Approvals

| | |
|------------|-----------------|
| ABS | 3H10, 3Y, 3Y400 |
| LR | 3Ym H15 |
| DNV | 3YH10 |
| BV | 3H, 3YHH |
| NK | KMW53Y40H10 |
| GL | 3YH15 |
| CR | 3YH10 |

Stick electrode

Features: • Better impact value
Classification: AWS A5.1 E7016
Redrying Conditions: 350~400°Cx1h
Identification color: 1st Red, 2nd White
Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 110H, 430L |
| 5.0 | 450 | 5 | 20 | 96 | 170W, 105H, 480L |
| 6.0 | 450 | 5 | 20 | 141 | 170W, 105H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|---------------------------|--------------|-----------------------|
| C | 0.08 | 0.15 |
| Si | 0.57 | 0.75 |
| Mn | 1.06 | 1.60 |
| P | 0.012 | 0.035 |
| S | 0.005 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | <0.01 | 0.08 |
| Others^b | 1.09 | 1.75 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | 150~200 |
| 6.0 | 250~310 | - |

All-weld mechanical properties

| | Typical (AC) | | Guaranty | |
|---------------------|--------------|-------|----------|----------|
| | | | | |
| 0.2%YS (MPa) | 500 | 430 | 400min. | 370min. |
| TS (MPa) | 580 | 530 | 483min. | 480min. |
| El on 4d (%) | 31 | 33 | 22min. | 25min. |
| IV -29°C (J) | 120 | 150 | 27min. | 27min. |
| PWHT (°C×h) | AW | 620x1 | AW | 620±15x1 |

Approvals

| NK | KMW53H10 |
|----|----------|
| | |

Stick electrode

Features:

- Suitable for one side welding of pipes
- Extremely good arc stability in one side welding with relatively low current

Classification:

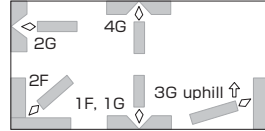
AWS A5.1 E7016
EN ISO 2560-A-E 42 2 B

Redrying Conditions: 300~350°Cx0.5~1h

Identification color: 1st Blue white, 2nd Pink

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 20 | 170W, 110H, 380L |
| 3.2 | 400 | 5 | 20 | 35 | 170W, 110H, 430L |
| 4.0 | 400 | 5 | 20 | 53 | 170W, 110H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|---------------------------|--------------|-----------------------|
| C | 0.08 | 0.15 |
| Si | 0.64 | 0.75 |
| Mn | 0.86 | 1.60 |
| P | 0.012 | 0.035 |
| S | 0.008 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Others^b | 0.90 | 1.75 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G | Root pass ^c |
|------|----------------|---------------|------------------------|
| 2.6 | 60~90 | 50~80 | 30~80 |
| 3.2 | 90~130 | 80~120 | 60~110 |
| 4.0 | 130~180 | 110~170 | 90~140 |
| 5.0 | 180~240 | 150~200 | 130~180 |

Note: ^c DCEN is also suitable.

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 480 | 400min. |
| TS (MPa) | 560 | 483min. |
| EI on 4d (%) | 31 | 22min. |
| IV -29°C (J) | 80 | 27min. |

Approvals

| | |
|-------------|----------------|
| ABS | 3H10, 3Y |
| LR | 3Ym H15 |
| DNV | 3YH10 |
| BV | 3, 3YHH |
| NK | KMW53H10 |
| CCS | 3YH10 |
| GL | 3YH15 |
| NAKS | AWS A5.1 E7016 |

Stick electrode

Features: • Suitable for butt and fillet welding of 520MPa high tensile steel

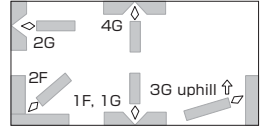
Classification: AWS A5.1 E7016

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Blue, 2nd Brown

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 20 | 170W, 125H, 380L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 110H, 430L |
| 5.0 | 450 | 5 | 20 | 97 | 170W, 105H, 480L |
| 6.0 | 450 | 5 | 20 | 138 | 170W, 105H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|---------------------------|--------------|-----------------------|
| C | 0.08 | 0.15 |
| Si | 0.64 | 0.75 |
| Mn | 0.81 | 1.60 |
| P | 0.011 | 0.035 |
| S | 0.003 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.03 | 0.20 |
| Mo | 0.17 | 0.30 |
| V | 0.01 | 0.08 |
| Others^b | 1.03 | 1.75 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 50~80 |
| 3.2 | 90~130 | 80~115 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~250 | 150~200 |
| 6.0 | 250~310 | - |

All-weld mechanical properties

| | Typical (AC) | | Guaranty | |
|---------------------|--------------|-------|----------|-----------|
| | | | | |
| 0.2%YS (MPa) | 530 | 470 | 400min. | 400min. |
| TS (MPa) | 610 | 540 | 483min. | 500min. |
| El on 4d (%) | 31 | 32 | 22min. | 25min. |
| IV -29°C (J) | 100 | 130 | 27min. | 27min. |
| PWHT (°C×h) | AW | 620x1 | AW | 620±15x10 |

Stick electrode

- Features:**
- Suitable for butt and fillet welding of heavy structure
 - Good performance by DCEP current

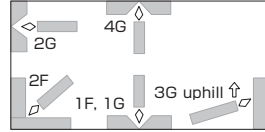
Classification: AWS A5.1 E7018
EN ISO 2560-A-E 42 3 B

Redrying Conditions: 300~350°Cx0.5~1h

Identification color: 1st Blue white, 2nd Blue

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 24 | 170W, 105H, 380L |
| 3.2 | 400 | 5 | 20 | 41 | 170W, 105H, 430L |
| 4.0 | 450 | 5 | 20 | 69 | 170W, 105H, 480L |
| 5.0 | 450 | 5 | 20 | 106 | 170W, 105H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|---------------------------|--------------|-----------------------|
| C | 0.07 | 0.15 |
| Si | 0.59 | 0.75 |
| Mn | 0.97 | 1.60 |
| P | 0.013 | 0.035 |
| S | 0.007 | 0.035 |
| Ni | 0.02 | 0.30 |
| Cr | 0.03 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Others^b | 1.03 | 1.75 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 65~95 | 60~90 |
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~190 | 110~170 |
| 5.0 | 190~250 | 165~210 |

All-weld mechanical properties

| | Typical (AC) | | Guaranty | |
|---------------------|--------------|-------|----------|----------|
| | | | | |
| 0.2%YS (MPa) | 500 | 420 | 400min. | 350min. |
| TS (MPa) | 560 | 520 | 483min. | 460min. |
| EI on 4d (%) | 31 | 32 | 22min. | 25min. |
| IV -29°C (J) | 110 | 140 | 27min. | 27min. |
| PWHT (°C×h) | AW | 620x1 | AW | 620±15x1 |

Approvals

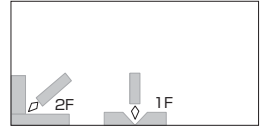
| | |
|------------|----------|
| ABS | 3Y H10 |
| LR | 3Ym H15 |
| DNV | 3YH10 |
| NK | KMW53H10 |

Stick electrode

Features:

- Suitable for flat and horizontal fillet welding
- Iron powder low hydrogen type

Welding Positions:



Classification: AWS A5.1 E7018

Redrying Conditions: 300~350°Cx0.5~1h

Identification color: 1st Silver, 2nd Orange

Polarity: AC, DCEP

Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|---------------|---------|-----------|---------------|-------------------------|
| 6.0 | 550 | 5 | 20 | 210 | 170W, 75H, 580L |
| 6.4 | 700 | 10 | 20 | 295 | 170W, 65H, 730L |
| 8.0 | 450, 550, 700 | 5, 10 | 20 | 268, 327, 416 | 170W, 80~115H, 480~730L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|---------------------------|--------------|-----------------------|
| C | 0.11 | 0.15 |
| Si | 0.40 | 0.75 |
| Mn | 1.12 | 1.60 |
| P | 0.014 | 0.035 |
| S | 0.004 | 0.035 |
| Ni | 0.02 | 0.30 |
| Cr | 0.03 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Others^b | 1.18 | 1.75 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

Welding parameters (A)

| φ mm | 1F, 2F |
|------|---------|
| 6.0 | 250~300 |
| 6.4 | 270~320 |
| 8.0 | 350~400 |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 480 | 400min. |
| TS (MPa) | 550 | 483min. |
| El on 4d (%) | 30 | 22min. |
| IV -29°C (J) | 74 | 27min. |

Approvals

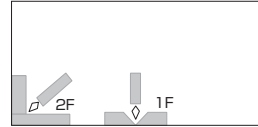
| | |
|------------|------------|
| ABS | 3, 3Y, H10 |
| LR | 3Ym, 3YG |
| DNV | 3Y, H15 |
| BV | 3, 3Y, H10 |
| NK | KMW53, H10 |

Stick electrode

Features:

- Suitable for flat and horizontal fillet welding
- Good welding usability in manual and gravity welding

Welding Positions:



Classification: AWS A5.1 E7024

Redrying Conditions: 70~100°Cx0.5~1h

Identification color: -

Polarity: AC, DCEP, DCEN

Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 400 | 5 | 20 | 57 | 175W, 115H, 430L |
| 4.0 | 450 | 5 | 20 | 101 | 175W, 115H, 480L |
| 5.0 | 450 | 5 | 20 | 147 | 175W, 115H, 480L |

Composition (all-weld metal mass%)

| | Typical (DCEP) | Guaranty ^a |
|---------------------------|----------------|-----------------------|
| C | 0.09 | 0.15 |
| Si | 0.35 | 0.90 |
| Mn | 0.63 | 1.25 |
| P | 0.017 | 0.035 |
| S | 0.008 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Others^b | 0.69 | 1.50 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

Welding parameters (A)

| φ mm | 1F, 2F |
|------|---------|
| 3.2 | 120~150 |
| 4.0 | 170~210 |
| 5.0 | 220~260 |

All-weld mechanical properties

| | Typical (DCEP) | Guaranty |
|---------------------|----------------|----------|
| 0.2%YS (MPa) | 470 | 400min. |
| TS (MPa) | 540 | 490min. |
| EI on 4d (%) | 27 | 17min. |
| IV 0°C (J) | 55 | - |

Approvals

| | |
|------------|-------|
| LR | 2Ym |
| DNV | 2YH15 |
| NK | KMW52 |

Stick electrode

Features: ▪ Low hydrogen type for tack welding

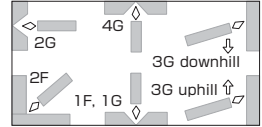
Classification: AWS A5.1 E7048

Redrying Conditions: 300~350°Cx0.5~1h

Identification color: 1st Red

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 36 | 170W, 115H, 380L |
| 4.0 | 400 | 5 | 20 | 60 | 170W, 105H, 430L |
| 5.0 | 450 | 5 | 20 | 96 | 170W, 105H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|---------------------------|--------------|-----------------------|
| C | 0.08 | 0.15 |
| Si | 0.47 | 0.90 |
| Mn | 1.04 | 1.60 |
| P | 0.012 | 0.035 |
| S | 0.002 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | <0.01 | 0.08 |
| Others^b | 1.07 | 1.75 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

Welding parameters (A)

| φ mm | All position (1F, 1G, 2F, 2G, 3G uphill, 4G) & 3G downhill |
|------|--|
| 3.2 | 110~160 |
| 4.0 | 160~220 |
| 5.0 | 200~260 |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 450 | 400min. |
| TS (MPa) | 540 | 483min. |
| El on 4d (%) | 32 | 22min. |
| IV -29°C (J) | 110 | 27min. |
| PWHT | AW | AW |

Approvals

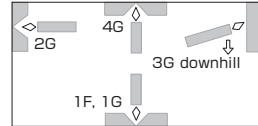
| | |
|------------|---------------|
| ABS | 3, 3Y, 3Y400 |
| LR | 3Ym (H15) |
| DNV | 3Y, H10 |
| BV | 3, 3Y, H10 |
| NK | KMW53Y40, H10 |
| CR | 3, 3Y, H10 |

Stick electrode

Features:

- Suitable for butt welding of pipes
- Excellent usability in vertical downward welding
- Good mechanical properties

Welding Positions:



Classification: AWS A5.1 E7048

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Orange, 2nd Black

Polarity: AC, DCEP

Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 33 | 170W, 110H, 380L |
| 4.0 | 400 | 5 | 20 | 56 | 170W, 110H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|---------------------------|--------------|-----------------------|
| C | 0.06 | 0.15 |
| Si | 0.56 | 0.90 |
| Mn | 1.18 | 1.60 |
| P | 0.012 | 0.035 |
| S | 0.005 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | <0.01 | 0.08 |
| Others^b | 1.23 | 1.75 |

Welding parameters (A)

| φ mm | 1F, 1G, 2G | 3G uphill, 4G | 3G downhill |
|------|------------|---------------|-------------|
| 3.2 | 80~140 | 80~120 | 80~140 |
| 4.0 | 130~210 | 110~160 | 130~210 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 490 | 400min. |
| TS (MPa) | 580 | 483min. |
| EI on 4d (%) | 30 | 22min. |
| IV -29°C (J) | 100 | 27min. |

Stick electrode

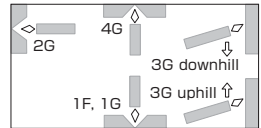
- Features:**
- Suitable for butt welding of pipes
 - Excellent usability in vertical downward welding

Classification: AWS A5.5 E7010-P1

Identification color: 1st Brown, 2nd Black

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.4 | 300 | 2 | 20 | 13 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 27 | 175W, 115H, 380L |
| 4.0 | 350 | 5 | 20 | 40 | 175W, 115H, 380L |
| 4.8 | 350 | 5 | 20 | 58 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.14 | 0.20 |
| Si | 0.10 | 0.60 |
| Mn | 1.01 | 1.20 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 1.00 |
| Cr | 0.02 | 0.30 |
| Mo | <0.01 | 0.50 |
| V | <0.01 | 0.10 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2G | 3G uphill, 4G | 3G downhill |
|------|------------|---------------|-------------|
| 2.4 | 40~70 | 40~70 | 40~70 |
| 3.2 | 60~120 | 60~120 | 70~120 |
| 4.0 | 90~170 | 80~160 | 100~170 |
| 4.8 | 130~210 | 120~200 | 150~210 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 470 | 414min. |
| TS (MPa) | 570 | 483min. |
| El on 4d (%) | 30 | 22min. |
| IV -29°C (J) | 61 | 27min. |

Stick electrode

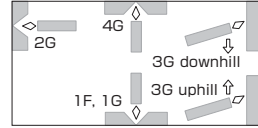
- Features:**
- Suitable for butt welding of pipes
 - Excellent usability in vertical downward welding

Classification: AWS A5.5 E8010-P1

Identification color: 1st Blue white, 2nd -

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 26 | 175W, 115H, 380L |
| 4.0 | 350 | 5 | 20 | 40 | 175W, 115H, 380L |
| 4.8 | 350 | 5 | 20 | 58 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.15 | 0.20 |
| Si | 0.12 | 0.60 |
| Mn | 1.05 | 1.20 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 1.00 |
| Cr | 0.03 | 0.30 |
| Mo | 0.27 | 0.50 |
| V | <0.01 | 0.10 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2G | 3G uphill, 4G | 3G downhill |
|------|------------|---------------|-------------|
| 3.2 | 60~120 | 70~120 | 60~120 |
| 4.0 | 90~170 | 100~170 | 80~160 |
| 4.8 | 130~210 | 150~210 | 120~200 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 520 | 462min. |
| TS (MPa) | 620 | 552min. |
| EI on 4d (%) | 28 | 19min. |
| IV -29°C (J) | 54 | 27min. |

Stick electrode

Features: • Suitable for butt and fillet welding of 520MPa high tensile steel

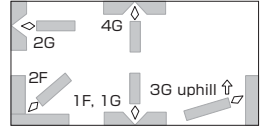
Classification: AWS A5.5 E7016-G

Redrying Conditions: 300~350°Cx0.5~1h

Identification color: 1st Blue white, 2nd Green

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 33 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 58 | 170W, 110H, 430L |
| 5.0 | 450 | 5 | 20 | 102 | 170W, 110H, 480L |
| 6.0 | 450 | 5 | 20 | 145 | 170W, 110H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.08 | 0.05~0.10 |
| Si | 0.58 | 0.30~0.75 |
| Mn | 1.30 | 1.00~1.50 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.30 |
| Cr | 0.03 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | 0.01 | 0.08 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 80~120 |
| 4.0 | 140~190 | 120~180 |
| 5.0 | 190~250 | - |
| 6.0 | 250~320 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 510 | 393min. |
| TS (MPa) | 600 | 483min. |
| El on 4d (%) | 29 | 25min. |
| IV -29°C (J) | 110 | - |

Stick electrode

- Features:**
- Suitable for butt welding of pipes
 - Excellent usability in vertical downward welding
 - Good mechanical properties

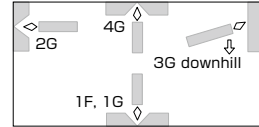
Classification: AWS A5.5 E8018-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Yellowish green, 2nd Yellowish green

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 110H, 380L |
| 4.0 | 400 | 5 | 20 | 56 | 170W, 110H, 430L |
| 4.5 | 400 | 5 | 20 | 68 | 170W, 110H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.05~0.10 |
| Si | 0.55 | 0.30~0.75 |
| Mn | 1.20 | 1.00~1.40 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.53 | 0.40~0.80 |
| Mo | 0.07 | 0.30 |

Welding parameters (A)

| φ mm | 1F, 1G, 2G | 4G | 3G downhill |
|------|------------|---------|-------------|
| 3.2 | 80~140 | 80~120 | 80~140 |
| 4.0 | 130~200 | 110~160 | 130~200 |
| 4.5 | 160~250 | 130~190 | 160~250 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 510 | 462min. |
| TS (MPa) | 620 | 552min. |
| EI on 4d (%) | 30 | 19min. |
| IV -18°C (J) | 120 | - |

Stick electrode

- Features:**
- Suitable for butt welding of pipes
 - Excellent usability in vertical downward welding
 - Good mechanical properties

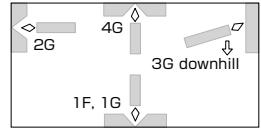
Classification: AWS A5.5 E9018-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Blue, 2nd Silver

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 110H, 380L |
| 4.0 | 400 | 5 | 20 | 56 | 170W, 110H, 430L |
| 4.5 | 400 | 5 | 20 | 67 | 170W, 110H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.05~0.10 |
| Si | 0.61 | 0.30~0.75 |
| Mn | 1.27 | 1.00~1.50 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 1.17 | 0.90~1.40 |
| Mo | 0.18 | 0.40 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2G | 4G | 3G downhill |
|------|------------|---------|-------------|
| 3.2 | 80~140 | 80~120 | 80~140 |
| 4.0 | 130~200 | 110~160 | 130~200 |
| 4.5 | 160~250 | 130~190 | 160~250 |

All-weld mechanical properties

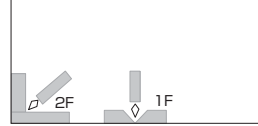
| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 560 | 531min. |
| TS (MPa) | 660 | 621min. |
| El on 4d (%) | 30 | 17min. |
| IV -18°C (J) | 130 | - |

Stick electrode

Features:

- Suitable for flat and horizontal fillet welding
- Lime titania type

Welding Positions:



Classification: AWS -

Redrying Conditions: 70~100°Cx0.5~1h

Identification color: 1st Purple, 2nd Orange

Polarity: AC, DCEP, DCEN

Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|---------------|---------|-----------|---------------|------------------------|
| 4.0 | 450 | 5 | 20 | 76 | 170W, 90H, 480L |
| 4.5 | 550, 700 | 5 | 20 | 138, 175 | 170W, 60~75H, 580~730L |
| 5.0 | 450, 550, 700 | 5, 10 | 20 | 130, 159, 203 | 170W, 60~95H, 480~730L |
| 5.5 | 450, 550, 700 | 5, 10 | 20 | 153, 187, 239 | 170W, 65~95H, 480~730L |
| 6.0 | 450, 550, 700 | 5, 10 | 20 | 176, 215, 273 | 170W, 65~95H, 480~730L |
| 6.4 | 450, 550, 700 | 5, 10 | 20 | 189, 231, 294 | 170W, 60~95H, 480~730L |
| 7.0 | 700 | 10 | 20 | 350 | 170W, 60H, 730L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.07 | 0.10 |
| Si | 0.39 | 0.10~0.70 |
| Mn | 0.94 | 0.60~1.25 |
| P | 0.017 | 0.030 |
| S | 0.009 | 0.025 |
| Ni | 0.01 | 0.30 |
| Cr | 0.02 | 0.20 |
| Mo | <0.01 | 0.30 |
| V | 0.01 | 0.08 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 2F |
|------|---------|
| 4.0 | 135~195 |
| 4.5 | 170~220 |
| 5.0 | 200~240 |
| 5.5 | 230~280 |
| 6.0 | 260~310 |
| 6.4 | 280~330 |
| 7.0 | 300~350 |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 480 | 390min. |
| TS (MPa) | 530 | 490min. |
| EI on 4d (%) | 29 | 16min. |
| IV 0°C (J) | 74 | 47min. |

Approvals

| | |
|------------|----------|
| ABS | 3, 3Y* |
| LR | 3Ym, 3YG |
| DNV | 3, MG |
| BV | 3, 3Y |
| NK | KMW53 |
| CR | 3Y |
| GL | 3Y |

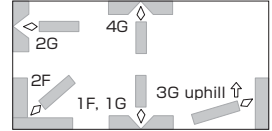
Flux cored wire

- Features:**
- Suitable for thin plates (e.g., 0.8mm)
 - Excellent arc stability in low current range (50~180A) for short circuiting welding

Classification: AWS A5.18 E70C-6C/6M
EN ISO 17632-A - T 42 2 M C/M 1 H5

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:**Packaging data**

| φ mm | Spool | Drum |
|------------------|------------------|--------------|
| 1.2 | 20kg | 250kg |
| 1.4 | 20kg | 250kg |
| Volume mm | 300W, 110H, 300L | 530 φ , 820H |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.08 | 0.12 |
| Si | 0.49 | 0.90 |
| Mn | 1.53 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.50 |
| Cr | 0.02 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | <0.01 | 0.08 |
| Cu | 0.02 | 0.50 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 1.2 | 50~300 | 50~180 |
| 1.4 | 80~400 | 70~180 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 480 | 400min. |
| TS (MPa) | 560 | 490min. |
| El on 4d (%) | 31 | 22min. |
| IV -29°C (J) | 62 | 27min. |

Approvals

| | |
|------------|-----------------------------|
| ABS | 3YSA, H5 (CO ₂) |
| LR | 3YS, H5 |
| DNV | III YMS (H5) |
| BV | SA3YM HHH |
| CR | 3YS-HH (CO ₂) |
| GL | 3YH5S |

MX-A100

Flux cored wire

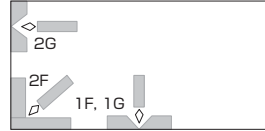
- Features:**
- Better arc stability and wider optimum current range for spray transfer arc with less spattering than solid wire

Classification: AWS A5.18 E70C-6M
EN ISO 17632-A - T 42 4 M M 3 H5

Shielding gas: Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| ø mm | Spool | | Drum | |
|------------------|------------------|------|-------------|-------------|
| | kg | kg | kg | kg |
| 1.2 | 15kg | 20kg | 200kg | - |
| 1.4 | 15kg | 20kg | - | 250kg |
| 1.6 | 15kg | 20kg | - | 250kg |
| Volume mm | 300W, 110H, 300L | | 530 ø, 820H | 680 ø, 770H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.74 | 0.90 |
| Mn | 1.58 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.02 | 0.50 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | <0.01 | 0.08 |
| Cu | 0.02 | 0.50 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| ø mm | 1F, 1G | 2F, 2G |
|------|---------|---------|
| 1.2 | 150~350 | 150~300 |
| 1.4 | 200~450 | 200~400 |
| 1.6 | 250~500 | 250~450 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 450 | 400min. |
| TS (MPa) | 550 | 483min. |
| EI on 4d (%) | 33 | 22min. |
| IV -40°C (J) | 71 | 27min. |

Approvals

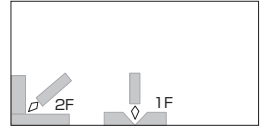
| | |
|------------|------------|
| ABS | 4YSA, H5 |
| LR | 4YS, H5 |
| DNV | IVYMS (H5) |
| BV | SA4YM HHH |
| GL | 4YH5S |

DW-200

Flux cored wire

- Features:**
- Suitable for flat and horizontal fillet welding
 - A large leg length of about 9mm in horizontal fillet

Welding Positions:



Classification: AWS A5.20 E70T-1C

Shielding gas: CO₂

Polarity: DCEP

Packaging data

| φ mm | Spool | Drum |
|------------------|--------------------|-------------|
| 1.2 | 12.5kg, 15kg, 20kg | - |
| 1.4 | 12.5kg, 15kg, 20kg | 200kg |
| Volume mm | 300W, 110H, 300L | 530 φ, 820H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.51 | 0.90 |
| Mn | 1.50 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.50 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Cu | 0.01 | 0.35 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F | 2F |
|------|---------|---------|
| 1.2 | 200~320 | 200~300 |
| 1.4 | 230~400 | 230~360 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 490 | 400min. |
| TS (MPa) | 560 | 490~655 |
| El on 4d (%) | 28 | 22min. |
| IV -18°C (J) | 60 | 27min. |

Approvals

| | |
|------------|------------|
| ABS | 3YSA |
| LR | 3YS (H10) |
| DNV | III YMS |
| BV | SA3YM |
| NK | KSW53G (C) |

Flux cored wire

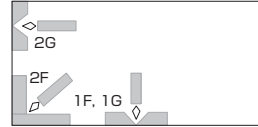
Features: • Suitable for butt and fillet welding

Classification: AWS A5.20 E70T-1C

Shielding gas: CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | Drum |
|------------------|------------------|-------------|
| 1.2 | 20kg | - |
| 1.4 | 15kg, 20kg | 250kg |
| 1.6 | 20kg | - |
| 2.0 | 20kg | - |
| Volume mm | 300W, 110H, 300L | 530 φ, 820H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.68 | 0.90 |
| Mn | 1.48 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.02 | 0.50 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | <0.01 | 0.08 |
| Cu | 0.02 | 0.35 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G | 2F, 2G |
|------|---------|---------|
| 1.2 | 200~350 | 200~300 |
| 1.4 | 250~450 | 250~400 |
| 1.6 | 300~500 | 300~450 |
| 2.0 | 400~600 | 400~500 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 510 | 400min. |
| TS (MPa) | 580 | 490~655 |
| EI on 4d (%) | 30 | 22min. |
| IV -18°C (J) | 50 | 27min. |

Approvals

| | |
|------------|------------|
| ABS | 2SA, 2YSA |
| LR | 2YS |
| DNV | II YMS |
| BV | SA2YM |
| NK | KSW52G (C) |
| CR | 2YS |
| GL | 2YS |

MX-200

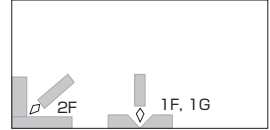
Flux cored wire

Features: • Excellent porosity resistibility to inorganic zinc primer

Classification: AWS A5.20 E70T-1C
EN ISO 17632-A - T 42 0 R C 3 H5

Shielding gas: CO₂
Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | | Drum | |
|------------------|------------------|------|-------------|-------------|
| | 15kg | 20kg | 250kg | - |
| 1.2 | 15kg | 20kg | 250kg | - |
| 1.4 | 15kg | 20kg | 250kg | - |
| 1.6 | - | 20kg | - | 350kg |
| Volume mm | 300W, 110H, 300L | | 530 φ, 820H | 600 φ, 770H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.50 | 0.90 |
| Mn | 1.50 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.50 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Cu | 0.02 | 0.35 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G | 2F |
|------|---------|---------|
| 1.2 | 150~300 | 180~300 |
| 1.4 | 170~400 | 200~350 |
| 1.6 | 200~450 | 270~400 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 530 | 400min. |
| TS (MPa) | 590 | 490~655 |
| El on 4d (%) | 29 | 22min. |
| IV -18°C (J) | 55 | 27min. |

Approvals

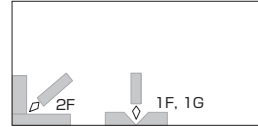
| | |
|------------|-------------------|
| ABS | 2YSA, 2Y400SA, H5 |
| LR | 2YS, H5 |
| DNV | II YMS (H5) |
| BV | SA2YM HHH |
| NK | KSW52Y40G (C) H5 |
| CR | 2YS-HH |
| GL | 3YH5S |
| KR | 2YSG (C) H10 |
| CCS | 2YSH5 |

MX-200H

Flux cored wire

- Features:**
- Suitable for horizontal fillet welding by high speed tandem method (150cm/min)
 - Excellent porosity resistibility to inorganic zinc primer

Welding Positions:



Classification: AWS A5.20 E70T-1C

Shielding gas: CO₂

Polarity: DCEP

Packaging data

| φ mm | Drum |
|------------------|--------------|
| 1.4 | 200kg, 250kg |
| 1.6 | 200kg, 250kg |
| Volume mm | 530 φ , 820H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.55 | 0.90 |
| Mn | 1.55 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.50 |
| Cr | 0.02 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Cu | 0.02 | 0.35 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 1.4 | 200~450 |
| 1.6 | 250~500 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 500 | 400min. |
| TS (MPa) | 600 | 490~655 |
| EI on 4d (%) | 27 | 22min. |
| IV -18°C (J) | 90 | 27min. |

Approvals

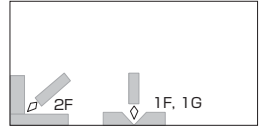
| | Single | Tandem |
|------------|---------------|---------------|
| ABS | 3YA, 3YSA | 3YA, 3YSA |
| LR | 3YS (H5) | 3YM (H5) |
| DNV | III YS | III YM |
| BV | SA3YM | A3YM |
| NK | KSW53Y40G (C) | KAW53Y40G (C) |
| CR | 3YSM | 3YSM |
| KR | 3YSG (C) | 3YMG (C) |
| GL | 3YS | 3YS |
| CCS | - | 3YM |

MX-200E

Flux cored wire

- Features:**
- Excellent porosity resistibility to inorganic zinc primer
 - Excellent impact value at low temperatures down to -29°C

Welding Positions:



Classification: AWS A5.20 E70T-9C

Shielding gas: CO₂

Polarity: DCEP

Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 15kg, 20kg |
| Volume mm | 300W, 110H, 300L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.12 |
| Si | 0.51 | 0.90 |
| Mn | 1.48 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.50 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Cu | 0.02 | 0.35 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G | 2F |
|------|---------|---------|
| 1.2 | 150~300 | 180~300 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 540 | 400min. |
| TS (MPa) | 600 | 490~655 |
| EI on 4d (%) | 30 | 22min. |
| IV -29°C (J) | 70 | 27min. |

Approvals

| | |
|------------|-------------------|
| ABS | 4Y400SA, H5 |
| LR | 4Y40S (H5) |
| DNV | IVY40MS, H5 |
| BV | SA4Y40M, H5 |
| NK | KSW54Y40G (C), H5 |
| GL | 4Y40H5S |

MX-A200

FAMILIARC™

Flux cored wire

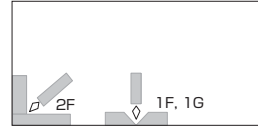
- Features:**
- Suitable for flat and horizontal fillet welding
 - Excellent porosity resistibility to inorganic zinc primer

Classification: AWS A5.20 E70T-1M

Shielding gas: Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | Drum |
|------------------|------------------|-------------|
| 1.1 | - | 250kg |
| 1.2 | 15kg | - |
| 1.3 | 20kg | - |
| Volume mm | 300W, 110H, 300L | 530 φ, 820H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.56 | 0.90 |
| Mn | 1.52 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.50 |
| Cr | 0.02 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Cu | 0.02 | 0.35 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G | 2F |
|------|---------|---------|
| 1.1 | 150~300 | 180~300 |
| 1.2 | 150~300 | 180~300 |
| 1.3 | 170~400 | 200~350 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 520 | 400min. |
| TS (MPa) | 590 | 490~655 |
| EI on 4d (%) | 29 | 22min. |
| IV -18°C (J) | 67 | 27min. |

Approvals

| | |
|------------|---------|
| ABS | 3YSA |
| LR | 3YS |
| DNV | III YMS |

Flux cored wire

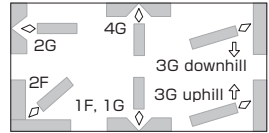
Features: ▪ Excellent usability with soft and stable arc, less fume and spattering, good bead appearance and smooth slag removal

Classification: AWS A5.20 E71T-1C/1M, -9C/9M
EN ISO 17632-A - T 42 2 P C/M 1 H5

Shielding gas: CO₂ or Ar-CO₂ mixture

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | | | Drum |
|------------------|-----------------------|------------------|------|-------------|
| | 5kg | 15kg | 20kg | |
| 1.2 | 5kg | 15kg | 20kg | 250kg |
| 1.6 | - | 15kg | 20kg | 250kg |
| Volume mm | 220W, 130H, 435L/4pcs | 300W, 110H, 300L | | 530 φ, 820H |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.04 | 0.12 |
| Si | 0.67 | 0.90 |
| Mn | 1.29 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.50 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.02 | 0.08 |
| Cu | 0.02 | 0.35 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G | 3G downhill |
|------|----------------|---------------|-------------|
| 1.2 | 120~250 | 120~250 | 200~250 |
| 1.6 | 180~340 | 180~280 | 250~300 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 510 | 400min. |
| TS (MPa) | 582 | 490~655 |
| EI on 4d (%) | 27 | 22min. |
| IV -29°C (J) | 71 | 27min. |

Approvals

| | |
|------------|----------------------------|
| ABS | 3YSA, H5 |
| LR | 3YS, H5 |
| DNV | III YMS (H5) |
| NK | KSW53G (C) H5 |
| GL | 3YH5S |
| CWB | E491T-9-H8, E491T-9M-H8 |

DW-100

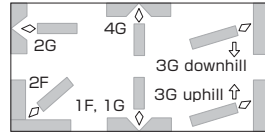
Flux cored wire

Features: • Soft and stable arc, less fume and spattering, smooth bead appearance, and good slag removal

Classification: AWS A5.20 E71T-1C
EN ISO 17632-A - T 42 0 P C 1 H10

Shielding gas: CO₂
Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | | | Drum | |
|------------------|------------------|------|------|-------------|-------------|
| | | | | | |
| 1.2 | 12.5kg | 15kg | 20kg | 250kg | - |
| 1.4 | - | 15kg | 20kg | 250kg | 350kg |
| 1.6 | - | 15kg | 20kg | - | 350kg |
| Volume mm | 300W, 110H, 300L | | | 530 φ, 820H | 680 φ, 770H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.45 | 0.90 |
| Mn | 1.35 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.50 |
| Cr | 0.02 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.01 | 0.80 |
| Cu | 0.02 | 0.35 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 510 | 400min. |
| TS (MPa) | 570 | 490~655 |
| EI on 4d (%) | 30 | 22min. |
| IV -18°C (J) | 85 | 27min. |

Approvals

| | |
|------------|-------------------------|
| ABS | 2YSA, 2Y400SA, H10 |
| LR | 2YS, 2YM H10 |
| DNV | II YMS (H10) |
| BV | SA2M, SA2YM, SA2Y40M HH |
| NK | KSW52Y40G (C) H10 |
| CR | 2YS-HH |
| GL | 2Y40H10S |
| KR | 2YSG (C) |
| CCS | 2SH10, 2YSH10 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G | 3G downhill |
|------|------------|---------|---------------|-------------|
| 1.2 | 120~300 | 120~280 | 120~260 | 200~300 |
| 1.4 | 160~350 | 160~320 | 160~270 | 220~300 |
| 1.6 | 200~400 | 200~350 | 200~280 | 250~300 |

DW-100V

Flux cored wire

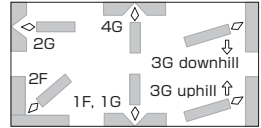
- Features:**
- Suitable for welding in all positions including vertical downward
 - Excellent performance especially in vertical upward

Classification: AWS A5.20 E71T-1C

Shielding gas: CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | Drum |
|------------------|--------------------|--------------|
| 1.2 | 12.5kg, 15kg, 20kg | 250kg |
| 1.4 | 12.5kg, 15kg, 20kg | - |
| Volume mm | 300W, 110H, 300L | 530 φ , 820H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.55 | 0.90 |
| Mn | 1.28 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.50 |
| Cr | 0.02 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.02 | 0.08 |
| Cu | 0.02 | 0.35 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 490 | 400min. |
| TS (MPa) | 580 | 490~655 |
| EI on 4d (%) | 30 | 22min. |
| IV -18°C (J) | 50 | 27min. |

Approvals

| | |
|------------|---------------|
| ABS | 2YSA |
| LR | 2YS (H10) |
| DNV | II YMS |
| BV | SA2YM |
| NK | KSW52Y40G (C) |
| GL | 2YS |
| CCS | 2YS, H10 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G | 3G downhill |
|------|------------|---------|---------------|-------------|
| 1.2 | 120~300 | 120~280 | 120~300 | 200~300 |
| 1.4 | 160~350 | 220~320 | 150~300 | 220~300 |

Flux cored wire

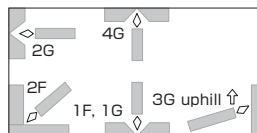
Features: ▪ Excellent impact value at low temperatures down to -29°C

Classification: AWS A5.20 E71T-9C
EN ISO 17632-A - T 42 2 P C 1 H10

Shielding gas: CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|------------------|------------------|------|
| 1.2 | 12.5kg | 15kg |
| 1.4 | - | 15kg |
| Volume mm | 300W, 110H, 300L | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.38 | 0.90 |
| Mn | 1.44 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.38 | 0.50 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.02 | 0.08 |
| Cu | 0.02 | 0.35 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 510 | 400min. |
| TS (MPa) | 570 | 483~655 |
| EI on 4d (%) | 29 | 22min. |
| IV -29°C (J) | 100 | 27min. |

Approvals

| | |
|------------|--------------------|
| ABS | 3YSA, 3Y400SA, H10 |
| LR | 3YS, H10 |
| DNV | III YMS |
| BV | SA3, 3YM |
| NK | KSW53G (C) |
| GL | 3YS |
| CCS | 3YSH10 |
| CR | 3YS |

Welding parameters (A)

| φ mm | 1F, 1G | 2F | 2G | 3G uphill, 4G |
|------|---------|---------|---------|---------------|
| 1.2 | 120~300 | 120~300 | 120~280 | 120~250 |
| 1.4 | 150~400 | 150~350 | 150~320 | 150~250 |

DW-A50

Flux cored wire

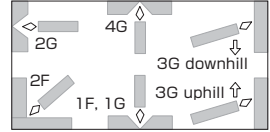
Features: • Excellent usability with soft and stable arc, less fume and spattering, good bead appearance and smooth slag removal

Classification: AWS A5.20 E71T-1M
EN ISO 17632-A - T 42 2 P M 1 H5

Shielding gas: Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|------------------|------------------|------|
| | 1.2 | 15kg |
| 1.6 | 15kg | - |
| Volume mm | 300W, 110H, 300L | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.48 | 0.90 |
| Mn | 1.16 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.01 | 0.50 |
| Cr | 0.02 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.01 | 0.08 |
| Cu | 0.01 | 0.35 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 510 | 400min. |
| TS (MPa) | 570 | 490~655 |
| EI on 4d (%) | 30 | 22min. |
| IV -18°C (J) | 110 | 27min. |

Approvals

| | |
|------------|------------------|
| ABS | 3YSA, H5 |
| LR | 3YS, H5 |
| DNV | III YMS (H5), MG |
| BV | SA3YM HHH |
| NK | KSW52G (M2) H5 |
| GL | 3YH5S |

Welding parameters (A)

| φ mm | 1F, 1G | 2F | 2G | 3G uphill, 4G | 3G downhill |
|------|---------|---------|---------|---------------|-------------|
| 1.2 | 120~300 | 120~300 | 120~280 | 120~260 | 200~300 |
| 1.6 | 180~450 | 180~400 | 180~350 | 180~280 | 250~300 |

Flux cored wire

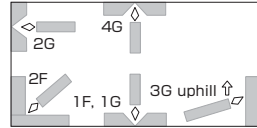
Features: • Suitable for butt and fillet welding in all positions

Welding Positions:

Classification: AWS A5.20 E71T-5M-J

Shielding gas: Ar-CO₂

Polarity: DCEN

**Packaging data**

| φ mm | Spool | Drum |
|------------------|--------------------|-------------|
| 1.2 | 12.5kg, 15kg, 20kg | 200kg |
| Volume mm | 300W, 110H, 300L | 530 φ, 820H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.45 | 0.90 |
| Mn | 1.40 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.02 | 0.50 |
| Cr | 0.03 | 0.20 |
| Mo | 0.02 | 0.30 |
| V | <0.01 | 0.08 |
| Cu | 0.02 | 0.35 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 1.2 | 150~300 | 150~200 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 480 | 400min. |
| TS (MPa) | 570 | 483~655 |
| EI on 4d (%) | 30 | 22min. |
| IV -40°C (J) | 95 | 27min. |

Approvals

| LR | 3YS (H5) |
|----|----------|
| | |

Solid wire

Features:

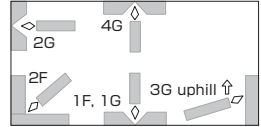
- Suitable for butt and fillet welding in all positions
- Suitable for lower currents

Welding Positions:

Classification: AWS A5.18 ER70S-3

Shielding gas: Ar-20%CO₂

Polarity: DCEP



Packaging data

| φ mm | Spool | | Drum | | | |
|------------------|------------------|------------------|-------------|--------|-------------|--------|
| | Weight | Weight | Volume | Weight | Volume | Volume |
| 0.9 | 10kg | 20kg | - | 250kg | - | - |
| 1.0 | 10kg | 20kg | - | 250kg | - | - |
| 1.2 | - | 20kg | - | - | 300kg | - |
| Volume mm | 240W, 110H, 240L | 300W, 110H, 300L | 530 φ, 820H | | 680 φ, 770H | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.06~0.15 |
| Si | 0.55 | 0.45~0.75 |
| Mn | 1.11 | 0.90~1.40 |
| P | 0.012 | 0.025 |
| S | 0.011 | 0.035 |
| Cu | 0.24 | 0.50 |
| Ni | 0.01 | 0.15 |
| Cr | 0.03 | 0.15 |
| Mo | <0.01 | 0.15 |
| V | <0.01 | 0.03 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 440 | 400min. |
| TS (MPa) | 540 | 483min. |
| EI on 4d (%) | 32 | 22min. |
| IV -18°C (J) | 170 | 27min. |
| PWHT | AW | AW |

Approvals

| | |
|------------|-------------|
| ABS | 3SA, 3YSA |
| NK | KSW53G (M2) |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|--------|-----------|--------|
| 0.9 | 50~200 | 50~180 | 50~140 | 50~120 |
| 1.0 | 50~220 | 50~200 | 50~140 | 50~120 |
| 1.2 | 80~350 | 80~300 | 50~160 | 50~140 |

Solid wire

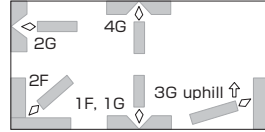
- Features:**
- Higher currents can be applied in vertical and overhead positions
 - Suitable for pipe welding in all positions

Classification: AWS A5.18 ER70S-6

Shielding gas: CO₂, Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | Drum | |
|------------------|------------------|-------------|-------------|
| | | | |
| 0.9 | 20kg | - | - |
| 1.0 | 20kg | 250kg | - |
| 1.2 | 20kg | - | 300kg |
| Volume mm | 300W, 110H, 300L | 530 φ, 820H | 680 φ, 770H |

Composition (wire mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.10 | 0.06~0.15 |
| Si | 0.88 | 0.80~1.15 |
| Mn | 1.56 | 1.40~1.85 |
| P | 0.011 | 0.025 |
| S | 0.012 | 0.035 |
| Ni | 0.01 | 0.15 |
| Cr | 0.02 | 0.15 |
| Mo | <0.01 | 0.15 |
| Cu | 0.24 | 0.50 |
| V | <0.01 | 0.03 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|----------------------|-----------------|-----------------------|-----------------|
| | | | |
| 0.2%YS (MPa) | 470 | 520 | 400min. |
| TS (MPa) | 560 | 600 | 483min. |
| EI on 4d. (%) | 32 | 31 | 22min. |
| IV -29°C (J) | 70 | 90 | 27min. |
| SG | CO ₂ | Ar-20%CO ₂ | CO ₂ |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|--------|-----------|--------|
| 0.9 | 50~200 | 50~180 | 50~140 | 50~120 |
| 1.0 | 50~220 | 50~200 | 50~140 | 50~120 |
| 1.2 | 80~350 | 80~300 | 50~160 | 50~140 |

Solid wire**Features:** ▪ Higher currents are recommended**Classification:** AWS A5.18 ER70S-G**Shielding gas:** CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| φ mm | Spool | | | Drum | | |
|------------------|------------------|------------------|------|-------------|-------------|-------|
| | | | | | | |
| 1.0 | - | - | 20kg | - | - | - |
| 1.2 | 10kg | 15kg | 20kg | - | 300kg | - |
| 1.4 | - | 15kg | 20kg | 250kg | - | 400kg |
| 1.6 | - | - | 20kg | - | - | 400kg |
| Volume mm | 240W, 110H, 240L | 300W, 110H, 300L | | 530 φ, 820H | 680 φ, 770H | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.04 | 0.02~0.15 |
| Si | 0.73 | 0.55~1.10 |
| Mn | 1.58 | 1.40~1.90 |
| P | 0.010 | 0.030 |
| S | 0.010 | 0.030 |
| Cu | 0.23 | 0.50 |
| Ti+Zr | 0.22 | 0.02~0.30 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 1.0 | 50~220 | 50~200 |
| 1.2 | 100~350 | 100~300 |
| 1.4 | 150~450 | 150~350 |
| 1.6 | 200~550 | 200~400 |

Note: ^aSingle values are maximum.**All-weld mechanical properties**

| | Typical | | Guaranty |
|---------------------|---------|-------|-------------|
| | | | |
| 0.2%YS (MPa) | 490 | 420 | 400min. |
| TS (MPa) | 570 | 530 | 483min. |
| El on 4d (%) | 30 | 34 | 22min. |
| IV -18°C (J) | 100 | 110 | 0°C: 47min. |
| PWHT (°Cxh) | AW | 625x1 | AW |

Approvals

| | |
|------------|-------------|
| ABS | 3SA, 3YSA |
| LR | 3YS, H15 |
| DNV | ⅢYMS |
| BV | SA3M, SA3YM |
| NK | KSW53G (C) |
| CR | 3YS |
| GL | 3YS |
| KR | 3YSG (C) |
| CCS | 3Y |

Solid wire

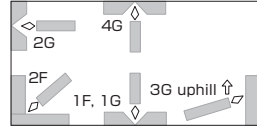
Features: - Suitable for butt and fillet welding in all positions

Welding Positions:

Classification: AWS A5.18 ER70S-G

Shielding gas: Ar-5~20%CO₂, Ar-2~5%O₂

Polarity: DCEP



Packaging data

| φ mm | Spool | | Drum | | |
|------------------|------------------|------------------|-------------|-------|-------------|
| | kg | kg | kg | kg | kg |
| 0.8 | 10kg | - | - | - | - |
| 0.9 | 10kg | 20kg | - | - | - |
| 1.0 | 10kg | 20kg | 100kg | - | - |
| 1.2 | 10kg | 20kg | - | 250kg | - |
| 1.4 | - | 20kg | - | - | - |
| 1.6 | 10kg | 20kg | - | - | 400kg |
| Volume mm | 240W, 110H, 240L | 300W, 110H, 300L | 530 φ, 820H | | 680 φ, 770H |

Composition (wire mass%)

| | Typical (Ar-20%CO ₂) | Guaranty ^a |
|-----------|----------------------------------|-----------------------|
| C | 0.10 | 0.02~0.15 |
| Si | 0.75 | 0.40~1.00 |
| Mn | 1.38 | 0.90~1.60 |
| P | 0.011 | 0.030 |
| S | 0.012 | 0.030 |
| Cu | 0.24 | 0.50 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|---------|-----------|--------|
| 0.8 | 50~180 | 50~180 | 50~140 | 50~120 |
| 0.9 | 50~200 | 50~180 | 50~140 | 50~120 |
| 1.0 | 50~220 | 50~200 | 50~140 | 50~120 |
| 1.2 | 80~300 | 80~300 | 50~160 | 50~140 |
| 1.4 | 150~400 | 150~350 | - | - |
| 1.6 | 200~450 | 200~400 | - | - |

All-weld mechanical properties

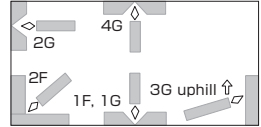
| | Typical | | Typical | | Guaranty |
|---------------------|-----------------------|-------|---------------------|-------|--|
| | MPa | MPa | MPa | MPa | |
| 0.2%YS (MPa) | 450 | 370 | 490 | 400 | 400min. |
| TS (MPa) | 570 | 520 | 590 | 540 | 483min. |
| EI on 4d (%) | 28 | 32 | 33 | 33 | 22min. |
| IV -29°C (J) | 180 | 190 | 180 | 200 | 27min. |
| PWHT (°Cxh) | AW | 620x1 | AW | 620x1 | AW |
| SG | Ar-20%CO ₂ | | Ar-2%O ₂ | | Ar-20%CO ₂ & Ar-2%O ₂ |

Solid wire

Features:

- Suitable for butt and fillet welding in all positions
- Suitable for higher currents

Welding Positions:



Classification: AWS A5.18 ER70S-G

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Packaging data

| φ mm | Spool | Drum | | |
|------------------|------------------|-------------|-------------|-------|
| 0.9 | 20kg | - | - | - |
| 1.0 | - | 250kg | - | - |
| 1.2 | 20kg | 250kg | 300kg | - |
| 1.4 | 20kg | 250kg | - | - |
| 1.6 | 20kg | - | - | 400kg |
| Volume mm | 300W, 110H, 300L | 530 φ, 820H | 680 φ, 770H | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.06 | 0.02~0.15 |
| Si | 0.57 | 0.40~1.00 |
| Mn | 1.17 | 1.00~1.60 |
| P | 0.009 | 0.030 |
| S | 0.011 | 0.030 |
| Cu | 0.24 | 0.50 |
| Ti+Zr | 0.07 | 0.02~0.15 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 470 | 400min. |
| TS (MPa) | 550 | 483min |
| El on 4d (%) | 32 | 22min. |
| IV -18°C (J) | 170 | 27min. |
| PWHT | AW | AW |

Approvals

| | |
|------------|-------------|
| ABS | 3SA, 3YSA |
| LR | 3YS (H15) |
| DNV | IIIYMS |
| BV | SA3YM |
| NK | KSW53G (M2) |
| GL | 3YS |

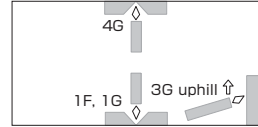
Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|---------|-----------|--------|
| 0.9 | 50~200 | 50~180 | 50~140 | 50~120 |
| 1.0 | 50~220 | 50~200 | 50~140 | 50~120 |
| 1.2 | 80~350 | 80~300 | 50~160 | 50~140 |
| 1.4 | 150~400 | 150~350 | - | - |
| 1.6 | 200~450 | 200~400 | - | - |

Solid wire

- Features:**
- Smooth wire feeding, Smooth arc start and stable arc with little spatter generation
 - The special surface treatment that eliminates the need for Cu coating

Welding Positions:



Classification: AWS A5.18 ER70S-G

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Packaging data

| φ mm | Spool | | Drum | | | |
|------------------|------------------|------------------|-------------|-------|-------------|-------|
| | 10kg | 20kg | - | 250kg | - | - |
| 0.9 | 10kg | 20kg | - | 250kg | - | - |
| 1.0 | 10kg | 20kg | - | 250kg | - | - |
| 1.2 | 10kg | 20kg | 100kg | - | 300kg | 400kg |
| Volume mm | 240W, 110H, 240L | 300W, 110H, 300L | 530 φ, 820H | | 680 φ, 770H | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.02~0.15 |
| Si | 0.89 | 0.40~1.00 |
| Mn | 1.40 | 0.90~1.60 |
| P | 0.010 | 0.030 |
| S | 0.015 | 0.030 |
| Cu | 0.01 | 0.50 |
| Ni | 0.01 | 0.15 |
| Cr | 0.02 | 0.15 |
| Mo | <0.01 | 0.15 |
| V | <0.01 | 0.03 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G | 3G uphill, 4G |
|------|--------|---------------|
| 0.9 | 50~220 | 50~150 |
| 1.0 | 50~250 | 50~160 |
| 1.2 | 80~300 | 50~180 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 460 | 400min. |
| TS (MPa) | 559 | 490min. |
| EI on 4d (%) | 30 | 22min. |
| IV -20°C (J) | 120 | 27min. |

Approvals

| | |
|-----------|-------------|
| NK | KSW53G (M2) |
|-----------|-------------|

Solid wire

Features:

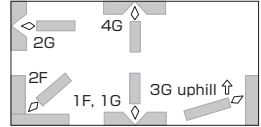
- Suitable for butt and fillet welding in all positions
- Suitable for lower currents

Welding Positions:

Classification: AWS -

Shielding gas: CO₂

Polarity: DCEP

**Packaging data**

| φ mm | Spool | | Drum | | | |
|------------------|------------------|------------------|-------------|-------|-------------|---|
| | 10kg | 20kg | - | 250kg | - | - |
| 0.9 | 10kg | 20kg | - | 250kg | - | - |
| 1.0 | 10kg | 20kg | - | 250kg | - | - |
| 1.2 | 10kg | 20kg | - | - | 300kg | - |
| Volume mm | 240W, 110H, 240L | 300W, 110H, 300L | 530 φ, 820H | | 680 φ, 770H | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.02~0.15 |
| Si | 0.75 | 0.50~1.00 |
| Mn | 1.34 | 1.25~2.00 |
| P | 0.010 | 0.030 |
| S | 0.013 | 0.030 |
| Cu | 0.24 | 0.50 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|--------|-----------|--------|
| 0.9 | 50~200 | 50~180 | 50~140 | 50~120 |
| 1.0 | 50~220 | 50~200 | 50~140 | 50~120 |
| 1.2 | 80~350 | 80~300 | 50~160 | 50~140 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|-------------|
| | 460 | 360 | 390min. |
| 0.2%YS (MPa) | 460 | 360 | 390min. |
| TS (MPa) | 540 | 490 | 490~600 |
| EI on 4d (%) | 31 | 34 | 18min. (5d) |
| IV -18°C (J) | 100 | 110 | 0°C: 27min. |
| PWHT (°C×h) | AW | 625x2 | AW |

Approvals

| | |
|------------|-------------|
| ABS | 3SA, 3YSA |
| LR | 3YS (H15) |
| DNV | ⅢYMS |
| BV | SA3M, SA3YM |
| NK | KSW53G (C) |
| CR | 3YS |
| KR | 3YSG (C) |

Solid wire

Features: ▪ Pulsed MAG with MIX-1TS offers better bead appearance on a galvanized steel plate

Classification: AWS -

Shielding gas: Ar-20%CO₂

Polarity: DCEP (Pulse MAG)

Packaging data

| φ mm | Spool | Drum |
|-----------|------------------|-------------|
| 1.2 | 20kg | 300kg |
| Volume mm | 300W, 110H, 300L | 680 φ, 770H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.02~0.15 |
| Si | 0.77 | 0.40~1.00 |
| Mn | 1.24 | 0.90~1.60 |
| P | 0.011 | 0.030 |
| S | 0.004 | 0.030 |
| Cu | 0.24 | 0.50 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | Pulse MAG |
|------|-----------|
| 1.2 | 100~280 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 440 | 390min. |
| TS (MPa) | 540 | 490~670 |
| EI on 4d (%) | 30 | 18min. |
| IV -20°C (J) | 150 | 27min. |

TIG welding rod and wire

Features: ▪ Suitable for root pass welding of pipes
Classification: AWS A5.18 ER70S-2
Shielding Gas: Ar
Identification color: 1st Blue white, 2nd -
Polarity: DCEN

Packaging data

| φ mm | Spool | | Tube | | |
|------------------|------------------|------------------|-----------------|-----------|---------|
| | kg | | kg | Length mm | g/piece |
| 0.9 | 10 | - | - | - | - |
| 1.0 | 10 | - | - | - | - |
| 1.2 | - | - | 5 | 1,000 | 9 |
| 1.6 | - | 20 | 5 | 1,000 | 16 |
| 2.0 | - | - | 5 | 1,000 | 25 |
| 2.4 | - | - | 5 | 1,000 | 35 |
| 3.2 | - | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.07 |
| Si | 0.54 | 0.40~0.70 |
| Mn | 1.25 | 0.90~1.40 |
| P | 0.007 | 0.025 |
| S | 0.014 | 0.035 |
| Ni | 0.04 | 0.15 |
| Cr | 0.05 | 0.15 |
| Mo | 0.01 | 0.15 |
| Cu | 0.16 | 0.50 |
| V | <0.01 | 0.03 |
| Al | 0.07 | 0.05~0.15 |
| Ti | 0.08 | 0.05~0.15 |
| Zr | 0.05 | 0.02~0.12 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------------------|-------|----------|
| | 0.2%YS (MPa) | 560 | 520 |
| TS (MPa) | 620 | 600 | 483min. |
| El on 4d (%) | 28 | 30 | 22min. |
| IV -29°C (J) | 200 | 160 | 27min. |
| PWHT (°C×h) | AW | 625x8 | AW |

TIG welding rod and wire

| | |
|------------------------------|---|
| Features: | ▪ Its tensile strength after long time PWHT is high enough for 490MPa |
| Classification: | AWS A5.18 ER70S-6 |
| Shielding Gas: | Ar |
| Identification color: | 1st Black |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 0.8 | 10 | - | - | - |
| 1.0 | 10 | - | - | - |
| 1.2 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| 3.2 | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | | 40W, 35H, 1015L | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.06~0.15 |
| Si | 0.86 | 0.80~1.15 |
| Mn | 1.56 | 1.40~1.85 |
| P | 0.012 | 0.025 |
| S | 0.012 | 0.035 |
| Ni | 0.01 | 0.15 |
| Cr | 0.02 | 0.15 |
| Mo | <0.01 | 0.15 |
| Cu | 0.24 | 0.50 |
| V | <0.01 | 0.03 |
| Al | <0.01 | - |
| Ti | <0.01 | - |
| Zr | <0.01 | - |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|--------|----------|
| | 510 | 420 | |
| 0.2%YS (MPa) | 510 | 420 | 400min. |
| TS (MPa) | 610 | 550 | 483min. |
| EI on 4d (%) | 32 | 35 | 22min. |
| IV -29°C (J) | 210 | 160 | 27min. |
| PWHT (°C×h) | AW | 625x24 | AW |

Approvals

| | |
|------------|---------|
| TÜV | DIN8559 |
|------------|---------|

TIG welding rod and wire

Features:

- Good impact value at low temperatures
- Most widely used in Japan

Classification: AWS A5.18 ER70S-G

Shielding Gas: Ar

Identification color: 1st Yellow

Polarity: DCEN

Packaging data

| φ mm | Spool | | Tube | | |
|------------------|------------------|------------------|-----------------|-----------|---------|
| | kg | | kg | Length mm | g/piece |
| 0.8 | 10 | - | - | - | - |
| 1.0 | 10 | - | - | - | - |
| 1.2 | 10 | 20 | 5 | 1,000 | 9 |
| 1.6 | 10 | - | 5 | 1,000 | 16 |
| 2.0 | - | - | 5 | 1,000 | 25 |
| 2.4 | - | - | 5 | 1,000 | 35 |
| 3.2 | - | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.02~0.12 |
| Si | 0.74 | 0.40~0.95 |
| Mn | 1.40 | 1.00~1.50 |
| P | 0.011 | 0.025 |
| S | 0.012 | 0.025 |
| Cu | 0.24 | 0.50 |
| Al | <0.01 | 0.15 |
| Ti | <0.01 | 0.15 |
| Zr | <0.01 | 0.12 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|----------|
| 0.2%YS (MPa) | 480 | 380 | 400min. |
| TS (MPa) | 580 | 500 | 483min. |
| EI on 4d (%) | 33 | 36 | 22min. |
| IV -29°C (J) | 180 | 230 | 27min. |
| PWHT (°C×h) | AW | 625×8 | AW |

Approvals

| | |
|------------|------------|
| ABS | 3**, 3Y** |
| LR | 3Ym (H15) |
| DNV | III YM |
| BV | SA3YM |
| NK | KSW53G (I) |
| CCS | 3, 3YSM |

SAW flux and wire combination

Features:

- Suitable for fillet welding
- Excellent bead appearance and slag removal

Classification: AWS A5.17 F7A0-EH14

Type of flux: Fused

Redrying Conditions: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | | | | | |
|------------------|------|------------------|------------------|-----------------|------------------|------------------|------------|
| MF-53 | 8x48 | 25kg | | | | | |
| Volume mm | | 240W, 350H, 240L | | | | | |
| Wire | φ mm | Spool | | Coil | | | Drum |
| US-36 | 1.6 | 10kg | 20kg | - | - | - | - |
| | 2.0 | 10kg | 20kg | - | - | - | - |
| | 2.4 | 10kg | - | 25kg | 76kg | - | 300kg |
| | 3.2 | - | - | 25kg | 76kg | - | 300kg |
| | 4.0 | - | - | 25kg | 75kg | 150kg | 300kg |
| | 4.8 | - | - | 25kg | 75kg | 150kg | - |
| 6.4 | - | - | 25kg | 78kg | 159kg | - | |
| Volume mm | | 240W, 110H, 240L | 300W, 110H, 300L | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L | 680φ, 770H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.10~0.20 |
| Si | 0.03 | 0.10 |
| Mn | 1.95 | 1.70~2.20 |
| P | 0.013 | 0.030 |
| S | 0.005 | 0.030 |
| Cu | 0.11 | 0.35 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 430 | 400min. |
| TS (MPa) | 510 | 483~655 |
| El on 4d (%) | 29 | 22min. |
| IV -18°C (J) | 40 | 27min. |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.05 |
| Si | 0.67 |
| Mn | 1.61 |
| P | 0.016 |
| S | 0.009 |

SAW flux and wire combination

Features:

- Suitable for welding of thin plates at high speeds
- DCEP is better for sheet metal of 4mm or thinner

Classification: AWS A5.17 F7A2-EH14

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | | | | | |
|------------------|------|------------------|------------------|-----------------|------------------|------------------|-------------|
| G-50 | 8x48 | 25kg | | | | | |
| Volume mm | | 240W, 350H, 240L | | | | | |
| Wire | φ mm | Spool | | Coil | | | Drum |
| US-36 | 1.6 | 10kg | 20kg | - | - | - | - |
| | 2.0 | 10kg | 20kg | - | - | - | - |
| | 2.4 | 10kg | - | 25kg | 76kg | - | 300kg |
| | 3.2 | - | - | 25kg | 76kg | - | 300kg |
| | 4.0 | - | - | 25kg | 75kg | 150kg | 300kg |
| | 4.8 | - | - | 25kg | 75kg | 150kg | - |
| | 6.4 | - | - | 25kg | 78kg | 159kg | - |
| Volume mm | | 240W, 110H, 240L | 300W, 110H, 300L | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L | 680 φ, 770H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.10~0.20 |
| Si | 0.03 | 0.10 |
| Mn | 1.95 | 1.70~2.20 |
| P | 0.013 | 0.030 |
| S | 0.005 | 0.030 |
| Cu | 0.11 | 0.35 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 440 | 400min. |
| TS (MPa) | 540 | 483~655 |
| El on 4d (%) | 29 | 22min. |
| IV -29°C (J) | 40 | 27min. |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.06 |
| Si | 0.44 |
| Mn | 1.83 |
| P | 0.012 |
| S | 0.004 |

SAW flux and wire combination

Features: ▪ Suitable for welding of thin or medium plate at high speeds

Classification: AWS A5.17 F7A2-EH14

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | | | | | |
|-----------|--------|------------------|------------------|-----------------|------------------|------------------|------------|
| G-60 | 12x65 | 25kg | | | | | |
| | 12x150 | 25kg | | | | | |
| Volume mm | | 240W, 350H, 240L | | | | | |
| Wire | φ mm | Spool | | Coil | | | Drum |
| US-36 | 1.6 | 10kg | 20kg | - | - | - | - |
| | 2.0 | 10kg | 20kg | - | - | - | - |
| | 2.4 | 10kg | - | 25kg | 76kg | - | 300kg |
| | 3.2 | - | - | 25kg | 76kg | - | 300kg |
| | 4.0 | - | - | 25kg | 75kg | 150kg | 300kg |
| | 4.8 | - | - | 25kg | 75kg | 150kg | - |
| | 6.4 | - | - | 25kg | 78kg | 159kg | - |
| Volume mm | | 240W, 110H, 240L | 300W, 110H, 300L | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L | 680φ, 770H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|----|---------|-----------------------|
| C | 0.12 | 0.10~0.20 |
| Si | 0.03 | 0.10 |
| Mn | 1.95 | 1.70~2.20 |
| P | 0.013 | 0.030 |
| S | 0.005 | 0.030 |
| Cu | 0.11 | 0.35 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|--------------|---------|----------|
| 0.2%YS (MPa) | 460 | 400min. |
| TS (MPa) | 560 | 483~655 |
| El on 4d (%) | 27 | 22min. |
| IV -29°C (J) | 40 | 27min. |

Composition (weld metal mass%)

| | Typical |
|----|---------|
| C | 0.07 |
| Si | 0.34 |
| Mn | 1.70 |
| P | 0.017 |
| S | 0.004 |

Approvals

| | Single electrode |
|-----|------------------|
| ABS | 1T |
| LR | 1T |
| DNV | I T |
| BV | A1T |
| NK | KAW1TM |
| CR | 1TM |

G-80/US-36**SAW flux and wire combination**

Features:

- Suitable for welding of medium or heavy thick plate
- Good Mechanical properties in multi-pass welding

Classification: AWS A5.17 F7A2-EH14, F6P2-EH14

Type of flux: Fused

Redrying Conditions: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | | | | | |
|------------------|--------|------------------|------------------|-----------------|------------------|------------------|--------------|
| G-80 | 12x65 | 25kg | | | | | |
| | 12x200 | 25kg | | | | | |
| | 20x200 | 25kg | | | | | |
| | 32x200 | 25kg | | | | | |
| | 20xD | 25kg | | | | | |
| Volume mm | | 240W, 350H, 240L | | | | | |
| Wire | φ mm | Spool | | Coil | | | Drum |
| US-36 | 1.6 | 10kg | 20kg | - | - | - | - |
| | 2.0 | 10kg | 20kg | - | - | - | - |
| | 2.4 | 10kg | - | 25kg | 76kg | - | 300kg |
| | 3.2 | - | - | 25kg | 76kg | - | 300kg |
| | 4.0 | - | - | 25kg | 75kg | 150kg | 300kg |
| | 4.8 | - | - | 25kg | 75kg | 150kg | - |
| | 6.4 | - | - | 25kg | 78kg | 159kg | - |
| Volume mm | | 240W, 110H, 240L | 300W, 110H, 300L | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L | 680 φ , 770H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.10~0.20 |
| Si | 0.03 | 0.10 |
| Mn | 1.95 | 1.70~2.20 |
| P | 0.013 | 0.030 |
| S | 0.005 | 0.030 |
| Cu | 0.11 | 0.35 |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | | Guaranty | |
|---------------------|---------|-------|----------|----------|
| 0.2%YS (MPa) | 410 | 360 | 400min. | 330min. |
| TS (MPa) | 520 | 500 | 483~655 | 410~550 |
| El on 4d (%) | 29 | 35 | 22min. | 22min. |
| IV -29°C (J) | 43 | 82 | 27min. | 27min. |
| PWHT (°C×h) | AW | 620x1 | AW | 620±15x1 |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.09 |
| Si | 0.46 |
| Mn | 1.41 |
| P | 0.018 |
| S | 0.011 |

Approvals

| LR | 2M |
|----|----|
| | |

SAW flux and wire combination

| | |
|-----------------------------|---|
| Features: | <ul style="list-style-type: none"> ▪ Suitable for single-pass-on-both-sides or multi-layer butt welding ▪ Good bead appearance and excellent impact value |
| Classification: | AWS A5.17 F7A4-EH14 |
| Type of flux: | Bonded |
| Redrying Conditions: | 200~300°Cx1h |
| Polarity: | AC |

Packaging data

| Flux | Mesh | Can | | | | | | |
|-----------|-------|------------------|------------------|-----------------|------------------|------------------|------------|------|
| PF-H55E | 10x48 | 25kg | | | | | | |
| Volume mm | | 240W, 350H, 240L | | | | | | |
| Wire | φ mm | Spool | | | Coil | | | Drum |
| US-36 | 1.6 | 10kg | 20kg | - | - | - | - | |
| | 2.0 | 10kg | 20kg | - | - | - | - | |
| | 2.4 | 10kg | - | 25kg | 76kg | - | 300kg | |
| | 3.2 | - | - | 25kg | 76kg | - | 300kg | |
| | 4.0 | - | - | 25kg | 75kg | 150kg | 300kg | |
| | 4.8 | - | - | 25kg | 75kg | 150kg | - | |
| | 6.4 | - | - | 25kg | 78kg | 159kg | - | |
| Volume mm | | 240W, 110H, 240L | 300W, 110H, 300L | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L | 680φ, 770H | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.10~0.20 |
| Si | 0.03 | 0.10 |
| Mn | 1.95 | 1.70~2.20 |
| P | 0.013 | 0.030 |
| S | 0.005 | 0.030 |
| Cu | 0.11 | 0.35 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 460 | 400min. |
| TS (MPa) | 530 | 483~655 |
| El on 4d (%) | 32 | 22min. |
| IV -40°C (J) | 118 | 27min. |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.09 |
| Si | 0.21 |
| Mn | 1.23 |
| P | 0.015 |
| S | 0.007 |

Approvals

| | Single electrode |
|------------|-------------------|
| ABS | 3TM, 3YTM, 3Y40TM |
| LR | 3T, 3YM, 3YT |
| DNV | III YTM |
| BV | A3YTM |
| NK | KAW53Y40TM |
| CR | 3M, 3YTM |

MF-38/US-36**SAW flux and wire combination**

Features:

- Suitable for welding of medium or heavy thick plate
- Excellent mechanical properties

Classification: AWS A5.17 F7A6-EH14, F7P6-EH14

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | | | | | |
|------------------|--------|------------------|------------------|-----------------|------------------|------------------|-------------|
| MF-38 | 12x65 | 25kg | | | | | |
| | 20x200 | 25kg | | | | | |
| | 20xD | 25kg | | | | | |
| Volume mm | | 240W, 350H, 240L | | | | | |
| Wire | φ mm | Spool | | Coil | | | Drum |
| US-36 | 1.6 | 10kg | 20kg | - | - | - | - |
| | 2.0 | 10kg | 20kg | - | - | - | - |
| | 2.4 | 10kg | - | 25kg | 76kg | - | 300kg |
| | 3.2 | - | - | 25kg | 76kg | - | 300kg |
| | 4.0 | - | - | 25kg | 75kg | 150kg | 300kg |
| | 4.8 | - | - | 25kg | 75kg | 150kg | - |
| | 6.4 | - | - | 25kg | 78kg | 159kg | - |
| Volume mm | | 240W, 110H, 240L | 300W, 110H, 300L | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L | 680 φ, 770H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.10~0.20 |
| Si | 0.03 | 0.10 |
| Mn | 1.95 | 1.70~2.20 |
| P | 0.013 | 0.030 |
| S | 0.005 | 0.030 |
| Cu | 0.11 | 0.35 |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | | Guaranty | |
|---------------------|---------|-------|----------|----------|
| 0.2%YS (MPa) | 490 | 420 | 400min. | 400min. |
| TS (MPa) | 570 | 530 | 483~655 | 483~655 |
| EI on 4d (%) | 30 | 31 | 22min. | 22min. |
| IV -51°C (J) | 59 | 64 | 27min. | 27min. |
| PWHT (°C/h) | AW | 620x1 | AW | 620±15x1 |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.09 |
| Si | 0.32 |
| Mn | 1.63 |
| P | 0.018 |
| S | 0.011 |

Approvals

| | Single electrode | | |
|------------|------------------|-----------|----------|
| ABS | 2T, 2YT, 3M, 3YM | CR | 2YT, 3YM |
| LR | 2T, 2YT, 3YM | GL | 2YT, 3YM |
| DNV | II YT, III YM | KR | 2YT, 3YM |
| BV | A2, 2YT, A3, 3YM | | |
| NK | KAW52T, KAW53M | | |

SAW flux and wire combination

- Features:**
- Suitable for welding of medium or heavy thick plate
 - Excellent slag removal and good mechanical properties

Classification: AWS A5.17 F7A6-EH14, F7P6-EH14

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can |
|--------|--------|------|
| MF-300 | 20x200 | 25kg |
| | 20xD | 25kg |

Volume mm 240W, 350H, 240L

| Wire | φ mm | Spool | | Coil | | | Drum |
|------------------|------|------------------|------------------|-----------------|------------------|------------------|------------|
| US-36 | 1.6 | 10kg | 20kg | - | - | - | - |
| | 2.0 | 10kg | 20kg | - | - | - | - |
| | 2.4 | 10kg | - | 25kg | 76kg | - | 300kg |
| | 3.2 | - | - | 25kg | 76kg | - | 300kg |
| | 4.0 | - | - | 25kg | 75kg | 150kg | 300kg |
| | 4.8 | - | - | 25kg | 75kg | 150kg | - |
| | 6.4 | - | - | 25kg | 78kg | 159kg | - |
| Volume mm | | 240W, 110H, 240L | 300W, 110H, 300L | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L | 680φ, 770H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.10~0.20 |
| Si | 0.03 | 0.10 |
| Mn | 1.95 | 1.70~2.20 |
| P | 0.013 | 0.030 |
| S | 0.005 | 0.030 |
| Cu | 0.11 | 0.35 |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | | Guaranty | |
|---------------------|---------|-------|----------|----------|
| 0.2%YS (MPa) | 470 | 410 | 400min. | 400min. |
| TS (MPa) | 570 | 520 | 483~655 | 483~655 |
| EI on 4d (%) | 30 | 31 | 22min. | 22min. |
| IV -51°C (J) | 90 | 82 | 27min. | 27min. |
| PWHT (°Cxh) | AW | 620x1 | AW | 620±15x1 |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.09 |
| Si | 0.23 |
| Mn | 1.62 |
| P | 0.014 |
| S | 0.007 |

For Weather Proof Steel

Welding Consumables for

SMAW

FCAW

GMAW

SAW

SMAW, FCAW, GMAW, SAW

A guide for selecting welding consumables

Table 1 shows suitable welding consumables for shielded metal arc welding (SMAW), flux cored arc welding (FCAW), gas metal arc welding (GMAW), and submerged arc welding (SAW) of weather proof steels.

Table 1 Welding consumables for weather proof steel

| | ASTM | ASTM |
|-------------|---|----------------------------------|
| Steel grade | A709 Gr.36 | A588 A709 Gr.50W A242 |
| SMAW | LB-W52B | LB-W588 LB-W62G |
| FCAW | DW-50W | DW-588 |
| GMAW | MG-W50TB | - |
| SAW | MF-38/US-W52B MF-53/US-W52B (2F) | - |

Note: 2F designate suitable welding position.

Tips for better welding results

In addition to the tips for mild steel and 490MPa high tensile strength steel, the following notes should be taken into consideration in welding weather proof steels.

- (1) Remove rust and dirt from welding grooves to prevent pits and blowholes in the weld metal.
- (2) Use an appropriate welding procedure taking into account the requirements for the mechanical properties of the weldment, because heat input, interpass temperature and plate thickness affect the cooling rate of welds and, where the cooling rate is excessively low, the tensile strength and notch toughness of the weld decrease.
- (3) Use appropriate preheating according to the type of base metal and the thickness of the work to prevent cold cracking in the weld. Table 2 shows the minimum preheat temperatures used in general applications.

Table 2 Minimum preheat temperatures (°C) for general uses

| Steel grade (See Table 1) | Welding process | Plate thickness (mm) | | |
|------------------------------|-----------------|----------------------|---------------------|---------------------|
| | | 25 max | Over 25 Up to 38 | Over 38 Up to 50 |
| A709 Gr.36 | SMAW | - | 50 | 100 |
| | FCAW, GMAW, SAW | - | - | 50 |
| A588 A709 Gr.50W A242 | SMAW | 50 | 100 | 100 |
| | FCAW, GMAW, SAW | - | - | 50 |

- (4) For welding a high-phosphorous weather proof steel (e.g., A242), use lower welding currents and slower welding speeds to prevent hot cracking.

Stick electrode

Features: ▪ Suitable for weather proof steel

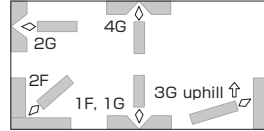
Classification: AWS A5.5 E7016-G

Redrying Conditions: 300~350°Cx0.5~1h

Identification color: 1st Blue, 2nd Pink

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 30 | 170W, 110H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 105H, 430L |
| 5.0 | 450 | 5 | 20 | 95 | 170W, 110H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.53 | 0.90 |
| Mn | 0.86 | 0.30~1.40 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.30 | 0.25~0.70 |
| Cr | 0.04 | 0.30 |
| Cu | 0.33 | 0.20~0.60 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 80~130 | 80~115 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | 150~210 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 490 | 393min. |
| TS (MPa) | 550 | 483min. |
| EI on 4d (%) | 31 | 22min. |
| IV -29°C (J) | 130 | - |

Stick electrode

Features: - Suitable for weather proof steel

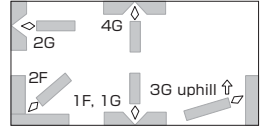
Classification: AWS A5.5 E7016-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Green, 2nd Red

Polarity: AC, DCEP

Welding Positions:



Packaging data

| ϕ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|-----------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 32 | 170W, 110H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 105H, 430L |
| 5.0 | 450 | 5 | 20 | 96 | 170W, 110H 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.59 | 0.90 |
| Mn | 0.65 | 0.30~1.40 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.22 | 0.05~0.45 |
| Cr | 0.61 | 0.45~0.75 |
| Cu | 0.32 | 0.30~0.70 |

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|-----------|----------------|---------------|
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | 150~210 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 480 | 393min. |
| TS (MPa) | 570 | 483min. |
| El on 4d (%) | 29 | 22min. |
| IV -29°C (J) | 140 | - |

DW-588

FAMILIARC™

Flux cored wire

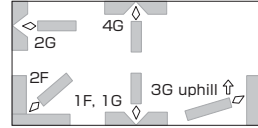
Features: - Applicable for A588 steel

Classification: AWS A5.29 E81T1-W2C

Shielding gas: CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| ϕ mm | Spool | | |
|------------------|------------------|------|------|
| 1.2 | 12.5kg | 15kg | 20kg |
| Volume mm | 300W, 110H, 300L | | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.03 | 0.12 |
| Si | 0.62 | 0.35~0.80 |
| Mn | 1.23 | 0.50~1.30 |
| P | 0.010 | 0.030 |
| S | 0.010 | 0.030 |
| Ni | 0.45 | 0.40~0.80 |
| Cr | 0.49 | 0.45~0.70 |
| Cu | 0.34 | 0.30~0.75 |

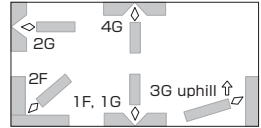
Welding parameters (A)

| ϕ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|-----------|----------------|---------------|
| 1.2 | 120~280 | 120~260 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 550 | 469min. |
| TS (MPa) | 620 | 552~689 |
| EI on 4d (%) | 27 | 19min. |
| IV -29°C (J) | 60 | 27min. |

Flux cored wire**Features:** ▪ Applicable for weather proof steel**Classification:** AWS -**Shielding gas:** CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| φ mm | Spool | | | Drum |
|------------------|------------------|--------|------|-------------|
| | 1.2 | 12.5kg | 15kg | |
| Volume mm | 300W, 110H, 300L | | | 530 φ, 820H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.12 |
| Si | 0.49 | 0.90 |
| Mn | 1.12 | 0.50~1.60 |
| P | 0.010 | 0.030 |
| S | 0.008 | 0.030 |
| Ni | 0.33 | 0.10~0.45 |
| Cr | 0.48 | 0.45~0.75 |
| Cu | 0.39 | 0.30~0.75 |

Note: ^a Single values are maximum.**Welding parameters (A)**

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 1.2 | 120~280 | 120~260 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 510 | 400min. |
| TS (MPa) | 590 | 490~670 |
| EI on 4d (%) | 27 | 20min. |
| IV 0°C (J) | 140 | 47min. |

Solid wire

Features:

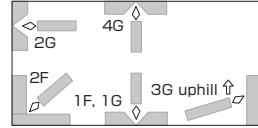
- Applicable for weatherproof steel
- Lower currents are suitable

Classification: AWS A5.28 ER80S-G

Shielding gas: CO₂, Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|------------------|------------------|------------------|
| 0.9 | - | 20kg |
| 1.0 | 10kg | - |
| 1.2 | 10kg | 20kg |
| Volume mm | 240W, 110H, 240L | 300W, 110H, 300L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.03 | 0.12 |
| Si | 0.77 | 0.50~0.90 |
| Mn | 1.35 | 1.00~1.80 |
| P | 0.008 | 0.030 |
| S | 0.013 | 0.030 |
| Ni | 0.18 | 0.10~0.80 |
| Cr | 0.61 | 0.50~0.80 |
| Cu | 0.45 | 0.30~0.60 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|--------|---------------|
| 0.9 | 50~200 | 50~180 | 50~120 |
| 1.0 | 50~220 | 50~200 | 50~120 |
| 1.2 | 80~320 | 80~300 | 50~140 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty | |
|---------------------|-----------------|-----------------------|-----------------|-----------------------|
| 0.2%YS (MPa) | 450 | 480 | 400min. | 400min. |
| TS (MPa) | 560 | 580 | 552min. | 552min. |
| EI on 4d (%) | 30 | 29 | 19min. | 19min. |
| IV (J) | 0°C: 110 | -18°C: 120 | 0°C: 47min. | -18°C: 47min. |
| SG | CO ₂ | Ar-20%CO ₂ | CO ₂ | Ar-20%CO ₂ |

MF-53/US-W52B**Flux and wire combination**

Features:

- Suitable for fillet welding
- Excellent bead appearance and good slag removal

Classification: AWS A5.23 F7A0-EG-G

Redrying Conditions: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | | | |
|-----------|------|------------------|------------------|-----------------|------------------|
| MF-53 | 8x48 | 20kg | | | |
| Volume mm | | 240W, 350H, 240L | | | |
| Wire | φ mm | Spool | | Coil | |
| US-W52B | 1.6 | 10kg | 20kg | - | - |
| | 2.0 | 10kg | 20kg | - | - |
| | 2.4 | 10kg | - | - | - |
| | 3.2 | - | - | 25kg | 76kg |
| | 4.0 | - | - | 25kg | 75kg |
| | 4.8 | - | - | 25kg | - |
| Volume mm | | 240W, 110H, 240L | 300W, 110H, 300L | 430W, 90H, 430L | 740W, 110H, 740L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.15 |
| Si | 0.03 | 0.10 |
| Mn | 1.51 | 1.20~1.80 |
| P | 0.010 | 0.025 |
| S | 0.004 | 0.025 |
| Ni | 0.14 | 0.10~0.25 |
| Cr | 0.62 | 0.50~0.80 |
| Cu | 0.36 | 0.30~0.55 |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.05 |
| Si | 0.58 |
| Mn | 1.35 |
| P | 0.009 |
| S | 0.007 |
| Ni | 0.18 |
| Cr | 0.59 |
| Cu | 0.36 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 430 | 400min. |
| TS (MPa) | 530 | 483~655 |
| El on 4d (%) | 23 | 22min. |
| IV -18°C (J) | 35 | 27min. |

MF-38/US-W52B**FAMILIARC™****Flux and wire combination**

Features:

- Suitable for butt and flat fillet welding
- Good impact value

Classification: AWS A5.23 F7A2-EG-G

Redrying Conditions: 150-350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | | | |
|------------------|--------|------------------|------------------|-----------------|------------------|
| MF-38 | 12x65 | 20kg | | | |
| | 20x200 | 20kg | | | |
| | 20xD | 20kg | | | |
| Volume mm | | 240W, 350H, 240L | | | |
| Wire | φ mm | Spool | | Coil | |
| US-W52B | 1.6 | 10kg | 20kg | - | - |
| | 2.0 | 10kg | 20kg | - | - |
| | 2.4 | 10kg | - | - | - |
| | 3.2 | - | - | 25kg | 76kg |
| | 4.0 | - | - | 25kg | 75kg |
| | 4.8 | - | - | 25kg | - |
| Volume mm | | 240W, 110H, 240L | 300W, 110H, 300L | 430W, 90H, 430L | 740W, 110H, 740L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.15 |
| Si | 0.03 | 0.10 |
| Mn | 1.51 | 1.20~1.80 |
| P | 0.010 | 0.025 |
| S | 0.004 | 0.025 |
| Ni | 0.14 | 0.10~0.25 |
| Cr | 0.62 | 0.50~0.80 |
| Cu | 0.36 | 0.30~0.55 |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.05 |
| Si | 0.32 |
| Mn | 1.48 |
| P | 0.017 |
| S | 0.005 |
| Ni | 0.14 |
| Cr | 0.51 |
| Cu | 0.35 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 490 | 400min. |
| TS (MPa) | 590 | 483~655 |
| EI on 4d (%) | 25 | 22min. |
| IV -29°C (J) | 76 | 27min. |

For High Tensile Strength Steel and Low Temperature Steel

Welding Consumables for

SMAW

FCAW

GMAW

GTAW

SAW

SMAW, FCAW, GMAW, GTAW, SAW

A guide for selecting welding consumables

| | | | |
|---------------|-----|-----|-----|
| TS (MPa) min. | 490 | 520 | 550 |
| YS (MPa) min. | 350 | 400 | 420 |
| IV (J) min. | 35 | 40 | 42 |

SMAW

| | | | |
|-------|---------------------------------|--------------------------------------|--|
| -20°C | LB-52 LB-52A | LB-57 | LB-62UL LB-62 |
| -40°C | LB-7018-1 (DCEP) | LB-52NS (AC) NB-1SJ | LB-55NS (DCEP) NB-1SJ (AC) LB-62L |
| -60°C | NB-1SJ LB-52NS | | |

FCAW, GMAW

| | | | |
|-------|--|--|---|
| -20°C | DW-100E (CO ₂) MG-S50 (Ar-20%CO ₂) | DW-55L (CO ₂) MG-T1NS (Ar-20%CO ₂) | |
| -30°C | DW-55E (CO ₂) DW-A55E (Ar-20%CO ₂) | | |
| -40°C | DW-A55ESR (do.) | | |
| -50°C | DW-50LSR (CO ₂) | DW-55LSR (CO ₂) | DW-A81Ni1 (Ar-20%CO ₂) |
| -60°C | DW-55L (CO ₂) DW-A55L (Ar-20%CO ₂) MG-S50LT (do.) MX-A55Ni1 (do.) | DW-A55L (Ar-20%CO ₂) DW-A55LSR (do.) MG-S50LT (do.) MX-A55Ni1 (do.) | DW-55LSR (CO ₂) DW-A55L (Ar-20%CO ₂) DW-A55LSR (do.) MX-A55Ni1 (do.) |

GTAW

| | | |
|-------|----------------|----------------|
| -20°C | TG-S50 | TG-S62 |
| -30°C | TG-S51T | |
| -40°C | TG-S1MT | TG-S60A |
| -60°C | TG-S1N | |

SAW

| | | | |
|-------|---|---|---|
| -20°C | MF-38/US-36 (AC) | MF-38/US-49A (AC) | |
| -40°C | PF-H55LT/US-36 (AC) PF-H55AS/US-36J (DCEP) | PF-H55S/US-49A (AC) | PF-H55S/US-49A (AC) PF-H80AK/US-56B (DCEP) |
| -60°C | | PF-H55LT/US-36 (AC) PF-H55LT/US-36J (do.) PF-H55AS/US-36J (DCEP) PF-H58AS/US-36J (do.) | PF-H55LT/US-36J (AC) |

| | | |
|-----|-----|-----|
| 610 | 670 | 770 |
| 500 | 550 | 690 |
| 50 | 55 | 69 |

| | | |
|---|--|---|
| LB-62UL LB-62 | LB-106 | LB-80UL (AC) LB-116 (AC) |
| LB-62L (AC) LB-65L (DCEP) LB-67L (do.) LB-67LJ (do.) | LB-70L (DCEP) LB-Y75 (AC) | LB-88LT (AC) LB-80L (DCEP) |

| | | |
|---|--------------------------------------|---|
| DW-A65L (Ar-20%CO₂) MG-T1NS (do.) | MG-S70 (Ar-20%CO₂) | MG-S80 (Ar-20%CO₂) |
| | | DW-A80L (Ar-20%CO₂) |
| DW-62L (CO₂) DW-A62L (Ar-20%CO₂) | - | MG-S88A (Ar-20%CO₂) MX-A80L (do.) |

| | |
|--|-----------------|
| | TG-S80AM |
|--|-----------------|

| | | |
|---|-------------------------------|--|
| MF-38/US-40 (AC) | PF-H80AS/US-255 (DCEP) | PF-H80AK/US-80LT (AC) PF-H80AS/US-80LT (DCEP) |
| PF-H55S/US-40 (AC) PF-H80AK/US-56B | | |
| PF-H80AK/US-56B (AC) PF-H55S/US-2N (do.) PF-H62AS/US-2N (DCEP) | PF-H80AK/US-255 (AC) | |

SMAW, FCAW, GMAW, GTAW, SAW

Tips for better welding results

Common

- (1) Use an appropriate welding procedure taking into account the requirements for the mechanical properties of the weldment, because heat input, Interpass temperature and plate thickness affect the cooling rate of welds and, where the cooling rate is excessively low, the tensile strength and notch toughness of the weld decrease.
- (2) Use appropriate preheat and Interpass temperatures to prevent cold cracking assisted by the diffusible hydrogen in welds. Suitable preheat and Interpass temperatures vary depending upon welding process, plate thickness, and kind of steel plate. In general, higher tensile strength steels need higher preheat and interpass temperatures.
- (3) Select appropriate welding consumables and welding conditions carefully particularly in cases where the weld metal dilution by the base metal is large, because the chemical composition of the weld metal can markedly be affected by the base metal chemical composition and thereby the properties of the weld metal can be varied.
- (4) Confirm the applicability of postweld heat treatment for welding consumables before use, because some welding consumables can provide good notch toughness only in the as-welded condition and some welding consumables can provide sufficient notch toughness in the postweld heat treated conditions.
- (5) Confirm the suitable electric current characteristics for welding consumables before use, because each welding consumable is designed to provide the highest performances with specific type of electric current (AC, DC, or both) and polarity (DCEP, DCEN, or both). Therefore, when a welding consumable designed for AC is used in DC or in opposite case, there are possibilities to deteriorate the properties of the weld metal and usability.
- (6) Some welding consumable can be used by both AC and DCEP; however, the use of DCEP causes a little decrease in strength of the weld metal.

SMAW

- (1) Low-hydrogen type electrodes should be stored in an oven (100-150°C) placed near the welding area after re-drying was finished. Take out minimize amounts of electrodes needed for a certain work from the oven. This manner is to keep the diffusible hydrogen content of the weld metal in a low level.
- (2) Use the backstep technique directly in the welding groove or strike an arc on a scrap plate before transferring the arc into the groove to prevent cracking.
- (3) Keep the arc length as short as possible to maintain good shielding by the coating flux decomposed gases during welding. The use of a long arc can cause a decrease of impact value of the weld metal caused by the nitrogen in the atmosphere and, where the arc length is excessive, blowholes can occur in the weld metal. Use a wind screen in windy areas.
- (4) Refer to the tips for Mild Steel and 490MPa High Tensile Strength Steel for other notes.

FCAW, GMAW, and GTAW

- (1) Use suitable shielding gas for each welding wire because the composition of a shielding gas can affect the mechanical properties of the weld metal.
- (2) Use a wind screen in windy areas to maintain the shielding gas in good condition. Insufficient or irregular shielding gas can cause weld defects.
- (3) Refer to the tips for welding Mild Steel and 490MPa High Tensile Strength Steel for other notes.

SAW

- (1) Remove rust, oil, grease, and water in the welding groove beforehand because such dirt can cause weld defects like pits and blowholes.
- (2) Select suitable steel plates and welding consumables carefully taking into account the dilution of weld metal by the base metal. Submerged arc welding characterizes deeper penetration and thus larger dilution; therefore, the properties of the weld metal can markedly be varied by the chemical composition of the base metal. Especially in the single-pass-on-both-side welding, the dilution ratio becomes as large as about 60% and thus the properties of the weld metal is considerably affected by the chemical composition of the base metal.
- (3) Refer to the tips for Mild Steel and 490MPa High Tensile Strength Steel for other notes.

How to prevent cold cracks

In order to prevent cold cracks in arc welding, preheat temperature is a key factor, which relates to the hardenability of the steel material, the amount of diffusible hydrogen in the weld metal, and the degree of restraint of the welding joint. Fig. 1 shows the relationship between preheat temperature and the Cracking Parameter (P_C) which consists of the Cracking Parameter of Material (P_{CM}), plate thickness (t), and diffusible hydrogen (H). This diagram was developed through the y-groove cracking test of high tensile strength steels having a variety of chemical compositions. It can be considered that P_{CM} relates to the hardenability of a steel material, and plate thickness relates to the degree of restraint of a welding joint. Hence, P_C can be a guide to estimating the preheat temperature needed for preventing a cold crack in arc welding of a particular steel material.

However, in the stricter sense, the following formula (P_W) is more recommended to use for estimating the cooling time after welding that relates to preheat temperature, heat input, ambient temperature, and other factors to prevent a cold crack in arc welding of actual steel structures. The applicable ranges of individual parameters are given in Table 1.

$$P_W = P_{CM} + H/60 + R_F/400,000$$

where P_{CM} (%): the same as that contained in the P_C formula

R_F (N/mm \cdot mm): the degree of restraint of a welding joint

The degree of restraint (N/mm \cdot mm) of a y-groove welding joint used for developing P_C is about 700 times the plate thickness (mm); if R_F is substituted by $700 \times t$, P_W becomes almost the same as P_C .

SMAW, FCAW, GMAW, GTAW, SAW

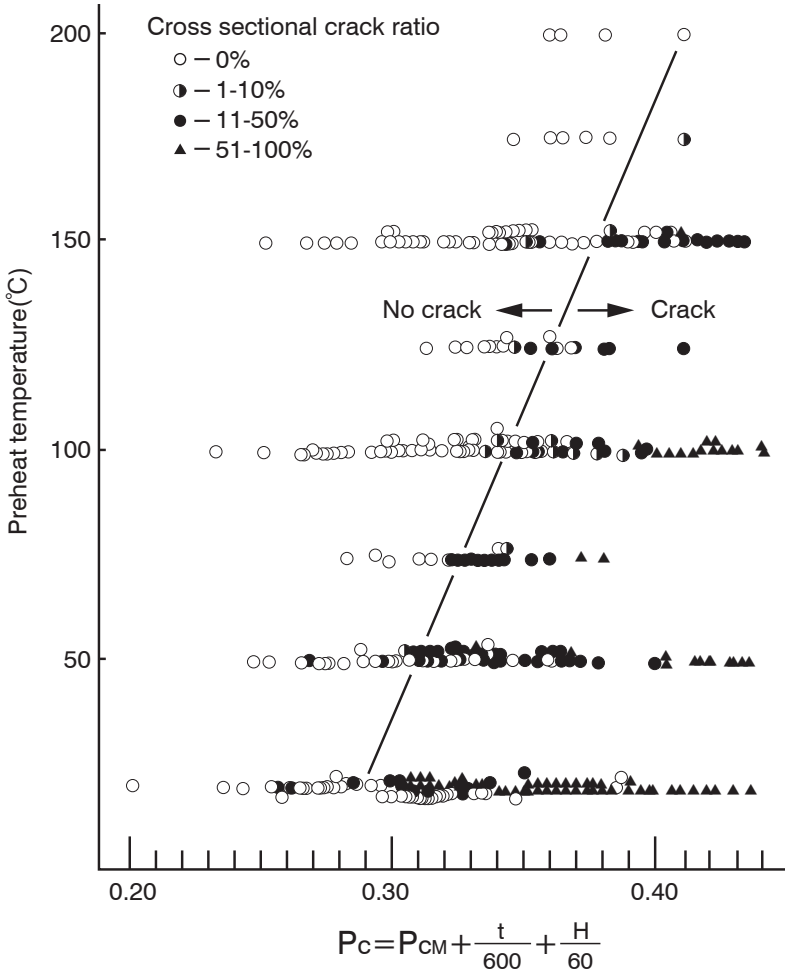


Fig. 1 Preheat temperature vs. cracking parameter P_c (t : 16-50 mm)

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

t : Plate thickness (mm)

H : Content of diffusible hydrogen of deposited metal (Glycerine method) (ml/100 g)

H (Glycerine method) = 0.79 H (Gas chromatography method) - 1.73

Table 1 Applicable ranges of parameters for Pw formula

| Chemical composition of steels (%) ^a | | | | | | | | | | |
|---|------|---------------|------|--------------------|------|------|-------------------------------------|------|------|-------|
| C | Si | Mn | Cu | Ni | Cr | Mo | V | Ti | Nb | B |
| 0.07~ 0.22 | 0.60 | 0.40~ 1.40 | 0.50 | 1.20 | 1.20 | 0.70 | 0.12 | 0.05 | 0.04 | 0.005 |
| Amount of diffusible hydrogen, H | | | | Plate thickness, t | | | Degree of restraint, R _F | | | |
| 1.0~5.0 ml/100g | | | | 19~50 mm | | | 5,000~33,000 N/mm·mm | | | |

Note: ^a Single values are maximum.

$$P_w = P_{CM} + H/60 + R_F/400,000$$

(References: WES 3001-1996 and JIS Z 3118-1992)

Stick electrode

Features: ▪ Suitable for low temperature service steel

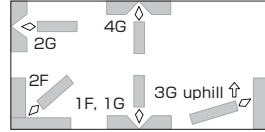
Classification: AWS A5.1 E7018-1
EN ISO 2560-A-E 42 4 B

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Brown, 2nd White

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 23 | 170W, 105H, 380L |
| 3.2 | 350 | 5 | 20 | 35 | 170W, 105H, 380L |
| 4.0 | 400 | 5 | 20 | 61 | 170W, 105H, 430L |
| 4.0 | 450 | 5 | 20 | 69 | 170W, 100H, 480L |
| 5.0 | 450 | 5 | 20 | 106 | 170W, 110H, 480L |

Composition (all-weld metal mass%)

| | Typical (DCEP) | Guaranty ^a |
|---------------------------|----------------|-----------------------|
| C | 0.08 | 0.15 |
| Si | 0.37 | 0.75 |
| Mn | 1.53 | 1.60 |
| P | 0.012 | 0.035 |
| S | 0.003 | 0.035 |
| Ni | 0.01 | 0.30 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | <0.01 | 0.08 |
| Ti | 0.025 | - |
| B | 0.0045 | - |
| Others^b | 1.58 | 1.75 |

Note: ^a Single values are maximum.

^b Combined Limit for Mn+Ni+Cr+Mo+V

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 70~100 | 65~95 |
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | - |

All-weld mechanical properties

| | Typical (DCEP) | Guaranty |
|---------------------|----------------|----------|
| 0.2%YS (MPa) | 490 | 400min. |
| TS (MPa) | 580 | 483min. |
| EI on 4d (%) | 31 | 22min. |
| IV -46°C (J) | 135 | 27min. |

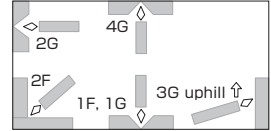
Approvals

| | |
|------------|------------|
| ABS | 4Y400, H10 |
| LR | 4Y40m H10 |

Stick electrode

Features: • Suitable for 3.5%Ni steel
Classification: AWS A5.5 E7016-C2L
Redrying Conditions: 350~400°Cx1h
Identification color: 1st Yellow green, 2nd Silver gray
Polarity: AC

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 32 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 56 | 170W, 110H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.05 |
| Si | 0.36 | 0.50 |
| Mn | 0.73 | 1.25 |
| P | <0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 3.50 | 3.00~3.75 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~170 | 110~150 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|-----------|------------|----------------|
| 0.2%YS (MPa) | 470 | 440 | 393min. |
| TS (MPa) | 560 | 530 | 483min. |
| EI on 4d (%) | 31 | 35 | 25min. |
| IV (J) | -85°C:170 | -100°C:140 | -101°C: 27min. |
| PWHT (°C×h) | AW | 605x1 | AW & 605±15x1 |

Stick electrode

Features:

- Good CTOD properties down to -10°C
- Better impact values down to -60°C
- AC is recommended for 570 to 610MPa class steel

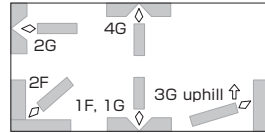
Classification: AWS A5.5 E8016-C1

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Blue, 2nd Orange

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 120H, 430L |
| 5.0 | 450 | 5 | 20 | 97 | 170W, 110H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.36 | 0.60 |
| Mn | 0.86 | 1.25 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 2.40 | 2.00~2.75 |
| Mo | 0.12 | - |
| Ti | 0.018 | - |
| B | 0.0021 | - |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~180 | 100~170 |
| 5.0 | 180~240 | - |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical (AC) | | Guaranty |
|---------------------|--------------|-------|---------------|
| 0.2%YS (MPa) | 540 | 530 | 462min. |
| TS (MPa) | 650 | 640 | 552min. |
| EI on 4d (%) | 27 | 28 | 19min. |
| IV -60°C (J) | 130 | 120 | 27min. |
| PWHT (°C×h) | AW | 608x1 | AW & 605±15x1 |

Approvals

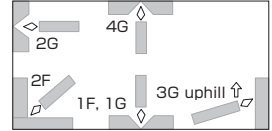
| | |
|------------|----------------|
| ABS | 5YQ500 H10, MG |
| DNV | 5Y50H5 |

Stick electrode

Features:

- Suitable for 610MPa tensile strength steel
- Good impact values down to -60°C
- Excellent crack resistibility

Welding Positions:



Classification: AWS A5.5 E8016-C1

Redrying Conditions: 350~400°Cx1h

Identification color: 1st White, 2nd Yellow

Polarity: DCEP

Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 120H, 430L |
| 5.0 | 450 | 5 | 20 | 97 | 170W, 110H, 480L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.42 | 0.60 |
| Mn | 1.00 | 1.25 |
| P | <0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 2.58 | 2.00~2.75 |
| Mo | 0.12 | - |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 80~120 | 70~110 |
| 4.0 | 120~170 | 90~160 |
| 5.0 | 170~230 | - |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|---------------|
| 0.2%YS (MPa) | 570 | 560 | 462min. |
| TS (MPa) | 660 | 645 | 552min. |
| EI on 4d (%) | 27 | 28 | 19min. |
| IV -60°C (J) | 120 | 110 | 27min. |
| PWHT (°C×h) | AW | 605x1 | AW & 605±15x1 |

Stick electrode

Features:

- Good CTOD properties at temperatures down to -30°C
- Better impact values at temperatures down to -60°C

Classification:

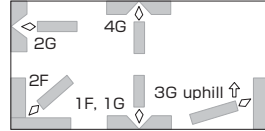
AWS A5.5 E7016-G
EN ISO 2560-A-E 42 6 Z B

Redrying Conditions: 350~400°Cx1h

Identification color: 1st White, 2nd Green

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 90H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 110H, 430L |
| 5.0 | 450 | 5 | 20 | 97 | 170W, 105H, 480L |
| 6.0 | 450 | 5 | 20 | 140 | 170W, 105H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.10 |
| Si | 0.36 | 0.30~0.90 |
| Mn | 1.38 | 1.00~1.60 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.46 | 0.30~0.70 |
| Ti | 0.019 | 0.005~0.035 |
| B | 0.0027 | 0.0005~0.0045 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | 150~200 |
| 6.0 | 250~310 | - |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical (AC) | | Guaranty |
|---------------------|--------------|-------|---------------|
| | 490 | 470 | |
| 0.2%YS (MPa) | 490 | 470 | 393min. |
| TS (MPa) | 580 | 570 | 483min. |
| EI on 4d (%) | 29 | 31 | 25min. |
| IV -60°C (J) | 130 | 120 | 27min. |
| PWHT (°Cxh) | AW | 620x1 | AW & 620±15x1 |

Approvals

| | |
|------------|-----------------------------|
| ABS | 3Y, 4Y400 H10 |
| LR | 5Y40m (H15) |
| DNV | 5Y40H10, NV2-4 (L), 4-4 (L) |
| BV | 4Y40M, HH (KV-60) |
| NK | KMWL3H10, KMW54Y40 |

Stick electrode

- Features:**
- Suitable for one-side welding
 - Good arc stability in one-side welding with relatively low current
 - Good impact values down to -60°C

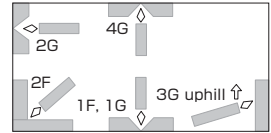
Classification: AWS A5.5 E7016-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st White, 2nd Pink

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 20 | 170W, 110H, 380L |
| 3.2 | 400 | 5 | 20 | 35 | 170W, 105H, 430L |

Composition (all-weld metal mass%)

| | Typical (DCEP) | Guaranty ^a |
|-----------|----------------|-----------------------|
| C | 0.06 | 0.10 |
| Si | 0.62 | 0.30~0.90 |
| Mn | 1.25 | 1.00~1.60 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.50 | 0.30~0.70 |
| Ti | 0.01 | - |
| B | 0.003 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G | Root pass ^b |
|------|-------------------|------------------|------------------------|
| 2.6 | 60~90 | 50~80 | 30~80 |
| 3.2 | 90~130 | 80~120 | 60~110 |

Note: ^b DCEN is also suitable

All-weld mechanical properties

| | Typical (DCEP) | | Guaranty |
|---------------------|----------------|-------|---------------|
| 0.2%YS (MPa) | 510 | 500 | 393min. |
| TS (MPa) | 600 | 590 | 483min. |
| EI on 4d (%) | 32 | 33 | 22min. |
| IV -60°C (J) | 60 | 55 | 27min. |
| PWHT (°Cxh) | AW | 620x1 | AW & 620±15x1 |

Approvals

| | |
|------------|-------------|
| ABS | 5Y400 H10 |
| LR | 5Y40m (H10) |
| DNV | 5Y40 H10 |
| BV | 5Y40 HH |

Stick electrode

Features:

- Suitable for butt and fillet welding
- Good impact values down to -60°C

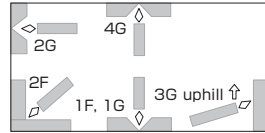
Classification: AWS A5.5 E8016-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Purple, 2nd Green

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 90H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 110H, 430L |
| 5.0 | 450 | 5 | 20 | 97 | 170W, 105H, 480L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.10 |
| Si | 0.35 | 0.30~0.90 |
| Mn | 1.40 | 1.00~1.60 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.83 | 0.70~1.0 |
| Mo | 0.10 | 0.05~0.15 |
| Ti | 0.018 | 0.005~0.035 |
| B | 0.0025 | 0.0005~0.0045 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | 150~200 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|---------------|
| | | | |
| 0.2%YS (MPa) | 520 | 510 | 462min. |
| TS (MPa) | 610 | 590 | 552min. |
| EI on 4d (%) | 33 | 31 | 19min. |
| IV -60°C (J) | 170 | 140 | 27min. |
| PWHT (°Cxh) | AW | 605x1 | AW & 605±15x1 |

Approvals

| | |
|------------|------------|
| ABS | 5YQ420H5 |
| LR | 5Y42m (H5) |
| DNV | 5Y42H5 |

Stick electrode

Features:

- Good CTOD properties down to -45°C
- Good impact values down to -80°C

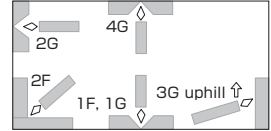
Classification: AWS A5.5 E8016-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st White, 2nd Brown

Polarity: AC

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 120H, 430L |
| 5.0 | 450 | 5 | 20 | 97 | 170W, 110H, 480L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.10 |
| Si | 0.43 | 0.15~0.50 |
| Mn | 1.36 | 1.10~1.70 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 1.37 | 1.10~1.70 |
| Ti | 0.021 | 0.005~0.035 |
| B | 0.0035 | 0.0005~0.0045 |

Note: ^a Single values are maximum.

Recommended welding parameters

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | 150~200 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|---------------|
| | 520 | 490 | |
| 0.2%YS (MPa) | 520 | 490 | 462min. |
| TS (MPa) | 610 | 580 | 552min. |
| EI on 4d (%) | 29 | 29 | 19min. |
| IV -80°C (J) | 127 | 130 | -60°C: 27min. |
| PWHT (°Cxh) | AW | 620x1 | AW & 620±15x1 |

Approvals

| | |
|------------|---------------------|
| LR | 5Y40m (H15) |
| DNV | 5YH10, NV2-4L, 4-4L |
| BV | 4Y40M HH, UP |
| NK | KMW5Y42H10 |

Stick electrode

- Features:**
- Suitable for butt and fillet welding
 - Typical stick electrode in this classification

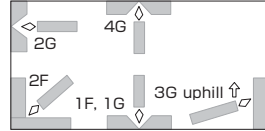
Classification: AWS A5.5 E9016-G
EN ISO 2560-A-E 50 3 Z B

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Blue white, 2nd Yellow

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 90H, 330L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 110H, 430L |
| 5.0 | 400 | 5 | 20 | 85 | 170W, 120H, 430L |
| 6.0 | 450 | 5 | 20 | 140 | 170W, 105H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.09 |
| Si | 0.66 | 0.40~0.75 |
| Mn | 1.04 | 0.75~1.35 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.61 | 0.40~0.75 |
| Mo | 0.26 | 0.20~0.40 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 90~130 | 80~115 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | 150~200 |
| 6.0 | 250~310 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 550 | 531min. |
| TS (MPa) | 650 | 621min. |
| EI on 4d (%) | 30 | 17min. |
| IV -18°C (J) | 150 | - |

Approvals

| | |
|------------|-------------|
| ABS | 3YQ500 H10 |
| LR | 3Ym H15 |
| DNV | 3YH10 |
| BV | 3 HH, 3Y HH |
| NK | KMW3Y50H10 |
| CR | MG |

Stick electrode

Features: • Excellent crack resistibility

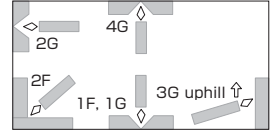
Classification: AWS A5.5 E9016-G
EN ISO 2560-A-E 50 3 Z B

Redrying Conditions: 350~430°Cx1h

Identification color: 1st Brown, 2nd Silver

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 120H, 430L |
| 5.0 | 400 | 5 | 20 | 85 | 170W, 125H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.07 | 0.09 |
| Si | 0.68 | 0.40~0.75 |
| Mn | 1.13 | 0.75~1.35 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.65 | 0.45~0.80 |
| Mo | 0.25 | 0.20~0.40 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 80~115 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | 150~200 |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 550 | 531min. |
| TS (MPa) | 650 | 621min. |
| El on 4d (%) | 30 | 17min. |
| IV -18°C (J) | 160 | - |

Approvals

| CCS | 3Y50H10 |
|-----|---------|
| | |

Stick electrode

Features:

- Suitable for one-side welding
- Good arc stability with relatively low currents
- Excellent crack resistibility

Classification:

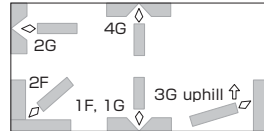
AWS A5.5 E9016-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Blue, 2nd Yellow

Polarity: AC, DCEP, DCEN (Root pass only)

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 350 | 5 | 20 | 20 | 170W, 120H, 380L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 53 | 170W, 110H, 430L |

Composition (all-weld metal mass%)

| | Typical (DCEP) | Guaranty ^a |
|-----------|----------------|-----------------------|
| C | 0.08 | 0.09 |
| Si | 0.70 | 0.40~0.75 |
| Mn | 1.08 | 0.70~1.20 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.62 | 0.45~0.80 |
| Mo | 0.25 | 0.20~0.40 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G | Root pass |
|------|-------------------|------------------|-----------|
| 2.6 | 60~90 | 50~80 | 30~80 |
| 3.2 | 90~130 | 80~115 | 60~110 |
| 4.0 | 130~180 | 110~170 | 90~140 |

All-weld mechanical properties

| | Typical (DCEP) | Guaranty |
|---------------------|----------------|----------|
| 0.2%YS (MPa) | 560 | 531min. |
| TS (MPa) | 650 | 621min. |
| EI on 4d (%) | 26 | 17min. |
| IV -20°C (J) | 88 | - |

Approvals

| | |
|------------|------------|
| ABS | 3YQ500 H10 |
| LR | 3Y50m, H10 |

Stick electrode

Features:

- Good CTOD properties down to -20°C
- Better impact values down to -60°C
- Excellent crack resistibility

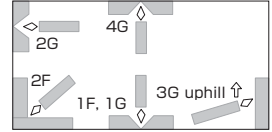
Classification: AWS A5.5 E9016-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st White, 2nd Yellow

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 270W, 90H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 120H, 430L |
| 5.0 | 450 | 5 | 20 | 97 | 170W, 110H, 480L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.42 | 0.15~0.60 |
| Mn | 0.97 | 0.60~1.20 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 2.55 | 2.00~2.75 |
| Mo | 0.12 | 0.30 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 70~100 | 65~95 |
| 3.2 | 80~120 | 70~110 |
| 4.0 | 120~170 | 90~160 |
| 5.0 | 170~230 | - |

All-weld mechanical properties

| | Typical | | Guaranty | |
|---------------------|---------|-------|----------|----------|
| | | | | |
| 0.2%YS (MPa) | 560 | 560 | 530min. | 490min. |
| TS (MPa) | 660 | 640 | 620min. | 590min. |
| EI on 4d (%) | 29 | 28 | 17min. | 16min. |
| IV -60°C (J) | 130 | 112 | 27min. | 27min. |
| PWHT (°Cxh) | AW | 620x1 | AW | 620±15x1 |

Approvals

| | |
|------------|-----------|
| ABS | 5YQ500 H5 |
| LR | 5Y50m, H5 |
| DNV | 5Y50H5 |

Stick electrode

Features: ▪ Suitable for 550 to 610MPa tensile strength steel

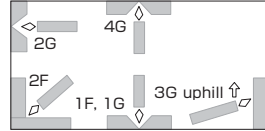
Classification: AWS A5.5 E9018-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Pink, 2nd Yellow

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 34 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 61 | 170W, 120H, 430L |
| 5.0 | 450 | 5 | 20 | 93 | 170W, 110H, 480L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.09 |
| Si | 0.68 | 0.40~0.75 |
| Mn | 1.21 | 0.80~1.40 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.59 | 0.45~0.80 |
| Mo | 0.26 | 0.20~0.35 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 80~120 |
| 4.0 | 135~185 | 110~170 |
| 5.0 | 190~250 | 150~200 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 570 | 531min. |
| TS (MPa) | 660 | 621min. |
| El on 4d (%) | 29 | 17min. |
| IV -20°C (J) | 170 | 27min. |

Stick electrode

Features: • Suitable for 690MPa tensile strength steel

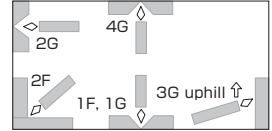
Classification: AWS A5.5 E10016-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Blue white, 2nd Purple

Polarity: AC

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 105H, 430L |
| 5.0 | 400 | 5 | 20 | 85 | 170W, 105H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.09 |
| Si | 0.65 | 0.40~0.75 |
| Mn | 1.29 | 1.20~1.70 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 1.44 | 1.20~1.70 |
| Cr | 0.22 | 0.10~0.30 |
| Mo | 0.19 | 0.10~0.30 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 80~115 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | 150~220 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 660 | 600min. |
| TS (MPa) | 760 | 690min. |
| El on 4d (%) | 25 | 16min. |
| IV -20°C (J) | 110 | 27min. |

Approvals

| | |
|------------|---------------|
| ABS | MG (E10016-G) |
| NK | KMW3Y62H5 |
| CR | MG (E10016-G) |

Stick electrode

Features:

- Suitable for butt and fillet welding
- Good impact values down to -40°C
- Excellent crack resistibility

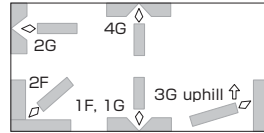
Classification: AWS A5.5 E10016-G

Redrying Conditions: 350~430°Cx1h

Identification color: 1st Green, 2nd Yellowish green

Polarity: AC

Welding Positions:



Packaging data

| φ mm | Length mm | kg/-pack | kg/carton | g/piece | carton mm |
|------|-----------|----------|-----------|---------|--------------------------|
| 3.2 | 350 | 5 | 20 | 32 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 56 | 170W, 120H, 430L |
| 5.0 | 400, 450 | 5 | 20 | 87, 98 | 170W, 110~120H, 430~480L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.07 |
| Si | 0.38 | 0.20~0.60 |
| Mn | 1.21 | 0.80~1.40 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 3.56 | 3.05~3.80 |
| Cr | 0.24 | 0.10~0.40 |
| Mo | 0.40 | 0.30~0.60 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 90~120 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 680 | 600min. |
| TS (MPa) | 760 | 690min. |
| EI on 4d (%) | 23 | 16min. |
| IV -40°C (J) | 115 | 27min. |

Stick electrode

- Features:**
- Suitable for butt and fillet welding
 - Good impact values down to -60°C
 - Excellent crack resistibility

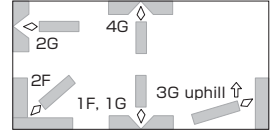
Classification: AWS A5.5 E10016-G

Redrying Conditions: 350~430°Cx1h

Identification color: 1st Green, 2nd Yellowish green

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 270W, 90H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 120H, 430L |
| 5.0 | 400 | 5 | 20 | 87 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.07 |
| Si | 0.40 | 0.20~0.60 |
| Mn | 1.18 | 0.80~1.40 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 3.71 | 3.05~3.90 |
| Cr | 0.22 | 0.10~0.40 |
| Mo | 0.40 | 0.30~0.60 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 70~100 | 65~95 |
| 3.2 | 80~120 | 70~110 |
| 4.0 | 120~170 | 90~160 |
| 5.0 | 170~230 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 685 | 600min. |
| TS (MPa) | 755 | 690min. |
| El on 4d (%) | 27 | 16min. |
| IV -60°C (J) | 110 | 27min. |

Approvals

| | |
|------------|-----------|
| ABS | 4YQ620 H5 |
| DNV | 4Y62H5 |

Stick electrode

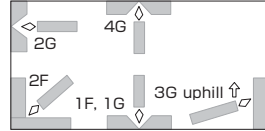
Features: ▪ Suitable for 780MPa tensile strength steel

Classification: AWS A5.5 E11016-G

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Blue white, 2nd Red

Polarity: AC

Welding Positions:**Packaging data**

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 90H, 330L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 54 | 170W, 110H, 430L |
| 5.0 | 400 | 5 | 20 | 86 | 170W, 110H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.09 |
| Si | 0.70 | 0.40~0.80 |
| Mn | 1.41 | 1.20~1.70 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 1.89 | 1.50~2.10 |
| Cr | 0.28 | 0.20~0.40 |
| Mo | 0.46 | 0.35~0.55 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 90~130 | 80~115 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | - |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 730 | 669min. |
| TS (MPa) | 830 | 759min. |
| EI on 4d (%) | 24 | 15min. |
| IV -20°C (J) | 110 | 27min. |

Stick electrode

Features:

- Suitable for 780MPa tensile strength steel
- Ultra low hydrogen type

Welding Positions:

Classification:

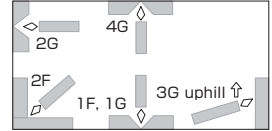
AWS A5.5 E11016-G

Redrying Conditions: 350~430°Cx1h

Identification color: 1st Brown, 2nd Green

Polarity:

AC



Packaging data

| ϕ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|-----------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 115H, 430L |
| 5.0 | 400 | 5 | 20 | 87 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.09 |
| Si | 0.59 | 0.35~0.70 |
| Mn | 1.50 | 1.30~1.80 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 1.90 | 1.70~2.10 |
| Cr | 0.22 | 0.10~0.40 |
| Mo | 0.45 | 0.25~0.55 |

Note: ^a Single values are maximum.

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|-----------|----------------|---------------|
| 3.2 | 90~130 | 80~115 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 710 | 669min. |
| TS (MPa) | 820 | 759min. |
| EI on 4d (%) | 25 | 15min. |
| IV -20°C (J) | 110 | 27min. |

Approvals

| | |
|------------|-----------|
| NK | KMW3Y69H5 |
| CCS | 3Y69H5 |

Stick electrode

Features:

- Good impact values down to -80°C
- Excellent crack resistibility

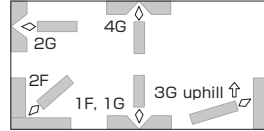
Classification: AWS A5.5 E11016-G

Redrying Conditions: 350~430°Cx1h

Identification color: 1st Brown, 2nd Brown

Polarity: AC

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 30 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 54 | 170W, 110H, 430L |
| 5.0 | 400 | 5 | 20 | 87 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.09 |
| Si | 0.70 | 0.40~0.75 |
| Mn | 1.75 | 1.40~2.00 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 2.62 | 2.10~2.80 |
| Mo | 0.73 | 0.50~0.80 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 80~115 |
| 4.0 | 130~180 | 100~170 |
| 5.0 | 180~240 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 750 | 669min. |
| TS (MPa) | 840 | 759min. |
| EI on 4d (%) | 20 | 15min. |
| IV -80°C (J) | 63 | 27min. |

Approvals

| | |
|------------|----------|
| ABS | 5YQ690H5 |
| DNV | 5Y69H5 |

Stick electrode

Features:

- Good impact values down to -60°C
- Excellent crack resistibility

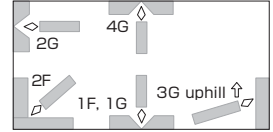
Classification: AWS A5.5 E11018-G H4

Redrying Conditions: 350~400°Cx1h

Identification color: 1st Brown, 2nd Brown

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 270W, 90H, 330L |
| 3.2 | 350 | 5 | 20 | 32 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 57 | 170W, 110H, 430L |
| 5.0 | 400 | 5 | 20 | 90 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.09 |
| Si | 0.60 | 0.20~0.75 |
| Mn | 1.49 | 1.20~1.90 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 2.92 | 2.50~3.30 |
| Mo | 0.77 | 0.40~1.00 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 70~100 | 65~95 |
| 3.2 | 80~120 | 70~110 |
| 4.0 | 120~160 | 90~150 |
| 5.0 | 170~210 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 770 | 669min. |
| TS (MPa) | 830 | 759min. |
| EI on 4d (%) | 24 | 15min. |
| IV -60°C (J) | 100 | 47min. |

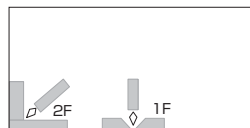
Approvals

| | |
|------------|-----------|
| ABS | 5YQ690 H5 |
| DNV | 5Y69H5 |

Flux cored wire

- Features:**
- Excellent porosity resistibility to inorganic zinc primer
 - Excellent impact value down to -60°C

Welding Positions:



Classification: AWS A5.20 E70T-9C-J

Shielding gas: CO₂

Polarity: DCEP

Packaging data

| φ mm | Spool | | Drum |
|------------------|------------------|------|-------------|
| 1.2 | 15kg | - | - |
| 1.4 | 15kg | - | 150kg |
| 1.6 | - | 20kg | - |
| Volume mm | 300W, 110H, 300L | | 530 φ, 820H |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.44 | 0.90 |
| Mn | 1.42 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.34 | 0.50 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| Cu | 0.02 | 0.35 |
| V | 0.01 | 0.08 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F | 2F |
|------|---------|---------|
| 1.2 | 150~300 | 180~300 |
| 1.4 | 170~400 | 200~350 |
| 1.6 | 200~450 | 270~400 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 540 | 400min. |
| TS (MPa) | 590 | 483~655 |
| EI on 4d (%) | 29 | 22min. |
| IV -60°C (J) | 58 | 27min. |

Approvals

| | |
|------------|------------------------|
| ABS | 3YSA, MG |
| LR | 5Y40S, H5 |
| DNV | VYMS, NV2-4L, 4-4L |
| BV | SA3YM, UP |
| NK | KSW54G (C), KSWL3G (C) |

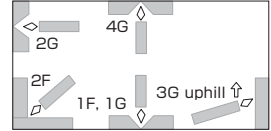
Flux cored wire

Features: ▪ Excellent impact values down to -40°C

Classification: AWS A5.20 E71T-9C-J
EN ISO 17632-A-T 42 4 P C 1 H5

Shielding gas: CO₂
Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | | |
|------------------|------------------|------|------|
| 1.2 | 12.5kg | 15kg | 20kg |
| 1.4 | - | 15kg | - |
| Volume mm | 300W, 110H, 300L | | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.38 | 0.90 |
| Mn | 1.42 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.35 | 0.50 |
| Cr | 0.03 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | 0.02 | 0.08 |
| Cu | 0.02 | 0.35 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 540 | 400min. |
| TS (MPa) | 590 | 483~655 |
| EI on 4d (%) | 29 | 22min. |
| IV -40°C (J) | 80 | 27min. |

Approvals

| | |
|------------|-------------------|
| ABS | 3YSA, 3Y400SA, H5 |
| LR | 3YS, 4Y40S, H5 |
| DNV | III YMS (H5) |
| BV | SA3, SA3YM HHH |
| NK | KSW54Y40G (C) H5 |
| CR | 3YS-HH, L1YS-HH |
| GL | 3YH5S |

Welding parameters (A)

| φ mm | 1F, 1G | 2F | 2G | 3G uphill, 4G |
|------|---------|---------|---------|---------------|
| 1.2 | 150~300 | 150~300 | 150~280 | 150~250 |
| 1.4 | 150~400 | 150~350 | 150~300 | 150~250 |

Flux cored wire

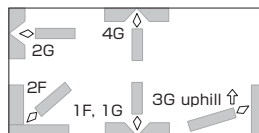
Features: • Excellent impact values down to -40°C

Classification: AWS A5.20 E71T-9M-J

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|-----------|------------------|------|
| 1.2 | 12.5kg | 15kg |
| Volume mm | 300W, 110H, 300L | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.54 | 0.90 |
| Mn | 1.31 | 1.75 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.34 | 0.50 |
| Cr | 0.02 | 0.20 |
| Mo | 0.01 | 0.30 |
| Cu | 0.02 | 0.35 |
| V | 0.01 | 0.08 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

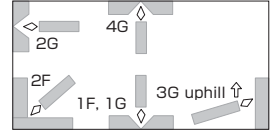
| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 540 | 400min. |
| TS (MPa) | 600 | 483~655 |
| EI on 4d (%) | 28 | 22min. |
| IV -40°C (J) | 100 | 27min. |

Approvals

| | |
|------------|--------------|
| ABS | 4Y400SA (H5) |
| LR | 4Y40S, H5 |
| DNV | IVYMS (H5) |
| BV | SA4Y40M HH |
| GL | 3YH5S |

Welding parameters (A)

| φ mm | 1F, 1G | 2F | 2G | 3G uphill, 4G |
|------|---------|---------|---------|---------------|
| 1.2 | 150~300 | 150~300 | 150~280 | 150~250 |

Flux cored wire**Features:** • Excellent impact value down to -46°C**Classification:** AWS A5.20 E71T-12M-J
EN ISO 17632-A-T 42 4 P M 1 H5**Shielding gas:** Ar-20%CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| φ mm | Spool | |
|------------------|-----------------------|------------------|
| | 1.2 | 5kg |
| 1.6 | - | 20kg |
| Volume mm | 220W, 130H, 435L/4pcs | 300W, 110H, 300L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.50 | 0.90 |
| Mn | 1.40 | 1.60 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.40 | 0.50 |
| Cr | 0.02 | 0.20 |
| Mo | 0.01 | 0.30 |
| V | <0.01 | 0.08 |
| Cu | 0.02 | 0.35 |

Note: ^a Single values are maximum.**Welding parameters (A)**

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 1.2 | 100~250 | 120~250 |
| 1.6 | 150~340 | 180~280 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------------------|-------|----------|
| | 0.2%YS (MPa) | 500 | |
| TS (MPa) | 580 | 560 | 483~620 |
| El on 4d (%) | 30 | 31 | 22min. |
| IV -46°C (J) | 100 | 60 | 27min. |
| PWHT (°C×h) | AW | 620x3 | AW |

Approvals

| | |
|------------|------------------------|
| ABS | 4Y400SA, H5 |
| CWB | CSA W48 E491 T-12MU-H8 |

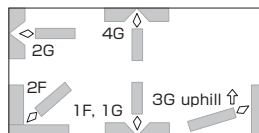
Flux cored wire

Features: • Excellent impact values down to -60°C

Classification: AWS A5.29 E81T1-K2C
EN ISO 17632-A-T 46 6 1.5Ni P C 1 H5

Shielding gas: CO₂
Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | | |
|------------------|------------------|------|------|
| 1.2 | 12.5kg | 15kg | 20kg |
| 1.4 | - | 15kg | - |
| Volume mm | 300W, 110H, 300L | | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.15 |
| Si | 0.38 | 0.80 |
| Mn | 1.32 | 0.50~1.75 |
| P | 0.010 | 0.030 |
| S | 0.008 | 0.030 |
| Ni | 1.51 | 1.00~2.00 |
| Cr | 0.02 | 0.15 |
| Mo | 0.01 | 0.35 |
| V | 0.02 | 0.05 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 550 | 469min. |
| TS (MPa) | 620 | 552~689 |
| EI on 4d (%) | 27 | 22min. |
| IV -60°C (J) | 70 | 27min. |

Approvals

| | |
|------------|-------------------------------|
| ABS | 3YSA, 5Y400SA, H5 MG |
| LR | 5Y40S, H5 |
| DNV | VY40MS (H5), NV2-4L, 4-4L |
| BV | SA5Y40M H5 |
| NK | KSWL3G (C), KSW54Y40G (C), H5 |
| GL | 6Y40H5S |
| KR | L 3SG (C) H5, 5Y40SG (C) H5 |
| CCS | 5Y40SH5 |

Welding parameters (A)

| φ mm | 1F, 1G | 2F | 2G | 3G uphill, 4G |
|------|---------|---------|---------|---------------|
| 1.2 | 150~300 | 150~300 | 150~280 | 150~250 |
| 1.4 | 150~400 | 150~350 | 150~300 | 150~250 |

DW-55LSR

Flux cored wire

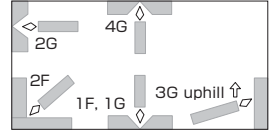
Features: ▪ Excellent impact value down to -60°C in the as-welded and PWHT conditions

Classification: AWS A5.29 E81T1-K2C
EN ISO 17632-A-T 46 6 1.5Ni P C 1 H5

Shielding gas: CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | | |
|-----------|------------------|--------|------|
| | 1.2 | 12.5kg | 15kg |
| Volume mm | 300W, 110H, 300L | | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.15 |
| Si | 0.29 | 0.80 |
| Mn | 1.21 | 0.50~1.75 |
| P | 0.008 | 0.030 |
| S | 0.007 | 0.030 |
| Ni | 1.56 | 1.00~2.00 |
| Cr | 0.01 | 0.15 |
| Mo | 0.01 | 0.35 |
| V | <0.01 | 0.05 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|---------|---------------|
| 1.2 | 150~300 | 150~280 | 150~250 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------------------|-------|----------|
| | 0.2%YS (MPa) | 480 | 440 |
| TS (MPa) | 565 | 530 | 552~689 |
| EI on 4d (%) | 33 | 34 | 22min. |
| IV -60°C (J) | 115 | 100 | 27min. |
| PWHT (°Cxh) | AW | 620X1 | AW |

Approvals

| | |
|------------|---------------------------------|
| ABS | 5YQ420SA (H5) 4Y400SA (H5) |
| LR | 5Y42S, MG, H5 |
| DNV | VY42MS (H5), MG NV2-4L, 4-4L |
| BV | SA4Y40M HH, UP |
| NK | KSW5Y42G (C) H5, MG |

Flux cored wire

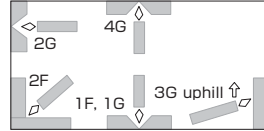
Features: • Excellent impact values down to -60°C

Classification: AWS A5.29 E81T1-K2M
EN ISO 17632-A-T 46 6 1.5Ni P M 1 H5

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 15kg |
| Volume mm | 300W, 110H, 300L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.15 |
| Si | 0.32 | 0.80 |
| Mn | 1.17 | 0.50~1.75 |
| P | 0.008 | 0.030 |
| S | 0.008 | 0.030 |
| Ni | 1.53 | 1.00~2.00 |
| Cr | 0.02 | 0.15 |
| Mo | 0.01 | 0.35 |
| V | 0.02 | 0.05 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|---------|---------------|
| 1.2 | 150~300 | 150~280 | 150~250 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 560 | 469min. |
| TS (MPa) | 630 | 552~689 |
| EI on 4d (%) | 27 | 22min. |
| IV -60°C (J) | 94 | 27min. |

Approvals

| | |
|------------|---------------------------|
| ABS | 3YSA, MG |
| LR | 5Y46S, H5 |
| DNV | VY46MS (H5), NV2-4, NV4-4 |
| BV | SA5Y46 H5 |
| CCS | 5Y46SH5 |

Flux cored wire

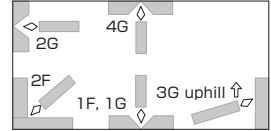
- Features:**
- Excellent impact value down to -60°C in the as-welded and PWHT conditions
 - Meets the NACE MR0175 requirements for both chemistry and hardness. The nickel content is normally 1% max.

Classification: AWS A5.29 E81T1-Ni1M
EN ISO 17632-A-T 46 6 Z P M 1 H5

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 15kg |
| Volume mm | 300W, 110H, 300L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.31 | 0.80 |
| Mn | 1.37 | 1.50 |
| P | 0.008 | 0.030 |
| S | 0.008 | 0.030 |
| Ni | 0.93 | 0.80~1.00 |
| Cr | 0.01 | 0.15 |
| Mo | 0.01 | 0.35 |
| V | <0.01 | 0.05 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|---------|---------------|
| 1.2 | 150~300 | 150~280 | 150~250 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|----------|
| | 510 | 450 | |
| 0.2%YS (MPa) | 510 | 450 | 469min. |
| TS (MPa) | 570 | 530 | 552~689 |
| EI on 4d (%) | 29 | 33 | 22min. |
| IV -60°C (J) | 120 | 70 | 27min. |
| PWHT (°Cxh) | AW | 620x2 | AW |

Approvals

| | |
|------------|---------------------------|
| ABS | 5YQ420SA (H5) |
| LR | 5Y42S (H5) |
| DNV | VY42MS (H5), NV2-4L, 4-4L |
| BV | SA5Y42 H5 |

DW-A81Ni1

Flux cored wire

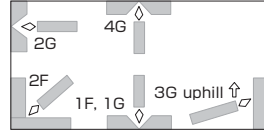
- Features:**
- Excellent impact values down to -60°C
 - Meets the NACE MR0175 requirements for both chemistry and hardness. The nickel content is normally 1% max.

Classification: AWS A5.29 E81T1-Ni1M-J
EN ISO 17632-A-T 46 6 1Ni P M 2 H5

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 15kg |
| Volume mm | 300W, 110H, 300L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.35 | 0.80 |
| Mn | 1.30 | 1.50 |
| P | 0.009 | 0.030 |
| S | 0.008 | 0.030 |
| Ni | 0.91 | 0.80~1.00 |
| Cr | 0.02 | 0.15 |
| Mo | 0.01 | 0.35 |
| V | 0.02 | 0.05 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|---------|---------------|
| 1.2 | 150~300 | 150~280 | 150~250 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 520 | 469min. |
| TS (MPa) | 580 | 552~689 |
| EI on 4d (%) | 29 | 19min. |
| IV -60°C (J) | 142 | 27min. |

Approvals

| | |
|------------|-----------------------------------|
| ABS | 5YQ420SA (H5) 4Y400SA (H5), MG |
| LR | 5Y42S, H5 |
| DNV | VY42MS (H5) |
| CWB | E 81T1-Ni1MJ-H8 |

DW-62L

Flux cored wire

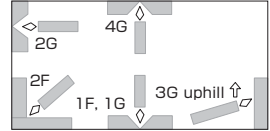
- Features:**
- Excellent impact value down to -60°C
 - Excellent CTOD value down to -40°C

Classification: AWS A5.29 E91T1-Ni2C-J
EN ISO 17632-A-T 50 6 Z P C 2 H5

Shielding gas: CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|-----------|------------------|--------|
| | 1.2 | 12.5kg |
| Volume mm | 300W, 110H, 300L | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.12 |
| Si | 0.30 | 0.80 |
| Mn | 1.37 | 1.50 |
| P | 0.008 | 0.030 |
| S | 0.010 | 0.030 |
| Ni | 2.57 | 1.75~2.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|---------|---------------|
| 1.2 | 150~300 | 150~280 | 150~250 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 580 | 538min. |
| TS (MPa) | 650 | 621~758 |
| El on 4d (%) | 25 | 17min. |
| IV -60°C (J) | 93 | 27min. |

Approvals

| | |
|------------|--------------|
| ABS | 5YQ500SA H5 |
| LR | 5Y50S, H5 |
| RS | 5Y50 MS H5 |
| DNV | V Y50MS (H5) |

DW-A62L

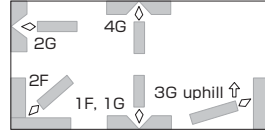
Flux cored wire

- Features:**
- Excellent impact value down to -60°C
 - Excellent CTOD value down to -40°C

Classification: AWS A5.29 E91T1-Ni2M-J
EN ISO 17632-A-T 50 6 Z P M 2 H5

Shielding gas: Ar-20%CO₂
Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|------------------|------------------|--------|
| | 1.2 | 12.5kg |
| Volume mm | 300W, 110H, 300L | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.30 | 0.80 |
| Mn | 1.38 | 1.50 |
| P | 0.008 | 0.030 |
| S | 0.009 | 0.030 |
| Ni | 2.13 | 1.75~2.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|---------|---------------|
| 1.2 | 150~300 | 150~280 | 150~250 |

All-weld Mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 560 | 538min. |
| TS (MPa) | 640 | 621~758 |
| EI on 4d (%) | 27 | 17min. |
| IV -60°C (J) | 82 | 27min. |

Approvals

| | |
|------------|-------------|
| ABS | 5YQ500SA H5 |
| LR | 5Y50S, H5 |
| DNV | VY50MS (H5) |

MX-A55T

Flux cored wire

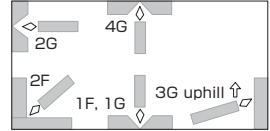
- Features:**
- Suitable with a short circuit arc
 - Excellent impact value down to -60°C

Classification: AWS A5.28 E80C-G

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 15kg |
| Volume mm | 300W, 110H, 300L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.15 |
| Si | 0.40 | 0.80 |
| Mn | 1.40 | 0.50~1.75 |
| P | 0.010 | 0.030 |
| S | 0.014 | 0.030 |
| Ni | 1.42 | 1.00~2.00 |
| Cr | 0.02 | 0.15 |
| Mo | 0.01 | 0.20 |
| V | 0.01 | 0.05 |
| Cu | 0.04 | 0.30 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 1.2 | 50~300 | 50~180 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 540 | 469min. |
| TS (MPa) | 600 | 552~689 |
| EI on 4d (%) | 29 | 19min. |
| IV -60°C (J) | 90 | 27min. |

Approvals

| | |
|------------|-----------------------|
| LR | 5Y40S, H5 |
| DNV | VYMS (H5), NV2-4, 4-4 |
| BV | SA3YM H5, UP |

Flux cored wire

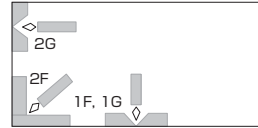
Features: • Excellent impact values down to -60°C

Classification: AWS A5.28 E80C-G
EN ISO 17632-A-T 46 6 Mn1Ni M M 3 H5

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 15kg |
| Volume mm | 300W, 110H, 300L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.15 |
| Si | 0.34 | 0.80 |
| Mn | 1.67 | 1.40~2.00 |
| P | 0.007 | 0.030 |
| S | 0.008 | 0.030 |
| Ni | 0.86 | 0.70~1.00 |
| Cr | 0.02 | 0.15 |
| Mo | 0.01 | 0.20 |
| V | <0.01 | 0.05 |
| Cu | 0.03 | 0.30 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 1.2 | 150~300 | 150~300 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 540 | 470min. |
| TS (MPa) | 610 | 552~680 |
| EI on 4d (%) | 29 | 20min. |
| IV -60°C (J) | 120 | 27min. |

MX-A80L

Flux cored wire

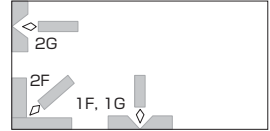
Features: ▪ Excellent impact values down to -60°C

Classification: AWS A5.28 E110C-G H4
EN ISO 18276-A-T69 6 Mn2.5Ni M M 3 H5

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 300W, 110H, 300L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.03~0.10 |
| Si | 0.48 | 0.90 |
| Mn | 1.87 | 1.1~2.0 |
| P | 0.009 | 0.020 |
| S | 0.009 | 0.020 |
| Ni | 2.49 | 2.1~3.0 |
| Cr | 0.01 | 0.2 |
| Mo | 0.09 | 0.2 |
| V | <0.01 | 0.05 |
| Nb | <0.01 | 0.05 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 1.2 | 150~300 | 150~300 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 720 | 676min. |
| TS (MPa) | 800 | 759~896 |
| El on 4d (%) | 24 | 15min. |
| IV -60°C (J) | 120 | 47min. |

Approvals

| | |
|------------|---------------|
| ABS | 5YQ690SA (H5) |
| DNV | V Y69MS (H5) |
| LR | 5Y69S, H5 |
| GL | 6Y69H5S |

Flux cored wire

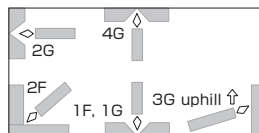
- Features:**
- Excellent impact values down to -60°C and down to -50°C in the PWHT condition
 - Meets the NACE MR0175 requirements for both chemistry and hardness. The nickel content is normally 1% max.

Classification: AWS A5.29 E71T1-GC

Shielding gas: CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|-----------|------------------|--------|
| | 1.2 | 12.5kg |
| Volume mm | 300W, 110H, 300L | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.29 | 1.00 |
| Mn | 1.34 | 0.50~1.75 |
| P | 0.009 | 0.030 |
| S | 0.007 | 0.030 |
| Ni | 0.88 | 0.70~1.00 |
| Cr | 0.01 | 0.15 |
| Mo | 0.01 | 0.35 |
| V | <0.01 | 0.05 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|---------|---------------|
| 1.2 | 150~300 | 150~280 | 150~250 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------------------|-------|----------|
| | 0.2%YS (MPa) | 480 | 425 |
| TS (MPa) | 560 | 520 | 483~655 |
| EI on 4d (%) | 31 | 35 | 20min. |
| IV -60°C (J) | 110 | 110 | 27min. |
| PWHT (°C/h) | AW | 620x1 | AW |

Approvals

| | |
|------------|-------------|
| ABS | 5Y400SA, H5 |
| LR | 5Y40S, H5 |
| DNV | VY40MS (H5) |

DW-A70L

Flux cored wire

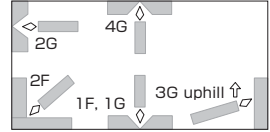
- Features:**
- Suitable for welding up to X80 grade pipe
 - Excellent impact value down to -50°C
 - The nickel content is normally 1% max.

Classification: AWS A5.29 E101T1-GM
EN ISO 18276-A-T62 5 Mn1NiMo P M 2 H5

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|------------------|-----------------------|------------------|
| | 5kg | 15kg |
| 1.2 | | |
| Volume mm | 220W, 130H, 435L/4pcs | 300W, 110H, 300L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.15 |
| Si | 0.36 | 0.80 |
| Mn | 1.90 | 1.00~2.00 |
| P | 0.005 | 0.030 |
| S | 0.008 | 0.030 |
| Ni | 0.89 | 0.40~1.00 |
| Cr | 0.02 | 0.20 |
| Mo | 0.42 | 0.50 |
| V | <0.01 | 0.05 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|---------|---------------|
| 1.2 | 150~300 | 150~280 | 150~250 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 660 | 607min. |
| TS (MPa) | 740 | 690~827 |
| EI on 4d (%) | 21 | 16min. |
| IV -50°C (J) | 70 | 27min. |

Approvals

| | |
|------------|-----------|
| LR | 4Y62SH5 |
| DNV | IVY62MSH5 |

Flux cored wire

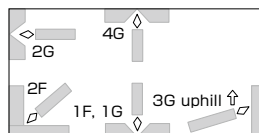
Features: • Excellent impact value down to -40°C

Classification: AWS A5.29 E111T1-GM-H4
EN ISO 18276-A-T69 4 Z P M 2 H5

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|------------------|-----------------------|------------------|
| | 1.2 | 5kg |
| Volume mm | 220W, 130H, 435L/4pcs | 300W, 110H, 300L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.31 | 0.80 |
| Mn | 1.86 | 1.25~2.25 |
| P | 0.007 | 0.030 |
| S | 0.006 | 0.030 |
| Ni | 2.49 | 1.75~2.75 |
| Cr | 0.02 | 0.20 |
| Mo | 0.16 | 0.50 |
| Cu | 0.01 | 0.50 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|---------|---------------|
| 1.2 | 150~300 | 150~280 | 150~250 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 760 | 676min. |
| TS (MPa) | 810 | 759~896 |
| EI on 4d (%) | 21 | 15min. |
| IV -40°C (J) | 90 | 27min. |

Approvals

| | |
|---------------|-----------------|
| ABS | 4YQ690SA H5, MG |
| DNV•GL | IVY69MS (H5) |

DW-460L

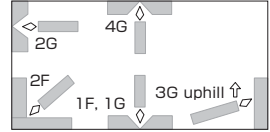
Flux cored wire

- Features:**
- Suitable for YP47 grade hull structural steel plates
 - Excellent impact value down to -60°C

Classification: AWS -
EN -

Shielding gas: CO₂
Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|------------------|------------------|--------|
| | 1.2 | 12.5kg |
| Volume mm | 300W, 110H, 300L | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.15 |
| Si | 0.43 | 0.80 |
| Mn | 1.53 | 0.50~1.75 |
| P | 0.009 | 0.030 |
| S | 0.007 | 0.030 |
| Ni | 1.56 | 1.00~2.00 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|---------|---------------|
| 1.2 | 150~300 | 150~280 | 150~250 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 580 | 460min. |
| TS (MPa) | 650 | 570~720 |
| El on 4d (%) | 25 | 20min. |
| IV -20°C (J) | 140 | 57min. |

Approvals

| | |
|------------|--------------------------------------|
| ABS | 5YQ460H5 |
| LR | 5Y46S (H5) |
| DNV | VY46MSH5 |
| BV | SA5Y46MH5 |
| NK | KSW5Y46G (C) H5, KSW63Y47G (C) H5 |
| GL | 6Y46H5S |

Solid wire

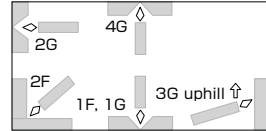
Features: • Suitable for 400 to 490MPa tensile strength steel

Classification: AWS A5.18 ER70S-G

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 20kg |
| Volume mm | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.03~0.10 |
| Si | 0.40 | 0.30~0.50 |
| Mn | 1.91 | 1.50~2.10 |
| P | 0.006 | 0.015 |
| S | 0.002 | 0.015 |
| Cu | 0.21 | 0.40 |
| Ti | 0.08 | 0.04~0.12 |
| B | 0.006 | 0.003~0.010 |

Note: ^a Single values are maximum.

Welding parameters (A)

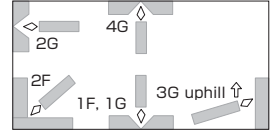
| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 1.2 | 80~300 | 50~180 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|------------------|
| 0.2%YS (MPa) | 470 | 440 | 400min. |
| TS (MPa) | 540 | 510 | 483min. |
| EI on 4d (%) | 33 | 35 | 22min. |
| IV -60°C (J) | 110 | 88 | 27min. |
| PWHT (°C×h) | AW | 620x1 | AW & 620±15x1 |

Approvals

| | |
|------------|--------------------------|
| ABS | 3YSA, MG |
| LR | 5Y40S (H15) |
| DNV | VYMS, NV2-4 (L), 4-4 (L) |
| NK | KSWL3G (M2) |

Solid wire**Features:** ▪ Suitable for low temperature steel**Classification:** AWS A5.28 ER70S-G**Shielding gas:** Ar-5~20%CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| ϕ mm | Spool |
|------------------|------------------|
| 1.2 | 20kg |
| Volume mm | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.07 |
| Si | 0.43 | 0.20~0.60 |
| Mn | 1.37 | 1.00~1.60 |
| P | 0.003 | 0.020 |
| S | 0.008 | 0.020 |
| Ni | 1.76 | 1.50~2.00 |
| Mo | 0.20 | 0.40 |
| Cu | 0.21 | 0.50 |

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|-----------|----------------|---------------|
| 1.2 | 80~300 | 50~180 |

Note: ^a Single values are maximum.**All-weld mechanical properties**

| | Typical | Guaranty |
|---------------------|-----------------------|-----------------------|
| 0.2%YS (MPa) | 410 | 360min. |
| TS (MPa) | 520 | 483min. |
| EI on 4d (%) | 32 | 22min. |
| IV -60°C (J) | 140 | 27min. |
| PWHT (°Cxh) | 620x1 | 620±15x1 |
| SG | Ar-20%CO ₂ | Ar-20%CO ₂ |

Solid wire

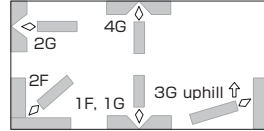
Features: • Suitable for 3.5% Ni steel

Classification: AWS A5.28 ER70S-G

Shielding gas: Ar-5~20%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 20kg |
| Volume mm | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.07 |
| Si | 0.29 | 0.50 |
| Mn | 1.24 | 1.00~1.50 |
| P | 0.006 | 0.020 |
| S | 0.002 | 0.020 |
| Ni | 4.16 | 3.80~4.50 |
| Mo | 0.21 | 0.40 |
| Cu | 0.22 | 0.50 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 1.2 | 80~300 | 50~180 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|----------------------|----------------------|
| 0.2%YS (MPa) | 470 | 360min. |
| TS (MPa) | 570 | 483min. |
| EI on 4d (%) | 32 | 16min. |
| IV (J) | -101°C: 130 | -105°C: 27min. |
| PWHT (°C×h) | 620x1 | 620±15x1 |
| SG | Ar-5%CO ₂ | Ar-5%CO ₂ |

Solid wire

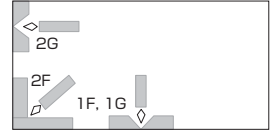
Features: ▪ Suitable for flat, horizontal and horizontal fillet welding

Classification: AWS A5.28 ER80S-G

Shielding gas: CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|------------------|------------------|
| 0.9 | 20kg |
| 1.2 | 20kg |
| 1.4 | 20kg |
| 1.6 | 20kg |
| Volume mm | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.12 |
| Si | 0.82 | 0.60~1.00 |
| Mn | 1.95 | 1.40~2.10 |
| P | 0.013 | 0.025 |
| S | 0.010 | 0.025 |
| Mo | 0.35 | 0.10~0.45 |
| Cu | 0.25 | 0.50 |
| Ti | 0.20 | 0.02~0.30 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 0.9 | 50~200 | 50~180 |
| 1.2 | 100~350 | 100~300 |
| 1.4 | 150~450 | 150~350 |
| 1.6 | 200~550 | 200~400 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|--------------|
| 0.2%YS (MPa) | 590 | 570 | 500min. |
| TS (MPa) | 670 | 660 | 552min. |
| EI on 4d (%) | 28 | 29 | 19min. |
| IV -18°C (J) | 90 | 80 | -5°C: 47min. |
| PWHT (°C×h) | AW | 620x5 | AW |

Approvals

| | |
|------------|-----------------|
| DNV | III Y46MS, MG |
| NK | KSW3Y50G (C) H5 |

Solid wire

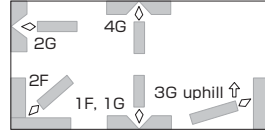
Features: • Suitable for 550 to 610MPa tensile strength steel

Classification: AWS A5.28 ER90S-G

Shielding gas: Ar-5~25%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 20kg |
| Volume mm | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.02~0.15 |
| Si | 0.71 | 0.50~0.90 |
| Mn | 1.36 | 1.10~1.60 |
| P | 0.006 | 0.025 |
| S | 0.012 | 0.025 |
| Cr | 0.45 | 0.30~0.60 |
| Mo | 0.28 | 0.10~0.45 |
| Cu | 0.25 | 0.40 |
| Ti | 0.08 | 0.02~0.30 |

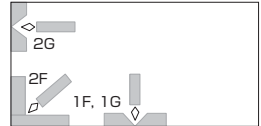
Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill, 4G |
|------|------------|--------|---------------|
| 1.2 | 80~350 | 80~300 | 50~160 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|-----------------------|-----------------------|
| 0.2%YS (MPa) | 580 | 500min. |
| TS (MPa) | 660 | 621min. |
| El on 4d (%) | 29 | 19min. |
| IV -18°C (J) | 150 | -5°C: 47min. |
| SG | Ar-20%CO ₂ | Ar-20%CO ₂ |

Solid wire**Features:** • Suitable for 690MPa tensile strength steel**Classification:** AWS A5.28 ER100S-G**Shielding gas:** CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| ϕ mm | Spool |
|------------------|------------------|
| 1.2 | 20kg |
| 1.6 | 20kg |
| Volume mm | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.78 | 0.50~1.00 |
| Mn | 2.00 | 1.70~2.30 |
| P | 0.011 | 0.030 |
| S | 0.007 | 0.030 |
| Ni | 1.05 | 0.70~1.50 |
| Mo | 0.64 | 0.40~0.90 |
| Cu | 0.23 | 0.35 |

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F, 2G |
|-----------|----------------|
| 1.2 | 100~300 |
| 1.6 | 200~450 |

Note: ^aSingle values are maximum.**All-weld mechanical properties**

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 610 | 550min. |
| TS (MPa) | 720 | 690min. |
| EI on 4d (%) | 26 | 16min. |
| IV -18°C (J) | 90 | 27min. |

Solid wire

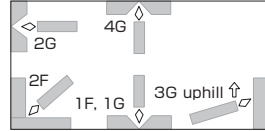
Features: • Suitable for 690MPa tensile strength steel

Classification: AWS A5.28 ER100S-G

Shielding gas: Ar-5~25%CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 20kg |
| Volume mm | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.11 |
| Si | 0.47 | 0.30~0.80 |
| Mn | 1.41 | 0.90~1.60 |
| P | 0.010 | 0.030 |
| S | 0.008 | 0.030 |
| Ni | 2.02 | 1.50~2.50 |
| Cr | 0.17 | 0.30 |
| Mo | 0.39 | 0.20~0.60 |
| Cu | 0.21 | 0.50 |

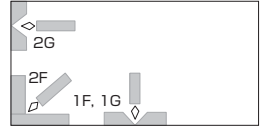
Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 1.2 | 80~300 | 50~180 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|-----------------------|-----------------------|
| 0.2%YS (MPa) | 650 | 550min. |
| TS (MPa) | 720 | 690min. |
| EI on 4d (%) | 25 | 16min. |
| IV -40°C (J) | 100 | 27min. |
| SG | Ar-20%CO ₂ | Ar-20%CO ₂ |

Solid wire**Features:** • Suitable for 780MPa tensile strength steel**Classification:** AWS A5.28 ER110S-G**Shielding gas:** CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| ϕ mm | Spool |
|------------------|------------------|
| 1.2 | 20kg |
| 1.6 | 20kg |
| Volume mm | 300W, 110H, 300L |

Composition (wire mass%)

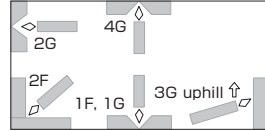
| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.67 | 0.40~0.90 |
| Mn | 1.78 | 1.60~2.20 |
| P | 0.009 | 0.025 |
| S | 0.008 | 0.025 |
| Ni | 2.16 | 1.80~2.60 |
| Mo | 0.62 | 0.40~0.90 |
| Cu | 0.23 | 0.35 |

Note: ^aSingle values are maximum.**Welding parameters (A)**

| ϕ mm | 1F, 1G, 2F, 2G |
|-----------|----------------|
| 1.2 | 100~300 |
| 1.6 | 200~450 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 710 | 590min. |
| TS (MPa) | 830 | 759min. |
| EI on 4d (%) | 24 | 15min. |
| IV -18°C (J) | 85 | 27min. |

Solid wire**Features:** • Suitable for 780MPa tensile strength steel**Classification:** AWS A5.28 ER110S-G**Shielding gas:** Ar-5~25%CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 20kg |
| Volume mm | 300W, 110H, 300L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.51 | 0.30~0.60 |
| Mn | 1.37 | 1.10~1.60 |
| P | 0.011 | 0.030 |
| S | 0.002 | 0.030 |
| Ni | 2.64 | 2.40~3.00 |
| Cr | 0.16 | 0.10~0.40 |
| Mo | 0.47 | 0.30~0.70 |
| Cu | 0.22 | 0.35 |

Note: ^aSingle values are maximum.**Welding parameters (A)**

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 1.2 | 80~300 | 50~180 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|-----------------------|-----------------------|
| 0.2%YS (MPa) | 770 | 665min. |
| TS (MPa) | 850 | 759min. |
| EI on 4d (%) | 20 | 15min. |
| IV -40°C (J) | 80 | 27min. |
| SG | Ar-20%CO ₂ | Ar-20%CO ₂ |

Approvals

| | |
|------------|---------------|
| ABS | MG |
| DNV | IVY69MS |
| NK | KSW4Y69G (M2) |

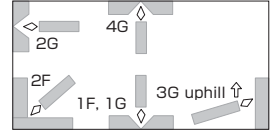
Solid wire

Features: ▪ Suitable for 780MPa tensile strength steel for low temperature service

Classification: AWS A5.28 ER120S-G

Shielding gas: Ar-20%CO₂

Polarity: DCEP

Welding Positions:**Packaging data**

| φ mm | Spool | |
|-----------|------------------|------------------|
| | 1.2 | 10kg |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.09 |
| Si | 0.50 | 0.30~0.70 |
| Mn | 1.48 | 1.30~1.70 |
| P | 0.004 | 0.020 |
| S | 0.002 | 0.020 |
| Ni | 3.51 | 3.20~3.80 |
| Mo | 0.76 | 0.60~0.90 |
| Cu | 0.23 | 0.50 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 1.2 | 80~300 | 50~180 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|-----------|---------------|
| 0.2%YS (MPa) | 770 | 690min. |
| TS (MPa) | 880 | 828min. |
| EI on 4d (%) | 22 | 15min. |
| IV (J) | -80°C: 78 | -60°C: 27min. |

Approvals

| | |
|------------|------------------|
| ABS | 4AQ690SAH5, MG |
| DNV | IVY69MS (H5), MG |

TIG welding rod and wire

| | |
|------------------------------|--------------------------------------|
| Features: | ▪ Suitable for low temperature steel |
| Classification: | AWS A5.28 ER70S-G |
| Shielding gas: | Ar |
| Identification color: | 1st Black |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.2 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| 3.2 | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | | 40W, 35H, 1015L | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.09 |
| Si | 0.31 | 0.60 |
| Mn | 1.07 | 0.70~1.30 |
| P | 0.005 | 0.025 |
| S | 0.007 | 0.025 |
| Ni | 0.79 | 0.60~1.00 |
| Mo | 0.15 | 0.30 |
| Cu | 0.15 | 0.40 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | Wire | Rod |
|------|--------|---------|
| 1.2 | 50~280 | - |
| 1.6 | - | 60~220 |
| 2.0 | - | 80~240 |
| 2.4 | - | 100~260 |
| 3.2 | - | 150~300 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|----------|
| | 460 | 390 | |
| 0.2%YS (MPa) | 540 | 450 | 360min. |
| TS (MPa) | 33 | 35 | 483min. |
| EI on 4d (%) | 200 | 250 | 24min. |
| IV -60°C (J) | AW | 620x1 | 27min. |
| PWHT (°C/h) | | | AW |

Approvals

| | |
|------------|--------------|
| ABS | 4YSA, MG |
| LR | MG |
| DNV | VYM, NV4-4L |
| BV | 4YM, UP |
| NK | KSWL2G (I) |
| GL | 4Y |

TIG welding rod and wire

| | |
|------------------------------|------------------------------|
| Features: | ▪ Suitable for 3.5% Ni steel |
| Classification: | AWS A5.28 ER70S-G |
| Shielding gas: | Ar |
| Identification color: | 1st Yellowish green |
| Polarity: | DCEN |

Packaging data

| ϕ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.2 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| 3.2 | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | | 40W, 35H, 1015L | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.06 |
| Si | 0.34 | 0.60 |
| Mn | 0.86 | 0.60~1.10 |
| P | 0.004 | 0.020 |
| S | 0.008 | 0.020 |
| Ni | 3.53 | 3.20~3.90 |
| Mo | 0.15 | 0.30 |
| Cu | 0.17 | 0.35 |

Note: ^a Single values are maximum.

Welding parameters (A)

| ϕ mm | Wire | Rod |
|------|--------|---------|
| 1.2 | 50~280 | - |
| 1.6 | - | 60~220 |
| 2.0 | - | 80~240 |
| 2.4 | - | 100~260 |
| 3.2 | - | 150~300 |

All-weld mechanical properties

| | Typical | | Guaranty |
|----------------------|---------|-------|------------------|
| 0.2%YS (MPa) | 510 | 490 | 360min. |
| TS (MPa) | 580 | 570 | 483min. |
| EI on 4d (%) | 30 | 31 | 24min. |
| IV -101°C (J) | 69 | 78 | -105°C: 27min. |
| PWHT (°C×h) | AW | 620x1 | AW & 620±15x1 |

TIG welding rod and wire

| | |
|------------------------------|---|
| Features: | ▪ Suitable for 550 to 590MPa tensile strength steel |
| Classification: | AWS A5.28 ER80S-G |
| Shielding gas: | Ar |
| Identification color: | 1st White |
| Polarity: | DCEN |

Packaging data

| φ mm | Tube | | |
|------------------|-----------------|-----------|---------|
| | kg | Length mm | g/piece |
| 1.6 | 5 | 1,000 | 16 |
| 2.0 | 5 | 1,000 | 25 |
| 2.4 | 5 | 1,000 | 35 |
| 3.2 | 5 | 1,000 | 63 |
| Volume mm | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.10 |
| Si | 0.74 | 0.30~0.85 |
| Mn | 1.38 | 1.15~1.65 |
| P | 0.007 | 0.020 |
| S | 0.006 | 0.020 |
| Ni | 0.03 | 0.60 |
| Mo | 0.52 | 0.25~0.65 |
| Cu | 0.16 | 0.50 |

Welding parameters (A)

| φ mm | Rod |
|------|---------|
| 1.6 | 60~220 |
| 2.0 | 80~240 |
| 2.4 | 100~260 |
| 3.2 | 150~300 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|------------------|
| 0.2%YS (MPa) | 540 | 530 | 420min. |
| TS (MPa) | 660 | 640 | 552min. |
| EI on 4d (%) | 28 | 26 | 18min. |
| IV -20°C (J) | 180 | 98 | 27min. |
| PWHT (°C×h) | AW | 620x1 | AW & 620±15x1 |

TIG welding rod and wire

| | |
|------------------------------|---|
| Features: | ▪ Suitable for 550 to 610MPa tensile strength steel |
| Classification: | AWS A5.28 ER80S-G |
| Shielding gas: | Ar |
| Identification color: | 1st Orange |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.2 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| Volume mm | 240W, 110H, 230L | | 40W, 35H, 1015L | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.12 |
| Si | 0.05 | 0.20 |
| Mn | 1.43 | 1.00~1.60 |
| P | 0.004 | 0.025 |
| S | 0.007 | 0.025 |
| Ni | 0.82 | 0.60~1.00 |
| Mo | 0.58 | 0.30~0.65 |
| Cu | 0.15 | 0.50 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | Wire | Rod |
|------|--------|---------|
| 1.2 | 50~280 | - |
| 1.6 | - | 60~220 |
| 2.0 | - | 80~240 |
| 2.4 | - | 100~260 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------------------|-------|------------------|
| | 0.2%YS (MPa) | 590 | 590 |
| TS (MPa) | 670 | 660 | 552min. |
| El on 4d (%) | 28 | 30 | 18min. |
| IV -60°C (J) | 270 | 280 | 27min. |
| PWHT (°C×h) | AW | 600x1 | AW & 600±15x1 |

Approvals

| | |
|------------|----------|
| ABS | 5YQ460SA |
| LR | 5Y46m |
| DNV | VY46MS |

TIG welding rod and wire

| | |
|-------------------------------|--|
| Features: | ▪ Suitable for 780MPa tensile strength steel |
| Classification: | AWS A5.28 ER110S-G |
| Shielding gas: | Ar |
| Identification color:- | |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| Volume mm | 240W, 110H, 230L | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.07 | 0.20 |
| Mn | 1.10 | 0.90~1.40 |
| P | 0.004 | 0.025 |
| S | 0.008 | 0.025 |
| Ni | 2.92 | 2.60~3.10 |
| Cr | 0.36 | 0.10~0.60 |
| Mo | 0.69 | 0.40~0.90 |
| Cu | 0.14 | 0.50 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | Wire | Rod |
|------|--------|---------|
| 1.2 | 50~280 | - |
| 1.6 | - | 60~220 |
| 2.0 | - | 80~240 |
| 2.4 | - | 100~260 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 760 | 665min. |
| TS (MPa) | 880 | 759min. |
| EI on 4d (%) | 23 | 15min. |
| IV -60°C (J) | 240 | 27min. |

Approvals

| | |
|------------|------------|
| LR | 5Y69m (H5) |
| DNV | VY69M, H5 |

FAMILIARC™ MF-38 / TRUSTARC™ US-49A

Flux and wire combination

- Features:**
- Suitable for multi-layer butt welding
 - Excellent impact value down to -40°C

Classification: AWS A5.17 F7A6-EH14, F7P6-EH14

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | | |
|-----------|--------|------------------|------------------|------------------|
| MF-38 | 12x65 | 25kg | | |
| | 20x200 | 25kg | | |
| | 20xD | 25kg | | |
| Volume mm | | 240W, 350H, 240L | | |
| Wire | φ mm | Coil | | |
| US-49A | 2.4 | 25kg | - | - |
| | 3.2 | 25kg | - | 150kg |
| | 4.0 | 25kg | 75kg | 150kg |
| | 4.8 | 25kg | 75kg | - |
| Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.10~0.20 |
| Si | 0.02 | 0.10 |
| Mn | 1.99 | 1.70~2.20 |
| P | 0.007 | 0.030 |
| S | 0.005 | 0.030 |
| Mo | 0.24 | 0.20~0.35 |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|---------------|
| 0.2%YS (MPa) | 540 | 490 | 400min. |
| TS (MPa) | 620 | 590 | 483~655 |
| El on 4d (%) | 28 | 30 | 22min. |
| IV -51°C (J) | 50 | 60 | 27min. |
| PWHT (°Cxh) | AW | 620x1 | AW & 620±15x1 |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.09 |
| Si | 0.40 |
| Mn | 1.63 |
| P | 0.019 |
| S | 0.013 |
| Mo | 0.21 |

TRUSTARC™ PF-H55LT/ FAMILIARC™ US-36

Flux and wire combination

- Features:**
- Suitable for welding of structures for low temperature service
 - Excellent impact value down to -60°C and CTOD down to -50°C

Classification: AWS A5.17 F7A8-EH14, F7P8-EH14

Type of flux: Bonded

Redrying of flux: 200~300°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | | |
|-----------|-------|------------------|------------------|------------------|
| PF-H55LT | 10x48 | 20kg | | |
| Volume mm | | 240W, 350H, 240L | | |
| Wire | φ mm | Coil | | |
| US-36 | 3.2 | 25kg | 76kg | - |
| | 4.0 | 25kg | 75kg | 150kg |
| | 4.8 | 25kg | 75kg | 150kg |
| Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.10~0.20 |
| Si | 0.03 | 0.10 |
| Mn | 1.95 | 1.70~2.20 |
| P | 0.013 | 0.030 |
| S | 0.008 | 0.030 |
| Cu | 0.12 | 0.35 |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|---------------|
| | | | |
| 0.2%YS (MPa) | 490 | 460 | 400min. |
| TS (MPa) | 555 | 540 | 483~655 |
| EI on 4d (%) | 34 | 34 | 22min. |
| IV -62°C (J) | 180 | 160 | 27min. |
| PWHT (°C×h) | AW | 620x1 | AW & 620±15x1 |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.08 |
| Si | 0.19 |
| Mn | 1.42 |
| P | 0.013 |
| S | 0.005 |
| Ti | 0.02 |
| B | 0.004 |

Approvals

| | Single | Tandem |
|------------|-------------------|---------|
| ABS | 3M, 3YM, MG | 4YM, MG |
| LR | 5Y40M, H5 | - |
| DNV | VYM, NV2-4, NV4-4 | VYM |
| BV | A4YM, UP | - |
| NK | KAWL3M | KAWL3M |

Flux and wire combination

- Features:**
- Suitable for welding of structures for low temperature service
 - Excellent impact value down to -60°C and CTOD at temperatures down to -20°C

Classification: AWS A5.17 F7A8-EH14, F7P8-EH14

Type of flux: Bonded

Redrying of flux: 200~300°Cx1h

Polarity: DCEP

Packaging data

| Flux | Mesh | Can | |
|-----------|-------|------------------|------------------|
| PF-H55AS | 10x48 | 20kg | |
| Volume mm | | 240W, 350H, 240L | |
| Wire | φ mm | Coil | |
| US-36J | 3.2 | 25kg | 76kg |
| | 4.0 | 25kg | 75kg |
| | 4.8 | 25kg | 75kg |
| Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.13 | 0.10~0.20 |
| Si | 0.01 | 0.10 |
| Mn | 2.00 | 1.70~2.20 |
| P | 0.007 | 0.030 |
| S | 0.008 | 0.030 |
| Cu | 0.10 | 0.35 |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|---------------|
| 0.2%YS (MPa) | 485 | 430 | 400min. |
| TS (MPa) | 555 | 530 | 483~655 |
| EI on 4d (%) | 33 | 31 | 22min. |
| IV -62°C (J) | 170 | 180 | 27min. |
| PWHT (°C×h) | AW | 620x1 | AW & 620±15x1 |

Composition (weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.07 |
| Si | 0.23 |
| Mn | 1.42 |
| P | 0.009 |
| S | 0.004 |
| Ti | 0.02 |
| B | 0.004 |

Approvals

| | Single | Tandem |
|------------|--------------------------|-------------------------------|
| ABS | 5Y400 H5 | 5Y400 H5 |
| LR | 5Y40M, H5 | 5Y40M, H5 |
| DNV | VY40M, NV2-4L, NV4-4L | VY40M (H5), NV2-4L, NV4-4L |
| BV | A5Y40M, H5 | A5Y40M, H5 |
| NK | KAWL3MH5 | KAWL3MH10 |
| GL | 6Y40MH5 | 6Y40MH5 |

Flux and wire combination

- Features:**
- Suitable for multi-layer butt welding of 3.5% Ni steel
 - Excellent impact value down to -100°C after PWHT

Classification: AWS A5.23 F7P15-ENi3-Ni3

Type of flux: Bonded

Redrying of flux: 200~300°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can |
|-----------|-------|------------------|
| PF-H203 | 10x48 | 25kg |
| Volume mm | | 240W, 350H, 240L |
| Wire | φ mm | Coil |
| US-203E | 4.0 | 25kg |
| Volume mm | | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.13 |
| Si | 0.18 | 0.05~0.30 |
| Mn | 0.98 | 0.60~1.20 |
| P | 0.005 | 0.020 |
| S | 0.002 | 0.020 |
| Ni | 3.48 | 3.10~3.80 |
| Cr | 0.03 | 0.15 |
| Cu | 0.11 | 0.35 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|----------------------|---------|----------|
| 0.2%YS (MPa) | 440 | 400min. |
| TS (MPa) | 530 | 483~655 |
| El on 4d (%) | 34 | 22min. |
| IV -101°C (J) | 130 | 27min. |
| PWHT (°Cxh) | 610x1 | 620±15x1 |

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.12 |
| Si | 0.21 | 0.80 |
| Mn | 0.73 | 1.60 |
| P | 0.008 | 0.030 |
| S | 0.004 | 0.025 |
| Ni | 3.35 | 2.80~3.80 |
| Cr | 0.02 | 0.15 |
| Cu | 0.10 | 0.35 |

Note: ^aSingle values are maximum.

FAMILIARC™ MF-38 / TRUSTARC™ US-A4

Flux and wire combination

- Features:**
- Suitable for butt and fillet welding
 - Applicable for 0.5%Mo steel

Classification: AWS A5.23 F8A4-EA4-A4, F8P6-EA4-A4

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | Wire | φ mm | Coil |
|-----------|--------|------------------|-----------|------|-----------------|
| MF-38 | 12x65 | 25kg | US-A4 | 3.2 | 25kg |
| | 20x200 | 25kg | | 4.0 | 25kg |
| | 20xD | 25kg | | 4.8 | 25kg |
| Volume mm | | 240W, 350H, 240L | Volume mm | | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.09 | 0.07~0.12 |
| Si | 0.04 | 0.05 |
| Mn | 1.59 | 1.25~1.70 |
| P | 0.01 | 0.025 |
| S | 0.014 | 0.025 |
| Ni | 0.02 | 0.25 |
| Cr | 0.04 | 0.15 |
| Mo | 0.52 | 0.45~0.60 |
| Cu | 0.10 | 0.35 |

Note: ^a Single values are maximum.

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.15 |
| Si | 0.39 | 0.80 |
| Mn | 1.35 | 1.60 |
| P | 0.013 | 0.030 |
| S | 0.013 | 0.030 |
| Mo | 0.52 | 0.40~0.65 |
| Cu | 0.11 | 0.35 |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | | Guaranty | |
|---------------------|---------------------|-----------|---------------|---------------|
| | 0.2%YS (MPa) | 520 | 510 | 469min. |
| TS (MPa) | 640 | 600 | 552~689 | |
| EI on 4d (%) | 28 | 29 | 20min. | |
| IV (J) | -40°C: 37 | -51°C: 40 | -40°C: 27min. | -51°C: 27min. |
| PWHT (°C/h) | AW | 620x1 | AW | 620±15x1 |

FAMILIARC™ MF-38/ TRUSTARC™ US-40

Flux and wire combination

- Features:**
- Suitable for butt and fillet welding
 - Applicable for 0.5%Mo steel

Classification: AWS A5.23 F9A6-EA3-A3, F8P6-EA3-A3

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | Wire | φ mm | Coil | |
|------------------|--------|------------------|------------------|------|-----------------|------------------|
| MF-38 | 12x65 | 25kg | US-40 | 2.4 | 25kg | - |
| | 20x200 | 25kg | | 3.2 | 25kg | - |
| | 20xD | 25kg | | 4.0 | 25kg | 75kg |
| | - | - | | 4.8 | 25kg | 75kg |
| Volume mm | | 240W, 350H, 240L | Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.13 | 0.10~0.17 |
| Si | 0.02 | 0.05 |
| Mn | 1.80 | 1.70~2.10 |
| P | 0.009 | 0.025 |
| S | 0.014 | 0.025 |
| Ni | 0.02 | 0.25 |
| Cr | 0.06 | 0.15 |
| Mo | 0.52 | 0.45~0.65 |
| Cu | 0.11 | 0.35 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | | Guaranty | |
|---------------------|---------|-------|----------|----------|
| | | | | |
| 0.2%YS (MPa) | 580 | 560 | 538min. | 469min. |
| TS (MPa) | 670 | 630 | 621~758 | 552~689 |
| El on 4d (%) | 28 | 29 | 17min. | 20min. |
| IV -51°C (J) | 51 | 58 | 27min. | 27min. |
| PWHT (°Cxh) | AW | 620x1 | AW | 620±15x1 |

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.15 |
| Si | 0.34 | 0.80 |
| Mn | 1.58 | 2.10 |
| P | 0.017 | 0.030 |
| S | 0.009 | 0.030 |
| Mo | 0.45 | 0.40~0.65 |
| Cu | 0.12 | 0.35 |

Note: ^aSingle values are maximum.

Approvals (Single)

| | |
|------------|-------------|
| ABS | MG |
| NK | KAW3Y50MH10 |

FAMILIARC™ MF-38/ TRUSTARC™ US-49

Flux and wire combination

Features:

- Suitable for butt and fillet welding
- Applicable for 0.5%Mo steel

Classification: AWS A5.23 F8A4-EG-A4, F8P6-EG-A4

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data & Type of flux

| Flux | Mesh | Can | | | |
|-----------|--------|------------------|------------------|-----------------|------------------|
| MF-38 | 12x65 | 25kg | | | |
| | 20x200 | 25kg | | | |
| | 20xD | 25kg | | | |
| Volume mm | | 240W, 350H, 240L | | | |
| Wire | φ mm | Spool | | Coil | |
| US-49 | 1.6 | - | 20kg | - | - |
| | 2.4 | 10kg | - | 25kg | - |
| | 3.2 | - | - | 25kg | 76kg |
| | 4.0 | - | - | 25kg | 75kg |
| | 4.8 | - | - | 25kg | 75kg |
| | 6.4 | - | - | 25kg | - |
| Volume mm | | 240W, 110H, 240L | 300W, 110H, 300L | 430W, 90H, 430L | 740W, 110H, 740L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.07~0.12 |
| Si | 0.03 | 0.05 |
| Mn | 1.58 | 1.25~1.80 |
| P | 0.009 | 0.025 |
| S | 0.011 | 0.025 |
| Ni | 0.02 | 0.25 |
| Cr | 0.05 | 0.15 |
| Mo | 0.52 | 0.45~0.60 |
| Cu | 0.12 | 0.35 |

Note: ^aSingle values are maximum.

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.15 |
| Si | 0.37 | 0.80 |
| Mn | 1.35 | 1.60 |
| P | 0.014 | 0.030 |
| S | 0.014 | 0.030 |
| Mo | 0.53 | 0.40~0.65 |
| Cu | 0.09 | 0.35 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | | Guaranty | |
|---------------------|-----------|-----------|---------------|---------------|
| 0.2%YS (MPa) | 520 | 510 | 470min. | |
| TS (MPa) | 640 | 600 | 550~690 | |
| EI on 4d (%) | 28 | 29 | 20min. | |
| IV (J) | -40°C: 37 | -51°C: 40 | -40°C: 27min. | -51°C: 27min. |
| PWHT (°C×h) | AW | 600x3 | AW | 620±15x1 |

Approvals (Single)

| | |
|------------|--------------|
| ABS | 3YTM |
| LR | 3T, 3YM, 3YT |
| DNV | III YTM |
| BV | A3YTM |
| NK | KAW3Y46TMH10 |
| CCS | 3YTM |

Flux and wire combination

- Features:**
- Suitable for welding of heavy structures
 - Bead appearance and slag removal are excellent

Classification: AWS A5.23 F11A4-EG-G

Type of flux: Bonded

Redrying of flux: 250~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | | |
|-----------|-------|------------------|------------------|------------------|
| PF-H80AK | 10x48 | 25kg | | |
| Volume mm | | 240W, 350H, 240L | | |
| Wire | φ mm | Coil | | |
| US-80BN | 4.0 | 25kg | 75kg | 150kg |
| | 4.8 | 25kg | - | - |
| Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|----|---------|-----------------------|
| C | 0.09 | 0.13 |
| Si | 0.13 | 0.30 |
| Mn | 2.50 | 2.10~2.80 |
| P | 0.013 | 0.020 |
| S | 0.002 | 0.020 |
| Cr | 0.78 | 0.70~0.90 |
| Mo | 0.88 | 0.70~1.05 |
| Cu | 0.13 | 0.40 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|--------------|---------|----------|
| 0.2%YS (MPa) | 720 | 676min. |
| TS (MPa) | 820 | 759~896 |
| EI on 4d (%) | 24 | 15min. |
| IV -40°C (J) | 80 | 27min. |

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|----|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.30 | 0.80 |
| Mn | 2.01 | 1.50~2.50 |
| P | 0.007 | 0.020 |
| S | 0.004 | 0.020 |
| Cr | 0.79 | 0.50~1.00 |
| Mo | 0.85 | 0.60~1.20 |

Note: ^aSingle values are maximum.

Flux and wire combination

Features:

- Suitable for welding of heavy duty structures
- Excellent impact value down to -80°C

Classification: AWS A5.23 F11A10-EG-G

Type of flux: Bonded

Redrying of flux: 250~350°Cx1h

Polarity: DCEP

Packaging data

| Flux | Mesh | Can | Wire | φ mm | Coil |
|-----------|-------|------------------|-----------|------|-----------------|
| PF-H80AS | 10x48 | 20kg | US-80LT | 3.2 | 25kg |
| | | | | 4.0 | 25kg |
| | | | | 4.8 | 25kg |
| Volume mm | | 240W, 350H, 240L | Volume mm | | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.15 |
| Si | 0.11 | 0.25 |
| Mn | 2.03 | 1.75~2.25 |
| P | 0.007 | 0.015 |
| S | 0.004 | 0.015 |
| Ni | 2.59 | 2.40~2.90 |
| Mo | 0.74 | 0.60~0.90 |
| Cu | 0.12 | 0.40 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 740 | 676min. |
| TS (MPa) | 860 | 759~896 |
| EI on 4d (%) | 23 | 15min. |
| IV -73°C (J) | 83 | 27min. |

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.51 | 0.80 |
| Mn | 1.64 | 1.20~2.20 |
| P | 0.011 | 0.030 |
| S | 0.002 | 0.030 |
| Ni | 2.42 | 2.10~2.90 |
| Mo | 0.73 | 0.50~1.00 |
| Cu | 0.11 | 0.35 |

Note: ^aSingle values are maximum.

Approvals (Single electrode)

| | |
|------------|-----------------|
| ABS | 4YQ690, MG |
| LR | 4Y69 (H5) |
| DNV | IVY69M (H5), MG |
| BV | 4Y69MH5 |
| GL | 4Y69MH5 |
| CCS | 4Y69 |

Flux and wire combination

- Features:**
- Suitable for welding of heavy duty structures
 - Excellent impact value down to -80°C

Classification: AWS A5.23 F12A10-EG-G

Type of flux: Bonded

Redrying of flux: 250~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | Wire | φ mm | Coil |
|-----------|-------|------------------|-----------|------|-----------------|
| PF-H80AK | 10x48 | 20kg | US-80LT | 3.2 | 25kg |
| | | | | 4.0 | 25kg |
| | | | | 4.8 | 25kg |
| Volume mm | | 240W, 350H, 240L | Volume mm | | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.15 |
| Si | 0.11 | 0.25 |
| Mn | 2.03 | 1.75~2.25 |
| P | 0.007 | 0.015 |
| S | 0.004 | 0.015 |
| Ni | 2.59 | 2.40~2.90 |
| Mo | 0.74 | 0.60~0.90 |
| Cu | 0.12 | 0.40 |

Note: ^aSingle values are maximum.

Weld Mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 760 | 745min. |
| TS (MPa) | 840 | 828~965 |
| EI on 4d (%) | 22 | 14min. |
| IV -73°C (J) | 90 | 27min. |

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.12 |
| Si | 0.28 | 0.80 |
| Mn | 1.65 | 1.20~2.20 |
| P | 0.009 | 0.030 |
| S | 0.004 | 0.030 |
| Ni | 2.45 | 2.10~2.90 |
| Mo | 0.74 | 0.50~1.00 |
| Cu | 0.12 | 0.35 |

Note: ^aSingle values are maximum.

Approvals (Single electrode)

| | |
|------------|------------|
| ABS | 5YQ690H5 |
| DNV | VY69M |
| NK | KAW5Y69MH5 |
| GL | 6Y69MH5 |

For Heat-Resistant Steel

Welding Consumables for

SMAW

GMAW

GTAW

SAW

SMAW, GMAW, GTAW, SAW

A guide for selecting welding consumables

| Type of steel | ASTM steel grade | | SMAW |
|---------------------------|--|--|---|
| | Plate | Pipe / Tube | |
| Mn-Mo Mn-Mo-Ni | A302Gr.B, C, D A533Type A, B, C, D | - | BL-96 |
| 0.5Mo | A204Gr.A, B, C | A209Gr.T1 A335Gr.P1 | CM-A76 |
| 1Cr-0.5Mo 1.25Cr-0.5Mo | A387Gr.12 Cl.1, Cl.2 A387Gr.11 Cl.1, Cl.2 | A213Gr.T11,T12 A335Gr.P11,T12 | CM-A96 CM-A96MB CM-A96MBD CM-B95 CM-B98 |
| 2.25Cr-1Mo | A387Gr.22 Cl.1, Cl.2 | A213Gr.T22 A335Gr.P22 | CM-A106 CM-A106N CM-A106ND CM-B105 CM-B108 |
| 2.25Cr-1Mo-V | A542Type D Cl.4a A832Gr.22V | - | CM-A106H CM-A106HD |
| Low C 2.25Cr-W-V-Nb | - | SA213Gr.T23 SA335Gr.P23 | CM-2CW |
| 5Cr-0.5Mo | A387Gr.5 Cl.1, Cl.2 | A213Gr.T5 A335Gr.P5 | CM-5 |
| 9Cr-1Mo | A387Gr.9 Cl.1, Cl.2 | A213Gr.T9 A335Gr.P9 | CM-9 |
| 9Cr-1Mo-V-Nb | A387Gr.91 Cl.2 | A213Gr.T91 A335Gr.P91 | CM-95B9 CM-96B9 CM-9Cb |
| 9Cr-W-V-Nb 12Cr-W-V-Nb | - | A213Gr.T92 A335Gr.P92 SA213Gr.T122 SA335Gr.P122 | CR-12S |

| | GMAW | GTAW | SAW |
|--|-----------------------------|--|--|
| | MG-S56 | TG-S56 TG-S63S | MF-27/US-56B PF-200/US-56B |
| | MG-SM | TG-S70SA1 TG-SM | MF-38/US-40 MF-38/US-49 MF-38/US-A4 |
| | MG-S1CM | TG-S80B2 TG-S1CM TG-S1CML | PF-200/US-511N PF-200D/US-511ND |
| | MG-S2CM MG-S2CMS | TG-S90B3 TG-S2CM TG-S2CML | PF-200/US-521S PF-200D/US-521S |
| | - | TG-S2CMH | PF-500/US-521H PF-500D/US-521HD |
| | MG-S2CW | TG-S2CW | MF-29A/US-2CW |
| | MG-S5CM | TG-S5CM | PF-200S/US-502 |
| | MG-S9CM | TG-S9CM | - |
| | MG-S9Cb | TG-S90B9 TG-S9Cb | PF-200S/US-9Cb PF-90B9/US-90B9 |
| | MG-S12CRS | TG-S12CRS | PF-200S/US-12CRSD |

SMAW, GMAW, GTAW, SAW

Tips for better welding results

SMAW

- (1) Remove scale, rust, oil, grease, water, and other dirt from welding grooves beforehand to prevent defects such as porosity and cracking in the weld metal.
- (2) Use welding currents in the recommended range because the use of excessively high currents can cause imperfections such as poor X-ray soundness, much undercuts, much spatter, and hot cracking.
- (3) Keep the arc length as short as possible to prevent porosity caused by nitrogen in the atmosphere. Limit the weaving width within two and a half times the diameter of the electrode. When striking an arc in the welding groove directly, use the backstep technique or strike an arc on a scrap plate before welding the groove to prevent blowholes in the arc starting bead.
- (4) Use preheating and interpass temperatures in the recommended range as shown in Table 1 in order to prevent the occurrence of cold cracks.
- (5) Use proper postweld heat treatment (PWHT) temperatures to ensure good mechanical properties of the weld. The use of an excessively high temperature can damage the weld causing inadequate tensile strength and impact value of the weld. In contrast, the use of an excessively low temperature can cause poor ductility and impact toughness of the weld in addition to inadequate stress relieving. The recommended ranges of PWHT temperatures are shown in Table 1. Hold weldments at PWHT temperatures for appropriate time according to the thickness of the base metal to ensure the quality of the weld.
- (6) Control heat input in predetermined ranges because heat input can markedly affect the crack resistibility and mechanical properties of the weld.

Table 1 Recommended temperatures

| Type of steel | Preheating and interpass temperature (°C) | PWHT temperature (°C) |
|----------------------------|---|-----------------------|
| Mn-Mo-Ni | 150-250 | 590-650 |
| 0.5Mo and 0.5Cr-0.5Mo | 100-250 | 620-680 |
| 1Cr-0.5Mo and 1.25Cr-0.5Mo | 150-300 | 650-700 |
| 2.25Cr-1Mo | 200-350 | 680-730 |
| 5Cr-0.5Mo and 9Cr-1Mo | 250-350 | 710-780 |
| 9Cr-1Mo-V-Nb | 250-350 | 710-760*1 750-800*2 |
| 9~12Cr-W-V-Nb | 250-350 | 750-800 |

*1: For CM-9Cb, MG-9Cb, TS-S9Cb, and PF-200S/US-9Cb

*2: For CM-95B9, CM-96B9, TG-S90B9, and PF-90B9/US-90B9

GMAW

- (1) Use DCEP polarity.
- (2) Use and appropriate shielded gas flow rate as shown in Table 2 for recommendation.
- (3) In spray arc welding with a shielding gas of Ar/O₂ or Ar/5-20%CO₂ admixture, short circuiting noise may occur when the arc voltage is excessively low. In such a case, keep the arc length about 4-5 mm in order to prevent blowholes in the weld metal.
- (4) Refer to (1), (4), (5), (6) of the tips for SMAW.

Table 2 Recommended shielding gas flow rate

| Flow rate (liter/min) | Nozzle standoff (mm) | Max wind velocity (m/sec) |
|--------------------------|-------------------------|------------------------------|
| 20-25 | 20 | 2 |

GTAW

- (1) Use DCEN polarity.
- (2) Use an appropriate shield gas flow rates as shown in Table 3.
- (3) Use back-shielding to ensure good reverse bead appearance and prevent the occurrence of porosity in the weld metal for low-alloy steels containing Cr over 1.25%.
- (4) Refer to (1), (4), (5), (6) of the tips for SMAW.

Table 3 Recommended shielding gas flow rate

| Flow rate (liter/min) | Max. wind velocity (m/sec) |
|--------------------------|-------------------------------|
| 10-15 | 1 |

SAW

- (1) Control flux supply at an appropriate flux-burden height. The flux-burden height can affect the appearance of beads and X-ray soundness. The most appropriate height varies depending on flux mesh size, shape of welding groove and other welding conditions; however, single electrode welding commonly use 25-35 mm while tandem welding generally use 30-45 mm.
- (2) Use lower currents and slower speeds for root pass welding of thick plates to prevent cracking.
- (3) Refer to (1), (4), (5), (6) of the tips for SMAW.

SMAW, GMAW, GTAW, SAW

How to select the proper welding consumable for dissimilar metal joints


The structural components of high temperature service equipment such as power generation boiler use several types of steels; therefore, joining dissimilar steels is unavoidable at the interface of different service condition areas. When joining carbon steels and Cr-Mo steels, or when joining dissimilar Cr-Mo steels, a filler metal with a composition similar to the lower-alloy steel or with an intermediate composition is commonly used for butt joints.

For instance, carbon steel can readily be joined to 2.25Cr-1Mo steel by using either a carbon steel or a 1.25Cr-0.5Mo steel filler metal; however, carbon steel filler metals are usually selected except where carbon migration (the diffusion of carbon from lower-Cr metal to higher-Cr metal during PWHT and high temperature service) must be decreased. Likewise, 2.25Cr-1Mo steel can be joined to 9Cr-1Mo-V-Nb steel by using a 2.25Cr-1Mo filler metal.

In contrast, Cr-Mo steel and austenitic stainless steel are joined with a high Cr-Ni stainless (e.g. E309) or, where carbon migration and thermal stress are important factors, nickel alloy (e.g. ENiCrFe-1) filler metal. For a quick guide to recommended welding consumables for joining dissimilar metals, refer to Table 1.

Table 1 A quick guide for joining dissimilar metals ^{(1) (2)}

| Base metal | Mild steel | 0.5Mo | 1.25Cr-0.5Mo | 2.25Cr-1Mo | 5Cr-0.5Mo | 9Cr-1Mo 9Cr-1Mo-V-Nb |
|---------------------------------|---|--|--|---|---|-------------------------|
| Type 304 stainless steel | <ul style="list-style-type: none"> • NC-39 (E309), NC-39L (E309L), TG-S309 (ER309), TG-S309L (ER309L) • NI-C703D (ENiCrFe-3), NI-C70A (ENiCrFe-1), TG-S70NCb (ERNiCr-3) | | | | | |
| 9Cr-1Mo 9Cr-1Mo-V-Nb | LB-52 (E7016) TG-S50 (ER70S-G) | CM-A76 (E7016-A1) TG-SM (ER80S-G) | CM-A96 (E8016-B2) TG-S1CM (ER80S-G) | CM-A106 (E9016-B3) TG-S2CM (ER90S-G) | CM-5 (E8016-B6) TG-S5CM (ER80S-B6) | |
| 5Cr-0.5Mo | LB-52 (E7016) TG-S50 (ER70S-G) | CM-A76 (E7016-A1) TG-SM (ER80S-G) | CM-A96 (E8016-B2) TG-S1CM (ER80S-G) | CM-A106 (E9016-B3) TG-S2CM (ER90S-G) | | |
| 2.25Cr-1Mo | LB-52 (E7016) TG-S50 (ER70S-G) | CM-A76 (E7016-A1) TG-SM (ER80S-G) | CM-A96 (E8016-B2) TG-S1CM (ER80S-G) | | | |
| 1.25Cr-0.5Mo | LB-52 (E7016) TG-S50 (ER70S-G) | CM-A76 (E7016-A1) TG-SM (ER80S-G) | | | | |
| 0.5Mo | LB-52 (E7016) TG-S50 (ER70S-G) | | | | | |



Note: (1) This table guides to recommended filler metals matching the lower-alloy steels in various dissimilar metal joints, excepting for Type 304 steel. Other types of filler metals may be needed where a specific requirement is imposed.

Note: (2) Preheating and postweld heat treatment for dissimilar Cr-Mo steels should be sufficient to the higher-alloy steel; however, the PWHT temperature should be lower to avoid damage to the lower-alloy steel and minimize the carbon migration. Type 304 stainless steel should not be preheated or postweld heat-treated to avoid sensitization.

Stick electrode for 0.5%Mo steel

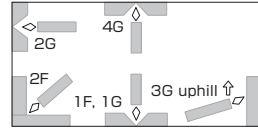
Features: ▪ Applied for ASTM A204 Gr. A, B, C and equivalents

Classification: AWS A5.5 E7016-A1

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Brown

Polarity: AC, DCEP

Welding Positions:**Packaging data**

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 170W, 120H, 330L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 120H, 430L |
| 5.0 | 400 | 5 | 20 | 86 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.08 | 0.12 |
| Si | 0.53 | 0.60 |
| Mn | 0.79 | 0.90 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Mo | 0.49 | 0.40~0.65 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 90~130 | 80~120 |
| 4.0 | 140~190 | 110~170 |
| 5.0 | 190~240 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 550 | 393min. |
| TS (MPa) | 630 | 483min. |
| EI on 4d (%) | 29 | 22min. |
| IV 0°C (J) | 210 | - |
| PWHT (°Cxh) | 620x1 | 620±15x1 |

Stick electrode for 1-1.25%Cr-0.5%Mo steel

Features: Applied for ASTM A387 Gr.11, Gr.12 and equivalents

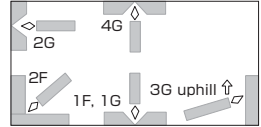
Welding Positions:

Classification: AWS A5.5 E7015-B2L

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Black, 2nd Yellow

Polarity: DCEP

**Packaging data**

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|--------------------------|
| 2.6 | 300 | 2 | 20 | 18 | 170W, 120H, 330L |
| 3.2 | 350, 400 | 5 | 20 | 31, 36 | 170W, 120H, 380L or 430L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.05 |
| Si | 0.93 | 1.00 |
| Mn | 0.74 | 0.90 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 1.20 | 1.00~1.50 |
| Mo | 0.52 | 0.40~0.65 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 70~100 | 60~90 |
| 3.2 | 110~140 | 100~130 |
| 4.0 | 150~180 | 120~160 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 470 | 393min. |
| TS (MPa) | 580 | 518min. |
| El on 4d (%) | 29 | 19min. |
| IV 0°C (J) | 78 | - |
| PWHT (°Cxh) | 690x1 | 690±15x1 |

Approvals

| LR | MG (E7015-B2L) |
|----|----------------|
| | |

Stick electrode for 1-1.25%Cr-0.5%Mo steel

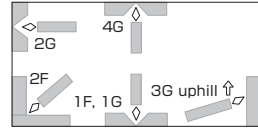
Features: Applied for ASTM A387 Gr.11, Gr.12 and equivalents

Classification: AWS A5.5 E8016-B2

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Silver, 2nd Black

Polarity: AC, DCEP

Welding Positions:**Packaging data**

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 29 | 170W, 110H, 380L |
| 4.0 | 400 | 5 | 20 | 53 | 170W, 115H, 430L |
| 5.0 | 400 | 5 | 20 | 82 | 170W, 120H, 430L |
| 6.0 | 400 | 5 | 20 | 122 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.05~0.12 |
| Si | 0.48 | 0.60 |
| Mn | 0.81 | 0.90 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 1.31 | 1.00~1.50 |
| Mo | 0.55 | 0.40~0.65 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 80~120 | 75~110 |
| 4.0 | 125~175 | 100~160 |
| 5.0 | 185~235 | - |
| 6.0 | 240~300 | - |

All-weld mechanical properties

| | Typical (AC) | | Guaranty |
|---------------------|--------------|-------|----------|
| Temp. (°C) | RT | 450 | RT |
| 0.2%YS (MPa) | 570 | 460 | 462min. |
| TS (MPa) | 650 | 520 | 552min. |
| El on 4d (%) | 26 | 21 | 19min. |
| IV 0°C (J) | 210 | - | - |
| PWHT (°Cxh) | 690x1 | 690x1 | 690±15x1 |

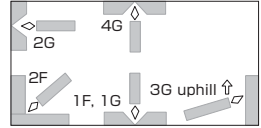
Approvals

| | |
|------------|-------------------------|
| ABS | MG (E8016-B2) |
| LR | MG (E8016-B2) |
| DNV | NV1Cr0.5Mo, H10 |
| BV | UP (E8016-B2) |
| NK | MG (E8016-B2) |
| TÜV | EN ISO 3580-A-E CrMo1 B |

Stick electrode for 1-1.25%Cr-0.5%Mo steel

Features:

- Applied for ASTM A387 Gr.11, Gr.12 and equivalents
- Lower TS and higher IV

Welding Positions:

Classification: AWS A5.5 E8016-B2

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Silver, 2nd Silver gray

Polarity: AC

Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 110H, 380L |
| 4.0 | 400 | 5 | 20 | 54 | 170W, 115H, 430L |
| 5.0 | 400 | 5 | 20 | 84 | 170W, 110H, 430L |
| 6.0 | 400 | 5 | 20 | 120 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.05~0.12 |
| Si | 0.48 | 0.60 |
| Mn | 0.78 | 0.90 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 1.35 | 1.00~1.50 |
| Mo | 0.57 | 0.40~0.65 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 80~120 | 75~110 |
| 4.0 | 125~175 | 100~160 |
| 5.0 | 185~235 | - |
| 6.0 | 240~300 | - |

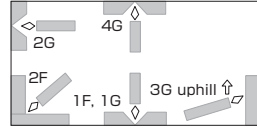
Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|----------|
| Temp. (°C) | RT | 450 | RT |
| 0.2%YS (MPa) | 490 | 360 | 462min. |
| TS (MPa) | 590 | 450 | 552min. |
| El on 4d (%) | 30 | 24 | 19min. |
| IV -18°C (J) | 200 | - | - |
| PWHT (°Cxh) | 690x1 | 690x1 | 690±15x1 |

Stick electrode for 1-1.25%Cr-0.5%Mo steel

- Features:**
- Applied for ASTM A387 Gr.11, Gr.12 and equivalents
 - Lower TS, higher IV and less sensitive to temper embrittlement

Welding Positions:

Classification: AWS A5.5 E8016-B2

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Black, 2nd Silver gray

Polarity: DCEP

Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 110H, 380L |
| 4.0 | 400 | 5 | 20 | 54 | 170W, 115H, 430L |
| 5.0 | 400 | 5 | 20 | 84 | 170W, 110H, 430L |
| 6.0 | 400 | 5 | 20 | 120 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.05~0.12 |
| Si | 0.47 | 0.60 |
| Mn | 0.79 | 0.90 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 1.31 | 1.00~1.50 |
| Mo | 0.57 | 0.40~0.65 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 80~120 | 75~110 |
| 4.0 | 125~175 | 100~160 |
| 5.0 | 185~235 | - |
| 6.0 | 240~300 | - |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|----------|
| Temp. (°C) | RT | 450 | RT |
| 0.2%YS (MPa) | 515 | 394 | 462min. |
| TS (MPa) | 617 | 484 | 552min. |
| EI on 4d (%) | 27 | 19 | 19min. |
| IV -20°C (J) | 174 | - | - |
| PWHT (°Cxh) | 690x1 | 690x1 | 690±15x1 |

Stick electrode for 1-1.25%Cr-0.5%Mo steel

Features: Applied for ASTM A387 Gr.11, Gr.12 and equivalents

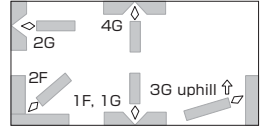
Welding Positions:

Classification: AWS A5.5 E8018-B2

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Black, 2nd Yellowish green

Polarity: AC, DCEP

**Packaging data**

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 19 | 170W, 120H, 330L |
| 3.2 | 400 | 5 | 20 | 38 | 170W, 120H, 430L |
| 4.0 | 450 | 5 | 20 | 69 | 170W, 120H, 480L |
| 5.0 | 450 | 5 | 20 | 106 | 170W, 120H, 480L |
| 6.0 | 450 | 5 | 20 | 154 | 170W, 120H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.07 | 0.05~0.12 |
| Si | 0.73 | 0.80 |
| Mn | 0.78 | 0.90 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 1.31 | 1.00~1.50 |
| Mo | 0.54 | 0.40~0.65 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 65~95 | 60~90 |
| 3.2 | 90~130 | 80~120 |
| 4.0 | 135~185 | 110~170 |
| 5.0 | 190~250 | - |
| 6.0 | 250~320 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 590 | 462min. |
| TS (MPa) | 690 | 552min. |
| EI on 4d (%) | 26 | 19min. |
| IV 0°C (J) | 66 | - |
| PWHT (°C×h) | 690x1 | 690±15x1 |

Approvals

| LR | MG (E8018-B2) |
|----|---------------|
|----|---------------|

Stick electrode for 2.25%Cr-1%Mo steel

Features: Applied for ASTM A387 Gr.22 and equivalents

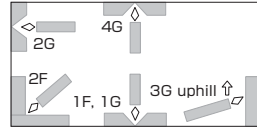
Classification: AWS A5.5 E8015-B3L

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Black, 2nd Blue

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 32 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 56 | 170W, 120H, 430L |
| 5.0 | 400 | 5 | 20 | 87 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.03 | 0.05 |
| Si | 0.90 | 1.00 |
| Mn | 0.79 | 0.90 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 2.20 | 2.00~2.50 |
| Mo | 0.98 | 0.90~1.20 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 110~140 | 100~130 |
| 4.0 | 150~180 | 120~160 |
| 5.0 | 190~220 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 550 | 462min. |
| TS (MPa) | 650 | 552min. |
| El on 4d (%) | 25 | 17min. |
| IV 0°C (J) | 79 | - |
| PWHT (°Cxh) | 690x1 | 690±15x1 |

Stick electrode for 2.25%Cr-1%Mo steel

Features: - Applied for ASTM A387 Gr.22 and equivalents

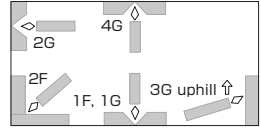
Classification: AWS A5.5 E9016-B3

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Silver, 2nd Brown

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 110H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 105H, 430L |
| 5.0 | 400 | 5 | 20 | 85 | 170W, 120H, 430L |
| 6.0 | 400 | 5 | 20 | 121 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.07 | 0.05~0.12 |
| Si | 0.44 | 0.60 |
| Mn | 0.63 | 0.90 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 2.10 | 2.00~2.50 |
| Mo | 1.02 | 0.90~1.20 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 90~130 | 75~115 |
| 4.0 | 140~190 | 100~160 |
| 5.0 | 190~240 | - |
| 6.0 | 240~300 | - |

All-weld mechanical properties

| | Typical (AC) | | Guaranty |
|---------------------|--------------|-------|----------|
| | RT | 450 | |
| Temp. (°C) | RT | 450 | RT |
| 0.2%YS (MPa) | 630 | 520 | 531min. |
| TS (MPa) | 730 | 580 | 621min. |
| El on 4d (%) | 22 | 17 | 17min. |
| IV 0°C (J) | 120 | - | - |
| PWHT (°Cxh) | 690x1 | 690x1 | 690±15x1 |

Approvals

| | |
|------------|-------------------------|
| ABS | MG (E9016-B3) |
| LR | MG (E9016-B3) |
| DNV | NV2.25Cr1Mo, H10 |
| BV | UP (E9016-B3) |
| NK | MG (E9016-B3) |
| TÜV | EN ISO 3580-A-E CrMo2 B |

Stick electrode for 2.25%Cr-1%Mo steel

- Features:**
- Applied for ASTM A387 Gr.22 and equivalents
 - Lower tensile strength, higher impact value and less sensitive to temper embrittlement

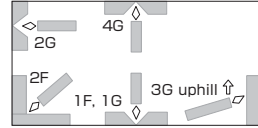
Classification: AWS A5.5 E9016-B3

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Silver, 2nd White

Polarity: AC

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 115H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 105H, 430L |
| 5.0 | 400 | 5 | 20 | 86 | 170W, 115H, 430L |
| 6.0 | 400 | 5 | 20 | 122 | 170W, 115H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.11 | 0.05~0.12 |
| Si | 0.38 | 0.60 |
| Mn | 0.76 | 0.90 |
| P | <0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 2.25 | 2.00~2.50 |
| Mo | 1.02 | 0.90~1.20 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 90~130 | 75~115 |
| 4.0 | 140~190 | 100~160 |
| 5.0 | 190~240 | - |
| 6.0 | 240~300 | - |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|----------|
| Temp. (°C) | RT | 450 | RT |
| 0.2%YS (MPa) | 510 | 430 | 531min. |
| TS (MPa) | 650 | 510 | 631min. |
| El on 4d (%) | 28 | 20 | 17min. |
| IV -29°C (J) | 120 | - | - |
| PWHT (°Cxh) | 690x8 | 690x8 | 690±15x1 |

Approvals

| BV | MG (E9016-B3) |
|----|---------------|
| | |

Stick electrode for 2.25%Cr-1%Mo steel

- Features:**
- Applied for ASTM A387 Gr.22 and equivalents
 - Lower tensile strength, higher impact value and less sensitive to temper embrittlement

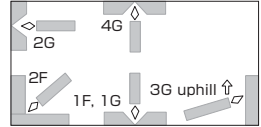
Classification: AWS A5.5 E9016-B3

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Black, 2nd White

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 105H, 430L |
| 5.0 | 400 | 5 | 20 | 86 | 170W, 115H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.09 | 0.05~0.12 |
| Si | 0.24 | 0.60 |
| Mn | 0.67 | 0.90 |
| P | <0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 2.21 | 2.00~2.50 |
| Mo | 1.02 | 0.90~1.20 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 90~130 | 75~115 |
| 4.0 | 140~190 | 100~160 |
| 5.0 | 190~240 | - |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|---------|-------|----------|
| Temp. (°C) | RT | 450 | RT |
| 0.2%YS (MPa) | 501 | 402 | 531 min. |
| TS (MPa) | 635 | 483 | 621 min. |
| El on 4d (%) | 26 | 19 | 17 min. |
| IV -40°C (J) | 151 | - | - |
| PWHT (°C×h) | 690x8 | 690x8 | 690±15x1 |

Stick electrode for 2.25%Cr-1%Mo steel

Features: Applied for ASTM A387 Gr.22 and equivalents

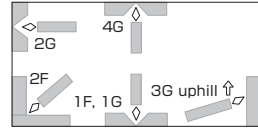
Classification: AWS A5.5 E9018-B3

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Black, 2nd Pink

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 19 | 170W, 120H, 330L |
| 3.2 | 400 | 5 | 20 | 40 | 170W, 120H, 430L |
| 4.0 | 450 | 5 | 20 | 69 | 170W, 120H, 480L |
| 5.0 | 450 | 5 | 20 | 108 | 170W, 120H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.07 | 0.05~0.12 |
| Si | 0.72 | 0.80 |
| Mn | 0.72 | 0.90 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Cr | 2.23 | 2.00~2.50 |
| Mo | 0.97 | 0.90~1.20 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 65~95 | 60~90 |
| 3.2 | 90~130 | 80~120 |
| 4.0 | 135~185 | 110~170 |
| 5.0 | 190~250 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 610 | 531min. |
| TS (MPa) | 720 | 621min. |
| EI on 4d (%) | 23 | 17min. |
| IV 0°C (J) | 106 | - |
| PWHT (°Cxh) | 690x1 | 690±15x1 |

Stick electrode for 5%Cr-0.5%Mo steel

Features: - Applied for ASTM A387 Gr.5 and equivalents

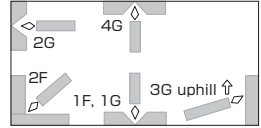
Classification: AWS A5.5 E8016-B6

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Orange

Polarity: AC, DCEP

Welding Positions:



Packaging data

| ϕ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|-----------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 54 | 170W, 120H, 430L |
| 5.0 | 400 | 5 | 20 | 82 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.08 | 0.05~0.10 |
| Si | 0.45 | 0.90 |
| Mn | 0.6 | 1.0 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.03 | 0.40 |
| Cr | 5.3 | 4.0~6.0 |
| Mo | 0.56 | 0.45~0.65 |

Note: ^a Single values are maximum.

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|-----------|----------------|---------------|
| 2.6 | 50~80 | 50~75 |
| 3.2 | 75~115 | 70~110 |
| 4.0 | 120~160 | 90~150 |
| 5.0 | 160~220 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 400 | 462min. |
| TS (MPa) | 560 | 552min. |
| El on 4d (%) | 33 | 19min. |
| IV 0°C (J) | 150 | - |
| PWHT (°Cxh) | 750x8 | 740±15x1 |

Stick electrode for 9%Cr-1%Mo steel

Features: Applied for ASTM A387 Gr.9 and equivalents

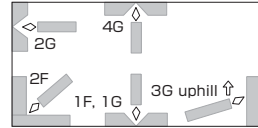
Classification: AWS A5.5 E8016-B8

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Yellow, 2nd Blue

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 30 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 110H, 430L |
| 5.0 | 400 | 5 | 20 | 85 | 170W, 115H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.08 | 0.05~0.10 |
| Si | 0.46 | 0.90 |
| Mn | 0.7 | 1.0 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.03 | 0.40 |
| Cr | 9.6 | 8.0~10.5 |
| Mo | 1.01 | 0.85~1.20 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 75~115 | 70~110 |
| 4.0 | 120~160 | 90~150 |
| 5.0 | 160~220 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 510 | 462min. |
| TS (MPa) | 680 | 552min. |
| EI on 4d (%) | 26 | 19min. |
| IV 0°C (J) | 110 | - |
| PWHT (°Cxh) | 740x10 | 740±15x1 |

Stick electrode for 9%Cr-1%Mo-Nb-V steel

- Features:**
- Applied for ASTM A387 Gr.91 and equivalents
 - Excellent creep rupture strength

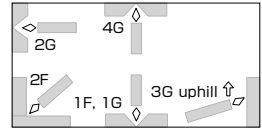
Classification: AWS -

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Yellow, 2nd Brown

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 115H, 430L |
| 5.0 | 400 | 5 | 20 | 85 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.10 | 0.08~0.13 |
| Si | 0.26 | 0.30 |
| Mn | 0.89 | 1.20 |
| P | 0.01 | 0.01 |
| S | <0.01 | 0.01 |
| Ni | 0.45 | 0.80 |
| Cr | 9.1 | 8.0~10.5 |
| Mo | 1.04 | 0.85~1.20 |
| Nb | 0.04 | 0.02~0.10 |
| V | 0.22 | 0.15~0.30 |
| Cu | 0.02 | 0.25 |
| Al | <0.01 | 0.04 |
| N | 0.03 | 0.02~0.07 |
| Mn+Ni | 1.34 | 1.50 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 75~115 | 70~110 |
| 4.0 | 120~160 | 90~140 |
| 5.0 | 160~220 | - |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 651 | 531min. |
| TS (MPa) | 768 | 621min. |
| El on 4d (%) | 22 | 17min. |
| IV 20°C (J) | 74 | - |
| PWHT (°C×h) | 760x2 | 760±15x2 |

Stick electrode for 9%Cr-1%Mo-V-Nb steel

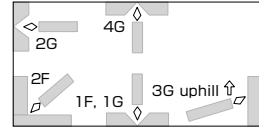
- Features:**
- Applied for ASTM A387 Gr.91 and equivalents
 - Excellent creep rupture strength

Classification: AWS -

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Yellow, 2nd Brown

Polarity: DCEP

Welding Positions:**Packaging data**

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 115H, 430L |
| 5.0 | 400 | 5 | 20 | 85 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.10 | 0.08~0.13 |
| Si | 0.27 | 0.30 |
| Mn | 0.88 | 1.20 |
| P | 0.01 | 0.01 |
| S | <0.01 | 0.01 |
| Ni | 0.44 | 0.80 |
| Cr | 9.0 | 8.0~10.5 |
| Mo | 1.06 | 0.85~1.20 |
| Nb | 0.04 | 0.02~0.10 |
| V | 0.22 | 0.15~0.30 |
| Cu | 0.03 | 0.25 |
| Al | <0.01 | 0.04 |
| N | 0.03 | 0.02~0.07 |
| Mn+Ni | 1.32 | 1.50 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 75~115 | 70~110 |
| 4.0 | 120~160 | 90~140 |
| 5.0 | 160~220 | - |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 657 | 531min. |
| TS (MPa) | 771 | 621min. |
| El on 4d (%) | 21 | 17min. |
| IV 20°C (J) | 71 | - |
| PWHT (°C×h) | 760x2 | 760±15x2 |

Stick electrode for Mn-Mo and Mn-Mo-Ni steel

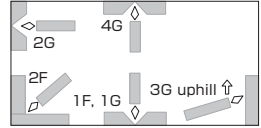
Features: - Applied for ASTM A533 Type A, B, C, D and equivalents

Classification: AWS A5.5 E9016-G

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Red, 2nd Green

Polarity: AC, DCEP

Welding Positions:**Packaging data**

| ϕ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|-----------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 120H, 430L |
| 5.0 | 400 | 5 | 20 | 86 | 170W, 120H, 430L |
| 6.0 | 450 | 5 | 20 | 137 | 170W, 120H, 480L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.50 | 0.60 |
| Mn | 1.23 | 0.90~1.70 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.40 | 0.20~1.00 |
| Mo | 0.58 | 0.35~0.65 |

Note: ^a Single values are maximum.

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|-----------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 90~130 | 80~120 |
| 4.0 | 130~180 | 110~170 |
| 5.0 | 180~240 | - |
| 6.0 | 240~300 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 540 | 531min. |
| TS (MPa) | 620 | 621min. |
| EI on 4d (%) | 26 | 17min. |
| IV -12°C (J) | 31 | - |
| PWHT (°Cxh) | 635x26 | 620±15x1 |

Stick electrode for 2.25%Cr-1%Mo-V steel

- Features:**
- Applied for ASTM A542 Type D Cl.4a and equivalents
 - Excellent tensile strength at high temperatures and good creep rupture strength

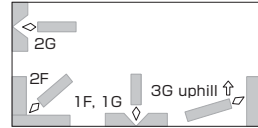
Classification: AWS A5.5 E9016-G

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Silver, 2nd Green

Polarity: AC

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 32 | 170W, 115H, 380L |
| 4.0 | 400 | 5 | 20 | 56 | 170W, 110H, 430L |
| 5.0 | 400 | 5 | 20 | 87 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.09 | 0.05~0.12 |
| Si | 0.28 | 0.20~0.50 |
| Mn | 0.87 | 0.50~1.30 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 2.13 | 2.00~2.60 |
| Mo | 1.03 | 0.90~1.20 |
| V | 0.39 | 0.20~0.40 |
| Nb | 0.018 | 0.010~0.040 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill |
|------|----------------|-----------|
| 3.2 | 90~130 | 75~115 |
| 4.0 | 140~190 | 100~160 |
| 5.0 | 190~240 | - |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 622 | 531min. |
| TS (MPa) | 730 | 621min. |
| EI on 4d (%) | 24 | 17min. |
| IV -18°C (J) | 144 | - |
| Tr (h) *1 | 1,524 | - |
| PWHT (°Cxh) | *2 | 705±15x8 |

*1: Creep rupture time (TP: 13φ)

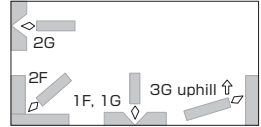
*2: 705°C×8h for tensile and impact test,
705°C×32h for creep rupture test

Stick electrode for 2.25%Cr-1%Mo-V steel

Features:

- Applied for ASTM A542 Type D Cl.4a and equivalents
- Excellent tensile strength at high temperatures and good creep rupture strength

Welding Positions:



Classification:

AWS A5.5 E9016-G

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Silver, 2nd Green

Polarity:

DCEP

Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 32 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 56 | 170W, 110H, 430L |
| 5.0 | 400 | 5 | 20 | 87 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.05~0.12 |
| Si | 0.24 | 0.20~0.50 |
| Mn | 0.87 | 0.50~1.30 |
| P | <0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Cr | 2.34 | 2.00~2.60 |
| Mo | 1.01 | 0.90~1.20 |
| V | 0.30 | 0.20~0.40 |
| Nb | 0.018 | 0.010~0.040 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill |
|------|----------------|-----------|
| 3.2 | 90~130 | 75~115 |
| 4.0 | 140~190 | 100~160 |
| 5.0 | 190~240 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 598 | 531min. |
| TS (MPa) | 713 | 621min. |
| El on 4d (%) | 21 | 17min. |
| IV -18°C (J) | 121 | - |
| PWHT (°C×h) | 705x8 | 705±15x8 |

Stick electrode for 9%Cr-1%Mo-V-Nb steel

- Features:**
- Applied for ASTM A387 Gr.91 and equivalents
 - Excellent creep rupture strength
 - Good performance by AC current

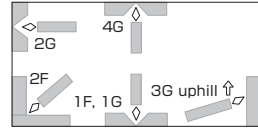
Classification: AWS A5.5 E9016-G

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Yellow, 2nd Purple

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 115H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 105H, 430L |
| 5.0 | 400 | 5 | 20 | 85 | 170W, 110H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.39 | 0.60 |
| Mn | 1.51 | 2.00 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.94 | 1.00 |
| Cr | 8.98 | 8.00~10.50 |
| Mo | 1.06 | 0.80~1.20 |
| Nb | 0.03 | 0.15 |
| V | 0.19 | 0.50 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 75~115 | 70~110 |
| 4.0 | 120~160 | 90~150 |
| 5.0 | 160~220 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 600 | 531min. |
| TS (MPa) | 750 | 621min. |
| EI on 4d (%) | 25 | 17min. |
| IV 0°C (J) | 81 | - |
| PWHT (°C×h) | 750×5 | 740±15×1 |

Approvals

| | |
|-----------|-----------|
| LR | MG |
| NK | MG |

Stick electrode for 9-12%Cr-W-V-Nb steel

Features:

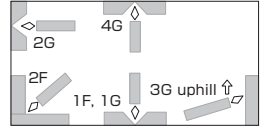
- Applied for ASTM A335 Gr. P92 and equivalents
- Excellent creep rupture strength

Classification: AWS A5.5 E9016-G

Redrying Conditions: 325~375°Cx1h

Identification color: 1st -, 2nd -

Polarity: DCEP, AC

Welding Positions:**Packaging data**

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 55 | 170W, 110H, 430L |
| 5.0 | 400 | 5 | 20 | 85 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical (DCEP) | Guaranty ^a |
|-----------|----------------|-----------------------|
| C | 0.07 | 0.15 |
| Si | 0.38 | 0.60 |
| Mn | 0.94 | 0.50~1.50 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 0.46 | 1.50 |
| Co | 1.57 | 0.50~1.80 |
| Cr | 9.52 | 8.60~13.00 |
| Mo | 0.21 | 0.50 |
| V | 0.30 | 0.50 |
| Nb | 0.030 | 0.080 |
| W | 1.56 | 1.30~2.50 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 75~115 | 70~110 |
| 4.0 | 120~160 | 90~150 |
| 5.0 | 160~220 | - |

All-weld mechanical properties

| | Typical (DCEP) | Guaranty |
|---------------------|----------------|----------|
| 0.2%YS (MPa) | 645 | 531min. |
| TS (MPa) | 771 | 621min. |
| El on 4d (%) | 22 | 17min. |
| IV 0°C (J) | 40 | - |
| PWHT (°Cxh) | 740x8 | 750±15x8 |

Stick electrode for low C-2.25%Cr-W-V-Nb steel

Features: Applied for ASTM A335 Gr. P23 and equivalents

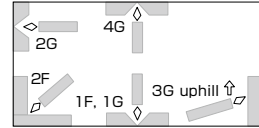
Classification: AWS A5.5 E9016-G

Redrying Conditions: 325~375°Cx1h

Identification color: 1st Orange, 2nd Green

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 270W, 85H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 170W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 57 | 170W, 120H, 430L |
| 5.0 | 400 | 5 | 20 | 86 | 170W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.05 | 0.15 |
| Si | 0.36 | 0.60 |
| Mn | 0.82 | 0.10~1.60 |
| P | 0.007 | 0.020 |
| S | 0.004 | 0.010 |
| Ni | 0.04 | 0.01~1.20 |
| Cr | 2.25 | 1.90~2.60 |
| Mo | 0.08 | 0.05~0.85 |
| Cu | 0.02 | 0.40 |
| W | 1.45 | 1.00~2.00 |
| V | 0.22 | 0.15~0.30 |
| Nb | 0.02 | 0.01~0.08 |

Note: ^a Single values are maximum.

Welding parameters (A)

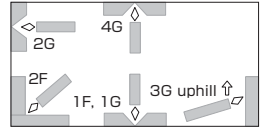
| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 55~85 | 50~80 |
| 3.2 | 75~115 | 70~110 |
| 4.0 | 120~160 | 90~150 |
| 5.0 | 190~240 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 565 | 295min. |
| TS (MPa) | 652 | 510min. |
| EI on 4d (%) | 20 | 17min. |
| IV 0°C (J) | 105 | - |
| PWHT (°Cxh) | 715x2 | 715±15x2 |

Approvals

| | |
|------------|---------------|
| LR | MG |
| NK | MG |
| TÜV | EN 1599-E Z B |

Solid wire for 5%Cr-0.5%Mo steel**Features:** ▪ Applied for ASTM A387 Gr.5 and equivalents**Classification:** AWS A5.28 ER80S-B6**Shielding gas:** Ar-2~5%O₂, Ar-5~20%CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| ϕ mm | Spool |
|------------------|------------------|
| 1.2 | 10kg |
| Volume mm | 240W, 110H, 230L |

Composition (wire mass%)

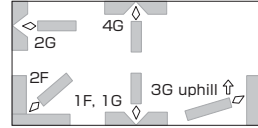
| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.09 | 0.10 |
| Si | 0.38 | 0.50 |
| Mn | 0.49 | 0.40~0.70 |
| P | 0.010 | 0.025 |
| S | 0.005 | 0.025 |
| Ni | 0.08 | 0.60 |
| Cr | 5.52 | 4.50~6.00 |
| Mo | 0.55 | 0.45~0.65 |
| Cu | 0.20 | 0.35 |

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F | 2G, 3G uphill, 4G |
|-----------|------------|-------------------|
| 1.2 | 260~320 | 140~200 |

Note: ^a Single values are maximum.**All-weld mechanical properties**

| | Typical | Guaranty |
|---------------------|---------------------|---------------------|
| 0.2%YS (MPa) | 480 | 469min. |
| TS (MPa) | 640 | 552min. |
| EI on 4d (%) | 26 | 17min. |
| IV 0°C (J) | 78 | - |
| PWHT (°Cxh) | 700x2 | 745±15x1 |
| SG | Ar-2%O ₂ | Ar-2%O ₂ |

Solid wire for 9%Cr-1%Mo steel**Features:** - Applied for ASTM A387 Gr.9 and equivalents**Classification:** AWS A5.28 ER80S-B8**Shielding gas:** Ar-2~5%O₂, Ar-5~20%CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| ϕ mm | Spool |
|------------------|------------------|
| 1.2 | 10kg |
| Volume mm | 240W, 110H, 230L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.10 |
| Si | 0.36 | 0.50 |
| Mn | 0.47 | 0.40~0.70 |
| P | 0.002 | 0.025 |
| S | 0.010 | 0.025 |
| Ni | 0.02 | 0.50 |
| Cr | 8.85 | 8.00~10.50 |
| Mo | 1.00 | 0.80~1.20 |
| Cu | 0.01 | 0.35 |

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F | 2G, 3G uphill, 4G |
|-----------|------------|-------------------|
| 1.2 | 260~320 | 140~200 |

Note: ^aSingle values are maximum.**All-weld mechanical properties**

| | Typical | Guaranty |
|---------------------|---------------------|---------------------|
| 0.2%YS (MPa) | 480 | 469min. |
| TS (MPa) | 640 | 552min. |
| EI on 4d (%) | 24 | 17min. |
| IV 0°C (J) | 130 | - |
| PWHT (°C×h) | 720x2 | 745±15x1 |
| SG | Ar-2%O ₂ | Ar-2%O ₂ |

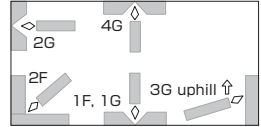
Solid wire for Mn-Mo & Mn-Mo-Ni steel

Features: ▪ Applied for ASTM A533 Type A, B, C, D and equivalents

Classification: AWS A5.28 ER80S-G

Shielding gas: Ar-5~20%CO₂

Polarity: DCEP

Welding Positions:**Packaging data**

| ϕ mm | Spool |
|------------------|------------------|
| 1.2 | 20kg |
| Volume mm | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.10 |
| Si | 0.41 | 0.30~0.90 |
| Mn | 1.50 | 1.00~1.60 |
| P | 0.004 | 0.020 |
| S | 0.007 | 0.020 |
| Ni | 0.92 | 0.50~1.00 |
| Mo | 0.35 | 0.20~0.60 |
| Cu | 0.16 | 0.35 |

Note: ^a Single values are maximum.

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F | 2G, 3G uphill, 4G |
|-----------|------------|-------------------|
| 1.2 | 240~300 | 130~190 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|-----------------------|-----------------------|
| 0.2%YS (MPa) | 500 | 469min. |
| TS (MPa) | 590 | 552min. |
| EI on 4d (%) | 29 | 19min. |
| IV -40°C (J) | 69 | - |
| PWHT (°Cxh) | 620x40 | 620±15x1 |
| SG | Ar-20%CO ₂ | Ar-20%CO ₂ |

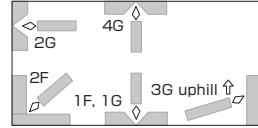
Solid wire for 0.5%Mo steel

Features: - Applied for ASTM A204 Gr. A, B, C and equivalents

Classification: AWS A5.28 ER80S-G

Shielding gas: Ar-2~5%O₂, Ar-5~20%CO₂

Polarity: DCEP

Welding Positions:**Packaging data**

| φ mm | Spool | | Drum | | |
|------------------|------------------|------------------|-------------|-------|-------------|
| | kg | kg | kg | kg | kg |
| 0.9 | 10kg | 20kg | - | - | - |
| 1.0 | 10kg | 20kg | - | - | - |
| 1.2 | 10kg | 20kg | 100kg | 250kg | 400kg |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L | 530 φ, 820H | | 680 φ, 770H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.53 | 0.30~0.70 |
| Mn | 1.03 | 0.60~1.30 |
| P | 0.006 | 0.025 |
| S | 0.008 | 0.025 |
| Ni | 0.02 | 0.20 |
| Mo | 0.54 | 0.40~0.65 |
| Cu | 0.17 | 0.35 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G, 3G uphill, 4G |
|------|------------|-------------------|
| 1.2 | 240~300 | 130~190 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|-----------------------|-----------------------|-----------------------|
| | MPa | MPa | |
| 0.2%YS (MPa) | 520 | 480 | 469min. |
| TS (MPa) | 610 | 580 | 552min. |
| EI on 4d (%) | 25 | 28 | 19min. |
| IV 0°C (J) | 98 | 160 | - |
| PWHT (°C×h) | AW | 620x1 | AW |
| SG | Ar-20%CO ₂ | Ar-20%CO ₂ | Ar-20%CO ₂ |

Approvals

| | |
|------------|--------------|
| ABS | MG (ER80S-G) |
| LR | MG (ER80S-G) |

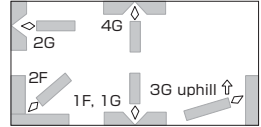
Solid wire for 1-1.25%Cr-0.5%Mo steel

Features: ▪ Applied for ASTM A387 Gr.11, Gr.12 and equivalents

Classification: AWS A5.28 ER80S-G

Shielding gas: Ar-2~5%O₂, Ar-5~20%CO₂

Polarity: DCEP

Welding Positions:**Packaging data**

| φ mm | Spool | | Drum | | |
|------------------|------------------|------------------|-------------|--------|-------------|
| | Weight | Length | Weight | Length | Weight |
| 0.8 | 10kg | - | - | - | - |
| 0.9 | 10kg | - | - | - | - |
| 1.0 | 10kg | 20kg | - | - | - |
| 1.2 | 10kg | 20kg | 250kg | 300kg | 400kg |
| 1.4 | 10kg | - | - | - | - |
| 1.6 | - | 20kg | - | - | 400kg |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L | 530 φ, 820H | | 680 φ, 770H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.55 | 0.30~0.90 |
| Mn | 1.05 | 0.80~1.50 |
| P | 0.007 | 0.025 |
| S | 0.008 | 0.025 |
| Cr | 1.38 | 1.00~1.60 |
| Mo | 0.56 | 0.40~0.65 |
| Cu | 0.26 | 0.40 |

Note: ^a Single values are maximum.

Welding parameters (A)

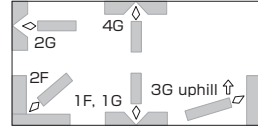
| φ mm | 1F, 1G, 2F | 2G, 3G uphill, 4G |
|------|------------|-------------------|
| 1.2 | 240~300 | 130~190 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|-----------------------|-----------------------|---------------------|
| 0.2%YS (MPa) | 570 | 420 | 469min. |
| TS (MPa) | 680 | 540 | 552min. |
| El on 4d (%) | 22 | 28 | 17min. |
| IV 0°C (J) | 69 | 170 | - |
| PWHT (°C×h) | 620x1 | 650x10 | 620±15x1 |
| SG | Ar-20%CO ₂ | Ar-20%CO ₂ | Ar-2%O ₂ |

Approvals

| | |
|------------|--------------|
| ABS | MG (ER80S-G) |
| LR | MG (ER80S-G) |
| BV | UP (ER80S-G) |
| NK | MG |

Solid wire for 2.25%Cr-1%Mo steel**Features:** - Applied for ASTM A387 Gr.22 and equivalents**Classification:** AWS A5.28 ER90S-G**Shielding gas:** Ar-2~5%O₂, Ar-5~20%CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| φ mm | Spool | | Drum | | |
|------------------|------------------|------------------|-------------|-------|-------------|
| | kg | kg | kg | kg | kg |
| 0.9 | 10kg | - | - | - | - |
| 1.0 | 10kg | - | - | - | - |
| 1.2 | 10kg | 20kg | 100kg | 250kg | 400kg |
| 1.4 | - | 20kg | - | 250kg | - |
| 1.6 | - | 20kg | - | - | 400kg |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L | 530 φ, 820H | | 680 φ, 770H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.56 | 0.30~0.90 |
| Mn | 1.03 | 0.75~1.40 |
| P | 0.005 | 0.025 |
| S | 0.008 | 0.025 |
| Cr | 2.35 | 2.10~2.70 |
| Mo | 1.11 | 0.90~1.20 |
| Cu | 0.17 | 0.40 |

Note: ^aSingle values are maximum.**Welding parameters (A)**

| φ mm | 1F, 1G, 2F | 2G, 3G uphill, 4G |
|------|------------|-------------------|
| 1.2 | 240~300 | 130~190 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|-----------------------|-----------------------|---------------------|
| | MPa | MPa | min. |
| 0.2%YS (MPa) | 550 | 430 | 538min. |
| TS (MPa) | 670 | 570 | 621min. |
| EI on 4d (%) | 26 | 30 | 17min. |
| IV 0°C (J) | 110 | 140 | - |
| PWHT (°C xh) | 680x1 | 690x15 | 690±15x1 |
| SG | Ar-20%CO ₂ | Ar-20%CO ₂ | Ar-2%O ₂ |

Approvals

| | |
|-----------|----|
| LR | MG |
| NK | MG |

Solid wire for 2.25%Cr-1%Mo steel

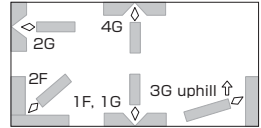
Features:

- Applied for ASTM A387 Gr.22 and equivalents
- Better toughness and lower sensitivity to temper embrittlement

Classification: AWS A5.28 ER90S-G

Shielding gas: Ar-10~20%CO₂

Polarity: DCEP

Welding Positions:**Packaging data**

| ϕ mm | Spool |
|-----------|------------------|
| 1.2 | 20kg |
| Volume mm | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.11 | 0.05~0.15 |
| Si | 0.37 | 0.20~0.60 |
| Mn | 0.80 | 0.50~1.20 |
| P | 0.004 | 0.025 |
| S | 0.007 | 0.025 |
| Cr | 2.35 | 2.10~2.70 |
| Mo | 1.13 | 0.92~1.20 |
| Cu | 0.14 | 0.40 |

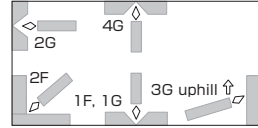
Note: ^a Single values are maximum.

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F | 2G, 3G uphill, 4G |
|-----------|------------|-------------------|
| 1.2 | 240~300 | 130~190 |

All-weld mechanical properties

| | Typical | | Guaranty |
|---------------------|-----------------------|-----------------------|-----------------------|
| 0.2%YS (MPa) | 600 | 410 | 538min. |
| TS (MPa) | 720 | 560 | 621min. |
| EI on 4d (%) | 21 | 28 | 17min. |
| IV -20°C (J) | 120 | 130 | - |
| PWHT (°C×h) | 670x1 | 690x25 | 690±15x1 |
| SG | Ar-15%CO ₂ | Ar-15%CO ₂ | Ar-15%CO ₂ |

Solid wire for low C-2.25%Cr-W-V-Nb steel**Features:** - Applied for ASTM A335 Gr. P23 and equivalents**Classification:** AWS A5.28 ER90S-G**Shielding gas:** Ar-5~20%CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| φ mm | Spool | Drum |
|------------------|------------------|-------------|
| 1.0 | 10kg | - |
| 1.2 | 10kg | 250kg |
| Volume mm | 240W, 110H, 230L | 530 φ, 820H |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.12 |
| Si | 0.38 | 0.10~0.60 |
| Mn | 1.16 | 0.80~1.60 |
| P | 0.003 | 0.020 |
| S | 0.007 | 0.010 |
| Ni | 0.55 | 0.30~1.00 |
| Cr | 2.24 | 2.00~2.60 |
| Mo | 0.10 | 0.05~0.30 |
| Cu | 0.13 | 0.40 |
| Nb | 0.04 | 0.01~0.08 |
| V | 0.27 | 0.15~0.30 |
| W | 1.80 | 1.00~2.00 |

Note: ^aSingle values are maximum.**Welding parameters (A)**

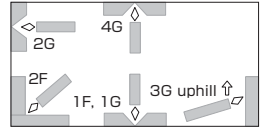
| φ mm | 1F, 1G, 2F | 2G, 3G uphill, 4G |
|------|------------|-------------------|
| 1.2 | 240~300 | 130~190 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|-----------------------|-----------------------|
| 0.2%YS (MPa) | 656 | 490min. |
| TS (MPa) | 727 | 621min. |
| El on 4d (%) | 19 | 15min. |
| IV 0°C (J) | 38 | - |
| PWHT (°Cxh) | 715x2 | 715x2 |
| SG | Ar-20%CO ₂ | Ar-20%CO ₂ |

Approvals

| | |
|-----------|----|
| LR | MG |
| NK | MG |

Solid wire for 9%Cr-1%Mo-Nb-V steel**Features:** • Applied for ASTM A387 Gr.91 and equivalents**Classification:** AWS A5.28 ER90S-G**Shielding gas:** Ar-2~5%O₂, Ar-5~20%CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| φ mm | Spool | |
|------------------|------------------|------------------|
| 1.0 | 10kg | - |
| 1.2 | 10kg | 20kg |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.12 |
| Si | 0.32 | 0.10~0.60 |
| Mn | 1.54 | 1.20~1.90 |
| P | 0.005 | 0.020 |
| S | 0.007 | 0.020 |
| Ni | 0.45 | 0.20~1.00 |
| Cr | 8.79 | 8.00~100 |
| Mo | 0.86 | 0.80~1.20 |
| Cu | 0.09 | 0.35 |
| Nb | 0.02 | 0.01~0.10 |
| V | 0.17 | 0.15~0.50 |
| N | 0.02 | 0.01~0.05 |

Note: ^aSingle values are maximum.**Welding parameters (A)**

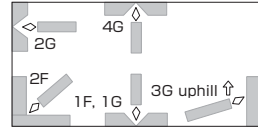
| φ mm | 1F, 1G, 2F | 2G, 3G uphill, 4G |
|------|------------|-------------------|
| 1.2 | 260~320 | 140~200 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|----------------------|---------------------|
| 0.2%YS (MPa) | 570 | 414min. |
| TS (MPa) | 700 | 621min. |
| El on 4d (%) | 27 | 15min. |
| IV 0°C (J) | 98 | - |
| PWHT (°C×h) | 740x8 | 745±15x1 |
| SG | Ar-2%CO ₂ | Ar-2%O ₂ |

Approvals

| | |
|------------|--------------|
| ABS | MG (ER90S-G) |
| LR | MG |
| NK | MG |

Solid wire for 9-12%Cr-W-V-Nb steel**Features:** - Applied for ASTM A335 Gr. P92 and equivalents**Classification:** AWS A5.28 ER90S-G**Shielding gas:** Ar-2~5%O₂, Ar-5~20%CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| φ mm | Spool | |
|-----------|------------------|------------------|
| 1.2 | 10kg | 20kg |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.12 |
| Si | 0.40 | 0.10~0.70 |
| Mn | 1.19 | 0.80~1.50 |
| P | 0.004 | 0.020 |
| S | 0.006 | 0.020 |
| Ni | 0.52 | 0.30~1.00 |
| Cr | 10.10 | 9.50~11.50 |
| Mo | 0.40 | 0.25~0.50 |
| Cu | 0.01 | 0.40 |
| Nb | 0.04 | 0.01~0.08 |
| V | 0.30 | 0.10~0.50 |
| W | 1.59 | 1.00~2.00 |
| N | 0.04 | 0.02~0.07 |
| Co | 1.59 | 1.00~1.70 |

Note: ^aSingle values are maximum.**Welding parameters (A)**

| φ mm | 1F, 1G, 2F | 2G, 3G uphill, 4G |
|------|------------|-------------------|
| 1.2 | 260~320 | 140~200 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------------------|---------------------|
| 0.2%YS (MPa) | 592 | 531min. |
| TS (MPa) | 721 | 621min. |
| El on 4d (%) | 25 | 15min. |
| IV 20°C (J) | 72 | - |
| PWHT (°C×h) | 750x8 | 750±15 |
| SG | Ar-2%O ₂ | Ar-2%O ₂ |

TG-S70SA1**TIG wire and rod for 0.5%Mo steel**

| | |
|------------------------------|---|
| Features: | • Applied for ASTM A204 Gr. A, B, C and equivalents |
| Classification: | AWS A5.28 ER70S-A1 |
| Shielding Gas: | Ar |
| Identification color: | 1st Green |
| Polarity: | DCEN |

Packaging data

| φ mm | kg | Tube | |
|------------------|-----------------|-----------|---------|
| | | Length mm | g/piece |
| 1.6 | 5 | 1,000 | 16 |
| 2.0 | 5 | 1,000 | 25 |
| 2.4 | 5 | 1,000 | 35 |
| 3.2 | 5 | 1,000 | 63 |
| Volume mm | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.53 | 0.30~0.70 |
| Mn | 1.03 | 1.30 |
| P | 0.006 | 0.025 |
| S | 0.008 | 0.025 |
| Ni | 0.02 | 0.20 |
| Mo | 0.54 | 0.40~0.65 |
| Cu | 0.15 | 0.35 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 534 | 400min. |
| TS (MPa) | 611 | 518min. |
| EI on 4d (%) | 32 | 19min. |
| IV 0°C (J) | 267 | - |
| PWHT (°C×h) | 620x1 | 620±15x1 |

TIG wire and rod for 1.25%Cr-0.5%Mo steel

Features: • Applied for ASTM A213 Gr.11 and equivalents
Classification: AWS A5.28 ER80S-B2
Shielding Gas: Ar
Identification color: 1st Silver
Polarity: DCEN

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | - | - | - |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| 3.2 | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | | 40W, 35H, 1015L | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.07~0.12 |
| Si | 0.52 | 0.40~0.70 |
| Mn | 0.60 | 0.40~0.70 |
| P | 0.004 | 0.025 |
| S | 0.007 | 0.025 |
| Ni | 0.03 | 0.20 |
| Cr | 1.35 | 1.20~1.50 |
| Mo | 0.52 | 0.40~0.65 |
| Cu | 0.15 | 0.35 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 490 | 469min. |
| TS (MPa) | 625 | 552min. |
| El on 4d (%) | 32 | 19min. |
| IV -20°C (J) | 246 | - |
| PWHT (°C×h) | 620×1 | 620±15×1 |

TIG wire and rod for 2.25%Cr-1%Mo steel

| | |
|------------------------------|---|
| Features: | • Applied for ASTM A387 Gr.22 and equivalents |
| Classification: | AWS A5.28 ER90S-B3 |
| Shielding Gas: | Ar |
| Identification color: | 1st Brown |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | - | - | - |
| 1.2 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| 3.2 | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.09 | 0.07~0.12 |
| Si | 0.64 | 0.40~0.70 |
| Mn | 0.60 | 0.40~0.70 |
| P | 0.004 | 0.025 |
| S | 0.006 | 0.025 |
| Cr | 2.39 | 2.30~2.70 |
| Mo | 1.08 | 0.90~1.20 |
| Ni | 0.06 | 0.20 |
| Cu | 0.15 | 0.35 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 596 | 538min. |
| TS (MPa) | 725 | 621min. |
| EI on 4d (%) | 27 | 17min. |
| IV -20°C (J) | 237 | - |
| PWHT (°C×h) | 690x1 | 690±15x1 |

TIG wire and rod for 5%Cr-0.5%Mo steel

| | |
|------------------------------|--|
| Features: | • Applied for ASTM A387 Gr.5 and equivalents |
| Classification: | AWS A5.28 ER80S-B6 |
| Shielding Gas: | Ar |
| Identification color: | 1st White |
| Polarity: | DCEN |

Packaging data

| Ø mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | - | - | - |
| 1.2 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| 3.2 | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.09 | 0.10 |
| Si | 0.38 | 0.50 |
| Mn | 0.49 | 0.40~0.70 |
| P | 0.010 | 0.025 |
| S | 0.005 | 0.025 |
| Ni | 0.08 | 0.60 |
| Cr | 5.51 | 4.50~6.00 |
| Mo | 0.55 | 0.45~0.65 |
| Cu | 0.17 | 0.35 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 480 | 469min. |
| TS (MPa) | 600 | 552min. |
| El on 4d (%) | 26 | 17min. |
| IV 0°C (J) | 280 | - |
| PWHT (°C×h) | 750x2 | 745±15x1 |

TIG wire and rod for 9%Cr-1%Mo steel

| | |
|------------------------------|--|
| Features: | • Applied for ASTM A387 Gr.9 and equivalents |
| Classification: | AWS A5.28 ER80S-B8 |
| Shielding Gas: | Ar |
| Identification color: | 1st Purple |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | - | - | - |
| 1.2 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| 3.2 | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.10 |
| Si | 0.37 | 0.50 |
| Mn | 0.47 | 0.40~0.70 |
| P | 0.002 | 0.025 |
| S | 0.009 | 0.025 |
| Ni | 0.02 | 0.50 |
| Cr | 8.88 | 8.00~10.50 |
| Mo | 1.00 | 0.80~1.20 |
| Cu | 0.02 | 0.35 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 410 | 469min. |
| TS (MPa) | 590 | 552min. |
| EI on 4d (%) | 32 | 17min. |
| IV 0°C (J) | 220 | - |
| PWHT (°C×h) | 750x2 | 745±15x1 |

TIG wire and rod for 9%Cr-1%Mo-Nb-V steel

Features:

- Applied for ASTM A387 Gr.91 and equivalents
- Excellent creep rupture strength

Classification: AWS A5.28 ER90S-B9

Shielding Gas: Ar

Identification color: 1st Black

Polarity: DCEN

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | - | - | - |
| 1.2 | 10 | - | - | - |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| 3.2 | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | | 40W, 35H, 1015L | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.11 | 0.07~0.13 |
| Si | 0.26 | 0.15~0.50 |
| Mn | 0.75 | 1.20 |
| P | 0.006 | 0.010 |
| S | 0.004 | 0.010 |
| Cu | 0.03 | 0.20 |
| Cr | 9.30 | 8.00~10.50 |
| Mo | 1.00 | 0.85~1.20 |
| Ni | 0.47 | 0.80 |
| V | 0.20 | 0.15~0.30 |
| Al | <0.01 | 0.04 |
| Nb | 0.06 | 0.02~0.10 |
| N | 0.04 | 0.03~0.07 |
| Mn+Ni | 1.22 | 1.50 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 706 | 414min. |
| TS (MPa) | 809 | 621min. |
| El on 4d (%) | 22 | 16min. |
| IV 0°C (J) | 160 | - |
| PWHT (°C×h) | 760x2 | 760±15x2 |

TIG wire and rod for 0.5%Mo steel

| | |
|------------------------------|---|
| Features: | • Applied for ASTM A204 Gr. A, B, C and equivalents |
| Classification: | AWS A5.28 ER80S-G |
| Shielding Gas: | Ar |
| Identification color: | 1st Green |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|------|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | - | - | - |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| 3.2 | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | | 40W, 35H, 1015L | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.05~0.12 |
| Si | 0.53 | 0.30~0.70 |
| Mn | 1.03 | 1.30 |
| P | 0.006 | 0.025 |
| S | 0.008 | 0.025 |
| Ni | 0.02 | 0.20 |
| Mo | 0.54 | 0.40~0.65 |
| Cu | 0.15 | 0.35 |

Note: ^a Single values are maximum.**All-weld mechanical properties**

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 500 | 469min. |
| TS (MPa) | 580 | 552min. |
| EI on 4d (%) | 32 | 19min. |
| IV 0°C (J) | 280 | - |
| PWHT (°C×h) | 620x1 | AW |

Approvals

| | |
|------------|-----------|
| ABS | MG |
|------------|-----------|

TIG wire and rod for Mn-Mo and Mn-Mo-Ni steel

| | |
|------------------------------|---|
| Features: | • Applied for ASTM A533 Type A, B, C, D and equivalents |
| Classification: | AWS A5.28 ER80S-G |
| Shielding Gas: | Ar |
| Identification color: | 1st Silver gray |
| Polarity: | DCEN |

Packaging data

| ø mm | Tube | | |
|------------------|-----------------|-----------|---------|
| | kg | Length mm | g/piece |
| 1.2 | 5 | 1,000 | 9 |
| 1.6 | 5 | 1,000 | 16 |
| 2.0 | 5 | 1,000 | 25 |
| 2.4 | 5 | 1,000 | 35 |
| Volume mm | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.12 |
| Si | 0.39 | 0.20~0.60 |
| Mn | 1.52 | 1.20~1.80 |
| P | 0.003 | 0.025 |
| S | 0.007 | 0.025 |
| Ni | 0.62 | 0.40~0.80 |
| Mo | 0.49 | 0.40~0.60 |
| Cu | 0.16 | 0.35 |

Note: ^aSingle values are maximum.**All-weld mechanical properties**

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 520 | 469min. |
| TS (MPa) | 590 | 552min. |
| EI on 4d (%) | 31 | 19min. |
| IV -12°C (J) | 290 | - |
| PWHT (°C×h) | 620x1 | 620±15x1 |

Approvals

| | |
|------------|----|
| TÜV | MG |
|------------|----|

TIG wire and rod for Mn-Mo and Mn-Mo-Ni steel

| | |
|------------------------------|---|
| Features: | • Applied for ASTM A533 Type A, B, C, D and equivalents |
| Classification: | AWS A5.28 ER90S-G |
| Shielding Gas: | Ar |
| Identification color: | 1st Light green |
| Polarity: | DCEN |

Packaging data

| φ mm | kg | Tube | |
|------------------|-----------------|-----------|---------|
| | | Length mm | g/piece |
| 1.6 | 5 | 1,000 | 16 |
| 2.0 | 5 | 1,000 | 25 |
| 2.4 | 5 | 1,000 | 35 |
| 3.2 | 5 | 1,000 | 63 |
| Volume mm | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.15 |
| Si | 0.34 | 0.20~0.50 |
| Mn | 1.27 | 1.05~1.45 |
| P | 0.003 | 0.025 |
| S | 0.007 | 0.025 |
| Ni | 1.58 | 1.45~1.75 |
| Cr | 0.02 | 0.30 |
| Mo | 0.41 | 0.25~0.55 |
| Cu | 0.11 | 0.35 |
| V | <0.01 | 0.05 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 566 | 530min. |
| TS (MPa) | 655 | 621min. |
| EI on 4d (%) | 27 | 15min. |
| IV -12°C (J) | 256 | - |
| PWHT (°C×h) | 625x15 | 620x1 |

TIG wire and rod for 1.25%Cr-0.5%Mo steel

Features: • Applied for ASTM A387 Gr.11, Gr.12 and equivalents
Classification: AWS A5.28 ER80S-G
Shielding Gas: Ar
Identification color: 1st Silver
Polarity: DCEN

Packaging data

| φ mm | Spool | | | Coil | Tube | | |
|------------------|------------------------|------------------|-----------------|-----------------|------|-----------|---------|
| | kg | | | kg | kg | Length mm | g/piece |
| 0.8 | 1 | 5 | 10 | - | - | - | - |
| 1.0 | - | 5 | 10 | - | - | - | - |
| 1.2 | - | - | 10 | - | 5 | 1,000 | 9 |
| 1.6 | - | - | 10 | - | 5 | 1,000 | 16 |
| 2.0 | - | - | - | - | 5 | 1,000 | 25 |
| 2.4 | - | - | - | - | 5 | 1,000 | 35 |
| 3.2 | - | - | - | 25 | 5 | 1,000 | 63 |
| Volume mm | 280W, 110H, 280L/10pcs | 240W, 110H, 230L | 430W, 90H, 430L | 40W, 35H, 1015L | | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.05~0.12 |
| Si | 0.52 | 0.30~0.70 |
| Mn | 1.06 | 0.80~1.20 |
| P | 0.006 | 0.025 |
| S | 0.007 | 0.025 |
| Ni | 0.02 | 0.20 |
| Cr | 1.40 | 1.00~1.50 |
| Mo | 0.55 | 0.40~0.65 |
| Cu | 0.20 | 0.35 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 634 | 469min. |
| TS (MPa) | 735 | 552min. |
| El on 4d (%) | 28 | 19min. |
| IV -20°C (J) | 210 | - |
| PWHT (°Cx h) | 620x1 | 620±15x1 |

Approvals

| | |
|------------|--------------|
| ABS | MG |
| LR | MG (ER80S-G) |
| DNV | MG |
| BV | UP (ER80S-G) |
| NK | MG (ER80S-G) |
| KR | MG (ER80S-G) |

TIG wire and rod for 1.25%Cr-0.5%Mo steel

Features:

- Applied for ASTM A387 Gr.11, Gr.12 and equivalents
- Lower carbon content than TG-S1CM

Classification: AWS A5.28 ER80S-G

Shielding Gas: Ar

Identification color: 1st Blue

Polarity: DCEN

Packaging data

| φ mm | Spool | | Tube | | |
|------------------|------------------|------------------|-----------------|-----------|---------|
| | kg | | kg | Length mm | g/piece |
| 0.8 | 10 | - | - | - | - |
| 1.0 | 10 | 20 | - | - | - |
| 1.2 | 10 | 20 | - | - | - |
| 1.6 | - | - | 5 | 1,000 | 16 |
| 2.0 | - | - | 5 | 1,000 | 25 |
| 2.4 | - | - | 5 | 1,000 | 35 |
| 3.2 | - | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.03 | 0.05 |
| Si | 0.47 | 0.20~0.70 |
| Mn | 1.07 | 0.80~1.30 |
| P | 0.004 | 0.025 |
| S | 0.010 | 0.025 |
| Ni | 0.02 | 0.20 |
| Cr | 1.40 | 1.00~1.50 |
| Mo | 0.51 | 0.40~0.65 |
| Cu | 0.12 | 0.35 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 480 | 469min. |
| TS (MPa) | 580 | 552min. |
| El on 4d (%) | 31 | 19min. |
| IV 0°C (J) | 300 | - |
| PWHT (°Cx h) | 620x1 | AW |

Note: ^a Single values are maximum.

TIG wire and rod for 2.25%Cr-1%Mo steel

| | |
|------------------------------|---|
| Features: | • Applied for ASTM A387 Gr.22 and equivalents |
| Classification: | AWS A5.28 ER90S-G |
| Shielding Gas: | Ar |
| Identification color: | 1st Brown |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | | | | Tube | | |
|------------------|------------------------|------------------|------------------|----|-----------------|-----------|---------|
| | kg | | | | kg | Length mm | g/piece |
| 0.8 | 1 | 5 | 10 | - | - | - | - |
| 1.0 | - | - | 10 | - | - | - | - |
| 1.2 | - | - | 10 | 20 | 5 | 1,000 | 9 |
| 1.6 | - | - | 10 | - | 5 | 1,000 | 16 |
| 2.0 | - | - | - | - | 5 | 1,000 | 25 |
| 2.4 | - | - | - | - | 5 | 1,000 | 35 |
| 3.2 | - | - | - | - | 5 | 1,000 | 63 |
| Volume mm | 280W, 110H, 280L/10pcs | 240W, 110H, 230L | 280W, 110H, 270L | | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.11 | 0.05~0.15 |
| Si | 0.36 | 0.60 |
| Mn | 0.70 | 0.50~1.20 |
| P | 0.005 | 0.025 |
| S | 0.008 | 0.025 |
| Ni | 0.04 | 0.20 |
| Cr | 2.29 | 2.10~2.50 |
| Mo | 1.07 | 0.90~1.20 |
| Cu | 0.15 | 0.35 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 610 | 538min. |
| TS (MPa) | 720 | 621min. |
| El on 4d (%) | 28 | 17min. |
| IV 0°C (J) | 250 | - |
| PWHT (°C×h) | 690×1 | 690±15×1 |

Approvals

| | |
|------------|--------------|
| ABS | MG |
| LR | MG |
| DNV | MG |
| BV | UP (ER90S-G) |
| NK | MG |
| KR | MG (ER90S-G) |

TIG wire and rod for 2.25%Cr-1%Mo steel

Features:

- Applied for ASTM A387 Gr.22 and equivalents
- Lower carbon content than TG-S2CM

Classification: AWS A5.28 ER80S-G

Shielding Gas: Ar

Identification color: 1st Red

Polarity: DCEN

Packaging data

| φ mm | Spool | | Tube | | |
|------------------|------------------|------------------|-----------------|-----------|---------|
| | kg | | kg | Length mm | g/piece |
| 1.0 | 10 | 20 | - | - | - |
| 1.2 | 10 | 20 | 5 | 1,000 | - |
| 1.6 | 10 | - | 5 | 1,000 | 16 |
| 2.0 | - | - | 5 | 1,000 | 25 |
| 2.4 | - | - | 5 | 1,000 | 35 |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.05 |
| Si | 0.50 | 0.30~0.80 |
| Mn | 1.09 | 0.80~1.40 |
| P | 0.005 | 0.025 |
| S | 0.010 | 0.025 |
| Ni | 0.02 | 0.20 |
| Cr | 2.34 | 2.10~2.70 |
| Mo | 1.10 | 0.90~1.20 |
| Cu | 0.16 | 0.40 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 520 | 469min. |
| TS (MPa) | 630 | 552min. |
| El on 4d (%) | 28 | 19min. |
| IV 0°C (J) | 250 | - |
| PWHT (°C×h) | 690×1 | 690±15×1 |

TIG wire and rod for 2.25%Cr-1%Mo-V steel

Features:

- Applied for ASTM A542 Type D Cl.4a and equivalents
- Excellent tensile strength at high temperatures and good creep rupture strength

Classification: AWS A5.28 ER90S-G

Shielding Gas: Ar

Identification color: 1st Silver

Polarity: DCEN

Packaging data

| Ø mm | Spool | | Tube | | |
|------------------|------------------|------------------|-----------------|-----------|---------|
| | kg | | kg | Length mm | g/piece |
| 1.0 | 10 | - | - | - | - |
| 1.2 | 10 | 20 | 5 | 1,000 | 9 |
| 1.6 | - | - | 5 | 1,000 | 16 |
| 2.0 | - | - | 5 | 1,000 | 25 |
| 2.4 | - | - | 5 | 1,000 | 35 |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.09~0.13 |
| Si | 0.16 | 0.70 |
| Mn | 0.41 | 0.20~0.70 |
| P | 0.004 | 0.010 |
| S | 0.007 | 0.010 |
| Ni | 0.02 | 0.20 |
| Cr | 2.31 | 2.00~2.50 |
| Mo | 1.06 | 0.90~1.20 |
| V | 0.28 | 0.20~0.40 |
| Nb | 0.033 | 0.015~0.040 |
| Cu | 0.14 | 0.35 |

Note: ^a Single values are maximum.

All-weld Mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 623 | - |
| TS (MPa) | 730 | 621min. |
| EI on 4d (%) | 22 | - |
| IV -18°C (J) | 300 | - |
| PWHT (°C×h) | 705×7 | 705±15×8 |

TIG wire and rod for 9%Cr-1%Mo-Nb-V steel

Features:

- Applied for ASTM A387 Gr.91 and equivalents
- Excellent creep rupture strength

Classification: AWS A5.28 ER90S-G

Shielding Gas: Ar

Identification color: 1st Gray

Polarity: DCEN

Packaging data

| φ mm | Spool | | Tube | | |
|------------------|------------------|----|-----------------|-----------|---------|
| | kg | | kg | Length mm | g/piece |
| 0.8 | 5 | 10 | - | - | - |
| 1.0 | - | 10 | - | - | - |
| 1.2 | - | 10 | - | - | - |
| 1.6 | - | 10 | 5 | 1,000 | 16 |
| 2.0 | - | - | 5 | 1,000 | 25 |
| 2.4 | - | - | 5 | 1,000 | 35 |
| 3.2 | - | - | 5 | 1,000 | 63 |
| Volume mm | 240W, 110H, 230L | | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.16 | 0.50 |
| Mn | 1.00 | 0.50~1.20 |
| P | 0.006 | 0.020 |
| S | 0.004 | 0.010 |
| Ni | 0.67 | 0.10~0.80 |
| Cr | 8.98 | 8.00~10.00 |
| Mo | 0.88 | 0.85~1.20 |
| Nb | 0.04 | 0.02~0.12 |
| V | 0.18 | 0.10~0.35 |
| Cu | 0.03 | 0.35 |
| N | 0.02 | 0.01~0.05 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 700 | 414min. |
| TS (MPa) | 780 | 621min. |
| El on 4d (%) | 24 | 16min. |
| IV 0°C (J) | 240 | - |
| PWHT (°C×h) | 740x8 | 745±15x1 |

Approvals

| | |
|-----------|----|
| LR | MG |
| NK | MG |

TIG wire and rod for 9-12%Cr-W-V-Nb steel

Features:

- Applied for ASTM A335 Gr. P92 and equivalents
- Excellent creep rupture strength

Classification: AWS A5.28 ER90S-G

Shielding Gas: Ar

Polarity: DCEN

Packaging data

| ø mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | - | - | - |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| Volume mm | 240W, 110H, 230L | | 40W, 35H, 1015L | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.12 |
| Si | 0.36 | 0.10~0.50 |
| Mn | 0.74 | 0.20~1.00 |
| P | 0.004 | 0.020 |
| S | 0.003 | 0.010 |
| Ni | 0.51 | 0.30~0.80 |
| Cr | 9.92 | 9.50~11.50 |
| Mo | 0.35 | 0.20~0.55 |
| Cu | 0.01 | 0.40 |
| Nb | 0.04 | 0.01~0.08 |
| V | 0.21 | 0.10~0.35 |
| W | 1.45 | 1.00~2.00 |
| Co | 1.01 | 0.80~1.20 |
| N | 0.04 | 0.02~0.07 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 686 | 531min. |
| TS (MPa) | 790 | 621min. |
| El on 4d (%) | 23 | 17min. |
| IV 0°C (J) | 44 | - |
| PWHT (°C×h) | 740×8 | 750±15 |

Note: ^aSingle values are maximum.

TIG wire and rod for low C-2.25%Cr-W-V-Nb steel

| | |
|------------------------------|---|
| Features: | • Applied for ASTM A335 Gr. P23 and equivalents |
| Classification: | AWS A5.28 ER80S-G |
| Shielding Gas: | Ar |
| Identification color: | 1st Blue white |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 0.8 | 10 | - | - | - |
| 1.0 | 10 | - | - | - |
| 1.2 | 10 | - | - | - |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 35 |
| Volume mm | 240W, 110H, 230L | 40W, 35H, 1015L | | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.42 | 0.10~0.60 |
| Mn | 0.46 | 0.20~1.00 |
| P | 0.006 | 0.020 |
| S | 0.008 | 0.010 |
| Cr | 2.30 | 2.00~2.60 |
| Mo | 0.47 | 0.40~0.65 |
| Cu | 0.17 | 0.40 |
| Nb | 0.03 | 0.01~0.08 |
| V | 0.32 | 0.15~0.40 |
| W | 1.19 | 1.00~2.00 |
| Al | <0.01 | 0.03 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 467 | 400min. |
| TS (MPa) | 578 | 520min. |
| El on 4d (%) | 31 | 17min. |
| IV 0°C (J) | 205 | - |
| PWHT (°C×h) | 715x2 | 715±15x2 |

Approvals

| | |
|-----------|----|
| LR | MG |
| NK | MG |

FAMILIARC™ MF-38/ TRUSTARC™ US-40

Flux and wire combination for 0.5%Mo steel

Features: • Applied for ASTM A204 Gr. A, B, C and equivalents

Classification: AWS A5.23 F8P6-EA3-A3, F9A6-EA3-A3

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | | Can | |
|-----------|--------|------------------|-----------------|
| MF-38 | 12x65 | 25kg | |
| | 20x200 | 25kg | |
| | 20xD | 25kg | |
| Volume mm | | 240W, 350H, 240L | |
| Wire | φ mm | Spool | Coil |
| US-40 | 2.4 | 20kg | 25kg |
| | 3.2 | - | 25kg |
| | 4.0 | - | 25kg |
| | 4.8 | - | 25kg |
| | 6.4 | - | 25kg |
| Volume mm | | 300W, 110H, 300L | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.14 | 0.05~0.17 |
| Si | 0.02 | 0.20 |
| Mn | 1.78 | 1.65~2.20 |
| P | 0.009 | 0.025 |
| S | 0.014 | 0.025 |
| Mo | 0.52 | 0.45~0.65 |
| Cu | 0.11 | 0.35 |

Note: ^aSingle values are maximum.

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.15 |
| Si | 0.34 | 0.80 |
| Mn | 1.58 | 2.10 |
| P | 0.017 | 0.030 |
| S | 0.009 | 0.030 |
| Mo | 0.45 | 0.40~0.65 |
| Cu | 0.12 | 0.35 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 560 | 469min. |
| TS (MPa) | 630 | 552~689 |
| EI on 4d (%) | 29 | 20min. |
| IV -51°C (J) | 58 | 27min. |
| PWHT (°Cxh) | 620x1 | 620±15x1 |

Approvals

| | Single electrode |
|------------|------------------|
| ABS | MG |
| NK | KAW3Y50MH10 |

FAMILIARC™ MF-38 / TRUSTARC™ US-A4

Flux and wire combination for 0.5%Mo steel

Features: • Applied for ASTM A204 Gr. A, B, C and equivalents

Classification: AWS A5.23 F8P6-EA4-A4, F8A4-EA4-A4

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | Wire | φ mm | Coil |
|-----------|--------|------------------|-----------|------|-----------------|
| MF-38 | 12x65 | 25kg | US-A4 | 3.2 | 25kg |
| | 20x200 | 25kg | | 4.0 | 25kg |
| | 20xD | 25kg | | 4.8 | 25kg |
| Volume mm | | 240W, 350H, 240L | Volume mm | | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.09 | 0.05~0.15 |
| Si | 0.04 | 0.20 |
| Mn | 1.59 | 1.20~1.70 |
| P | 0.01 | 0.025 |
| S | 0.014 | 0.025 |
| Ni | 0.02 | 0.25 |
| Cr | 0.04 | 0.15 |
| Mo | 0.52 | 0.45~0.65 |
| Cu | 0.10 | 0.35 |

Note: ^a Single values are maximum.

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.15 |
| Si | 0.39 | 0.80 |
| Mn | 1.35 | 1.60 |
| P | 0.013 | 0.030 |
| S | 0.013 | 0.030 |
| Mo | 0.52 | 0.40~0.65 |
| Cu | 0.11 | 0.35 |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 510 | 469min. |
| TS (MPa) | 600 | 552~689 |
| El on 4d (%) | 29 | 20min. |
| IV -51°C (J) | 40 | 27min. |
| PWHT (°C/h) | 620x1 | 620±15x1 |

PF-90B9/US-90B9**TRUSTARC™****Flux and wire combination for 9%Cr-1%Mo-V-Nb steel**

Features:

- Applied for ASTM A387 Gr.91 and equivalents
- Excellent creep rupture strength

Classification: AWS A5.23 F9PZ-EB91-B91

Type of flux: Bonded

Redrying of flux: 200~300°Cx1h

Polarity: DCEP

Packaging data

| Flux | Mesh | Can | |
|-----------|-------|------------------|-----------------|
| PF-90B9 | 10x48 | 20kg | |
| Volume mm | | 240W, 350H, 240L | |
| Wire | φ mm | Spool | Coil |
| US-90B9 | 1.6 | 20kg | - |
| | 2.4 | - | 25kg |
| | 3.2 | - | 25kg |
| | 4.0 | - | 25kg |
| Volume mm | | 300W, 110H, 300L | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-------|---------|-----------------------|
| C | 0.11 | 0.07~0.13 |
| Si | 0.26 | 0.50 |
| Mn | 0.74 | 1.25 |
| P | 0.006 | 0.010 |
| S | 0.004 | 0.010 |
| Cu | 0.03 | 0.10 |
| Ni | 0.47 | 1.00 |
| Cr | 9.30 | 8.50~10.50 |
| Mo | 1.00 | 0.85~1.15 |
| V | 0.20 | 0.15~0.25 |
| Al | <0.01 | 0.04 |
| Nb | 0.06 | 0.02~0.10 |
| N | 0.04 | 0.03~0.07 |
| Ti | 0.01 | 0.40 |
| Mn+Ni | 1.21 | 1.40 |

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-------|---------|-----------------------|
| C | 0.10 | 0.08~0.13 |
| Si | 0.21 | 0.80 |
| Mn | 0.92 | 1.20 |
| P | 0.009 | 0.010 |
| S | 0.004 | 0.010 |
| Cu | 0.01 | 0.25 |
| Ni | 0.50 | 0.80 |
| Cr | 9.00 | 8.0~10.5 |
| Mo | 0.97 | 0.85~1.20 |
| V | 0.21 | 0.15~0.25 |
| Al | 0.01 | 0.04 |
| Nb | 0.04 | 0.02~0.10 |
| N | 0.04 | 0.02~0.07 |
| Mn+Ni | 1.42 | 1.50 |

Note: ^aSingle values are maximum.

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|--------------|---------|----------|
| 0.2%YS (MPa) | 582 | 538min. |
| TS (MPa) | 716 | 621~758 |
| El on 4d (%) | 23 | 17min. |
| IV 20°C (J) | 37 | - |
| PWHT (°Cxh) | 760x2 | 760x2 |

FAMILIARC™ MF-38 / TRUSTARC™ US-49

Flux and wire combination for 0.5%Mo steel

Features: ▪ Applied for ASTM A204 Gr. A, B, C and equivalents

Classification: AWS A5.23 F8P6-EG-A4, F8A4-EG-A4

Type of flux: Fused

Redrying of flux: 150~350°Cx1h

Polarity: AC

Packaging data

| Flux | | Can | | | | |
|------------------|------------------|------------------|-----------------|------------------|------------------|-------|
| MF-38 | 12x65 | 25kg | | | | |
| | 20x200 | 25kg | | | | |
| | 20xD | 25kg | | | | |
| Volume mm | 240W, 350H, 240L | | | | | |
| Wire | φ mm | Spool | | Coil | | |
| US-49 | 1.6 | - | 20kg | - | - | - |
| | 2.0 | 10kg | - | - | - | - |
| | 2.4 | 10kg | - | 25kg | - | - |
| | 3.2 | - | - | 25kg | 76kg | - |
| | 4.0 | - | - | 25kg | 75kg | - |
| | 4.8 | - | - | 25kg | 75kg | 150kg |
| | 6.4 | - | - | 25kg | - | 159kg |
| Volume mm | 240W, 110H, 230L | 280W, 110H, 270L | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.07~0.12 |
| Si | 0.02 | 0.05 |
| Mn | 1.58 | 1.25~1.80 |
| P | 0.009 | 0.025 |
| S | 0.011 | 0.025 |
| Mo | 0.53 | 0.45~0.60 |
| Cu | 0.11 | 0.35 |

Note: ^a Single values are maximum.

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.15 |
| Si | 0.37 | 0.80 |
| Mn | 1.35 | 1.60 |
| P | 0.014 | 0.030 |
| S | 0.014 | 0.030 |
| Mo | 0.53 | 0.40~0.65 |
| Cu | 0.09 | 0.35 |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 508 | 469min. |
| TS (MPa) | 592 | 552~689 |
| El on 4d (%) | 30 | 20min. |
| IV -51°C (J) | 45 | 27min. |
| PWHT (°Cxh) | 620x1 | 620±15x1 |

Approvals (Single electrode)

| | |
|------------|--------------|
| ABS | 3YTM |
| LR | 3T, 3YM, 3YT |
| DNV | III YTM |
| BV | A3YTM |
| NK | KAW3Y46TMH10 |
| CCS | 3YTM |

Flux and wire combination for Mn-Mo and Mn-Mo-Ni steel**Features:** • Applied for ASTM A533 Type A, B, C, D and equivalents**Classification:** AWS A5.23 F9P4-EG-G**Type of flux:** Fused**Redrying of flux:** 150~350°Cx1h**Polarity:** AC**Packaging data**

| Flux | Mesh | Can | |
|-----------|------|------------------|------------------|
| MF-27 | 48xD | 25kg | |
| Volume mm | | 240W, 350H, 240L | |
| Wire | φ mm | Coil | |
| US-56B | 3.2 | 25kg | - |
| | 4.0 | 25kg | 75kg |
| | 4.8 | 25kg | 75kg |
| Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.11 | 0.15 |
| Si | 0.17 | 0.35 |
| Mn | 1.59 | 1.40~2.20 |
| P | 0.003 | 0.018 |
| S | 0.001 | 0.018 |
| Ni | 0.86 | 0.70~1.20 |
| Cr | 0.03 | 0.20 |
| Mo | 0.48 | 0.40~0.70 |
| Cu | 0.06 | 0.30 |

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.12 |
| Si | 0.28 | 0.50 |
| Mn | 1.05 | 0.90~1.80 |
| P | 0.009 | 0.020 |
| S | 0.002 | 0.020 |
| Ni | 0.87 | 0.70~1.20 |
| Mo | 0.45 | 0.40~0.70 |
| Cu | 0.08 | 0.30 |

Note: ^a Single values are maximum.Note: ^a Single values are maximum.**Weld mechanical properties**

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 480 | 538min. |
| TS (MPa) | 560 | 621~758 |
| EI on 4d (%) | 32 | 17min. |
| IV -40°C (J) | 85 | 27min. |
| PWHT (°Cxh) | 635x26 | 620±15x1 |

PF-200/US-56B**Flux and wire combination for Mn-Mo and Mn-Mo-Ni steel****Features:** ▪ Applied for ASTM A533 Type A, B, C, D and equivalents**Classification:** AWS A5.23 F9P4-EG-G**Type of flux:** Bonded**Redrying of flux:** 200~300°Cx1h**Polarity:** AC**Packaging data**

| Flux | Mesh | Can | |
|-----------|------|------------------|------------------|
| PF-200 | 48xD | 20kg | |
| Volume mm | | 240W, 350H, 240L | |
| Wire | φ mm | Coil | |
| US-56B | 3.2 | 25kg | - |
| | 4.0 | 25kg | 75kg |
| | 4.8 | 25kg | 75kg |
| Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.11 | 0.15 |
| Si | 0.17 | 0.35 |
| Mn | 1.59 | 1.40~2.20 |
| P | 0.003 | 0.018 |
| S | 0.001 | 0.018 |
| Ni | 0.86 | 0.70~1.20 |
| Cr | 0.03 | 0.20 |
| Mo | 0.48 | 0.40~0.70 |
| Cu | 0.06 | 0.30 |

Note: ^a Single values are maximum.**Composition (weld metal mass%)**

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.12 |
| Si | 0.11 | 0.50 |
| Mn | 1.33 | 0.90~1.80 |
| P | 0.007 | 0.020 |
| S | 0.003 | 0.020 |
| Ni | 0.83 | 0.70~1.20 |
| Mo | 0.43 | 0.40~0.70 |
| Cu | 0.08 | 0.30 |

Note: ^a Single values are maximum.**Weld mechanical properties**

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 490 | 538min. |
| TS (MPa) | 580 | 621~758 |
| El on 4d (%) | 30 | 17min. |
| IV -40°C (J) | 182 | 27min. |
| PWHT (°Cxh) | 620x11 | 620±15x1 |

PF-200/US-511N

TRUSTARC™**Flux and wire combination for 1-1.25%Cr-0.5%Mo steel**

Features:

- Applied for ASTM A387 Gr.11, Gr.12 and equivalents
- Excellent notch toughness

Classification: AWS A5.23 F8P2-EG-B2

Type of flux: Bonded

Redrying of flux: 200~300°Cx1h

Polarity: AC

Packaging data

| Flux | | Can | |
|-----------|-------|------------------|------------------|
| PF-200 | 10x48 | 20kg | |
| Volume mm | | 240W, 350H, 240L | |
| Wire | φ mm | Coil | |
| US-511N | 3.2 | 25kg | - |
| | 4.0 | 25kg | 75kg |
| Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.09 | 0.15 |
| Si | 0.30 | 0.40 |
| Mn | 0.90 | 0.50~1.00 |
| P | 0.004 | 0.015 |
| S | 0.002 | 0.015 |
| Ni | 0.17 | 0.25 |
| Cr | 1.48 | 1.25~1.80 |
| Mo | 0.52 | 0.40~0.65 |
| Cu | 0.11 | 0.25 |

Note: ^aSingle values are maximum.

Composition (weld metal mass %)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.05~0.15 |
| Si | 0.20 | 0.80 |
| Mn | 0.88 | 1.20 |
| P | 0.007 | 0.030 |
| S | 0.002 | 0.030 |
| Ni | 0.15 | 0.25 |
| Cr | 1.39 | 1.00~1.50 |
| Mo | 0.55 | 0.40~0.65 |
| Cu | 0.11 | 0.35 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 450 | 469min. |
| TS (MPa) | 560 | 552~689 |
| El on 4d (%) | 31 | 20min. |
| IV -29°C (J) | 120 | 27min. |
| PWHT (°C×h) | 690x8 | 690±15x1 |

PF-200D/US-511ND**TRUSTARC™****Flux and wire combination for 1-1.25%Cr-0.5%Mo steel****Features:** • Applied for ASTM A387 Gr.11, Gr.12 and equivalents**Classification:** AWS A5.23 F8P2-EG-B2**Type of flux:** Bonded**Redrying of flux:** 200~300°Cx1h**Polarity:** DCEP**Packaging data**

| Flux | Mesh | Can | Wire | φ mm | Coil |
|-----------|-------|------------------|-----------|------|-----------------|
| PF-200D | 10x48 | 20kg | US-511ND | 2.4 | 25kg |
| | | | | 3.2 | 25kg |
| | | | | 4.0 | 25kg |
| Volume mm | | 240W, 350H, 240L | Volume mm | | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.13 | 0.15 |
| Si | 0.11 | 0.40 |
| Mn | 0.88 | 0.50~1.00 |
| P | 0.005 | 0.015 |
| S | 0.001 | 0.015 |
| Ni | 0.15 | 0.25 |
| Cr | 1.49 | 1.25~1.80 |
| Mo | 0.56 | 0.40~0.65 |
| Cu | 0.12 | 0.25 |

Note: ^aSingle values are maximum.**Composition (weld metal mass%)**

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.05~0.15 |
| Si | 0.21 | 0.80 |
| Mn | 0.82 | 1.20 |
| P | 0.007 | 0.030 |
| S | 0.003 | 0.030 |
| Ni | 0.15 | 0.25 |
| Cr | 1.39 | 1.00~1.50 |
| Mo | 0.56 | 0.40~0.65 |
| Cu | 0.09 | 0.35 |

Note: ^aSingle values are maximum.**Weld Mechanical properties**

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 477 | 469min. |
| TS (MPa) | 589 | 552~689 |
| El on 4d (%) | 27 | 20min. |
| IV -29°C (J) | 116 | 27min. |
| PWHT (°Cxh) | 690x4 | 690±15x1 |

PF-200/US-521S

TRUSTARC™**Flux and wire combination for 2.25%Cr-1%Mo steel**

Features:

- Applied for ASTM A387 Gr.22 and equivalents
- Excellent notch toughness

Classification: AWS A5.23 F9P2-EG-B3

Type of flux: Bonded

Redrying of flux: 200~300°Cx1h

Polarity: AC

Packaging data

| Flux | | Can | | | |
|-----------|-------|------------------|------------------|------------------|--|
| PF-200 | 10x48 | 20kg | | | |
| Volume mm | | 240W, 350H, 240L | | | |
| Wire | φ mm | Coil | | | |
| US-521S | 3.2 | 25kg | - | 150kg | |
| | 4.0 | 25kg | 75kg | 150kg | |
| Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.16 | 0.08~0.18 |
| Si | 0.13 | 0.25 |
| Mn | 0.93 | 0.80~1.20 |
| P | 0.003 | 0.012 |
| S | 0.002 | 0.012 |
| Ni | 0.14 | 0.25 |
| Cr | 2.45 | 2.20~2.70 |
| Mo | 1.00 | 0.90~1.20 |
| Cu | 0.12 | 0.30 |

Note: ^aSingle values are maximum.

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.12 | 0.05~0.15 |
| Si | 0.10 | 0.80 |
| Mn | 0.82 | 1.20 |
| P | 0.008 | 0.030 |
| S | 0.001 | 0.030 |
| Ni | 0.13 | 0.25 |
| Cr | 2.34 | 2.00~2.50 |
| Mo | 1.04 | 0.90~1.20 |
| Cu | 0.12 | 0.35 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 470 | 538min. |
| TS (MPa) | 610 | 621~758 |
| El on 4d (%) | 27 | 17min. |
| IV -29°C (J) | 150 | 27min. |
| PWHT (°C×h) | 690x8 | 690±15x1 |

PF-200D/US-521S**TRUSTARC™****Flux and wire combination for 2.25%Cr-1%Mo steel****Features:** • Applied for ASTM A387 Gr.22 and equivalents**Classification:** AWS A5.23 F9P2-EG-B3**Type of flux:** Bonded**Redrying of flux:** 200~300°Cx1h**Polarity:** DCEP**Packaging data**

| Flux | | Can | | |
|-----------|-------|------------------|------------------|------------------|
| PF-200D | 10x48 | 20kg | | |
| Volume mm | | 240W, 350H, 240L | | |
| Wire | φ mm | Coil | | |
| US-521S | 3.2 | 25kg | - | 150kg |
| | 4.0 | 25kg | 75kg | 150kg |
| Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.16 | 0.08~0.18 |
| Si | 0.13 | 0.25 |
| Mn | 0.93 | 0.80~1.20 |
| P | 0.003 | 0.012 |
| S | 0.002 | 0.012 |
| Ni | 0.14 | 0.25 |
| Cr | 2.45 | 2.20~2.70 |
| Mo | 1.00 | 0.90~1.20 |
| Cu | 0.12 | 0.30 |

Note: ^a Single values are maximum.**Composition (weld metal mass%)**

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.09 | 0.05~0.15 |
| Si | 0.16 | 0.80 |
| Mn | 0.81 | 1.20 |
| P | 0.006 | 0.030 |
| S | 0.003 | 0.030 |
| Ni | 0.13 | 0.25 |
| Cr | 2.41 | 2.00~2.50 |
| Mo | 1.07 | 0.90~1.20 |
| Cu | 0.13 | 0.35 |

Note: ^a Single values are maximum.**Weld mechanical properties**

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 507 | 538min. |
| TS (MPa) | 621 | 621~758 |
| El on 4d (%) | 26 | 17min. |
| IV -29°C (J) | 164 | 27min. |
| PWHT (°Cxh) | 690x6 | 690±15x1 |

PF-200S/US-502

TRUSTARC™**Flux and wire combination for 5%Cr-0.5%Mo steel****Features:** • Applied for ASTM A387 Gr.5 and equivalents**Classification:** AWS A5.23 F7P2-EG-B6**Type of flux:** Bonded**Redrying of flux:** 200~300°Cx1h**Polarity:** AC**Packaging data**

| Flux | Mesh | Can | Wire | φ mm | Coil |
|-----------|-------|------------------|-----------|------|-----------------|
| PF-200S | 10x48 | 20kg | US-502 | 3.2 | 25kg |
| | | | | 4.0 | 25kg |
| Volume mm | | 240W, 350H, 240L | Volume mm | | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.15 |
| Si | 0.18 | 0.35 |
| Mn | 0.50 | 0.30~0.85 |
| P | 0.008 | 0.025 |
| S | 0.002 | 0.025 |
| Cu | 0.12 | 0.30 |
| Ni | 0.03 | 0.20 |
| Cr | 5.50 | 4.80~6.00 |
| Mo | 0.55 | 0.40~0.65 |

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.21 | 0.80 |
| Mn | 0.78 | 1.20 |
| P | 0.012 | 0.030 |
| S | 0.002 | 0.030 |
| Cu | 0.12 | 0.35 |
| Cr | 5.25 | 4.50~6.00 |
| Mo | 0.55 | 0.40~0.65 |

Note: ^a Single values are maximum.Note: ^a Single values are maximum.**Weld mechanical properties**

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 460 | 400min. |
| TS (MPa) | 590 | 483~655 |
| El on 4d (%) | 32 | 22min. |
| IV -29°C (J) | 133 | 27min. |
| PWHT (°Cxh) | 720x1 | 745±15x1 |

PF-200S/US-9Cb**TRUSTARC™****Flux and wire combination for 9%Cr-1%Mo-V-Nb steel**

Features:

- Suitable for multi-pass butt welding of 9%Cr-1%Mo-V-Nb steel
- Excellent creep rupture strength

Classification: AWS A5.23 F10PZ-EG-G

Type of flux: Bonded

Redrying of flux: 200~300°Cx1h

Polarity: AC

Packaging data

| Flux | Mesh | Can | |
|-----------|-------|------------------|-----------------|
| PF-200S | 10x48 | 20kg | |
| Volume mm | | 240W, 350H, 240L | |
| Wire | φ mm | Spool | Coil |
| US-9Cb | 1.2 | 20kg | - |
| | 1.6 | 20kg | - |
| | 2.4 | - | 25kg |
| | 3.2 | - | 25kg |
| | 4.0 | - | 25kg |
| Volume mm | | 300W, 110H, 300L | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.14 |
| Si | 0.13 | 0.30 |
| Mn | 1.73 | 2.00 |
| P | 0.005 | 0.020 |
| S | 0.003 | 0.020 |
| Ni | 0.57 | 1.00 |
| Cr | 8.81 | 8.00~10.50 |
| Mo | 0.90 | 0.80~1.20 |
| Nb | 0.05 | 0.10 |
| V | 0.23 | 0.50 |
| Cu | 0.02 | 0.15 |

Note: ^aSingle values are maximum.

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.12 | 0.60 |
| Mn | 1.58 | 2.00 |
| P | 0.008 | 0.025 |
| S | 0.004 | 0.025 |
| Ni | 0.55 | 1.00 |
| Cr | 8.31 | 8.00~10.50 |
| Mo | 0.88 | 0.80~1.20 |
| Nb | 0.03 | 0.15 |
| V | 0.21 | 0.50 |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 580 | 607min. |
| TS (MPa) | 710 | 690~827 |
| El on 4d (%) | 24 | 16min. |
| IV 0°C (J) | 68 | - |
| PWHT (°C×h) | 740x8 | 745±15x1 |

PF-500/US-521H

TRUSTARC™**Flux and wire combination for 2.25%Cr-1%Mo-V steel**

- Features:**
- Applied for ASTM A542 Type D Cl.4a and equivalents
 - Excellent tensile strength at high temperatures and good creep rupture strength

Classification: AWS A5.23 F9P2-EG-G

Type of flux: Bonded

Redrying of flux: 200~300°Cx1h

Polarity: AC

Packaging data

| Flux | | Can | | |
|-----------|-------|------------------|------------------|------------------|
| PF-500 | 10x48 | 20kg | | |
| Volume mm | | 240W, 350H, 240L | | |
| Wire | φ mm | Coil | | |
| US-521H | 2.4 | 25kg | - | - |
| | 3.2 | 25kg | - | - |
| | 4.0 | 25kg | 75kg | 150kg |
| Volume mm | | 430W, 90H, 430L | 740W, 110H, 740L | 840W, 110H, 840L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|----|---------|-----------------------|
| C | 0.16 | 0.18 |
| Si | 0.21 | 0.30 |
| Mn | 1.19 | 0.30~1.50 |
| P | 0.002 | 0.010 |
| S | 0.001 | 0.010 |
| Ni | <0.01 | 0.20 |
| Cr | 2.13 | 2.00~2.65 |
| Mo | 0.99 | 0.90~1.20 |
| V | 0.36 | 0.25~0.45 |
| Nb | 0.019 | 0.010~0.040 |
| Cu | 0.10 | 0.30 |

Note: ^aSingle values are maximum.

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|----|---------|-----------------------|
| C | 0.12 | 0.05~0.15 |
| Si | 0.15 | 0.05~0.35 |
| Mn | 1.14 | 0.50~1.30 |
| P | 0.003 | 0.010 |
| S | 0.001 | 0.010 |
| Ni | <0.01 | 0.20 |
| Cr | 2.04 | 2.00~2.60 |
| Mo | 0.99 | 0.90~1.20 |
| V | 0.33 | 0.20~0.40 |
| Nb | 0.015 | 0.010~0.040 |
| Cu | 0.09 | - |

Note: ^aSingle values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|--------------|---------|----------|
| 0.2%YS (MPa) | 620 | 530min. |
| TS (MPa) | 722 | 620min. |
| EI on 4d (%) | 23 | 16min. |
| IV -18°C (J) | 150 | - |
| Tr (h) *1 | 1,387 | - |
| PWHT (°C×h) | *2 | 705±15×8 |

*1: Creep rupture time (TP: 13φ)

*2: 705×8 for tensile and impact test

705×32 for creep rupture test

Flux and wire combination for 2.25%Cr-1%Mo-V steel

Features:

- Applied for ASTM A542 Type D Cl.4a and equivalents
- Excellent tensile strength at high temperatures and good creep rupture strength

Classification: AWS A5.23 F9P2-EG-G

Type of flux: Bonded

Redrying of flux: 200~300°Cx1h

Polarity: DCEP

Packaging data

| Flux | Mesh | Can | Wire | φ mm | Coil |
|-----------|-------|------------------|-----------|------|-----------------|
| PF-500D | 10x48 | 20kg | US-521HD | 4.0 | 25kg |
| Volume mm | | 240W, 350H, 240L | Volume mm | | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.16 | 0.18 |
| Si | 0.19 | 0.30 |
| Mn | 1.07 | 0.30~1.50 |
| P | 0.005 | 0.010 |
| S | 0.001 | 0.010 |
| Ni | 0.04 | 0.20 |
| Cr | 2.60 | 2.00~2.65 |
| Mo | 1.00 | 0.90~1.20 |
| V | 0.37 | 0.25~0.45 |
| Nb | 0.032 | 0.010~0.040 |
| Cu | 0.09 | 0.30 |

Note: ^a Single values are maximum.

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.08 | 0.05~0.15 |
| Si | 0.12 | 0.05~0.35 |
| Mn | 0.78 | 0.50~1.30 |
| P | 0.008 | 0.010 |
| S | 0.001 | 0.010 |
| Ni | 0.03 | 0.20 |
| Cr | 2.42 | 2.00~2.60 |
| Mo | 1.00 | 0.90~1.20 |
| V | 0.31 | 0.20~0.40 |
| Nb | 0.017 | 0.010~0.040 |
| Cu | 0.09 | - |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 593 | 530min. |
| TS (MPa) | 693 | 620min. |
| El on 4d (%) | 25 | 18min. |
| IV -18°C (J) | 130 | - |
| PWHT (°Cxh) | 705x8 | 705±15x8 |

Flux and wire combination for low C-2.25%Cr-W-V-Nb steel

Features: • Applied for ASTM A335 Gr.23 and equivalents

Classification: AWS -

Type of flux: Fused

Polarity: DCEP

Packaging data

| Flux | Mesh | Can | |
|-----------|------|------------------|-----------------|
| MF-29A | 48xD | 25kg | |
| Volume mm | | 240W, 350H, 240L | |
| Wire | φ mm | Spool | Coil |
| US-2CW | 1.6 | 20kg | - |
| | 2.4 | - | 25kg |
| | 3.2 | - | 25kg |
| | 4.0 | - | 25kg |
| Volume mm | | 300W, 110H, 300L | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.15 |
| Si | 0.13 | 0.60 |
| Mn | 1.15 | 0.10~1.60 |
| P | 0.004 | 0.020 |
| S | 0.004 | 0.010 |
| Cu | 0.11 | 0.40 |
| Cr | 2.26 | 1.90~2.60 |
| Mo | 0.12 | 0.05~0.85 |
| W | 1.75 | 1.00~2.00 |
| V | 0.24 | 0.15~0.30 |
| Nb | 0.026 | 0.040 |

Note: ^a Single values are maximum.

Composition (weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.15 |
| Si | 0.25 | 0.60 |
| Mn | 1.15 | 0.10~1.60 |
| P | 0.006 | 0.020 |
| S | 0.002 | 0.010 |
| Cu | 0.13 | 0.40 |
| Cr | 2.12 | 1.90~2.60 |
| Mo | 0.12 | 0.05~0.85 |
| W | 1.69 | 1.00~2.00 |
| V | 0.22 | 0.15~0.30 |
| Nb | 0.016 | 0.040 |

Note: ^a Single values are maximum.

Weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 521 | 300min. |
| TS (MPa) | 615 | 510min. |
| El on 4d (%) | 27 | 17min. |
| IV 20°C (J) | 98 | - |
| PWHT (°Cxh) | 715x2 | 715x2 |

PF-200S/US-12CRSD**Flux and wire combination for 9-12%Cr-W-V-Nb steel****Features:** • Applied for ASTM A335 Gr. P92 and equivalents**Classification:** AWS -**Type of flux:** Bonded**Redrying of flux:** 200~300°Cx1h**Polarity:** DCEP**Packaging data**

| Flux | Mesh | Can | |
|-----------|-------|------------------|-----------------|
| PF-200S | 10x48 | 20kg | |
| Volume mm | | 240W, 350H, 240L | |
| Wire | φ mm | Spool | Coil |
| US-12CRSD | 1.2 | 20kg | - |
| | 1.6 | 20kg | - |
| | 2.4 | - | 25kg |
| Volume mm | | 300W, 110H, 300L | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.07 | 0.15 |
| Si | 0.35 | 0.50 |
| Mn | 0.74 | 1.00 |
| P | 0.004 | 0.020 |
| S | 0.003 | 0.010 |
| Cu | 0.01 | 1.30 |
| Ni | 0.51 | 0.80 |
| Cr | 9.92 | 9.50~12.00 |
| Mo | 0.35 | 0.10~0.70 |
| W | 1.45 | 1.00~2.00 |
| V | 0.21 | 0.05~0.35 |
| Nb | 0.035 | 0.01~0.10 |
| Co | 1.01 | 0.80~1.20 |

Note: ^aSingle values are maximum.**Composition (weld metal mass%)**

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.06 | 0.15 |
| Si | 0.24 | 0.60 |
| Mn | 0.88 | 1.50 |
| P | 0.008 | 0.010 |
| S | 0.004 | 0.010 |
| Cu | 0.02 | 0.80 |
| Ni | 0.52 | 1.50 |
| Cr | 9.48 | 8.60~13.0 |
| Mo | 0.32 | 0.10~0.70 |
| W | 1.36 | 1.00~2.00 |
| V | 0.20 | 0.35 |
| Nb | 0.030 | 0.080 |
| Co | 0.98 | 0.50~1.80 |
| N | 0.04 | 0.10 |

Note: ^aSingle values are maximum.**Weld mechanical properties**

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 652 | 440min. |
| TS (MPa) | 775 | 621min. |
| El on 4d (%) | 23 | 17min. |
| IV 20°C (J) | 31 | - |
| PWHT (°Cxh) | 745x8 | 750±15 |

For Stainless Steel

Welding Consumables for

SMAW

FCAW

GMAW

GTAW

SMAW, FCAW, GMAW, GTAW

A guide for selecting welding consumables (Product names)

| Steel type | Key note for application | SMAW |
|-------------------|---|--|
| 304 | ▪ General | NC-38 |
| 304L | ▪ Cryogenic temperature | NC-38LT |
| | ▪ Low carbon 0.04% max. | NC-38L |
| | ▪ High temperature service and solution treatment | NC-38L |
| 304H | ▪ High temperature | NC-38H |
| Dissimilar metals | ▪ General | NC-39 NC-39L NC-39MoL NC-32 |
| | ▪ Solution treatment | - |
| 316 | ▪ General | NC-36 |
| 316L | ▪ Cryogenic temperature | NC-36LT |
| | ▪ Low carbon (0.04% max.) | NC-36L |
| | ▪ Solution treatment | NC-36L |
| 316H | ▪ High temperature | - |
| 316L Mod. | ▪ Urea (Low ferrite content) | NC-316MF |
| 317L | ▪ Low carbon (0.04% max.) | NC-317L |
| 347 | ▪ General | NC-37 |
| | ▪ Low carbon | NC-37L |
| | ▪ High temperature | NC-37 |
| 321 | ▪ General | NC-37 |
| | ▪ High temperature | NC-37 |
| 310S | ▪ General | NC-30 |
| Duplex | ▪ Normal duplex | NC-2209 |
| | ▪ Super duplex | NC-2594 |
| | ▪ Lean duplex | - |
| 410 | ▪ General | CR-40 |
| 405, 409 | ▪ Overlaying in cladding | CR-40Cb |
| - | ▪ Low carbon martensite | - |
| 409,430,436,410L | ▪ Car exhaust system | - |

| | FCAW | GMAW | GTAW |
|--|--|----------------------|---|
| | DW-308 DW-308LP | MG-S308 | TG-S308 |
| | DW-308LT | - | TG-S308L |
| | DW-308L DW-308LP | MG-S308LS | TG-S308L TG-X308L |
| | DW-308LH | - | - |
| | DW-308H | - | - |
| | DW-309 DW-309L DW-309MoL DW-309LP DW-309MoLP DW-312 | MG-S309 MG-S309LS | TG-S309 TG-S309L TG-S309MoL TG-X309L |
| | DW-309LH | - | - |
| | DW-316LP | - | TG-S316 |
| | DW-316LT | - | TG-S316L |
| | DW-316L DW-316LP | MG-S316LS | TG-S316L TG-X316L |
| | DW-316LH | - | - |
| | DW-316H | - | - |
| | - | - | NO4051 TG-S310MF |
| | DW-317L DW-317LP | - | TG-S317L |
| | DW-347 | - | TG-S347 TG-X347 |
| | - | - | TG-S347L |
| | DW-347H | - | TG-S347 |
| | DW-347 | - | TG-S347 |
| | DW-347H | - | TG-S347 |
| | DW-310 | - | TG-S310 |
| | DW-2209 | - | TG-S2209 |
| | DW-2594 | - | TG-S2594 |
| | DW-2307 | - | - |
| | - | MG-S410 | TG-S410 |
| | DW-410Cb | - | TG-S410Cb |
| | MX-A410NiMo | - | - |
| | MX-A430M | MG-S430NbS | - |

SMAW, FCAW

Tips for better welding results

SMAW

- (1) Use proper welding currents because the use of an excessive current causes overheating electrodes and thereby welding usability and weld metal mechanical properties can be deteriorated.
- (2) Keep the arc as short as possible.
- (3) Control the weaving width of electrode within two and a half times the diameter of the electrode.

FCAW

1. Features:

- (1) DW stainless flux-cored wires are cost-effective wires because of high welding efficiency with the deposition rate 2-4 times as high as those of stick electrodes as shown in Fig. 1 and deposition efficiency of about 90%.
- (2) DW stainless wires offer a wider range of current and voltage in comparison with solid wire as shown in Fig. 2, which facilitates easier application for both semi-automatic and automatic welding.
- (3) DW stainless series has excellent usability and weldability with stable arc, low spatter, good slag removal, smooth bead appearance, and high X-ray soundness.

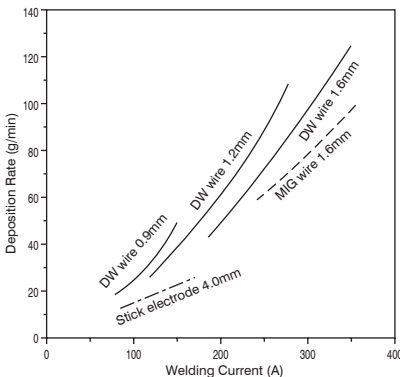


Fig. 1 Deposition rate as a function of welding current

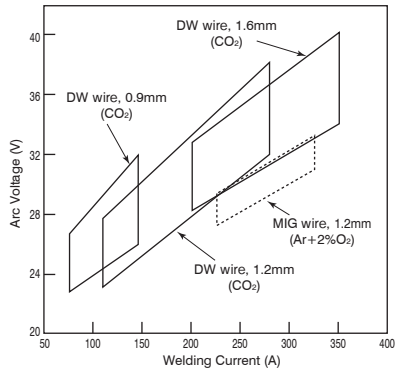


Fig. 2 Proper ranges of welding current and arc voltage

2. Notes on usage

- (1) Welding power source:
Use a DC power source with constant voltage and the polarity DCEP. Inverter-type welding power sources can also be used. When the use of a certain pulsed arc power source causes much spatter, use the wire with ordinary currents, turning off the pulse switch.
- (2) Shielding gas:
Use CO₂ for shielding gas for general applications. Ar-CO₂ mixtures with 20-50% CO₂ can also be used, but compared with CO₂, porosity (pit and blowhole) is apt to occur. The proper flow rate of shielding gas is 20-25 liter/min.
- (3) Wire extension:
Keep the wire extension at about 15 mm for 0.9-mm wire and 15-20 mm for 1.2- and 1.6-mm wire. The use of a shorter wire extension may cause pit and worm-tracking porosity. The wire extension in welding with an Ar-CO₂ mixture should be 5 mm longer than in use of CO₂.
- (4) Protection against wind:
When wind velocity at the vicinity of an arc is more than 1 m/sec., blowhole is apt to occur, and dissolution of nitrogen into the weld metal may deteriorate slag removal and decrease the ferrite content of the weld metal, thereby causing hot cracking. To prevent these problems, use an adequate shielding gas flow rate and a windscreen.
- (5) Welding fumes:
Flux-cored wires generate much more welding fumes in terms of the amount of fumes at unit time in comparison with that of stick electrodes. To protect welders from harmful welding fumes, be sure to use a local ventilator and an appropriate respirator.
- (6) Storage of wire:
Once a DW stainless wire picked up moisture, it cannot be dried at high temperatures, unlike stick electrodes. If a DW wire was left in a wire feeder in a high-temperature high-humidity atmosphere in summer season, a wet environment in rainy season or a dewfall environment at night in winter season, the use of it may cause pit and worm-tracking porosity due to moisture pick up. Once a wire was unpacked, the wire should be kept in an area of low humidity, taking appropriate preventive measures against dewfall water and dust.

3. Applications

(1) Butt welding:

Applicable plate thicknesses are 2 mm or larger with a 1.2mm wire and 5 mm or larger with a 1.6mm wire in flat position. P-series wires enable to weld thin plates with 3-4 mm thickness in vertical position. One-side welding can be applied for similar-shape grooves in flat, horizontal and vertical positions by using a backing material of FBB-3 (T size). In this case, the root opening should be about 3-4 mm to obtain good reverse beads.

(2) Horizontal fillet welding:

Proper welding speeds are approximately 30-70 cm/min in horizontal fillet welding. With a 309 type wire, dissimilar-metal welding of stainless steel to carbon steel can be done in the same welding condition as used for welding stainless steels. However to secure the ferrite content of weld metal, welding currents should be 200A or lower and welding speeds should be 40 cm/mm or slower with a 1.2mm wire.

(3) Overlaying and joining of clad steels:

The 1st layer of overlaying onto carbon steel should be welded with a 309 (or 309MoL) type wire by the half lapping method. In case where the dilution by the base metal is excessive, the ferrite content of the weld metal decreases and thereby hot cracking may occur. Therefore, it is important to use appropriate welding conditions to control the dilution particularly for the first layer. In order to obtain the proper dilution ratio, welding currents should be 200A or lower and welding speeds should be 20-40 cm/min with a 1.2mm wire. With a 1.6mm wire, use welding currents in the 200-250 range and welding speeds in the 20-30 cm/min range. Refer to Fig. 3.

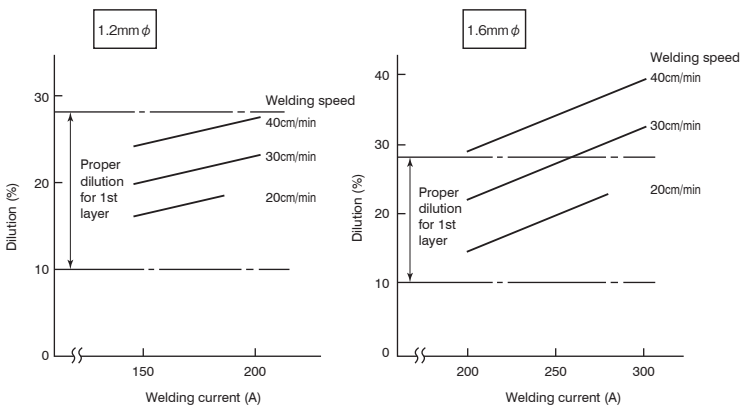


Fig. 3 Dilution ratios as a function of welding currents

GMAW

- (1) Polarity:
DCEP is suitable.
- (2) Shielding gas:
98% Ar-2%O₂ mixture is recommended for general applications. Proper gas flow rates range in 20-25 l/min. Ar-CO₂ mixture is not suitable for low carbon stainless steel (Type 304L) because the carbon content of deposited metal increases.
- (3) Arc length:
GMAW of stainless steel generally uses the spray arc transfer mode due to lower spatter generation. Adjust arc voltage so that arc length becomes 4-6 mm. When arc length is excessively short, blowholes are apt to occur. Inversely, when arc length is excessively long, the wetting of deposited metal on the base metal becomes poor.
- (4) Protection against wind:
GMAW is likely to be influenced by wind and thereby blowholes may occur. Use a windscreen to protect the arcing area against wind when the wind velocity near the arc is 0.5m/sec or more.
- (5) Pulsed arc welding:
In pulsed arc welding, a stable spray arc can be obtained even with low welding currents. Pulsed arc is suitable for overlaying, welding of thin plates and vertical welding.

GTAW

- (1) Polarity:
DCEN is suitable.
- (2) Shielding gas:
Argon gas is mainly used for shielding. Suitable flow rates of shielding gas are in the range of 7-15 l/min. at 100-200A of welding current and 12-20 l/min. at 200-300A in manual GTAW.
- (3) Torch:
Two types of GTAW torches are available. One has a gas lens, another has no gas lens. A torch with a gas lens provides better shielding effect preventing the weld bead from oxidation since the gas lens can provide a regular gas flow.
- (4) Tungsten electrode extension:
Proper tungsten electrode extensions are generally in the range of 4-5 mm. In the case where shielding effect tends to be lower as in welding corner joint, tungsten extension is recommended to be 2-3 mm. In welding of deep groove joints, tungsten extension should be longer as 5-6 mm.
- (5) Arc length:
Proper arc lengths are in the range of 1-3 mm. When it is excessively long, the shielding effect becomes poor.
- (6) One-side welding without backing materials:
In the case of one-side welding without backing materials, adopt back shielding in order to prevent oxidization of the penetration bead. However, with a flux-cored filler rod for GTAW, sound penetration bead can be obtained without back shielding.
- (7) Fully austenitic type filler wires:
With a fully austenitic type filler wire (e.g., TGS-310, TGS-310MF), use lower welding currents and welding speeds to prevent hot cracking.

Ferrite content measuring methods for austenitic stainless steel weld metal

| Method | Principles of measuring ferrite content |
|--------------------|--|
| Structure Diagram: | Calculating Ni equivalent and Cr equivalent of the chemical composition of a test specimen and reading the crossing point of the two equivalents in a structure diagram. Three structure diagrams are available: Schaeffler diagram, DeLong diagram and WRC diagram. See Figs. 1, 2 and 3. |
| Ferrite Indicator: | Comparing the magnetic attraction between a standard ferrite percent insert and a test specimen |
| Ferrite Scope: | Measuring a change of magnetic induction affected by the ferrite content of a test specimen |
| Magne Gage: | Measuring the pull off force necessary to detach a standard permanent magnet from a test specimen |
| Point Counting: | Calculating the area percentage of ferrite in the microstructure of a test specimen, by using an optical microscope |

Fig. 1 Schaeffler Diagram

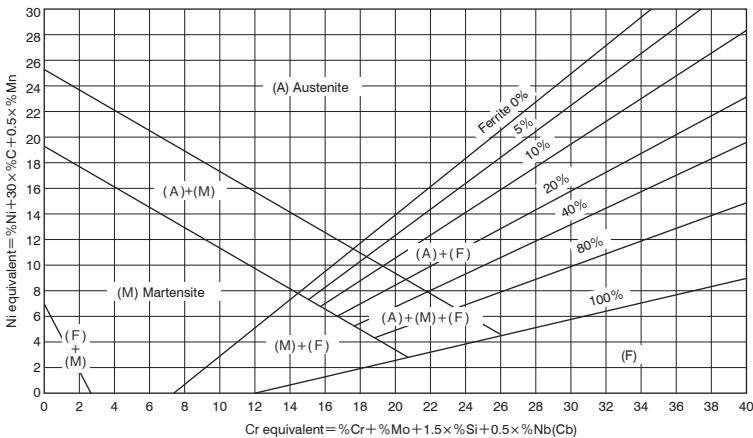


Fig. 2 DeLong Diagram

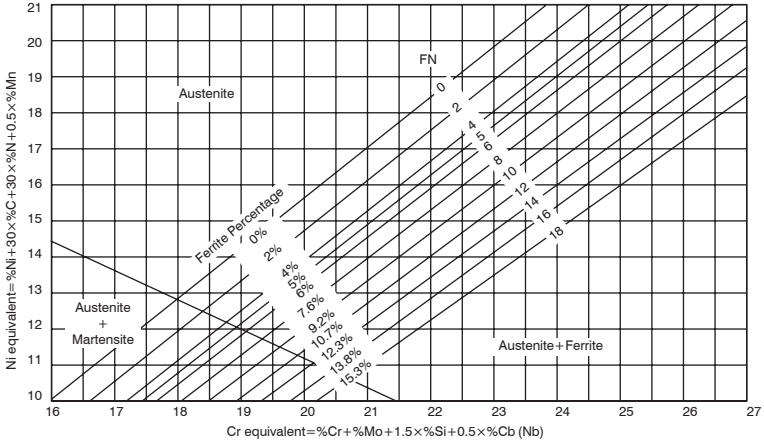
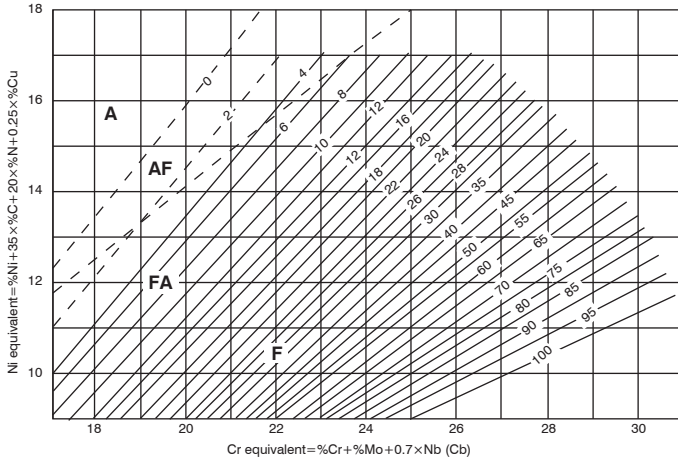


Fig. 3 WRC Diagram



A, AF, FA, F stand for solidification modes
 A : Austenitic single phase (γ)
 AF : Primary phase (γ) + Eutectic Ferrite (δ)
 FA : Primary phase (δ) + Peritectic / Eutectic phase (γ)
 F : δ Single phase Solidification

Stick electrode

Features: ▪ Applicable for 304 type steel

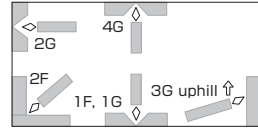
Classification: AWS A5.4 E308-16

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st Yellow, 2nd -

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.0 | 250 | 2 | 20 | 11 | 300W, 125H, 280L |
| 2.6 | 300 | 2 | 20 | 20 | 300W, 95H, 330L |
| 3.2 | 350 | 5 | 20 | 36 | 175W, 115H, 380L |
| 4.0 | 350 | 5 | 20 | 55 | 175W, 115H, 380L |
| 5.0 | 350 | 5 | 20 | 82 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.08 |
| Si | 0.37 | 1.00 |
| Mn | 1.5 | 0.5~2.5 |
| P | 0.03 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.4 | 9.0~11.0 |
| Cr | 20.0 | 18.0~21.0 |
| Mo | 0.16 | 0.75 |
| Cu | 0.08 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.0 | 50~75 | 45~65 |
| 2.6 | 75~95 | 70~90 |
| 3.2 | 85~120 | 80~115 |
| 4.0 | 110~160 | 90~140 |
| 5.0 | 150~200 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 410 | - |
| TS (MPa) | 600 | 552min. |
| El on 4d (%) | 46 | 30min. |
| IV 0°C (J) | 74 | - |

Approvals

| | |
|------------|--------------|
| ABS | MG (E308-16) |
| DNV | 308 |
| NK | KD308 |

Stick electrode

- Features:**
- Applicable for 304 type steel for high temperature
 - Excellent mechanical properties at high temperatures

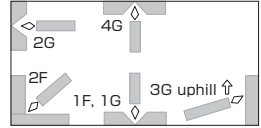
Classification: AWS A5.4 E308H-16

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st Yellow, 2nd -

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 20 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 36 | 175W, 125H, 380L |
| 4.0 | 350 | 5 | 20 | 54 | 175W, 125H, 380L |
| 5.0 | 350 | 5 | 20 | 80 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.04~0.08 |
| Si | 0.45 | 1.00 |
| Mn | 1.95 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.5 | 9.0~11.0 |
| Cr | 19.5 | 18.0~21.0 |
| Mo | 0.05 | 0.75 |
| Cu | 0.07 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 45~80 |
| 3.2 | 70~115 | 65~110 |
| 4.0 | 95~145 | 85~135 |
| 5.0 | 135~180 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 403 | - |
| TS (MPa) | 572 | 552min. |
| El on 4d (%) | 48 | 30min. |
| IV 0°C (J) | 79 | - |

Stick electrode

Features: ▪ Applicable for 304L type steel

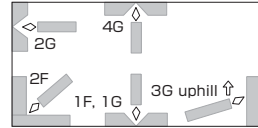
Classification: AWS A5.4 E308L-16

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st Red, 2nd -

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.0 | 250 | 2 | 20 | 11 | 300W, 125H, 280L |
| 2.6 | 300 | 2 | 20 | 20 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 36 | 175W, 115H, 380L |
| 4.0 | 350 | 5 | 20 | 55 | 175W, 130H, 380L |
| 5.0 | 350 | 5 | 20 | 82 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.38 | 1.00 |
| Mn | 1.5 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.6 | 9.0~11.0 |
| Cr | 20.3 | 18.0~21.0 |
| Mo | 0.14 | 0.75 |
| Cu | 0.05 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.0 | 50~75 | 45~65 |
| 2.6 | 75~95 | 70~90 |
| 3.2 | 85~120 | 80~115 |
| 4.0 | 110~160 | 90~140 |
| 5.0 | 150~200 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 410 | - |
| TS (MPa) | 580 | 518min. |
| El on 4d (%) | 48 | 30min. |
| IV 0°C (J) | 78 | - |

Approvals

| | |
|-----------|----------------|
| LR | 304L m (Chem.) |
| BV | UP (E308L-16) |
| NK | KD308L |
| GL | 4306 |

Stick electrode

Features: • Suitable for 18%Cr-8%Ni steel for cryogenic temperature service

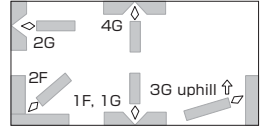
Classification: AWS A5.4 E308L-16

Redrying Conditions: 150~200°Cx 0.5~1h

Identification color: 1st Red, 2nd Yellow

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 33 | 175W, 115H, 380L |
| 4.0 | 350 | 5 | 20 | 51 | 175W, 130H, 380L |
| 5.0 | 350 | 5 | 20 | 79 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.46 | 1.00 |
| Mn | 2.2 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 10.3 | 9.0~11.0 |
| Cr | 18.8 | 18.0~21.0 |
| Mo | 0.05 | 0.75 |
| Cu | 0.05 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 45~80 |
| 3.2 | 70~115 | 65~110 |
| 4.0 | 95~145 | 85~130 |
| 5.0 | 135~180 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|----------------------|--------------|----------|
| 0.2%YS (MPa) | 370 | - |
| TS (MPa) | 540 | 518min. |
| EI on 4d (%) | 51 | 35min. |
| IV -196°C (J) | 52 | 34min. |

Approvals

| | |
|------------|---------------|
| LR | 304L m (Cryo) |
| DNV | 308L, MG |
| NK | KD308L |

Stick electrode

Features: ▪ Suitable for dissimilar-metal joint and underlaying on ferritic steels

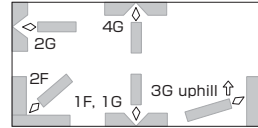
Classification: AWS A5.4 E309-16

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st Black, 2nd White

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.0 | 250 | 2 | 20 | 11 | 300W, 125H, 280L |
| 2.6 | 300 | 2 | 20 | 20 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 36 | 175W, 115H, 380L |
| 4.0 | 350 | 5 | 20 | 55 | 175W, 115H, 380L |
| 5.0 | 350 | 5 | 20 | 82 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.07 | 0.15 |
| Si | 0.40 | 1.00 |
| Mn | 1.0 | 0.5~2.5 |
| P | 0.03 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 13.4 | 12.0~14.0 |
| Cr | 23.9 | 22.0~25.0 |
| Mo | 0.21 | 0.75 |
| Cu | 0.12 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.0 | 50~75 | 45~65 |
| 2.6 | 75~95 | 70~90 |
| 3.2 | 85~120 | 80~115 |
| 4.0 | 110~160 | 90~140 |
| 5.0 | 150~200 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 410 | - |
| TS (MPa) | 590 | 552min. |
| EI on 4d (%) | 39 | 30min. |
| IV 0°C (J) | 62 | - |

Approvals

| | |
|------------|------------------|
| ABS | MG (E309-16) |
| LR | SS/CMn m (Chem.) |
| DNV | 309, MG |
| BV | UP (E309-16) |
| NK | KD309 |
| GL | 4332 |
| CCS | AS2-B |

Stick electrode

Features: • Suitable for dissimilar-metal joint and underlaying on ferritic steels

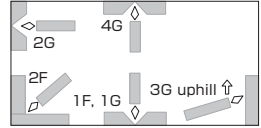
Classification: AWS A5.4 E309L-16

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st Yellow green, 2nd Blue white

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.0 | 250 | 2 | 20 | 11 | 300W, 125H, 280L |
| 2.6 | 300 | 2 | 20 | 20 | 300W, 95H, 330L |
| 3.2 | 350 | 5 | 20 | 36 | 175W, 125H, 380L |
| 4.0 | 350 | 5 | 20 | 55 | 175W, 115H, 380L |
| 5.0 | 350 | 5 | 20 | 82 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.04 | 0.04 |
| Si | 0.42 | 1.00 |
| Mn | 1.6 | 0.5~2.5 |
| P | 0.03 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 13.3 | 12.0~14.0 |
| Cr | 23.8 | 22.0~25.0 |
| Mo | 0.18 | 0.75 |
| Cu | 0.09 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.0 | 50~75 | 45~65 |
| 2.6 | 75~95 | 70~90 |
| 3.2 | 85~120 | 80~115 |
| 4.0 | 110~160 | 90~140 |
| 5.0 | 150~200 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 410 | - |
| TS (MPa) | 560 | 518min. |
| El on 4d (%) | 42 | 30min. |
| IV 0°C (J) | 67 | - |

Approvals

| | |
|------------|---------------------------|
| LR | SS/CMn m (Chem.) |
| DNV | 309L |
| BV | UP (E309L-16) |
| NK | KD309L |
| TÜV | EN ISO 3581-A-E 23 12 L R |

Stick electrode

Features: ▪ Suitable for dissimilar-metal joint and underlaying on ferritic steels

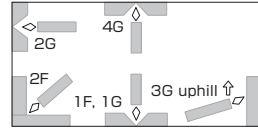
Classification: AWS A5.4 E309LMO-16

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st Silver, 2nd Blue

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 19 | 300W, 95H, 330L |
| 3.2 | 350 | 5 | 20 | 33 | 175W, 135H, 380L |
| 4.0 | 350 | 5 | 20 | 54 | 175W, 130H, 380L |
| 5.0 | 350 | 5 | 20 | 85 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.51 | 1.00 |
| Mn | 1.3 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.9 | 12.0~14.0 |
| Cr | 23.5 | 22.0~25.0 |
| Mo | 2.1 | 2.0~3.0 |
| Cu | 0.07 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 45~80 |
| 3.2 | 70~115 | 65~110 |
| 4.0 | 95~145 | 85~135 |
| 5.0 | 135~180 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 450 | - |
| TS (MPa) | 630 | 518min. |
| EI on 4d (%) | 41 | 30min. |
| IV 0°C (J) | 65 | - |

Approvals

| | |
|------------|----------------|
| ABS | MG |
| NK | KD309Mo |

Stick electrode

Features: • Suitable for dissimilar joint between carbon steel and stainless steel rich in carbon or nickel.

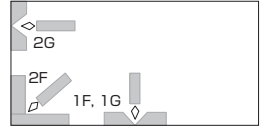
Classification: AWS A5.4 E312-16

Redrying Conditions: 150~250°Cx0.5-1h

Identification color: 1st Green, 2nd Red

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 300 | 2 | 20 | 27 | 300W, 110H, 330L |
| 4.0 | 350 | 5 | 20 | 49 | 175W, 120H, 380L |
| 5.0 | 350 | 5 | 20 | 76 | 175W, 120H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.13 | 0.15 |
| Si | 0.62 | 1.00 |
| Mn | 1.2 | 0.5~2.5 |
| P | 0.01 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.6 | 8.0~10.5 |
| Cr | 28.2 | 28.0~32.0 |
| Mo | 0.01 | 0.75 |
| Cu | 0.05 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G |
|------|----------------|
| 3.2 | 70~115 |
| 4.0 | 95~145 |
| 5.0 | 135~180 |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 624 | - |
| TS (MPa) | 785 | 655min. |
| El on 4d (%) | 20 | 22min. |

Stick electrode

Features: ▪ Applicable for 316 type steel

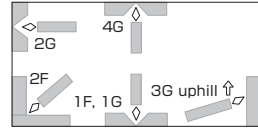
Classification: AWS A5.4 E316-16

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st White, 2nd -

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.0 | 250 | 2 | 20 | 11 | 300W, 130H, 280L |
| 2.6 | 300 | 2 | 20 | 20 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 36 | 175W, 115H, 380L |
| 4.0 | 350 | 5 | 20 | 55 | 175W, 115H, 380L |
| 5.0 | 350 | 5 | 20 | 82 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.04 | 0.08 |
| Si | 0.35 | 1.00 |
| Mn | 1.5 | 0.5~2.5 |
| P | 0.03 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.0 | 11.0~14.0 |
| Cr | 19.2 | 17.0~20.0 |
| Mo | 2.2 | 2.0~3.0 |
| Cu | 0.10 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.0 | 50~75 | 45~65 |
| 2.6 | 75~95 | 70~90 |
| 3.2 | 85~120 | 80~115 |
| 4.0 | 110~160 | 90~140 |
| 5.0 | 150~200 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 410 | - |
| TS (MPa) | 570 | 518min. |
| EI on 4d (%) | 46 | 30min. |
| IV 0°C (J) | 80 | - |

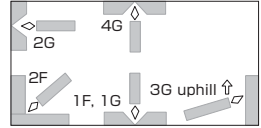
Approvals

| NK | KD316 |
|----|-------|
| | |

Stick electrode

Features: - Applicable for 316L type steel
Classification: AWS A5.4 E316L-16
Redrying Conditions: 150~200°Cx0.5~1h
Identification color: 1st Green, 2nd -
Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.0 | 250 | 2 | 20 | 11 | 300W, 130H, 280L |
| 2.6 | 300 | 2 | 20 | 20 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 36 | 175W, 110H, 380L |
| 4.0 | 350 | 5 | 20 | 55 | 175W, 115H, 380L |
| 5.0 | 350 | 5 | 20 | 82 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.36 | 1.00 |
| Mn | 1.5 | 0.5~2.5 |
| P | 0.03 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.0 | 11.0~14.0 |
| Cr | 19.4 | 17.0~20.0 |
| Mo | 2.2 | 2.0~3.0 |
| Cu | 0.11 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.0 | 50~75 | 45~65 |
| 2.6 | 75~95 | 70~90 |
| 3.2 | 85~120 | 80~115 |
| 4.0 | 110~160 | 90~140 |
| 5.0 | 150~200 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 420 | - |
| TS (MPa) | 580 | 483min. |
| El on 4d (%) | 45 | 30min. |
| IV 0°C (J) | 83 | - |

Approvals

| | |
|------------|----------------|
| ABS | MG (E316L-16) |
| LR | 316L m (Chem.) |
| DNV | 316L, MG |
| BV | UP (E316L-16) |
| NK | KD316L |
| GL | 4435 |

Stick electrode

Features: ▪ Suitable for 18%Cr-12%Ni-2%Mo steel for cryogenic temperature service

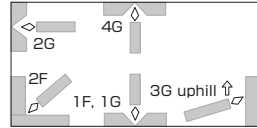
Classification: AWS A5.4 E316L-16

Redrying Conditions: 150~200°Cx 0.5~1h

Identification color: 1st Green, 2nd -

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 19 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 34 | 175W, 110H, 380L |
| 4.0 | 350 | 5 | 20 | 51 | 175W, 115H, 380L |
| 5.0 | 350 | 5 | 20 | 78 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.59 | 1.00 |
| Mn | 2.0 | 0.5~2.5 |
| P | 0.03 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 13.1 | 11.0~14.0 |
| Cr | 18.0 | 17.0~20.0 |
| Mo | 2.2 | 2.0~3.0 |
| Cu | 0.05 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 45~80 |
| 3.2 | 70~115 | 65~110 |
| 4.0 | 95~145 | 85~130 |
| 5.0 | 135~180 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|----------------------|--------------|----------|
| 0.2%YS (MPa) | 390 | - |
| TS (MPa) | 530 | 483min. |
| EI on 4d (%) | 44 | 30min. |
| IV -196°C (J) | 40 | 27min. |

Stick electrode

Features: ▪ Suitable for low carbon 19%Cr-13%Ni-3%Mo steel

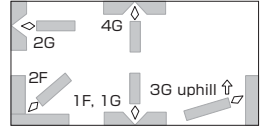
Classification: AWS A5.4 E317L-16

Redrying Conditions: 150~200°Cx 0.5~1h

Identification color: 1st Sorrel, 2nd Orange

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 19 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 34 | 175W, 110H, 380L |
| 4.0 | 350 | 5 | 20 | 51 | 175W, 115H, 380L |
| 5.0 | 350 | 5 | 20 | 79 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.55 | 1.00 |
| Mn | 1.2 | 0.5~2.5 |
| P | 0.03 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 13.3 | 12.0~14.0 |
| Cr | 19.7 | 18.0~21.0 |
| Mo | 3.7 | 3.0~4.0 |
| Cu | 0.05 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 45~80 |
| 3.2 | 70~115 | 65~110 |
| 4.0 | 95~145 | 85~135 |
| 5.0 | 135~180 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 440 | - |
| TS (MPa) | 600 | 518min. |
| El on 4d (%) | 39 | 30min. |

Stick electrode

Features: ▪ Suitable for 18%Cr-8%Ni-Nb steel

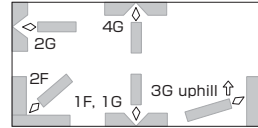
Classification: AWS A5.4 E347-16

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st Blue, 2nd Blue

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 250 | 2 | 20 | 15 | 300W, 100H, 280L |
| 3.2 | 300 | 2 | 20 | 28 | 300W, 95H, 330L |
| 4.0 | 350 | 5 | 20 | 50 | 175W, 120H, 380L |
| 5.0 | 350 | 5 | 20 | 77 | 175W, 120H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|--------------|--------------|-----------------------|
| C | 0.06 | 0.08 |
| Si | 0.55 | 1.00 |
| Mn | 1.5 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 10.1 | 9.0~11.0 |
| Cr | 19.6 | 18.0~21.0 |
| Mo | 0.04 | 0.75 |
| Cu | 0.04 | 0.75 |
| Nb+Ta | 0.67 | 8xC%~1.00 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 45~80 |
| 3.2 | 70~115 | 65~110 |
| 4.0 | 95~145 | 85~135 |
| 5.0 | 135~180 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 470 | - |
| TS (MPa) | 670 | 518min. |
| El on 4d (%) | 34 | 30min. |

Stick electrode

Features: • Suitable for 18%Cr-8%Ni-Nb steel

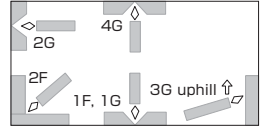
Classification: AWS A5.4 E347-16

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st Blue, 2nd Green

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 33 | 175W, 110H, 380L |
| 4.0 | 350 | 5 | 20 | 51 | 175W, 115H, 380L |
| 5.0 | 350 | 5 | 20 | 79 | 175W, 115H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.04 | 0.08 |
| Si | 0.58 | 1.00 |
| Mn | 2.3 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.7 | 9.0~11.0 |
| Cr | 19.1 | 18.0~21.0 |
| Nb | 0.59 | 8xC%~1.00 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 45~80 |
| 3.2 | 70~115 | 65~110 |
| 4.0 | 95~145 | 85~135 |
| 5.0 | 135~180 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 420 | - |
| TS (MPa) | 600 | 518min. |
| EI on 4d (%) | 45 | 30min. |

Approvals

| TÜV | EN ISO 3581-A-E Z19 9 Nb R |
|-----|----------------------------|
|-----|----------------------------|

CR-40Cb

PREMIARC™

Stick electrode

- Features:**
- Suitable for 13%Cr stainless steels such as 403, 410 and 405 type.
 - Preheat: 100~250°C

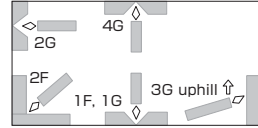
Classification: AWS A5.4 E409Nb-16

Redrying Conditions: 300~350°Cx0.5~1h

Identification color: 1st Purple, 2nd Orange

Polarity: AC, DCEP

Welding Positions:



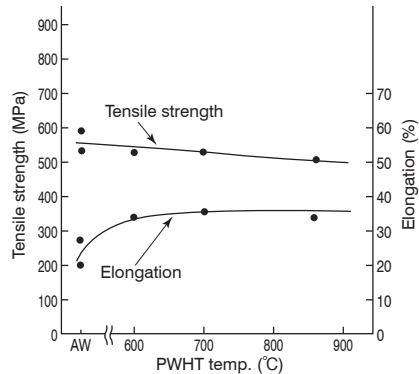
Packaging data

| φ mm | Length mm | kg/-pack | kg/carton | g/piece | carton mm |
|------|-----------|----------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 17 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 31 | 175W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 53 | 175W, 120H, 430L |
| 5.0 | 400 | 5 | 20 | 82 | 175W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|--------------|--------------|-----------------------|
| C | 0.09 | 0.12 |
| Si | 0.40 | 1.00 |
| Mn | 0.3 | 1.0 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 0.1 | 0.6 |
| Cr | 12.9 | 11.0~14.0 |
| Mo | 0.05 | 0.75 |
| Cu | 0.03 | 0.75 |
| Nb+Ta | 0.81 | 0.50~1.50 |

Note: ^aSingle values are maximum.



Mechanical properties vs. PWHT temp.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 270 | - |
| TS (MPa) | 500 | 450min. |
| EI on 4d (%) | 35 | 20min. |
| PWHT (°C×h) | 850x2 | |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 60~85 | 50~80 |
| 3.2 | 80~115 | 65~105 |
| 4.0 | 100~145 | 95~140 |
| 5.0 | 140~180 | - |

Stick electrode

- Features:**
- Suitable for 13%Cr stainless steels such as 403 and 410 types.
 - Preheat: 200~400°C

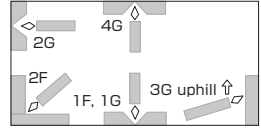
Classification: AWS A5.4 E410-16

Redrying Conditions: 300~350°Cx0.5~1h

Identification color: 1st Purple, 2nd -

Polarity: AC, DCEP

Welding Positions:



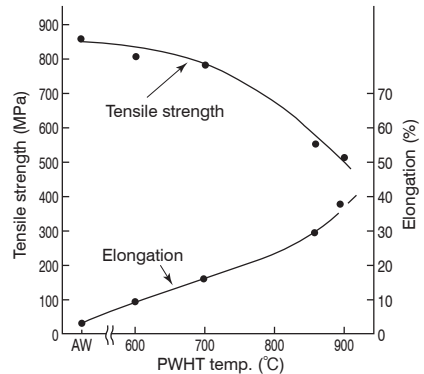
Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 300W, 100H, 330L |
| 3.2 | 350 | 5 | 20 | 30 | 175W, 120H, 380L |
| 4.0 | 400 | 5 | 20 | 54 | 175W, 120H, 430L |
| 5.0 | 400 | 5 | 20 | 83 | 175W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.06 | 0.12 |
| Si | 0.47 | 0.90 |
| Mn | 0.3 | 1.0 |
| P | 0.02 | 0.04 |
| S | 0.01 | 0.03 |
| Ni | 0.1 | 0.7 |
| Cr | 12.8 | 11.0~13.5 |
| Mo | 0.04 | 0.75 |
| Cu | 0.02 | 0.75 |

Note: ^a Single values are maximum.



Mechanical properties vs. PWHT temp.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 290 | - |
| TS (MPa) | 510 | 450min. |
| El on 4d (%) | 33 | 20min. |
| PWHT (°Cxh) | 850x2 | |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~85 | 45~80 |
| 3.2 | 70~115 | 65~110 |
| 4.0 | 95~145 | 85~135 |
| 5.0 | 135~180 | - |

Stick electrode

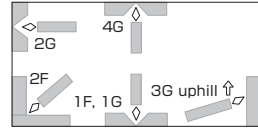
Features: ▪ Suitable for normal duplex stainless steel (S32205, S31803, etc.)

Classification: AWS A5.4 E2209-16

Redrying Conditions: 250~350°Cx1~2h

Identification color: -

Polarity: AC, DCEP

Welding Positions:**Packaging data**

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 20 | 300W, 95H, 330L |
| 3.2 | 350 | 5 | 20 | 35 | 175W, 135H, 380L |
| 4.0 | 350 | 5 | 20 | 53 | 175W, 130H, 380L |
| 5.0 | 350 | 5 | 20 | 79 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.47 | 1.00 |
| Mn | 1.1 | 0.5~2.0 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.0 | 8.5~10.5 |
| Cr | 23.2 | 21.5~23.5 |
| Mo | 3.2 | 2.5~3.5 |
| N | 0.17 | 0.08~0.20 |
| Cu | 0.05 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 75~95 | 70~90 |
| 3.2 | 85~120 | 80~115 |
| 4.0 | 110~160 | 90~140 |
| 5.0 | 150~200 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 667 | - |
| TS (MPa) | 845 | 690min. |
| EI on 4d (%) | 30 | 20min. |
| IV -50°C (J) | 72 | - |

Stick electrode

Features: • Suitable for super duplex stainless steel (S32750, S32760, etc.)

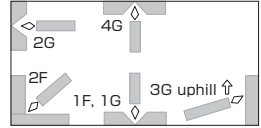
Welding Positions:

Classification: AWS A5.4 E2594-16

Redrying Conditions: 250~350°Cx1~2h

Identification color: -

Polarity: AC, DCEP



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 20 | 300W, 95H, 330L |
| 3.2 | 350 | 5 | 20 | 35 | 175W, 135H, 380L |
| 4.0 | 350 | 5 | 20 | 53 | 175W, 130H, 380L |
| 5.0 | 350 | 5 | 20 | 79 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.55 | 1.00 |
| Mn | 0.7 | 0.5~2.0 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.3 | 8.0~10.5 |
| Cr | 25.4 | 24.0~27.0 |
| Mo | 3.9 | 3.5~4.5 |
| N | 0.24 | 0.20~0.30 |
| Cu | 0.05 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 75~95 | 70~90 |
| 3.2 | 85~120 | 80~115 |
| 4.0 | 110~160 | 90~140 |
| 5.0 | 150~200 | - |

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|---------------------|--------------|----------|
| 0.2%YS (MPa) | 750 | - |
| TS (MPa) | 935 | 759min. |
| El on 4d (%) | 28 | 15min. |
| IV -50°C (J) | 40 | - |

Approvals

| DNV | MG |
|-----|----|
|-----|----|

Stick electrode

- Features:**
- Suitable for urea plant in cryogenic temperature service
 - Lime titania type

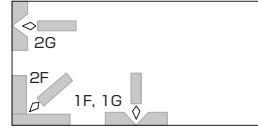
Classification: AWS -

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st Green, 2nd Pink

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 300 | 2 | 20 | 18 | 300W, 120H, 330L |
| 3.2 | 300 | 5 | 20 | 29 | 300W, 110H, 330L |
| 4.0 | 350 | 5 | 20 | 55 | 175W, 120H, 380L |
| 5.0 | 350 | 5 | 20 | 83 | 175W, 120H, 380L |

Composition (all-weld metal mass%)

| | Typical (AC) | Guaranty ^a |
|-----------|--------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.31 | 0.90 |
| Mn | 5.09 | 4.00~7.00 |
| P | 0.013 | 0.030 |
| S | 0.002 | 0.020 |
| Ni | 17.06 | 15.00~18.00 |
| Cr | 17.97 | 17.00~19.50 |
| Mo | 2.80 | 2.20~3.00 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G |
|------|----------------|
| 2.6 | 50~85 |
| 3.2 | 70~115 |
| 4.0 | 95~145 |
| 5.0 | 135~180 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical (AC) | Guaranty |
|----------------------|--------------|----------|
| 0.2%YS (MPa) | 370 | - |
| TS (MPa) | 520 | 480min. |
| El on 4d (%) | 44 | 25min. |
| IV -257°C (J) | 70 | - |

DW-308H

Flux cored wire

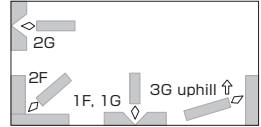
- Features:**
- Suitable for 18%Cr-8%Ni steel for high temperature service
 - Bi-free type

Classification: AWS A5.22 E308HT1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.05 | 0.04~0.08 |
| Si | 0.5 | 1.0 |
| Mn | 1.2 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.6 | 9.0~11.0 |
| Cr | 19.0 | 18.0~21.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.03 | 0.75 |
| Bi | <0.0005 | - |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill |
|------|------------|---------|-----------|
| 1.2 | 130~270 | 150~220 | 130~180 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 370 | - |
| TS (MPa) | 560 | 552min. |
| El on 4d (%) | 48 | 30min. |
| IV 0°C (J) | 71 | - |

Approvals

| CWB | E308HT1-1, E308HT1-4 |
|-----|----------------------|
|-----|----------------------|

Flux cored wire

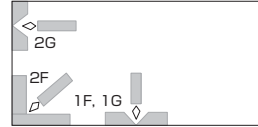
Features: - Applied for 304L type steel

Classification: AWS A5.22 E308LT0-1/4
EN ISO 17633-A-T 19 9 L R C/M 3

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|-----------|------------------|------------------|
| 0.9 | 5kg | 12.5kg |
| 1.2 | - | 12.5kg |
| 1.6 | - | 12.5kg |
| Volume mm | 235W, 110H, 230L | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.6 | 1.0 |
| Mn | 1.5 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 10.0 | 9.0~11.0 |
| Cr | 19.5 | 18.0~21.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.03 | 0.75 |
| Bi | >0.002 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 0.9 | 80~150 | 90~130 |
| 1.2 | 130~270 | 150~220 |
| 1.6 | 190~320 | 220~270 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 370 | - |
| TS (MPa) | 550 | 518min. |
| EI on 4d (%) | 42 | 30min. |
| IV 0°C (J) | 41 | - |

Approvals

| | |
|------------|---|
| ABS | MG (CO ₂) |
| LR | 304L S (Chem & Cryo) (CO ₂) |
| DNV | NV308L |
| NK | KW308LG (C) |
| GL | 4306S |
| CWB | E308LT0-1, E308LT0-4 |

Flux cored wire

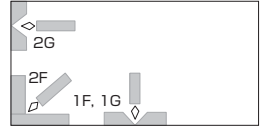
Features: ▪ Suitable for 18%Cr-8%Ni steel for low temperature service

Welding Positions:

Classification: AWS A5.22 E308LT0-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

**Packaging data**

| ϕ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.3 | 1.0 |
| Mn | 2.2 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | 0.01 | 0.03 |
| Ni | 10.3 | 9.0~11.0 |
| Cr | 18.6 | 18.0~21.0 |
| Mo | 0.01 | 0.75 |
| Cu | 0.05 | 0.75 |
| Bi | >0.002 | - |

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F | 2G |
|-----------|------------|---------|
| 1.2 | 130~270 | 150~220 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|----------------------|----------------------------|----------|
| 0.2%YS (MPa) | 380 | - |
| TS (MPa) | 530 | 518min. |
| El on 4d (%) | 51 | 30min. |
| IV -196°C (J) | 39 | 27min. |

Approvals

| | |
|------------|----------------------|
| LR | 304L S (Chem & Cryo) |
| DNV | NV308L, MG |
| NK | KW308LG (C), MG |

Flux cored wire

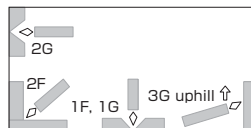
- Features:**
- Suitable for 18%Cr-8%Ni steel with high temperature heat treatment such as solution treatment
 - Bi-free type

Classification: AWS A5.22 E308LT1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.4 | 1.0 |
| Mn | 1.3 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 10.2 | 9.0~11.0 |
| Cr | 18.7 | 18.0~21.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.02 | 0.75 |
| Bi | <0.0005 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill |
|------|------------|---------|-----------|
| 1.2 | 130~270 | 150~220 | 130~180 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 360 | - |
| TS (MPa) | 540 | 518min. |
| EI on 4d (%) | 52 | 30min. |
| IV 0°C (J) | 76 | - |

DW-308LP

Flux cored wire

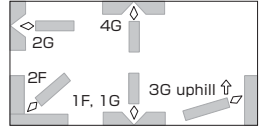
Features: • Applicable for 304 and 304L type steel

Classification: AWS A5.22 E308LT1-1/4
EN ISO 17633-A-T 19 9 L P C/M 1

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.02 | 0.04 |
| Si | 0.8 | 1.0 |
| Mn | 1.1 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.9 | 9.0~11.0 |
| Cr | 20.3 | 18.0~21.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.03 | 0.75 |
| Bi | >0.002 | - |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 380 | - |
| TS (MPa) | 550 | 518min. |
| EI on 4d (%) | 45 | 30min. |
| IV 0°C (J) | 57 | - |

Approvals

| | |
|------------|---|
| ABS | MG (E308LT1-1) |
| LR | 304L S (Chem & Cryo) (CO ₂) |
| DNV | NV308L, MG (CO ₂) |
| BV | 308L BT (CO ₂) |
| NK | KW308LG (C) |
| KR | RW308LG (C) |
| CWB | E308LT1-1, E308LT1-4 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|---------|-----------|---------|
| 1.2 | 130~270 | 150~220 | 130~220 | 150~200 |

Flux cored wire

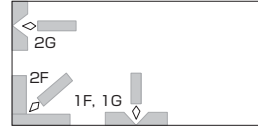
Features: - Applicable for 304 type steel

Classification: AWS A5.22 E308T0-1/4
EN ISO 17633-A-T Z 19 9 R C/M 3

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|------------------|------------------|------------------|
| 0.9 | 5kg | 12.5kg |
| 1.2 | - | 12.5kg |
| 1.6 | - | 12.5kg |
| Volume mm | 235W, 110H, 230L | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.05 | 0.08 |
| Si | 0.6 | 1.0 |
| Mn | 1.5 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | 0.01 | 0.03 |
| Ni | 9.7 | 9.0~11.0 |
| Cr | 19.7 | 18.0~21.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.03 | 0.75 |
| Bi | >0.002 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 0.9 | 80~150 | 90~130 |
| 1.2 | 130~270 | 150~220 |
| 1.6 | 190~320 | 220~270 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 390 | - |
| TS (MPa) | 570 | 552min. |
| EI on 4d (%) | 41 | 30min. |
| IV 0°C (J) | 39 | - |

Approvals

| | |
|------------|---------------------|
| ABS | MG (A5.22 E308T0-1) |
| NK | KW308G (C) |

DW-309MoL

Flux cored wire

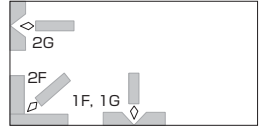
Features: ▪ Suitable for dissimilar-metal joint and underlaying on ferritic steels

Classification: AWS A5.22 E309LMoT0-1/4
EN ISO 17633-A-T 23 12 2 L R C/M 3

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| 1.6 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.7 | 1.0 |
| Mn | 1.4 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.3 | 12.0~16.0 |
| Cr | 23.2 | 21.0~25.0 |
| Mo | 2.4 | 2.0~3.0 |
| Cu | 0.07 | 0.75 |
| Bi | >0.002 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 1.2 | 130~270 | 150~220 |
| 1.6 | 190~320 | 220~270 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 540 | - |
| TS (MPa) | 720 | 518min. |
| EI on 4d (%) | 30 | 25min. |

Approvals

| | |
|------------|------------------------------------|
| ABS | MG (CO ₂) |
| LR | SS/CMn S (Chem) (CO ₂) |
| DNV | NV309MoL |
| BV | UP (CO ₂) |
| NK | KW309MoLG (C) |

DW-309MoLP

PREMIARC™

Flux cored wire

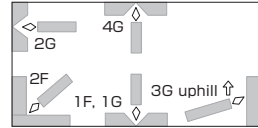
Features: • Suitable for dissimilar-metal joint and underlaying on ferritic steels

Classification: AWS A5.22 E309LMoT1-1/4
EN ISO 17633-A-T 23 12 2 L R C/M 1

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.4 | 1.0 |
| Mn | 0.6 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.4 | 12.0~16.0 |
| Cr | 22.3 | 21.0~25.0 |
| Mo | 2.3 | 2.0~3.0 |
| Cu | 0.04 | 0.75 |
| Bi | >0.002 | - |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 540 | - |
| TS (MPa) | 699 | 518min. |
| EI on 4d (%) | 30 | 25min. |

Approvals

| | |
|-----------|---------------|
| NK | KW309MoLG (C) |
|-----------|---------------|

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|---------|-----------|---------|
| 1.2 | 130~270 | 150~220 | 130~220 | 150~200 |

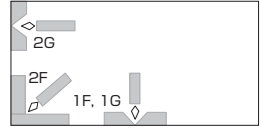
Flux cored wire

Features: ▪ Suitable for dissimilar-metal joint and underlaying on ferritic steels

Classification: AWS A5.22 E309LT0-1/4
EN ISO 17633-A-T 23 12 L R C/M 3

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:**Packaging data**

| φ mm | Spool | | Drum | |
|------------------|------------------|------------------|-------------|-------------|
| | 5kg | 12.5kg | - | - |
| 0.9 | 5kg | 12.5kg | - | - |
| 1.2 | - | 12.5kg | 150kg | - |
| 1.6 | - | 12.5kg | - | 200kg |
| Volume mm | 235W, 110H, 230L | 295W, 110H, 295L | 530 φ, 820H | 680 φ, 770H |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.6 | 1.0 |
| Mn | 1.2 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.4 | 12.0~14.0 |
| Cr | 23.8 | 22.0~25.0 |
| Mo | 0.03 | 0.75 |
| Cu | 0.02 | 0.75 |
| Bi | >0.002 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 0.9 | 80~150 | 90~130 |
| 1.2 | 130~270 | 150~220 |
| 1.6 | 190~320 | 220~270 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 450 | - |
| TS (MPa) | 580 | 518min. |
| El on 4d (%) | 33 | 30min. |

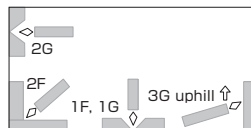
Approvals

| | |
|------------|---------------------------|
| ABS | MG (CO ₂) |
| LR | SS/CMn S (Chem) |
| DNV | NV309L (CO ₂) |
| BV | UP (CO ₂) |
| NK | KW309G (C) |
| GL | 4332S |
| CWB | E309LT0-1, E309LT0-4 |

Flux cored wire

- Features:**
- Suitable for dissimilar metal joint and underlaying on ferritic steels for overlaying stainless steel weld metals
 - Bi-free type

Welding Positions:



Classification: AWS A5.22 E309LT1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.4 | 1.0 |
| Mn | 1.2 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.6 | 12.0~14.0 |
| Cr | 23.1 | 22.0~25.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.02 | 0.75 |
| Bi | <0.0005 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill |
|------|------------|---------|-----------|
| 1.2 | 130~270 | 150~220 | 130~180 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 380 | - |
| TS (MPa) | 590 | 518min. |
| EI on 4d (%) | 36 | 30min. |

DW-309LP

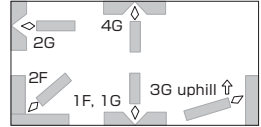
Flux cored wire

Features: ▪ Suitable for dissimilar-metal joint and underlaying on ferritic steels

Classification: AWS A5.22 E309LT1-1/4
EN ISO 17633-A-T 23 12 L P C/M 1

Shielding gas: CO₂ or Ar-CO₂
Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.02 | 0.04 |
| Si | 0.8 | 1.0 |
| Mn | 0.8 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.4 | 12.0~14.0 |
| Cr | 23.2 | 22.0~25.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.02 | 0.75 |
| Bi | >0.002 | - |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 430 | - |
| TS (MPa) | 570 | 518min. |
| EI on 4d (%) | 38 | 30min. |

Approvals

| | |
|------------|--|
| ABS | MG (A5.22 E309LT-1,4) |
| LR | SS/CMn S (Chem) (CO ₂) SS/CMn S (Chem & Cryo) (Ar-CO ₂) |
| DNV | NV309L |
| BV | 309L, UP |
| NK | KW309LG (C) |
| CWB | E309LT1-1, E309LT1-4 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|---------|-----------|---------|
| 1.2 | 130~270 | 150~220 | 130~220 | 150~200 |

DW-309

Flux cored wire

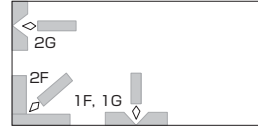
Features: • Suitable for dissimilar-metal joint and underlaying on ferritic steels

Classification: AWS A5.22 E309T0-1/4
EN ISO 17633-A-T Z 23 12 R C/M 3

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | Drum |
|------------------|------------------|--------------|
| 1.2 | 12.5kg | 200kg |
| 1.6 | 12.5kg | - |
| Volume mm | 295W, 110H, 295L | 680 φ , 770H |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.03 | 0.10 |
| Si | 0.7 | 1.0 |
| Mn | 1.2 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.3 | 12.0~14.0 |
| Cr | 24.0 | 22.0~25.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.03 | 0.75 |
| Bi | >0.002 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 1.2 | 130~270 | 150~220 |
| 1.6 | 190~320 | 220~270 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 450 | - |
| TS (MPa) | 590 | 552min. |
| EI on 4d (%) | 32 | 30min. |
| IV 0°C (J) | 33 | - |

Approvals

| LR | SS/CMn S (Chem) |
|----|-----------------|
|----|-----------------|

DW-310

Flux cored wire

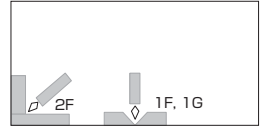
Features: • Suitable for 25%Cr-20%Ni steel

Classification: AWS A5.22 E310T0-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.18 | 0.20 |
| Si | 0.4 | 1.0 |
| Mn | 2.0 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 20.6 | 20.0~22.5 |
| Cr | 25.3 | 25.0~28.0 |
| Mo | 0.03 | 0.75 |
| Cu | 0.03 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 1.2 | 130~220 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 420 | - |
| TS (MPa) | 620 | 552min. |
| El on 4d (%) | 33 | 30min. |
| IV 0°C (J) | 68 | - |

Approvals

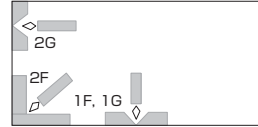
| CWB | E310T0-1, E310T0-4 |
|-----|--------------------|
| | |

DW-312

Flux cored wire

Features: • Suitable for dissimilar-metal joint and underlaying on ferritic steels for overlaying stainless steel weld metals

Welding Positions:



Classification: AWS A5.22 E312T0-1

Shielding gas: CO₂

Polarity: DCEP

Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.11 | 0.15 |
| Si | 0.5 | 1.0 |
| Mn | 1.6 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | 0.01 | 0.03 |
| Ni | 10.2 | 8.0~10.5 |
| Cr | 28.4 | 28.0~32.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.02 | 0.75 |
| Bi | >0.002 | - |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 1.2 | 130~270 | 150~220 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 600 | - |
| TS (MPa) | 720 | 655min. |
| EI on 4d (%) | 23 | 22min. |

Approvals

| CWB | E312T0-1 |
|-----|----------|
| | |

DW-316L

Flux cored wire

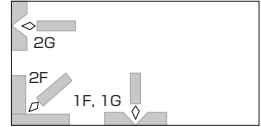
Features: • Applicable for 316L type steel

Classification: AWS A5.22 E316LT0-1/4
EN ISO 17633-A-T Z 19 12 3 R C/M 3

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | | Drum |
|------------------|------------------|------------------|-------------|
| 0.9 | 5kg | 12.5kg | - |
| 1.2 | - | 12.5kg | 150kg |
| 1.6 | - | 12.5kg | - |
| Volume mm | 235W, 110H, 230L | 295W, 110H, 295L | 530 φ, 820H |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.02 | 0.04 |
| Si | 0.6 | 1.0 |
| Mn | 1.3 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | 0.01 | 0.03 |
| Ni | 12.0 | 11.0~14.0 |
| Cr | 18.9 | 17.0~20.0 |
| Mo | 2.5 | 2.0~3.0 |
| Cu | 0.06 | 0.75 |
| Bi | >0.002 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 0.9 | 80~150 | 90~130 |
| 1.2 | 130~270 | 150~220 |
| 1.6 | 190~320 | 220~270 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 380 | - |
| TS (MPa) | 540 | 483min. |
| El on 4d (%) | 41 | 30min. |
| IV 0°C (J) | 44 | - |

Approvals

| | |
|------------|-----------------------|
| ABS | MG (CO ₂) |
| LR | 316L S (Chem) |
| DNV | NV316L |
| BV | UP (CO ₂) |
| NK | KW316LG (C) |
| GL | 4435S |
| CWB | E316LT0-1, E316LT0-4 |

Flux cored wire

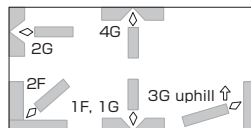
Features: • Suitable for 18%Cr-12%Ni-2%Mo steel for low temperature service

Classification: AWS A5.22 E316LT1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.02 | 0.04 |
| Si | 0.4 | 1.0 |
| Mn | 1.2 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.0 | 11.0~14.0 |
| Cr | 17.4 | 17.0~20.0 |
| Mo | 2.2 | 2.0~3.0 |
| Cu | 0.06 | 0.75 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|----------------------|----------------------------|----------|
| 0.2%YS (MPa) | 398 | - |
| TS (MPa) | 528 | 483min. |
| EI on 4d (%) | 44 | 30min. |
| IV -196°C (J) | 36 | 27min. |

Approvals

| | |
|------------|---------------------|
| ABS | MG (E316LT1-1) |
| LR | 316LS (Chem & Cryo) |
| BV | 316LBT |
| KR | RW316LG (C) |
| DNV | NV316L, MG |
| NK | KW316LG (C) |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|---------|-----------|---------|
| 1.2 | 130~220 | 150~220 | 130~180 | 160~200 |

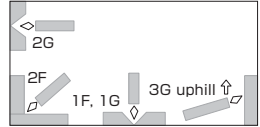
Flux cored wire

- Features:**
- Suitable for 18%Cr-12%Ni-2%Mo steel with high temperature heat treatment such as solution treatment
 - Bi-free type

Classification: AWS A5.22 E316LT1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:**Packaging data**

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.02 | 0.04 |
| Si | 0.4 | 1.0 |
| Mn | 1.1 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 11.9 | 11.0~14.0 |
| Cr | 18.5 | 17.0~20.0 |
| Mo | 2.4 | 2.0~3.0 |
| Cu | 0.02 | 0.75 |
| Bi | <0.0005 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill |
|------|------------|---------|-----------|
| 1.2 | 130~270 | 150~220 | 130~180 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 390 | - |
| TS (MPa) | 540 | 483min. |
| EI on 4d (%) | 44 | 30min. |
| IV 0°C (J) | 66 | - |

Flux cored wire

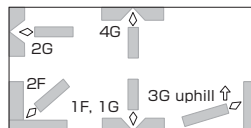
Features: - Applicable for 316 and 316L type steel

Classification: AWS A5.22 E316LT1-1/4
EN ISO 17633-A-T 19 12 3 L P C/M 1

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.02 | 0.04 |
| Si | 0.8 | 1.0 |
| Mn | 1.3 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.3 | 11.0~14.0 |
| Cr | 18.1 | 17.0~20.0 |
| Mo | 2.8 | 2.0~3.0 |
| Cu | 0.08 | 0.75 |
| Bi | >0.002 | - |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 370 | - |
| TS (MPa) | 540 | 483min. |
| EI on 4d (%) | 43 | 30min. |
| IV 0°C (J) | 54 | - |

Approvals

| | |
|------------|-------------------------------------|
| LR | 316L S (Chem) (Ar-CO ₂) |
| DNV | 316L |
| BV | 316L (CO ₂) |
| NK | KW316LG (C) |
| CWB | E316LT1-1, E316LT1-4 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|---------|-----------|---------|
| 1.2 | 130~270 | 150~220 | 130~220 | 150~200 |

DW-316H

Flux cored wire

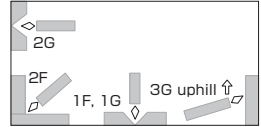
- Features:**
- Suitable for 18%Cr-12%Ni-2%Mo steel for high temperature service
 - Bi-free type

Classification: AWS A5.22 E316T1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.05 | 0.08 |
| Si | 0.4 | 1.0 |
| Mn | 1.1 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 11.6 | 11.0~14.0 |
| Cr | 18.2 | 17.0~20.0 |
| Mo | 2.4 | 2.0~3.0 |
| Cu | 0.05 | 0.75 |
| Bi | <0.0005 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill |
|------|------------|---------|-----------|
| 1.2 | 130~270 | 150~220 | 130~180 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 390 | - |
| TS (MPa) | 570 | 518min. |
| El on 4d (%) | 41 | 30min. |
| IV 0°C (J) | 68 | - |

DW-317L

Flux cored wire

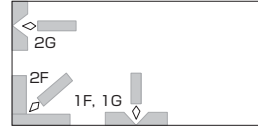
Features: • Suitable for 18%Cr-12%Ni-2%Mo-N and 19%Cr-13%Ni-3%Mo steel

Classification: AWS A5.22 E317LT0-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.4 | 1.0 |
| Mn | 1.0 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.8 | 12.0~14.0 |
| Cr | 18.9 | 18.0~21.0 |
| Mo | 3.1 | 3.0~4.0 |
| Cu | 0.04 | 0.75 |
| Bi | >0.002 | - |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G |
|------|------------|---------|
| 1.2 | 130~270 | 150~220 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 380 | - |
| TS (MPa) | 590 | 518min. |
| EI on 4d (%) | 37 | 20min. |
| IV 0°C (J) | 43 | - |

Approvals

| | |
|------------|----------------------|
| LR | MG |
| DNV | NV317L |
| BV | UP |
| NK | KW317LG (C) |
| CWB | E317LT0-1, E317LT0-4 |

DW-317LP

PREMIARC™

Flux cored wire

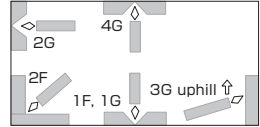
Features: ▪ Suitable for 18%Cr-12%Ni-2%Mo-N and 19%Cr-13%Ni-3%Mo stainless steel

Classification: AWS A5.22 E317LT1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|-----------|----------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.6 | 1.0 |
| Mn | 1.3 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 13.8 | 12.0~14.0 |
| Cr | 18.6 | 18.0~21.0 |
| Mo | 3.3 | 3.0~4.0 |
| Cu | 0.09 | 0.75 |
| Bi | >0.002 | - |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 435 | - |
| TS (MPa) | 582 | 518min. |
| El on 4d (%) | 37 | 20min. |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|---------|-----------|---------|
| 1.2 | 130~270 | 150~220 | 130~220 | 150~200 |

DW-347

Flux cored wire

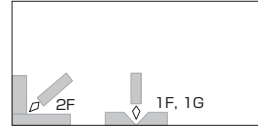
Features: • Suitable for 18%Cr-8%Ni-Nb and 18%Cr-8%Ni-Ti steel

Classification: AWS A5.22 E347T0-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| 1.6 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|--------------|----------------------------|-----------------------|
| C | 0.02 | 0.08 |
| Si | 0.3 | 1.0 |
| Mn | 1.5 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 10.5 | 9.0~11.0 |
| Cr | 18.6 | 18.0~21.0 |
| Mo | 0.01 | 0.75 |
| Cu | 0.04 | 0.75 |
| Nb+Ta | 0.59 | 8xC~1.0 |
| Bi | >0.002 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 1.2 | 130~270 |
| 1.6 | 180~300 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 390 | - |
| TS (MPa) | 550 | 518min. |
| EI on 4d (%) | 43 | 30min. |
| IV 0°C (J) | 49 | - |

Approvals

| CWB | E347T0-1, E347T0-4 |
|-----|--------------------|
|-----|--------------------|

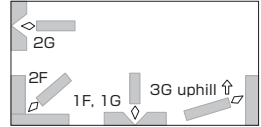
DW-347H

PREMIARC™

Flux cored wire

- Features:**
- Suitable for 18%Cr-8%Ni-Nb and 18%Cr-8%Ni-Ti steel for high temperature service
 - Bi-free type

Welding Positions:



Classification: AWS A5.22 E347T1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|--------------|----------------------------|-----------------------|
| C | 0.03 | 0.08 |
| Si | 0.4 | 1.0 |
| Mn | 1.2 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | 0.01 | 0.03 |
| Ni | 10.2 | 9.0~11.0 |
| Cr | 18.9 | 18.0~21.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.04 | 0.75 |
| Nb+Ta | 0.68 | 8xC~1.0 |
| Bi | <0.0005 | - |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill |
|------|------------|---------|-----------|
| 1.2 | 130~270 | 150~220 | 130~180 |

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|----------|
| 0.2%YS (MPa) | 420 | - |
| TS (MPa) | 600 | 518min. |
| EI on 4d (%) | 43 | 30min. |
| IV 0°C (J) | 80 | - |

Flux cored wire

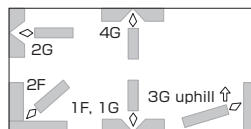
Features: • Suitable for normal duplex stainless steel (S32205, S31803, etc.)

Classification: AWS A5.22 E2209T1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (Ar-CO ₂) | Guaranty ^a |
|-----------|-------------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.5 | 1.0 |
| Mn | 0.7 | 0.5~2.0 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.4 | 7.5~10.0 |
| Cr | 23.0 | 21.0~24.0 |
| Mo | 3.3 | 2.5~4.0 |
| Cu | 0.03 | 0.75 |
| N | 0.14 | 0.08~0.20 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical (Ar-CO ₂) | Guaranty |
|---------------------|-------------------------------|----------|
| 0.2%YS (MPa) | 630 | - |
| TS (MPa) | 815 | 690min. |
| EI on 4d (%) | 28 | 20min. |
| IV -40°C (J) | 60 | - |

Approvals

| | |
|------------|----------------------|
| LR | S31803S (Chem) |
| CWB | E2209T1-1, E2209T1-4 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill | 4G |
|------|------------|---------|-----------|---------|
| 1.2 | 130~250 | 150~220 | 130~180 | 160~200 |

DW-2307

Flux cored wire

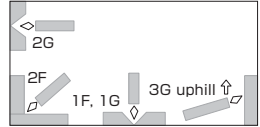
Features: ▪ Suitable for lean duplex stainless steel of S32101, S32304, S82122

Classification: AWS A5.22 E2307T1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (Ar-CO ₂) | Guaranty ^a |
|-----------|-------------------------------|-----------------------|
| C | 0.02 | 0.04 |
| Si | 0.6 | 1.0 |
| Mn | 1.4 | 2.0 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.02 |
| Ni | 8.3 | 6.5~10.0 |
| Cr | 24.6 | 22.5~25.5 |
| Mo | 0.05 | 0.8 |
| Cu | 0.03 | 0.50 |
| N | 0.13 | 0.10~0.20 |
| Bi | >0.002 | - |

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill |
|------|------------|---------|-----------|
| 1.2 | 130~250 | 150~220 | 130~180 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical (Ar-CO ₂) | Guaranty |
|---------------------|-------------------------------|----------|
| 0.2%YS (MPa) | 590 | - |
| TS (MPa) | 754 | 690min. |
| EI on 4d (%) | 29 | 20min. |
| IV 0°C (J) | 52 | - |

DW-2594

Flux cored wire

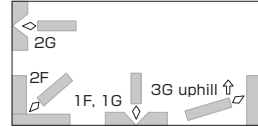
Features: • Suitable for super duplex stainless steel (S32750, S32760, etc.)

Classification: AWS A5.22 E2594T1-1/4

Shielding gas: CO₂ or Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (Ar-CO ₂) | Guaranty ^a |
|-----------|-------------------------------|-----------------------|
| C | 0.03 | 0.04 |
| Si | 0.5 | 1.0 |
| Mn | 1.2 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 9.5 | 8.0~10.5 |
| Cr | 25.5 | 24.0~27.0 |
| Mo | 3.8 | 2.5~4.5 |
| Cu | <0.1 | 1.5 |
| W | <0.1 | 1.0 |
| N | 0.22 | 0.20~0.30 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F | 2G | 3G uphill |
|------|------------|---------|-----------|
| 1.2 | 130~250 | 150~220 | 130~180 |

All-weld mechanical properties

| | Typical (Ar-CO ₂) | Guaranty |
|---------------------|-------------------------------|----------|
| 0.2%YS (MPa) | 714 | - |
| TS (MPa) | 896 | 759min. |
| EI on 4d (%) | 28 | 15min. |
| IV -40°C (J) | 38 | - |

Approvals

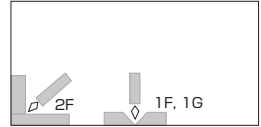
| | |
|------------|----------------------|
| CWB | E2594T1-1, E2594T1-4 |
|------------|----------------------|

DW-410Cb

Flux cored wire

Features: ▪ Suitable for 13%Cr martensitic stainless steel such as 403 and 410 types and 13%Cr ferritic stainless steels such as 405 type

Welding Positions:



Classification: AWS A5.22 E409NbT0-1

Shielding gas: CO₂

Polarity: DCEP

Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (CO ₂) | Guaranty ^a |
|--------------|----------------------------|-----------------------|
| C | 0.05 | 0.10 |
| Si | 0.5 | 1.0 |
| Mn | 0.7 | 1.2 |
| P | 0.03 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 0.1 | 0.6 |
| Cr | 12.6 | 10.5~13.5 |
| Mo | <0.1 | 0.5 |
| Cu | <0.1 | 0.5 |
| Nb+Ta | 0.64 | 8xC~1.5 |
| Bi | >0.002 | - |

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 1.2 | 130~270 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical (CO ₂) | Guaranty |
|---------------------|----------------------------|-----------|
| 0.2%YS (MPa) | 282 | - |
| TS (MPa) | 515 | 449min. |
| EI on 4d (%) | 30 | 15min. |
| IV (J) | - | - |
| PWHT (°C×h) | 775x2 | 760~790x2 |

MX-A410NiMo

PREMIARC™

Flux cored wire

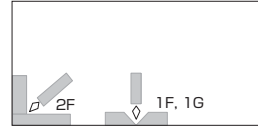
- Features:**
- Suitable for 13%Cr-Ni steel
 - Preheat (100°C) must be done depending on thickness of base metal

Classification: AWS A5.22 EC410NiMo

Shielding gas: Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.06 |
| Si | 0.3 | 0.5 |
| Mn | 0.5 | 0.6 |
| P | 0.02 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 4.2 | 4.0~5.0 |
| Cr | 12.0 | 11.0~12.5 |
| Mo | 0.5 | 0.4~0.7 |
| Cu | 0.03 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 1.2 | 180~320 |

All-weld mechanical properties

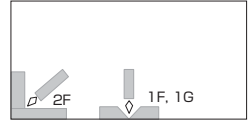
| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 870 |
| TS (MPa) | 920 |
| EI on 4d (%) | 20 |
| IV 0°C (J) | 64 |
| PWHT (°C×h) | 600x1 |

MX-A430M

Flux cored wire

- Features:**
- Suitable for 17%Cr and 13% Cr steel
 - Applied for thin plate in short circuiting welding

Welding Positions:



Classification: AWS -

Shielding gas: Ar-CO₂ or Ar-O₂

Polarity: DCEP

Packaging data

| φ mm | Spool | Drum | |
|------------------|------------------|-------------|-------|
| 1.2 | 20kg | 200kg | 250kg |
| Volume mm | 295W, 110H, 295L | 530 φ, 820H | |

Composition (all-weld metal mass%)

| | Typical (Ar-CO ₂) | Guaranty ^a |
|-----------|-------------------------------|-----------------------|
| C | 0.05 | 0.10 |
| Si | 0.4 | 0.9 |
| Mn | 0.1 | 1.0 |
| P | 0.01 | 0.04 |
| S | 0.02 | 0.03 |
| Ni | 0.1 | 0.6 |
| Cr | 17.0 | 15.0~18.5 |
| Nb | 0.7 | 1.0 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 1.2 | 100~250 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical (Ar-CO ₂) |
|---------------------|-------------------------------|
| 0.2%YS (MPa) | 390 |
| TS (MPa) | 540 |
| El on 4d (%) | 26 |
| PWHT | AW |

TG-X308L

Flux cored filler rod

- Features:**
- Applicable for 304 and 304L type steels
 - Suitable for root pass in one-side welding without back shielding

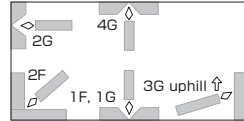
Classification: AWS A5.22 R308LT1-5

Shielding gas: Ar

Identification color: Red

Polarity: DCEN

Welding Positions:



Packaging data

| Tube | | | | |
|------|----|-----------|---------|-----------------|
| φ mm | kg | Length mm | g/piece | Volume mm |
| 2.2 | 5 | 1,000 | 26 | 42W, 35H, 1015L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.03 |
| Si | 0.7 | 1.2 |
| Mn | 1.4 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 10.3 | 9.0~11.0 |
| Cr | 19.6 | 18.0~21.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.04 | 0.75 |
| Bi | >0.002 | - |

Welding parameters

| thickness mm | 3~5 | 6~9 | Over 10 |
|------------------|-------|--------|---------|
| current A | 80~90 | 90~105 | 90~110 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|----------------------|---------|----------|
| 0.2%YS (MPa) | 450 | - |
| TS (MPa) | 620 | 518min. |
| EI on 4d (%) | 47 | 30min. |
| IV -196°C (J) | 60 | - |

TG-X309L

Flux cored filler rod

- Features:**
- Applicable for dissimilar-metal joint of stainless steels and ferritic steels
 - Suitable for root pass in one-side welding without back shielding

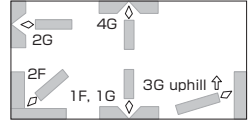
Classification: AWS A5.22 R309LT1-5

Shielding gas: Ar

Identification color: Yellow green

Polarity: DCEN

Welding Positions:



Packaging data

| Tube | | | | |
|------|----|-----------|---------|-----------------|
| φ mm | kg | Length mm | g/piece | Volume mm |
| 2.2 | 5 | 1,000 | 26 | 42W, 35H, 1015L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.03 |
| Si | 0.8 | 1.2 |
| Mn | 1.4 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.1 | 12.0~14.0 |
| Cr | 23.7 | 22.0~25.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.04 | 0.75 |
| Bi | >0.002 | - |

Note: ^aSingle values are maximum.

Welding parameters

| thickness mm | 3~5 | 6~9 | Over 10 |
|------------------|-------|--------|---------|
| current A | 80~90 | 90~105 | 90~110 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 530 | - |
| TS (MPa) | 680 | 518min. |
| EI on 4d (%) | 32 | 30min. |

TG-X316L

Flux cored filler rod

- Features:**
- Applicable for 316 and 316L type steels
 - Suitable for root pass in one-side TIG welding without back shielding

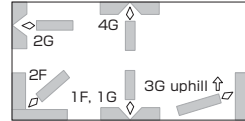
Classification: AWS A5.22 R316LT1-5

Shielding gas: Ar

Identification color: Green

Polarity: DCEN

Welding Positions:



Packaging data

| Tube | | | | |
|------|----|-----------|---------|-----------------|
| φ mm | kg | Length mm | g/piece | Volume mm |
| 2.2 | 5 | 1,000 | 26 | 42W, 35H, 1015L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.03 |
| Si | 0.7 | 1.2 |
| Mn | 1.4 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 12.0 | 11.0~14.0 |
| Cr | 18.4 | 17.0~20.0 |
| Mo | 2.2 | 2.0~3.0 |
| Cu | 0.05 | 0.75 |
| Bi | >0.002 | - |

Note: ^a Single values are maximum.

Welding parameters

| thickness mm | 3~5 | 6~9 | Over 10 |
|------------------|-------|--------|---------|
| current A | 80~90 | 90~105 | 90~110 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 440 | - |
| TS (MPa) | 600 | 483min. |
| EI on 4d (%) | 38 | 30min. |
| IV 0°C (J) | 110 | - |

TG-X347

Flux cored filler rod

- Features:**
- Applicable for 347 and 321 type steels
 - Suitable for root pass in one-side TIG welding without back shielding

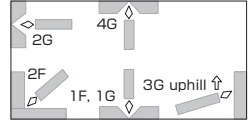
Classification: AWS A5.22 R347T1-5

Shielding gas: Ar

Identification color: Blue

Polarity: DCEN

Welding Positions:



Packaging data

| φ mm | Tube | | | |
|------|------|-----------|---------|-----------------|
| | kg | Length mm | g/piece | Volume mm |
| 2.2 | 5 | 1,000 | 26 | 42W, 35H, 1015L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.02 | 0.08 |
| Si | 0.8 | 1.2 |
| Mn | 1.4 | 0.5~2.5 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 10.2 | 9.0~11.0 |
| Cr | 18.9 | 18.0~21.0 |
| Nb+Ta | 0.60 | 8xC%~1.0 |
| Mo | 0.01 | 0.75 |
| Cu | 0.03 | 0.75 |
| Bi | >0.002 | - |

Note: ^a Single values are maximum.

Welding parameters

| thickness mm | 3~5 | 6~9 | Over 10 |
|------------------|-------|--------|---------|
| current A | 80~90 | 90~105 | 90~110 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 460 | - |
| TS (MPa) | 630 | 518min. |
| EI on 4d (%) | 48 | 30min. |
| IV 0°C (J) | 130 | - |

Solid wire

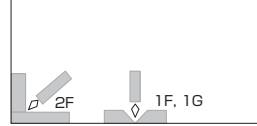
Features: • Suitable for 18%Cr-8%Ni steel

Classification: AWS A5.9 ER308

Shielding gas: Ar-2%O₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | | Drum | |
|------------------|------------------|------------------|--------------|--------|
| | Weight | Length | Weight | Length |
| 0.8 | 10kg | - | - | - |
| 0.9 | - | 20kg | - | - |
| 1.0 | - | 20kg | 200kg | - |
| 1.2 | - | 20kg | - | 250kg |
| Volume mm | 240W, 110H, 240L | 285W, 110H, 285L | 530 φ , 820H | |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.08 |
| Si | 0.43 | 0.30~0.65 |
| Mn | 1.7 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 9.7 | 9.0~11.0 |
| Cr | 19.9 | 19.5~22.0 |
| Mo | 0.08 | 0.75 |
| Cu | 0.11 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 0.8 | 50~150 |
| 0.9 | 70~200 |
| 1.0 | 80~250 |
| 1.2 | 100~300 |

All-weld mechanical properties

| | Typical |
|----------------------|---------|
| 0.2%YS (MPa) | 410 |
| TS (MPa) | 600 |
| EI on 4d (%) | 40 |
| IV -196°C (J) | 49 |

Solid wire

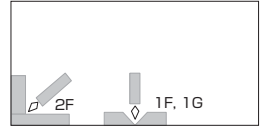
Features: ▪ Suitable for low carbon 18%Cr-8%Ni steel

Classification: AWS A5.9 ER308LSi

Shielding gas: Ar-2%O₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|------------------|------------------|------------------|
| | 0.8 | 10kg |
| 0.9 | 10kg | - |
| 1.0 | 10kg | 20kg |
| 1.2 | 10kg | 20kg |
| Volume mm | 240W, 110H, 240L | 285W, 110H, 285L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.03 |
| Si | 0.79 | 0.65~1.00 |
| Mn | 1.9 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 9.9 | 9.0~11.0 |
| Cr | 19.8 | 19.5~22.0 |
| Mo | 0.04 | 0.75 |
| Cu | 0.04 | 0.75 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 0.8 | 50~150 |
| 0.9 | 70~200 |
| 1.0 | 80~250 |
| 1.2 | 100~300 |

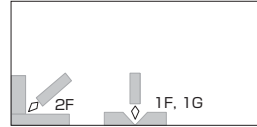
Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical |
|----------------------|---------|
| 0.2%YS (MPa) | 400 |
| TS (MPa) | 580 |
| EI on 4d (%) | 42 |
| IV -196°C (J) | 59 |

Solid wire

Features: • Suitable for dissimilar-metal joint and underlaying on ferritic steels for overlaying stainless steel weld metals

Welding Positions:

Classification: AWS A5.9 ER309

Shielding gas: Ar-2%O₂

Polarity: DCEP

Packaging data

| φ mm | Spool | |
|------------------|------------------|------------------|
| | 0.9 | 10kg |
| 1.0 | 10kg | 20kg |
| 1.2 | 10kg | 20kg |
| Volume mm | 240W, 110H, 240L | 285W, 110H, 285L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.46 | 0.30~0.65 |
| Mn | 2.0 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 13.7 | 12.0~14.0 |
| Cr | 23.3 | 23.0~25.0 |
| Mo | 0.03 | 0.75 |
| Cu | 0.03 | 0.75 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 0.9 | 70~200 |
| 1.0 | 80~250 |
| 1.2 | 100~300 |

Note: ^a Single values are maximum.

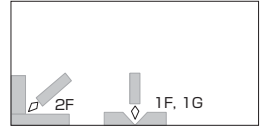
All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 430 |
| TS (MPa) | 610 |
| EI on 4d (%) | 39 |

Solid wire

Features: ▪ Suitable for dissimilar-metal joint and underlaying on ferritic steels for overlaying stainless steel weld metals

Welding Positions:



Classification: AWS A5.9 ER309LSi

Shielding gas: Ar-2%O₂

Polarity: DCEP

Packaging data

| φ mm | Spool | |
|------|------------------|------------------|
| | 10kg | 20kg |
| 1.2 | 240W, 110H, 240L | 285W, 110H, 285L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.03 |
| Si | 0.84 | 0.65~1.00 |
| Mn | 1.8 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 13.3 | 12.0~14.0 |
| Cr | 23.6 | 23.0~25.0 |
| Mo | 0.03 | 0.75 |
| Cu | 0.03 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 1.2 | 100~300 |

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 410 |
| TS (MPa) | 570 |
| El on 4d (%) | 40 |
| IV 0°C (J) | 88 |

Solid wire

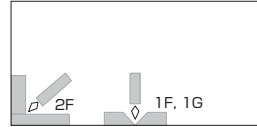
Features: • Suitable for low carbon 18%Cr-12%Ni-2%Mo steel

Classification: AWS A5.9 ER316LSi

Shielding gas: Ar-2%O₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|------------------|------------------|------------------|
| 1.0 | 10kg | - |
| 1.2 | 10kg | 20kg |
| Volume mm | 240W, 110H, 240L | 285W, 110H, 285L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.03 |
| Si | 0.79 | 0.65~1.00 |
| Mn | 2.0 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 12.2 | 11.0~14.0 |
| Cr | 19.3 | 18.0~20.0 |
| Mo | 2.4 | 2.0~3.0 |
| Cu | 0.12 | 0.75 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 1.0 | 80~250 |
| 1.2 | 100~300 |

Note: ^a Single values are maximum.

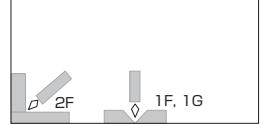
All-weld mechanical properties

| | Typical |
|----------------------|---------|
| 0.2%YS (MPa) | 380 |
| TS (MPa) | 550 |
| EI on 4d (%) | 41 |
| IV -196°C (J) | 39 |

MG-S430NbS**PREMIARC™****Solid wire**

Features:

- Suitable for automobile exhaust system
- Applicable for ferritic stainless steel

Welding Positions:**Classification:** AWS -**Shielding gas:** Ar-2%O₂**Polarity:** DCEP**Packaging data**

| ϕ mm | Spool | | Drum | |
|------------------|------------------|------|-------------------|-------|
| 1.0 | 12.5kg | 20kg | 200kg | - |
| 1.2 | 12.5kg | 20kg | - | 250kg |
| Volume mm | 285W, 110H, 285L | | 530 ϕ , 820H | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.03 |
| Si | 1.15 | 1.5 |
| Mn | 0.36 | 1.00 |
| P | 0.02 | 0.04 |
| S | <0.01 | 0.03 |
| Ni | 0.16 | 0.60 |
| Cr | 18.1 | 17.5~19.0 |
| Nb | 0.47 | 0.40~0.70 |

Welding parameters (A)

| ϕ mm | 1F, 1G, 2F |
|-----------|------------|
| 1.0 | 80~250 |
| 1.2 | 100~300 |

Note: ^a Single values are maximum.

Filler rod and wire

Features: ▪ Suitable for 18%Cr-8%Ni steel

Classification: AWS A5.9 ER308

Shielding gas: Ar

Identification color: 1st Yellow

Polarity: DCEN

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 0.8 | - | 5 | 1,000 | 4 |
| 1.0 | - | 5 | 1,000 | 6 |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.08 |
| Si | 0.38 | 0.30~0.65 |
| Mn | 1.5 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 9.5 | 9.0~11.0 |
| Cr | 19.9 | 19.5~22.0 |
| Mo | 0.11 | 0.75 |
| Cu | 0.12 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters

| φ mm | Current A |
|------|-----------|
| 0.8 | 50~80 |
| 1.0 | 50~80 |
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 410 |
| TS (MPa) | 580 |
| EI on 4d (%) | 42 |
| IV 0°C (J) | 150 |

Approvals

| | |
|------------|--------------------|
| ABS | AWS A5.9 ER308, MG |
| DNV | NV308 |
| NK | KY308 |

Filler rod and wire

| | |
|------------------------------|--|
| Features: | ▪ Suitable for low carbon 18%Cr-8%Ni steel |
| Classification: | AWS A5.9 ER308L |
| Shielding gas: | Ar |
| Identification color: | 1st Red |
| Polarity: | DCEN |

Packaging data

| ϕ mm | Spool | | Tube | | |
|------------------|------------------|----|-----------------|---------|--|
| | kg | kg | Length mm | g/piece | |
| 0.8 | 10 | 5 | 1,000 | 4 | |
| 1.0 | 10 | 5 | 1,000 | 6 | |
| 1.2 | 10 | 5 | 1,000 | 9 | |
| 1.6 | 10 | 5 | 1,000 | 16 | |
| 2.0 | - | 5 | 1,000 | 25 | |
| 2.4 | - | 5 | 1,000 | 36 | |
| 3.2 | - | 5 | 1,000 | 64 | |
| Volume mm | 240W, 110H, 240L | | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.01 | 0.03 |
| Si | 0.37 | 0.30~0.65 |
| Mn | 1.8 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 10.1 | 9.0~11.0 |
| Cr | 19.8 | 19.5~22.0 |
| Mo | 0.07 | 0.75 |
| Cu | 0.08 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters

| ϕ mm | Current A |
|------|-----------|
| 0.8 | 50~80 |
| 1.0 | 50~80 |
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

All-weld mechanical properties

| | Typical |
|----------------------|---------|
| 0.2%YS (MPa) | 420 |
| TS (MPa) | 590 |
| EI on 4d (%) | 45 |
| IV -196°C (J) | 78 |

Approvals

| | |
|------------|-----------------|
| ABS | AWS A5.9 ER308L |
| LR | MG |
| DNV | NV308L, MG |
| BV | 308LBT, UP |
| NK | KY308L |
| GL | 4306 |
| CCS | AS1-A |

Filler rod and wire

| | |
|------------------------------|--|
| Features: | ▪ Suitable for dissimilar-metal joint and underlaying on ferritic steels |
| Classification: | AWS A5.9 ER309 |
| Shielding gas: | Ar |
| Identification color: | 1st Black |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | 5 | 1,000 | 6 |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | | 40W, 35H, 1015L | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.12 |
| Si | 0.47 | 0.30~0.65 |
| Mn | 1.6 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 13.6 | 12.0~14.0 |
| Cr | 23.1 | 23.0~25.0 |
| Mo | 0.10 | 0.75 |
| Cu | 0.12 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 1.0 | 50~80 |
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 410 |
| TS (MPa) | 580 |
| EI on 4d (%) | 39 |
| IV 0°C (J) | 150 |

Approvals

| | |
|------------|-------|
| DNV | NV309 |
| NK | KY309 |
| GL | 4332 |

Filler rod and wire

| | |
|------------------------------|--|
| Features: | ▪ Suitable for dissimilar-metal joint and underlaying on ferritic steels |
| Classification: | AWS A5.9 ER309L |
| Shielding gas: | Ar |
| Identification color: | 1st Yellow green |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 0.9 | 10 | - | - | - |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.01 | 0.03 |
| Si | 0.42 | 0.30~0.65 |
| Mn | 1.7 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 13.5 | 12.0~14.0 |
| Cr | 23.3 | 23.0~25.0 |
| Mo | 0.04 | 0.75 |
| Cu | 0.05 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 0.9 | 50~80 |
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 410 |
| TS (MPa) | 570 |
| El on 4d (%) | 38 |
| IV 0°C (J) | 110 |

Approvals

| | |
|-----------|------------------------|
| LR | SS/CMn m (Chem & Cryo) |
| NK | KY309L |

Filler rod and wire

| | |
|------------------------------|--|
| Features: | ▪ Suitable for dissimilar-metal joint and underlaying on ferritic steels |
| Classification: | AWS A5.9 ER309LMo |
| Shielding gas: | Ar |
| Identification color: | 1st Silver, 2nd Red |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | | 40W, 35H, 1015L | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.03 |
| Si | 0.43 | 0.30~0.65 |
| Mn | 2.1 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 13.6 | 12.0~14.0 |
| Cr | 23.5 | 23.0~25.0 |
| Mo | 2.2 | 2.0~3.0 |
| Cu | 0.05 | 0.75 |

Welding parameters (A)

| φ mm | |
|------|---------|
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 440 |
| TS (MPa) | 590 |
| EI on 4d (%) | 36 |

Filler rod and wire

| | |
|------------------------------|----------------------------------|
| Features: | ▪ Suitable for 25%Cr-20%Ni steel |
| Classification: | AWS A5.9 ER310 |
| Shielding gas: | Ar |
| Identification color: | 1st Gold |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| Volume mm | 240W, 110H, 240L | | 40W, 35H, 1015L | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.11 | 0.08~0.15 |
| Si | 0.49 | 0.30~0.65 |
| Mn | 1.8 | 1.0~2.5 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 21.2 | 20.0~22.5 |
| Cr | 26.7 | 25.0~28.0 |
| Mo | 0.02 | 0.75 |
| Cu | 0.02 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 1.0 | 50~80 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 450 |
| TS (MPa) | 610 |
| El on 4d (%) | 39 |
| IV 0°C (J) | 110 |

Filler rod and wire

| | |
|------------------------------|---------------------------------------|
| Features: | ▪ Suitable for 18%Cr-12%Ni-2%Mo steel |
| Classification: | AWS A5.9 ER316 |
| Shielding gas: | Ar |
| Identification color: | 1st White |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | 5 | 1,000 | 6 |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | | 40W, 35H, 1015L | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.04 | 0.08 |
| Si | 0.47 | 0.30~0.65 |
| Mn | 1.5 | 1.0~2.5 |
| P | 0.03 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 12.0 | 11.0~14.0 |
| Cr | 19.1 | 18.0~20.0 |
| Mo | 2.1 | 2.0~3.0 |
| Cu | 0.26 | 0.75 |

Welding parameters (A)

| φ mm | |
|------|---------|
| 1.0 | 50~80 |
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 390 |
| TS (MPa) | 570 |
| EI on 4d (%) | 42 |
| IV 0°C (J) | 110 |

Filler rod and wire

| | |
|------------------------------|--|
| Features: | ▪ Suitable for low carbon 18%Cr-12%Ni-2%Mo steel |
| Classification: | AWS A5.9 ER316L |
| Shielding gas: | Ar |
| Identification color: | 1st Green |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 0.8 | 10 | 5 | 1,000 | 4 |
| 1.0 | 10 | 5 | 1,000 | 6 |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.01 | 0.03 |
| Si | 0.40 | 0.30~0.65 |
| Mn | 1.7 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 12.0 | 11.0~14.0 |
| Cr | 18.7 | 18.0~20.0 |
| Mo | 2.2 | 2.0~3.0 |
| Cu | 0.11 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 0.8 | 50~80 |
| 1.0 | 50~80 |
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

All-weld mechanical properties

| | Typical |
|----------------------|---------|
| 0.2%YS (MPa) | 390 |
| TS (MPa) | 550 |
| El on 4d (%) | 43 |
| IV -196°C (J) | 49 |

Approvals

| | |
|------------|-----------------|
| ABS | AWS A5.9 ER316L |
| LR | MG |
| DNV | NV316L, MG |
| BV | 316LBT |
| NK | KY316L |
| GL | 4435 |
| CCS | AS-1B |

Filler rod and wire

Features: ▪ Suitable for low carbon 18%Cr-12%Ni-2%Mo-N and low carbon 19%Cr-13%Ni-3%Mo steel

Classification: AWS A5.9 ER317L

Shielding gas: Ar

Identification color: 1st Sorrel

Polarity: DCEN

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.01 | 0.03 |
| Si | 0.43 | 0.30~0.65 |
| Mn | 1.8 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 13.1 | 13.0~15.0 |
| Cr | 18.8 | 18.5~20.5 |
| Mo | 3.4 | 3.0~4.0 |
| Cu | 0.04 | 0.75 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 410 |
| TS (MPa) | 570 |
| EI on 4d (%) | 39 |
| IV 0°C (J) | 98 |

Approvals

| LR | 317L m (Chem) |
|----|---------------|
| | |

Filler rod and wire

| | |
|------------------------------|--|
| Features: | ▪ Suitable for 18%Cr-8%Ni-Nb and 18%Cr-8%Ni-Ti steel |
| Classification: | AWS A5.9 ER347 |
| Shielding gas: | Ar |
| Identification color: | 1st Blue |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | - | - | - |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | | 40W, 35H, 1015L | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.08 |
| Si | 0.40 | 0.30~0.65 |
| Mn | 2.1 | 1.0~2.5 |
| P | 0.02 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 10.0 | 9.0~11.0 |
| Cr | 19.3 | 19.0~21.5 |
| Mo | 0.07 | 0.75 |
| Cu | 0.07 | 0.75 |
| Nb | 0.6 | 10xC~1.0 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 1.0 | 50~80 |
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 460 |
| TS (MPa) | 630 |
| El on 4d (%) | 38 |
| IV 0°C (J) | 88 |

Approvals

| NK | KY347 |
|----|-------|
|----|-------|

Filler rod and wire

| | |
|------------------------------|--------------------------------------|
| Features: | ▪ Suitable for 13%Cr stainless steel |
| Classification: | AWS A5.9 ER410 |
| Shielding gas: | Ar |
| Identification color: | 1st Purple |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 1.2 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| Volume mm | 240W, 110H, 240L | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.10 | 0.12 |
| Si | 0.3 | 0.5 |
| Mn | 0.5 | 0.6 |
| P | 0.01 | 0.03 |
| S | 0.01 | 0.03 |
| Ni | 0.4 | 0.6 |
| Cr | 12.8 | 11.5~13.5 |
| Mo | 0.50 | 0.75 |
| Cu | <0.01 | 0.75 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |

All-weld mechanical properties

| | Typical |
|---------------------|-----------|
| 0.2%YS (MPa) | 520 |
| TS (MPa) | 660 |
| EI on 4d (%) | 25 |
| PWHT (°C×h) | 760×1, FC |

Filler rod and wire

| | |
|------------------------------|---|
| Features: | ▪ Suitable for normal duplex stainless steel (S32205, S31803, etc.) |
| Classification: | AWS A5.9 ER2209 |
| Shielding gas: | Ar or Ar-2%N ₂ |
| Identification color: | 1st Red, 2nd Green |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.01 | 0.03 |
| Si | 0.38 | 0.90 |
| Mn | 1.49 | 0.50~2.00 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 8.6 | 7.5~9.5 |
| Cr | 23.0 | 21.5~23.5 |
| Mo | 3.3 | 2.5~3.5 |
| Cu | 0.05 | 0.75 |
| N | 0.15 | 0.08~0.20 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 615 |
| TS (MPa) | 814 |
| EI on 4d (%) | 38 |
| IV -50°C (J) | 150 |

Filler rod and wire

| | |
|------------------------------|--|
| Features: | ▪ Suitable for super duplex stainless steel (S32750, S32760, etc.) |
| Classification: | AWS A5.9 ER2594 |
| Shielding gas: | Ar or Ar-2%N ₂ |
| Identification color: | 1st Red, 2nd Blue |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | | 40W, 35H, 1015L | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.01 | 0.03 |
| Si | 0.4 | 1.0 |
| Mn | 0.6 | 2.5 |
| P | 0.02 | 0.03 |
| S | <0.01 | 0.02 |
| Ni | 9.2 | 8.0~10.5 |
| Cr | 24.8 | 24.0~27.0 |
| Mo | 3.8 | 2.5~4.5 |
| Cu | 0.1 | 1.5 |
| N | 0.26 | 0.20~0.30 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

All-weld mechanical properties

| | Typical (Ar-2%N ₂) |
|---------------------|--------------------------------|
| 0.2%YS (MPa) | 646 |
| TS (MPa) | 859 |
| EI on 4d (%) | 38 |
| IV -50°C (J) | 171 |

Approvals

| DNV | MG (Super duplex) |
|-----|-------------------|
| | |

Filler rod and wire

| | |
|------------------------------|---|
| Features: | ▪ Suitable for 25%Cr-22%Ni-2%Mo steel of urea plant |
| Classification: | AWS - |
| Shielding gas: | Ar |
| Identification color: | - |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 0.8 | - | 5 | 1,000 | 4 |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| Volume mm | 240W, 110H, 240L | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.009 | 0.020 |
| Si | 0.03 | 0.50 |
| Mn | 4.87 | 3.00~5.50 |
| P | 0.005 | 0.030 |
| S | 0.002 | 0.020 |
| Ni | 22.52 | 21.00~23.00 |
| Cr | 25.33 | 24.00~26.00 |
| Mo | 2.27 | 1.90~2.70 |
| N | 0.13 | 0.20 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 0.8 | 50~80 |
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 480 |
| TS (MPa) | 630 |
| EI on 4d (%) | 40 |

Filler rod and wire

| | |
|------------------------------|---|
| Features: | ▪ Suitable for 13%Cr and 13%Cr-Al steel |
| Classification: | AWS - |
| Shielding gas: | Ar |
| Identification color: | 1st Purple |
| Polarity: | DCEN |

Packaging data

| ø mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| 3.2 | - | 5 | 1,000 | 64 |
| Volume mm | 240W, 110H, 240L | | 40W, 35H, 1015L | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.09 | 0.12 |
| Si | 0.41 | 0.50 |
| Mn | 0.46 | 0.60 |
| P | 0.007 | 0.030 |
| S | 0.002 | 0.030 |
| Ni | 0.07 | 0.60 |
| Cr | 11.93 | 11.50~13.50 |
| Mo | 0.01 | 0.75 |
| Cu | 0.01 | 0.75 |
| Nb | 0.89 | 0.70~1.10 |

Welding parameters (A)

| ø mm | |
|------|---------|
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |
| 3.2 | 200~300 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 270 |
| TS (MPa) | 540 |
| EI on 4d (%) | 23 |
| IV 20°C (J) | 39 |

Filler rod and wire

| | |
|------------------------------|---|
| Features: | ▪ Suitable for modified 316 stainless steel of urea plant |
| Classification: | AWS - |
| Shielding gas: | Ar |
| Identification color: | - |
| Polarity: | DCEN |

Packaging data

| φ mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 1.0 | 10 | 5 | 1,000 | 6 |
| 1.2 | 10 | 5 | 1,000 | 9 |
| 1.6 | 10 | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 25 |
| 2.4 | - | 5 | 1,000 | 36 |
| Volume mm | 240W, 110H, 240L | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.005 | 0.045 |
| Si | 0.16 | 1.00 |
| Mn | 6.10 | 4.00~7.00 |
| P | 0.011 | 0.030 |
| S | 0.004 | 0.020 |
| Ni | 16.29 | 14.00~18.00 |
| Cr | 18.24 | 17.00~19.50 |
| Mo | 2.56 | 2.20~3.00 |
| N | 0.01 | 0.20 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | |
|------|---------|
| 1.0 | 50~80 |
| 1.2 | 50~100 |
| 1.6 | 100~200 |
| 2.0 | 100~200 |
| 2.4 | 150~250 |

All-weld mechanical properties

| | Typical |
|----------------------|---------|
| 0.2%YS (MPa) | 360 |
| TS (MPa) | 490 |
| EI on 4d (%) | 41 |
| IV -257°C (J) | 99 |

For Hardfacing

Welding Consumables for

SMAW

FCAW

GMAW

SAW

SMAW, FCAW, GMAW, SAW

A guide for selecting welding consumables

Weld metal microstructure and main alloying elements determine the performances of welding consumables for hardfacing as summarized in Table 1. In addition, PF-200S/US-63B is good for reclamation of mill rolls.

Table 1 Welding consumables and their characteristics

| Weld metal microstructure and alloying formula | Hv | Features | Type of wear ⁽¹⁾ | | | | | | |
|--|------------------------|---|-----------------------------|-----|-----|-----|-----|-----|-----|
| | | | MTM | ABR | HTW | CAV | COR | HRT | IMP |
| Pearlite | 200-400 | <ul style="list-style-type: none"> Good crack resistance Good machinability | ○ | △ | × | - | - | × | ○ |
| Martensite | 350-800 | <ul style="list-style-type: none"> Good wear resistance | ○ | ○ | △ | - | × | △ | △ |
| 13%Cr stainless steel type | 350-500 | <ul style="list-style-type: none"> Good resistance to oxidation, heat and corrosion Good wear resistance | ○ | △ | ○ | ○ | ○ | ○ | △ |
| Semi-Austenite | 500-700 | <ul style="list-style-type: none"> High toughness and good wear resistance | ○ | ○ | △ | △ | △ | △ | △ |
| High Mn Austenite | 13%Mn 150-500 | <ul style="list-style-type: none"> High toughness and good impact wear resistance High work hardenability | × | ○ | × | △ | × | × | ◎ |
| | 16%Mn-16%Cr 200-400 | <ul style="list-style-type: none"> High hardness at high temperatures High toughness | ○ | △ | ○ | ○ | ○ | ○ | ○ |
| High Cr-Fe | 600-800 | <ul style="list-style-type: none"> Excellent erosion resistance Good resistance to corrosion and heat | △ | ◎ | ◎ | × | ○ | ○ | × |
| Tungsten carbide type | 800-1200 | <ul style="list-style-type: none"> Excellent resistance to heavy abrasion | × | ◎ | × | × | × | × | × |

Note (1) MTM: Metal-to-metal wear, ABR: Abrasion, HTW: High temp. wear, CAV: Cavitation, COR: Corrosion wear, HRT: Heat resistance, IMP: Impact wear
 ◎: Excellent resistance, ○: Good resistance, △: Slightly inferior, ×: Inferior, -: Not used for general applications

Material to be introduced here, is for hardfacing. Please do not use the joint welding.

| | SMAW | FCAW | GMAW | SAW |
|--|---|--|------------------|---|
| | HF-240 HF-260 HF-330 HF-350 | DW-H250 DW-H350 | MG-250 MG-350 | G-50/US-H250N G-50/US-H350N |
| | HF-450 HF-500 HF-600 HF-650 HF-700 HF-800K | DW-H450 DW-H600 DW-H700 DW-H800 | - | G-50/US-H400N G-50/US-H450N G-50/US-H500N MF-30/US-H550N MF-30/US-H600N |
| | HF-13 | - | - | - |
| | HF-12 | - | - | - |
| | HF-11 | DW-H11 | - | - |
| | HF-16 | DW-H16 | - | - |
| | HF-30 | DW-H30 DW-H30MV | - | - |
| | HF-950 | - | - | - |

SMAW, FCAW, GMAW, SAW

Tips for better welding results

Common

Important points in hardfacing are to obtain sufficient hardness and to minimize cracking. In order to achieve them, proper selection of welding consumables and proper welding procedures mentioned below are necessary.

1) Preparation of base metal:

Rust, oil and soil attached on the base metal may cause blowholes. Cracks in the base metal may cause cracking of the weld metal; therefore, they must be removed completely beforehand.

2) Preheat and interpass temperature:

In order to minimize cracking, control of preheat and interpass temperature is a key technique. Table 1 shows a rule of thumb for proper preheat and interpass temperatures in relation to the carbon equivalent of the base metal. In practice, size of work, type of welding consumable and method of hardfacing should be taken into consideration to determine the most appropriate temperatures.

Table 1 A rule of thumb for preheat and interpass temperature in relation to base metal carbon equivalents

| Type of steel | Carbon equivalent ⁽¹⁾ | Preheat and interpass temperature (°C) |
|--|----------------------------------|---|
| Carbon steel and Low alloy steel | Less than 0.3 | 100 max. |
| | 0.3-0.4 | 100 min. |
| | 0.4-0.5 | 150 min. |
| | 0.5-0.6 | 200 min. |
| | 0.6-0.7 | 250 min. |
| | 0.7-0.8 | 300 min. |
| | Over 0.8 | 350 min. |
| High-Mn steel (13%Mn steel) | | Use no preheat and cool each weld pass with water |
| Austenitic stainless steel | | Use no preheat and control the interpass temperature 150°C or lower |
| High alloy steel (e.g., High-Cr steel) | | 400 min. |

Note (1) Carbon equivalent = $C + Mn/6 + Si/24 + Cr/5 + Mo/4 + Ni/15$

3) Immediate postweld heating:

Heating the weldment at 300-350°C for 10-30 minutes just after welding was finished is effective to prevent cold cracking. Control the temperature carefully, or the hardness of the weld will be decreased by excessive heating.

4) Postweld heat treatment:

Postweld heat treatment (PWHT) at 550-750°C is effective to prevent cold cracking and distortion in service, and to improve properties of the welds. It is important to set the PWHT conditions taking into account that the hardness of the weld is normally decreased by PWHT.

5) Underlaying:

Underlaying is effective to prevent cracking in welds where low-alloy steel having high hardenability is hardfaced or where high-hardness weld metal is deposited on carbon steel. For underlaying, mild steel type welding consumables or austenitic stainless steel type welding consumables should be used.

6) Penetration:

In hardfacing, the properties of the weld metal will considerably be affected by welding penetration into the base metal, because the chemical composition of the welding consumable is generally very different from those of the base metal. In order to use sufficiently the desired properties of the welding consumable, welding penetration must be controlled by using an appropriate welding procedure, for instance, multi-layer welding.

7) Welding distortion:

Intermittent and symmetrical welding sequences are effective to minimize welding distortion. Restraint of the work is also effective to minimize welding distortion.

SMAW

- 1) Control the arc length as short as possible.
- 2) Use the backstep method for arc starting to prevent blowholes.
- 3) Control the weaving width less than 3-4 times the diameter of a stick electrode.
- 4) Re-dry stick electrodes before use.

FCAW, GMAW

- 1) Control shielding gas flow rates within 20-25 l/mm for general applications. Note that poor shielding due to low flow rates and wind can cause blowholes and pits in the weld metal.
- 2) Refer to proper currents for individual wire sizes as shown in Table 2.

Table 2 Proper welding currents

| Type of wire | Diameter (mm) | Polarity | Welding current (A) |
|--------------|---------------|----------|---------------------|
| DW-H series | 1.2 | DCEP | 120-360 |
| | 1.6 | DCEP | 200-420 |
| MG series | 1.2 | DCEP | 120-320 |
| | 1.6 | DCEP | 200-420 |

| Product names | Typical use & Redrying condition | Nominal hardness | Pol. | WP | Composition C |
|---------------|---|------------------|------------|-----------------------------|------------------|
| HF-240 | <ul style="list-style-type: none"> Gears and wheels 70~100°Cx0.5~1h | Hv 240 | AC DCEP | 1F 1G 3G uphill 4G | Ty 0.09 |
| HF-260 | <ul style="list-style-type: none"> Shafts, crane wheels and couplings 300~350°Cx0.5~1h | Hv 260 | AC DCEP | 1F 1G 3G uphill 4G | Ty 0.17 |
| HF-330 | <ul style="list-style-type: none"> Keys and clutch lugs 70~100°Cx0.5~1h | Hv 330 | AC DCEP | 1F 1G 3G uphill 4G | Ty 0.10 |
| HF-350 | <ul style="list-style-type: none"> Upper rollers and sprockets of bulldozers 300~350°Cx0.5~1h | Hv 350 | AC DCEP | 1F 1G 3G uphill 4G | Ty 0.25 |

Note: Welding tests are as per Kobe Steel's Standard. Ty: Typical (polarity: AC)

Identification color

| Product names | 1st | 2nd |
|---------------|--------|--------|
| HF-240 | Red | White |
| HF-260 | Red | Green |
| HF-330 | Red | Purple |
| HF-350 | Orange | Green |

Please do not use the joint welding.

PREMIARC™

| (overlay weld metal mass%) | | | Weld metal hardness | | |
|----------------------------|------|------|---------------------|-----|-----------------|
| Si | Mn | Cr | PWHT | Hv | Pre. H & IPT °C |
| 0.58 | 0.58 | 0.81 | AW | 240 | 150min. |
| | | | 900°C, OQ | 350 | |
| 0.69 | 1.81 | - | AW | 271 | 150min. |
| | | | 900°C, OQ | 395 | |
| 0.69 | 0.86 | 2.29 | AW | 340 | 150min. |
| | | | - | - | |
| 0.49 | 1.38 | 1.16 | AW | 366 | 150min. |
| | | | 850°C, OQ | 510 | |

Packaging data

| φ mm | 2.6 | 3.2 | 4.0 | 5.0 | 6.0 |
|------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|
| HF-240 | - | 350 | 400 | 400 | 450 |
| HF-260 | 300 | 350 | 400 | 400 | 450 |
| HF-330 | - | 350 | 400 | 400 | 450 |
| HF-350 | 300 | 350 | 400 | 400 | 450 |
| carton mm | 270W, 90H, 330L | 170W, 120H, 380L | 170W, 120H, 430L | 170W, 120H, 430L | 170W, 110H, 480L |

| Product names | Typical use & Redrying condition | Nominal hardness | Pol. | WP | Composition | |
|---------------|---|------------------|------------|----------|-------------|------|
| | | | | | Ty | C |
| HF-450 | <ul style="list-style-type: none"> Idlers, rollers and truck links of bulldozers 300~350°Cx0.5~1h | Hv 450 | AC DCEP | 1F 1G | Ty | 0.20 |
| HF-500 | <ul style="list-style-type: none"> Idlers and truck links of bulldozers 300~350°Cx0.5~1h | Hv 500 | AC DCEP | 1F 1G | Ty | 0.45 |
| HF-600 | <ul style="list-style-type: none"> Lower rollers and bucket edges 300~350°Cx0.5~1h | Hv 600 | AC DCEP | 1F 1G | Ty | 0.48 |
| HF-650 | <ul style="list-style-type: none"> Tamping dies and mixer blades 300~350°Cx0.5~1h | Hv 650 | AC DCEP | 1F 1G | Ty | 0.67 |

Note: Welding tests are as per Kobe Steel's Standard. Ty: Typical (polarity: AC)

Identification color

| Product names | 1st | 2nd |
|---------------|--------|------------|
| HF-450 | Red | Pink |
| HF-500 | Orange | Blue white |
| HF-600 | Red | Red |
| HF-650 | Red | Orange |

Please do not use the joint welding.

PREMIARC™

(overlay weld metal mass%)

Weld metal hardness

| Si | Mn | Cr | Mo | V | W | PWHT (°C×h) | Hv | Pre. H & IPT °C |
|----|----|----|----|---|---|----------------|----|-----------------|
|----|----|----|----|---|---|----------------|----|-----------------|

| | | | | | | | | |
|------|------|------|------|------|---|-------|-----|---------|
| 1.30 | 0.31 | 2.54 | 0.60 | 0.23 | - | AW | 456 | 150min. |
| | | | | | | 550x6 | 443 | |

| | | | | | | | | |
|------|------|---|------|------|---|----|-----|---------|
| 1.37 | 0.91 | - | 0.98 | 0.28 | - | AW | 517 | 150min. |
|------|------|---|------|------|---|----|-----|---------|

| | | | | | | | | |
|------|------|------|---|---|---|----|-----|---------|
| 0.77 | 2.58 | 2.50 | - | - | - | AW | 595 | 200min. |
|------|------|------|---|---|---|----|-----|---------|

| | | | | | | | | |
|------|------|------|------|------|------|-----------|-----|---------|
| 0.90 | 0.87 | 4.91 | 1.17 | 0.55 | 1.42 | AW | 634 | 200min. |
| | | | | | | 600x1, AC | 580 | |

Packaging data

| φ mm | 2.6 | 3.2 | 4.0 | 5.0 | 6.0 |
|------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| HF-450 | - | - | 400 | 400 | 450 |
| HF-500 | - | 350 | 400 | 400 | 450 |
| HF-600 | 300 | 350 | 400 | 400 | 450 |
| HF-650 | 300 | 350 | 400 | 400 | 450 |
| carton mm | 270W, 100H, 330L | 170W, 130H, 380L | 170W, 120H, 430L | 170W, 125H, 430L | 170W, 115H, 480L |

| Product names | Typical use & Redrying condition | Nominal hardness | Pol. | WP | Composition | |
|----------------|--|------------------|------------|----------|-------------|------|
| | | | | | Ty | C |
| HF-700 | <ul style="list-style-type: none"> Cutter knives and casings 300~350°Cx0.5~1h | Hv 700 | AC DCEP | 1F 1G | Ty | 0.62 |
| HF-800K | <ul style="list-style-type: none"> Cutter knives and casings 300~350°Cx0.5~1h | Hv 800 | AC DCEP | 1F 1G | Ty | 0.80 |
| HF-950 | <ul style="list-style-type: none"> Shovel teeth and cutter knives 150~200°Cx0.5~1h | Hv 950 | AC DCEP | 1F 1G | Ty | 3.5 |

Note: Welding tests are as per Kobe Steel's Standard. Ty: Typical (polarity: AC)

Identification color

| Product names | 1st | 2nd |
|----------------|--------|--------|
| HF-700 | Orange | Orange |
| HF-800K | Orange | Yellow |
| HF-950 | Orange | - |

Please do not use the joint welding.

PREMIARC™

| (overlay weld metal mass%) | | | | | | Weld metal hardness | | |
|----------------------------|------|------|------|------|------|---------------------|-----|-----------------|
| Si | Mn | Cr | Mo | W | B | PWHT (°C×h) | Hv | Pre. H & IPT °C |
| 0.80 | 0.78 | 5.12 | 2.21 | - | - | AW | 654 | 200min. |
| | | | | | | 600x1, AC | 485 | |
| 1.65 | 1.24 | 3.82 | - | 2.42 | 0.29 | AW | 736 | 200min. |
| | | | | | | 600x1, AC | 535 | |
| 0.1 | 2.6 | - | - | 26 | - | AW | 930 | 300min. |

Packaging data

| φ mm | 3.2 | 4.0 | 5.0 | 6.0 |
|------------------|------------------------|------------------------|------------------------|------------------------|
| HF-700 | - | 400 | 400 | 450 |
| HF-800K | 350 | 400 | 400 | 450 |
| HF-950 | - | 400 | 400 | - |
| carton mm | 170W, 120H, 380L | 170W, 115H, 430L | 170W, 120H, 430L | 170W, 120H, 480L |

| Product names | Typical use & Redrying condition | Nominal hardness | Pol. | WP | Composition | |
|---------------|--|------------------|------------|----------|-------------|------|
| | | | | | Ty | C |
| HF-11 | <ul style="list-style-type: none"> Crusher hammers and crusher jaws 150~200°Cx0.5~1h | Hv 250 | AC DCEP | 1F 1G | Ty | 0.82 |
| HF-12 | <ul style="list-style-type: none"> Ripper teeth, impellers and breakers 300~350°Cx0.5~1h | Hv 500 | AC DCEP | 1F 1G | Ty | 0.72 |
| HF-13 | <ul style="list-style-type: none"> Valve seats and agitator propellers 300~350°Cx0.5~1h | Hv 450 | AC DCEP | 1F 1G | Ty | 0.13 |
| HF-16 | <ul style="list-style-type: none"> Hot shears and hot dies 150~200°Cx0.5~1h | Hv 300 | AC DCEP | 1F 1G | Ty | 0.71 |
| HF-30 | <ul style="list-style-type: none"> Crusher rotors and liners 300~350°Cx0.5~1h | Hv 700 | AC DCEP | 1F 1G | Ty | 5.00 |

Note: Welding tests are as per Kobe Steel's Standard. Ty: Typical (polarity: AC)

Identification color

| Product names | 1st | 2nd |
|---------------|--------|------------|
| HF-11 | Red | Black |
| HF-12 | Red | Brown |
| HF-13 | Red | Blue white |
| HF-16 | Orange | Brown |
| HF-30 | Red | Silver |

Please do not use the joint welding.

PREMIARC™

| (overlay weld metal mass%) | | | | | | Weld metal hardness | |
|----------------------------|-------|-------|------|------|------|---------------------|-----|
| Si | Mn | Cr | Mo | V | Ni | PWHT (°Cxh) | Hv |
| 0.39 | 13.88 | - | - | - | - | AW | 266 |
| 0.89 | 1.17 | 7.30 | 1.12 | - | - | AW | 532 |
| | | | | | | 500x2 | 630 |
| 0.50 | 0.74 | 12.97 | 0.97 | - | 0.99 | AW | 420 |
| | | | | | | 750x1 | 260 |
| 0.48 | 14.59 | 15.33 | 1.85 | 0.42 | 2.20 | AW | 306 |
| 0.42 | 1.23 | 30.5 | - | - | - | AW | 770 |

Packaging data

| φ mm | 2.6 | 3.2 | 4.0 | 5.0 | 6.0 |
|------------------|------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------|
| HF-11 | - | 350 | 400 | 400 | 450 |
| HF-12 | 300 | 350 | 400 | 400 | 450 |
| HF-13 | - | 350 | 400 | 400 | - |
| HF-16 | - | 300 | 350 | 350 | - |
| HF-30 | - | - | 400 | 450 | - |
| carton mm | 270W, 100H, 330L | 170W, 125H, 380L or 330L | 170W, 120H, 430L or 380L | 170W, 120H, 430L or 380L | 170W, 110H, 480L |

| Product names | Typical use | Nominal hardness | SG | WP |
|----------------------|---|-------------------------|-----------------|----------------|
| DW-H250 | ▪ Metal-to-metal wear parts and underlaying for hardfacing and repair | Hv 250 | CO ₂ | 1F 1G 2F |
| DW-H350 | ▪ Metal-to-metal wear and light abrasion parts | Hv 350 | CO ₂ | 1F 1G 2F |
| DW-H450 | ▪ Metal-to-metal wear and abrasion parts | Hv 450 | CO ₂ | 1F 1G 2F |
| DW-H600 | ▪ Abrasion parts | Hv 600 | CO ₂ | 1F 1G 2F |
| DW-H700 | ▪ Abrasion parts | Hv 700 | CO ₂ | 1F 1G 2F |
| DW-H800 | ▪ Heavy abrasion parts | Hv 800 | CO ₂ | 1F 1G 2F |

Note: Polarity: DCEP, Welding tests are as per Kobe Steel’s Standard. Ty: Typical

Please do not use the joint welding.

PREMIARC™

| | Composition (overlay weld metal mass%) | | | | | | | | Weld metal hardness | | |
|----|--|------|------|------|------|------|------|------|---------------------|-----|-----------------|
| | C | Si | Mn | Cr | Mo | V | W | B | PWHT (°C×h) | Hv | Pre. H & IPT °C |
| Ty | 0.09 | 0.49 | 1.30 | 1.02 | 0.40 | - | - | - | AW | 269 | 150min. |
| | | | | | | | | | 600x2 | 270 | |
| Ty | 0.13 | 0.64 | 1.70 | 0.48 | 0.53 | - | - | - | AW | 370 | 150min. |
| | | | | | | | | | 600x2 | 297 | |
| Ty | 0.15 | 0.57 | 1.40 | 3.70 | 0.47 | 0.25 | - | - | AW | 431 | 150min. |
| | | | | | | | | | 600x2 | 384 | |
| Ty | 0.45 | 0.48 | 0.97 | 4.31 | 0.51 | - | - | - | AW | 574 | 200min. |
| | | | | | | | | | 600x2 | 398 | |
| Ty | 0.57 | 0.73 | 1.05 | 5.40 | 1.01 | 0.54 | 1.21 | - | AW | 673 | 250min. |
| | | | | | | | | | 600x2 | 605 | |
| Ty | 1.10 | 0.68 | 1.83 | 4.22 | - | - | 2.26 | 0.54 | AW | 772 | 250min. |
| | | | | | | | | | 600x2 | 612 | |

Packaging data

| φ mm | DW-H250 | DW-H350 | DW-H450 | DW-H600 | DW-H700 | DW-H800 |
|-----------|------------------|---------|---------|---------|---------|---------|
| 1.2 | 20kg | 20kg | 20kg | 20kg | 20kg | 20kg |
| 1.6 | 20kg | 20kg | 20kg | 20kg | 20kg | 20kg |
| Volume mm | 300W, 110H, 300L | | | | | |

| Product names | Typical use | Nominal hardness | SG | WP |
|----------------------|---|-------------------------|--------------------|----------------|
| DW-H11 | ▪ Abrasion accompanied by heavy impact parts and repair welding of 13%-Mn cast steel | Hv 250 | Ar-CO ₂ | 1F 1G 2F |
| DW-H16 | ▪ High temperature wear, impact wear and cavitation parts such as hot shear bytes, hot saws, and hydraulic power water turbines | Hv 300 | Ar-CO ₂ | 1F 1G 2F |
| DW-H30 | ▪ Heavy abrasive parts such as crushers and hoppers | Hv 700 | CO ₂ | 1F 1G 2F |
| DW-H30MV | ▪ Heavy abrasive and high temperature wear parts such as liners, screws, and crushers | Hv 800 | CO ₂ | 1F 1G 2F |

Note: Polarity: DCEP, Welding tests are as per Kobe Steel’s Standard. Ty: Typical

Please do not use the joint welding.

PREMIARC™

| | Composition (overlay weld metal mass%) | | | | | | Weld metal hardness | | | |
|----|--|------|-------|-------|------|------|---------------------|------|-----|-----------------|
| | C | Si | Mn | Cr | Mo | V | B | PWHT | Hv | Pre. H & IPT °C |
| Ty | 0.84 | 0.68 | 14.17 | - | - | - | - | AW | 233 | - |
| Ty | 0.60 | 0.51 | 16.76 | 16.21 | 1.49 | 0.49 | - | AW | 278 | 150min. |
| Ty | 2.92 | 1.16 | 0.16 | 24.06 | - | - | 0.3 | AW | 755 | 250min. |
| Ty | 5.03 | 2.39 | 0.19 | 21.60 | 0.94 | 2.61 | 0.28 | AW | 821 | 200min. |

Packaging data

| φ mm | DW-H11 | DW-H16 | DW-H30 | DW-H30MV |
|------------------|------------------|--------|--------|----------|
| 1.2 | - | 12.5kg | 20kg | 12.5kg |
| 1.6 | 12.5kg | - | 20kg | 12.5kg |
| Volume mm | 300W, 110H, 300L | | | |

| Product names | Typical use & Redrying condition | Nominal hardness | Pol. | |
|-------------------|---|------------------|------|----|
| G-50/ US-H250N | <ul style="list-style-type: none"> Wheels and rollers and for underlaying of idlers and rollers 150~350°Cx1h | Hv 250 | AC | Ty |
| G-50/ US-H350N | <ul style="list-style-type: none"> Idlers and links of tractors and shovels, rollers for steel mills, and tires, and hutches 150~350°Cx1h | Hv 350 | AC | Ty |
| G-50/ US-H400N | <ul style="list-style-type: none"> Idlers and links of tractors and shovels, rollers for steel mills, and tires 150~350°Cx1h | Hv 400 | AC | Ty |
| G-50/ US-H450N | <ul style="list-style-type: none"> Rollers and idlers of tractors and shovels, rollers for steel mills, and bells for blast furnaces 150~350°Cx1h | Hv 450 | AC | Ty |

Note: Type of flux: Fused, Welding tests are as per Kobe Steel's Standard, Ty: Typical

Packaging data

| Flux | Mesh | Can | | |
|-------------|------------------|------------------|----------|----------|
| G-50 | 8x48 | 25kg | | |
| Volume mm | | 240W, 350H, 240L | | |
| φ mm | US-H250N | US-H350N | US-H400N | US-H450N |
| Coil | | | | |
| 3.2 | 25kg | 25kg | 25kg | 25kg |
| 4.0 | 25kg | - | 25kg | 25kg |
| Volume mm | 440W, 100H, 425L | | | |

Please do not use the joint welding.

FAMILIARC™ / PREMIARC™

| Composition (overlay weld metal mass%) | | | | | | Weld metal hardness | |
|--|------|------|------|------|------|---------------------|-----|
| C | Si | Mn | Cr | Mo | V | PWHT (°C×h) | Hv |
| 0.06 | 0.60 | 1.82 | - | 0.62 | - | AW | 267 |
| 0.10 | 0.63 | 1.95 | 1.10 | 0.52 | - | AW | 361 |
| 0.13 | 0.65 | 2.02 | 2.21 | 0.36 | 0.17 | AW | 409 |
| 0.19 | 0.72 | 2.22 | 2.69 | 0.60 | 0.31 | AW | 453 |
| | | | | | | 600x5 | 431 |

| Product names | Typical use & Redrying condition | Nominal hardness | Pol. | |
|----------------------------|---|------------------|------|----|
| G-50/ US-H500N | <ul style="list-style-type: none"> Rollers and idlers of tractors and shovels, rollers for steel mills, and bells for blast furnaces 150~350°Cx1h | Hv 500 | AC | Ty |
| MF-30/ US-H550N | <ul style="list-style-type: none"> Rollers for steel mills, and bells for blast furnaces 150~350°Cx1h | Hv 550 | AC | Ty |
| MF-30/ US-H600N | <ul style="list-style-type: none"> Rollers for steel mills, and crusher cones 150~350°Cx1h | Hv 600 | AC | Ty |

Note: Type of flux: Fused, Welding tests are as per Kobe Steel's Standard. Ty: Typical

Packaging data

| Flux | Mesh | Can | | |
|------------------|------------------|------------------|----------|--|
| G-50 | 8x48 | 25kg | | |
| MF-30 | 12x65 | 25kg | | |
| Volume mm | | 240W, 350H, 240L | | |
| φ mm | US-H500N | US-H550N | US-H600N | |
| Coil | | | | |
| 3.2 | 25kg | 25kg | 25kg | |
| Volume mm | 440W, 100H, 425L | | | |

Please do not use the joint welding.

FAMILIARC™ / PREMIARC™

| C | Composition (overlay weld metal mass%) | | | | | | Weld metal hardness | |
|------|--|------|------|------|------|------|---------------------|-----|
| | Si | Mn | Cr | Mo | W | V | PWHT (°C×h) | Hv |
| 0.22 | 0.85 | 2.26 | 2.85 | 1.10 | 1.45 | 0.32 | AW | 509 |
| | | | | | | | 600x2 | 506 |
| 0.34 | 0.58 | 2.12 | 6.72 | 3.75 | - | - | AW | 540 |
| | | | | | | | 600x2 | 503 |
| 0.38 | 0.63 | 2.19 | 6.96 | 3.72 | - | - | AW | 596 |
| | | | | | | | 600x2 | 570 |

For Cast Iron

Welding Consumables for

SMAW

A guide for selecting welding consumables

Table 1 shows stick electrodes for shielded metal arc welding of cast irons in conjunction with weldability, usability, color matching, and machinability.

Table 1 Welding consumables for cast irons ⁽¹⁾

| Product names | Preheat temperature (°C) | Wettability with base metal | Color matching with base metal | Joint efficiency | X-ray soundness | Machinability of weld metal | Machinability of HAZ |
|---------------|--------------------------|-----------------------------|--------------------------------|------------------|-----------------|-----------------------------|----------------------|
| CI-A1 | 100-300 | ○ | △ | ◎ | ○ | ◎ | ◎ |
| CI-A2 | 150-350 | ◎ | △ | ◎ | ○ | ◎ | ○ |
| CI-A3 | 350-400 | ◎ | ◎ | ○ | ○ | △ | △ |

Note (1) ◎: Good, ○: Better, △: Inferior

Tips for better welding results

1) Preparation for base metal:

- (1) When cast irons have impregnated oil, the base metal must be heated at 400°C to burn off the oil before welding. Other contaminants should also be removed off before welding.
- (2) To repair a defect, it must be removed completely by machining or grinding (arc air gouging is not suitable for cast irons) before welding. The welding groove should have a round bottom for better fusion. Where a crack defect seems to be propagated by machining or grinding, make stop-holes at both ends of the crack.

2) Welding procedure:

- (1) The most appropriate preheating temperature depends on the size and thickness of the work; however, Table 1 can be a rule of thumb.
- (2) Stringer welding with the maximum bead length of about 50 mm is recommended to prevent overheat, distortion and cracking.
- (3) Peening is needed to minimize residual stresses. Just after one bead was laid, it must be peened with a hammer to the extent that the ripple of the bead disappears.
- (4) Comparatively small conical groove should be welded in the spiral sequence from the bottom of the groove to the surface of the base metal. Backstep, symmetrical or intermittent sequence is recommended for a long welding line to prevent cracking. The buttering method, in which the surface of the groove is clad first and the filling passes are laid later, is recommended for a deep groove.



SMAW

| Product names | Typical use & Redrying condition | AWS Class. | Pol. | WP | C | Si | |
|---------------|---|----------------|------------|----|-----------------|------|------|
| CI-A1 | <ul style="list-style-type: none"> Repairing and joining various kinds of cast irons 70~100°Cx0.5~1h | A5.15 ENi-CI | AC DCEP | F | Ty | 1.0 | 0.1 |
| | | | | | Gt ^a | 2.0 | 4.0 |
| CI-A2 | <ul style="list-style-type: none"> Repairing and joining various kinds of cast irons 70~100°Cx0.5~1h | A5.15 ENiFe-CI | AC DCEP | F | Ty | 1.1 | 0.3 |
| | | | | | Gt ^a | 2.0 | 4.0 |
| CI-A3 | <ul style="list-style-type: none"> Repairing and joining various kinds of cast irons 300~350°Cx0.5~1h | - | AC DCEP | F | Ty | 0.04 | 0.50 |
| | | | | | Gt ^a | 0.15 | 1.00 |

Note: ^a Single values are maximum. Ty: Typical (polarity: AC), Gt: Guaranty

Identification color

| Product names | 1st | 2nd |
|---------------|-------|--------|
| CI-A1 | Gold | Red |
| CI-A2 | Gold | Pink |
| CI-A3 | Black | Orange |

| Composition (all-weld metal mass%) | | | | | | | All-weld mechanical properties | |
|------------------------------------|-------|-------|--------|------|------|------|--------------------------------|--------------|
| Mn | P | S | Ni | Fe | Cu | Al | TS (MPa) | El on 4d (%) |
| 0.6 | <0.01 | <0.01 | Bal. | 1.7 | <0.1 | <0.1 | 480 | - |
| 2.5 | - | 0.03 | 85min. | 8.0 | 2.5 | 1.0 | - | - |
| 2.0 | <0.01 | <0.01 | 55 | Bal. | <0.1 | <0.1 | 520 | - |
| 2.5 | - | 0.03 | 45~60 | Bal. | 2.5 | 1.0 | - | - |
| 0.48 | 0.01 | <0.01 | - | Bal. | - | - | 490 | 33 |
| 0.80 | 0.04 | 0.04 | - | Bal. | - | - | - | - |

Packaging data

| φ mm | 2.6 | 3.2 | 4.0 |
|------------------|------------------|------------------|------------------|
| CI-A1 | - | 350 | 350 |
| CI-A2 | 300 | 300 | 350 |
| CI-A3 | 300 | 350 | - |
| carton mm | 250W, 135H, 450L | 250W, 120H, 440L | 240W, 85H, 440L |
| | | | 170W, 115H, 430L |

For 9%Ni Steel and Nickel-Based Alloy

Welding Consumables for

SMAW

FCAW

GMAW

GTAW

SAW

Inconel, Incoloy and Monel are trademarks of Special Metals Corporation.
Hastelloy is a trademark of Haynes International.

SMAW, FCAW, GMAW, GTAW, SAW

For 9%Ni Steel

For welding of 9%Ni steel, Ni-base alloys such as Ni-Cr alloy (e.g., Inconel) and Ni-Mo alloy (e.g., Hastelloy) welding consumables are commonly used to obtain sufficient notch toughness at cryogenic temperatures. 9%Ni steel is used for storage tanks for liquefied natural gas (LNG), liquefied oxygen and liquefied nitrogen, and LNG carriers. In the construction of such cryogenic temperature service equipment, automatic gas tungsten arc welding and submerged arc welding are often used to ensure consistent weld quality, as shown in Fig. 1.

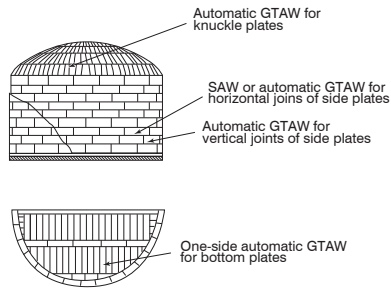


Fig. 1 Typical applications of automatic welding processes for a LNG storage tank

Tips for better welding results

Common

- (1) Remove scale, rust, and other dirt from welding grooves beforehand by grinding or other appropriate means.
- (2) Use no preheat and control interpass temperatures at 150°C or lower.
- (3) Minimize welding currents and welding speeds to prevent hot cracking.
- (4) Use no magnetic power crane because 9%Ni steel is likely to be magnetized.

SMAW

- (1) Re-dry stick electrodes by 200-250°C for 30-60 minutes before use.
- (2) Keep the arc length as short as possible.

FCAW, GMAW

- (1) Use Ar-CO₂ mixtures with 20-25%CO₂ for shielding gas. The gas flow rates should be 20-25 l/min.
- (2) Refer to Pages 211 and 213 of the stainless steel article about power source, wire extension, protection against wind and welding fumes, and storage of welding wires.

GTAW

- (1) Use multi-pass welding because the use of single-pass welding may cause a decrease of weld metal strength affected by the dilution from the base metal.

SAW

- (1) Re-dry fluxes by 200-300°C for 1 hour before use.
- (2) Use multi-pass welding because the use of single-pass welding may cause a decrease of weld metal strength affected by the dilution from the base metal.

For Ni-base alloy

Typical Ni-base alloys for welding are Ni-Cu alloy (e.g. Monel), Ni-Cr alloy (e.g. Inconel) and Ni-Fe-Cr alloys (e.g. Incoloy). Ni-base welding consumables are used for joining these Ni-base alloys and dissimilar-metal joints consisting of Ni-base alloy and low alloy steel, stainless steel, and low alloy steel.

Tips for better welding results

SMAW

- (1) Use proper welding currents because the use of an excessive welding current causes electrode-burn and thereby usability and weld metal properties can be deteriorated.
- (2) Use no preheating for welding matching Ni-base alloys. Control interpass temperatures at 150°C or lower.
- (3) Use the backstep technique when an arc is struck in the welding groove, or strike an arc on a piece of metal outside the groove to prevent the occurrence of blowholes at the arc starting area of a bead.
- (4) Keep the arc length as short as possible.
- (5) Use flat-position welding as much as possible because vertical or overhead welding requires higher welding skill.
- (6) Minimize welding currents and speeds to prevent hot cracking.

FCAW

- (1) Use Ar-CO₂ mixtures with 20-25%CO₂ for shielding gas. The gas flow rates should be 20-25 l/min.
- (2) Refer to Page 211 of the stainless steel article about power source, wire extension, protection against wind and welding fumes, and storage of welding wires.

GMAW

- (1) Pulsed arc welding with the spray droplet transfer mode using low currents is most appropriate, although conventional gas metal arc welding power sources can be used. DC-EP polarity is suitable.
- (2) Argon gas shielding with gas flow rates in the 25-30 l/min range is suitable. Ar-He mixture gases are also suitable.
- (3) Use no preheating and control interpass temperatures at 150°C or lower.
- (4) Minimize welding currents and speeds to prevent hot cracking.

GTAW

- (1) Use DCEN polarity.
- (2) Argon gas shielding with gas flow rates in the 10-15 l/min range is suitable where welding currents are within 100-200A. In one-side welding, back shielding is needed to avoid oxidation of the back side bead.
- (3) Control the arc length at approximately 2-3 mm because the use of an excessive arc length may cause lack of shielding, thereby causing blowholes.
- (4) Use no preheating and control interpass temperatures at 150°C or lower.
- (5) Minimize welding currents and speeds to prevent hot cracking.

SMAW, FCAW, GMAW, GTAW

How to select the proper welding consumable for dissimilar metal joints

Recommended welding consumables and preheat temperatures are shown in Table 1. ⁽¹⁾ ⁽²⁾

Table 1 Recommended welding consumables

| Base metal: A Base metal: B | | Carbon steel and low alloy steel | Nickel and | | |
|--------------------------------|-------------|--|-----------------------------|-----------------------------|--|
| | | | Inconel | Incoloy | |
| Stainless steel | Austenitic | NC-39, NC-39L NC-39MoL NI-C70A ⁽³⁾ 100~200°C | NI-C70A NI-C625 — | NI-C70A NI-C625 — | |
| | Martensitic | NC-39, NC-39L CR-43Cb ⁽⁴⁾ NI-C70A ⁽³⁾ 200~400°C | NI-C70A 100~300°C | NI-C70A 100~300°C | |
| | Ferritic | NC-39, NC-39L CR-43Cb ⁽⁴⁾ NI-C70A ⁽³⁾ 100~300°C | NI-C70A 100~200°C | NI-C70A 100~200°C | |
| Nickel and nickel alloy | Nickel | NI-C70A 100~200°C | NI-C70A — | NI-C70A — | |
| | Monel | NI-C70A ME-L34 100~200°C | NI-C70A ME-L34 — | NI-C70A ME-L34 — | |
| | Incoloy | NI-C70A NI-C625 100~200°C | NI-C70A NI-C625 — | | |
| | Inconel | NI-C70A NI-C625 100~200°C | | | |

| nickel alloy | | Stainless steel | |
|--------------------------------|----------------------|--|--|
| Monel | Nickel | Ferritic | Martensitic |
| NI-C70A ME-L34 — | NI-C70A — | NC-39, NC-39L NI-C70A ⁽³⁾ 100~200°C | NC-39, NC-39L NI-C70A ⁽³⁾ 100~300°C |
| NI-C70A ME-L34 100~300°C | NI-C70A 100~300°C | NC-39 CR-43Cb ⁽⁵⁾ CR-40Cb ⁽⁵⁾ 200~400°C | |
| NI-C70A ME-L34 100~200°C | NI-C70A 100~200°C | | |
| NI-C70A ME-L34 — | | | |

Note: (1) This table shows only stick electrodes for SMAW. Other welding consumables having the similar chemical composition for GTAW, GMAW, and FCAW can also be used. Instead of NI-C70A, NI-C703D can also be used.

- (2) The preheat temperature in this table is a rough guide. In a case where the welding joint consists of thick plates and is restrained to a great extent, a higher temperature may be necessary. Even when preheat temperature is given for particular dissimilar metal joints, austenitic stainless steel, nickel, and nickel alloy need not be preheated, and the counterpart base metals such as carbon steel, martensitic stainless steel, and ferritic stainless steel should be preheated sufficiently. In addition, for a dissimilar metal joint consisting of carbon steel (Base metal: A) and austenitic stainless steel, nickel, or nickel alloy (Base metal: B), both base metals need not be preheated.
- (3) In a case where the weld is used at about 400°C or higher or under thermal cycles, NI-C70A should be selected.
- (4) In a case where Ni is restricted in a special service environment, CR-43Cb should be used.
- (5) In a case where Ni is restricted in a special service environment, CR-43Cb or CR-40Cb should be selected.

Stick electrode

Features: ▪ Suitable for Inconel and dissimilar-metal joints such as Inconel to low alloy steel, and stainless steel to low alloy steel

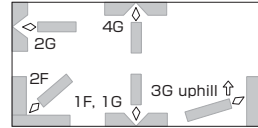
Classification: AWS A5.11 ENiCrFe-1

Redrying Conditions: 200~250°Cx0.5~1h

Identification color: 1st Silver, 2nd Green

Polarity: AC

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 300 | 2 | 20 | 29 | 300W, 100H, 330L |
| 4.0 | 350 | 5 | 20 | 51 | 175W, 130H, 380L |
| 5.0 | 350 | 5 | 20 | 80 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.04 | 0.08 |
| Si | 0.20 | 0.75 |
| Mn | 3.0 | 3.5 |
| P | 0.01 | 0.03 |
| S | 0.003 | 0.015 |
| Ni | 72.0 | 62.0min. |
| Cr | 14.7 | 13.0~17.0 |
| Cu | 0.01 | 0.50 |
| Nb+Ta | 1.8 | 1.5~4.0 |
| Fe | 7.9 | 11.0 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 70~115 | 65~110 |
| 4.0 | 95~145 | 85~135 |
| 5.0 | 115~170 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|----------------------|---------|----------|
| 0.2%YS (MPa) | 380 | - |
| TS (MPa) | 610 | 552min. |
| EI on 4d (%) | 44 | 30min. |
| IV -196°C (J) | 93 | - |

Stick electrode

Features: • Suitable for Inconel and dissimilar-metal joints such as Inconel to low alloy steel, and stainless steel to low alloy steel

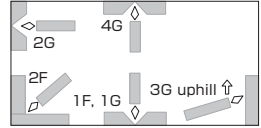
Classification: AWS A5.11 ENiCrFe-3

Redrying Conditions: 200~250°Cx0.5~1h

Identification color: 1st Silver, 2nd Blue

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 2.6 | 250 | 2 | 20 | 16 | 300W, 130H, 290L |
| 3.2 | 300 | 2 | 20 | 31 | 300W, 100H, 330L |
| 4.0 | 350 | 5 | 20 | 54 | 175W, 130H, 380L |
| 5.0 | 350 | 5 | 20 | 85 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.06 | 0.10 |
| Si | 0.3 | 1.0 |
| Mn | 6.5 | 5.0~9.5 |
| P | 0.004 | 0.03 |
| S | 0.003 | 0.015 |
| Ni | 69.4 | 59.0min. |
| Cr | 13.2 | 13.0~17.0 |
| Cu | 0.03 | 0.50 |
| Nb+Ta | 2.0 | 1.0~2.5 |
| Fe | 7.90 | 10.00 |
| Ti | <0.1 | 1.0 |
| Co | 0.03 | 0.12 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 2.6 | 50~80 | 45~75 |
| 3.2 | 80~110 | 80~105 |
| 4.0 | 90~140 | 90~120 |
| 5.0 | 140~180 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|----------------------|---------|----------|
| 0.2%YS (MPa) | 360 | - |
| TS (MPa) | 620 | 552min. |
| EI on 4d (%) | 45 | 30min. |
| IV -196°C (J) | 110 | - |

Stick electrode

Features: ▪ Suitable for 9% Ni steel

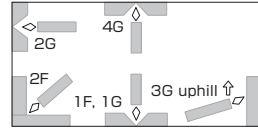
Classification: AWS A5.11 ENiCrFe-9

Redrying Conditions: 200~250°Cx0.5~1h

Identification color: 1st Silver gray, 2nd Pink

Polarity: AC

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 300 | 2 | 20 | 29 | 300W, 100H, 330L |
| 4.0 | 350 | 5 | 20 | 53 | 175W, 130H, 380L |
| 5.0 | 350 | 5 | 20 | 82 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.08 | 0.15 |
| Si | 0.26 | 0.75 |
| Mn | 2.4 | 1.0~4.5 |
| P | 0.01 | 0.02 |
| S | <0.01 | 0.015 |
| Ni | 66.6 | 55.0min. |
| Cr | 13.8 | 12.0~17.0 |
| Mo | 3.9 | 2.5~5.5 |
| Cu | 0.02 | 0.50 |
| Nb+Ta | 1.5 | 0.5~3.0 |
| Fe | 10.3 | 12.00 |
| W | 0.6 | 1.5 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 70~115 | 65~110 |
| 4.0 | 95~145 | 85~135 |
| 5.0 | 115~180 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|----------------------|---------|----------|
| 0.2%YS (MPa) | 450 | - |
| TS (MPa) | 703 | 655min. |
| EI on 4d (%) | 43 | 25min. |
| IV -196°C (J) | 63 | - |

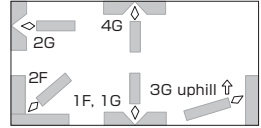
Approvals

| | |
|------------|------------|
| ABS | ENiCrFe-9 |
| LR | 9Ni |
| DNV | NV9Ni, H10 |
| BV | ENiCrFe-9 |
| NK | KMWL91 |

Stick electrode

Features: - Suitable for 9% Ni steel
Classification: AWS A5.11 ENiMo-8
Redrying Conditions: 200~250°Cx0.5~1h
Identification color: 1st Yellow, 2nd Green
Polarity: AC

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 300 | 2 | 20 | 30 | 300W, 100H, 330L |
| 4.0 | 350 | 5 | 20 | 55 | 175W, 130H, 380L |
| 5.0 | 350 | 5 | 20 | 84 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.10 |
| Si | 0.47 | 0.75 |
| Mn | 0.3 | 1.5 |
| P | <0.01 | 0.02 |
| S | 0.001 | 0.015 |
| Ni | 68.7 | 60.0min. |
| Cr | 1.8 | 0.5~3.5 |
| Mo | 18.4 | 17.0~20.0 |
| Cu | 0.01 | 0.50 |
| Fe | 7.0 | 10.0 |
| W | 2.9 | 2.0~4.0 |

Note: ^aSingle values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill, 4G |
|------|----------------|---------------|
| 3.2 | 70~115 | 65~110 |
| 4.0 | 100~145 | 85~135 |
| 5.0 | 130~200 | - |

All-weld mechanical properties

| | Typical | Guaranty |
|----------------------|---------|----------|
| 0.2%YS (MPa) | 473 | - |
| TS (MPa) | 750 | 655min. |
| El on 4d (%) | 46 | 25min. |
| IV -196°C (J) | 92 | - |

Approvals

| | |
|----|--------|
| NK | KMWL92 |
|----|--------|

Stick electrode

Features: ▪ Suitable for Inconel 625, Incoloy 825, dissimilar-metal joints and overlaying

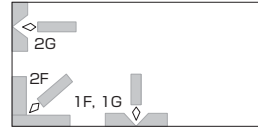
Classification: AWS -

Redrying Conditions: 200~250°Cx0.5~1h

Identification color: 1st Silver, 2nd Purple

Polarity: AC, DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 300 | 2 | 20 | 30 | 300W, 100H, 330L |
| 4.0 | 350 | 5 | 20 | 50 | 175W, 130H, 380L |
| 5.0 | 350 | 5 | 20 | 79 | 175W, 130H, 380L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.04 | 0.10 |
| Si | 0.32 | 0.75 |
| Mn | 0.67 | 1.00 |
| P | 0.003 | 0.020 |
| S | 0.004 | 0.015 |
| Ni | 61.1 | 55.0min. |
| Cr | 21.65 | 20.00~23.00 |
| Cu | 0.03 | 0.50 |
| Nb+Ta | 3.41 | 3.15~4.15 |
| Fe | 3.66 | 7.00 |
| Mo | 8.70 | 8.00~10.00 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G |
|------|----------------|
| 3.2 | 70~115 |
| 4.0 | 95~145 |
| 5.0 | 130~180 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 420 | - |
| TS (MPa) | 760 | 690min. |
| EI on 4d (%) | 47 | 30min. |

ME-L34

Stick electrode

Features: • Suitable for monel metal and dissimilar-metal joints and overlaying applicable

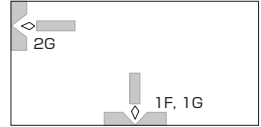
Classification: AWS -

Redrying Conditions: 150~200°Cx0.5~1h

Identification color: 1st Silver, 2nd Yellowish green

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Length mm | kg/pack | kg/carton | g/piece | carton mm |
|------|-----------|---------|-----------|---------|------------------|
| 3.2 | 350 | 5 | 20 | 34 | 175W, 130H, 380L |
| 4.0 | 400 | 5 | 20 | 60 | 175W, 120H, 430L |
| 5.0 | 400 | 5 | 20 | 91 | 175W, 120H, 430L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.03 | 0.15 |
| Si | 0.80 | 1.25 |
| Mn | 3.26 | 4.00 |
| P | 0.002 | 0.020 |
| S | 0.002 | 0.015 |
| Ni | 65.21 | 62.00~70.00 |
| Nb | 1.81 | 3.00 |
| Fe | 1.58 | 2.50 |
| Cu | Bal. | 24.0~31.0 |
| Al | 0.25 | 1.00 |
| Ti | 0.61 | 1.50 |

Welding parameters (A)

| φ mm | 1F, 1G, 2G |
|------|------------|
| 3.2 | 75~115 |
| 4.0 | 110~150 |
| 5.0 | 140~190 |

Note: ^a Single values are maximum.

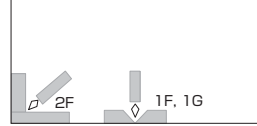
All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 320 | - |
| TS (MPa) | 550 | 480min. |
| EI on 4d (%) | 44 | 30min. |

Flux cored wire

Features: • Suitable for Ni-based alloy of 600 and dissimilar-metal joints such as Ni-based alloy to low alloy steel and stainless steel to low alloy steel

Welding Positions:



Classification: AWS A5.34 ENiCr3T0-4

Shielding gas: Ar-CO₂

Polarity: DCEP

Packaging data

| φ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.04 | 0.10 |
| Si | 0.23 | 0.50 |
| Mn | 3.4 | 2.5~3.5 |
| P | <0.01 | 0.03 |
| S | 0.006 | 0.015 |
| Ni | 70.6 | 67.0min. |
| Cr | 21.2 | 18.0~22.0 |
| Cu | 0.01 | 0.50 |
| Fe | 1.5 | 3.0 |
| Nb+Ta | 2.3 | 2.0~3.0 |
| Ti | 0.31 | 0.75 |

Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 1.2 | 150~220 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 380 | - |
| TS (MPa) | 650 | 552min. |
| EI on 4d (%) | 46 | 25min. |
| IV 0°C (J) | 128 | - |

DW-N625

Flux cored wire

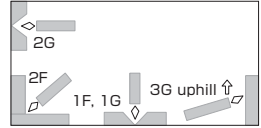
Features: ▪ Suitable for Ni-based alloy of 625, dissimilar-metal joints and overlaying

Classification: AWS A5.34 ENiCrMo3T1-1
ENiCrMo3T1-4

Shielding gas: Ar-CO₂, CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool |
|-----------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical (Ar-CO ₂) | Guaranty ^a |
|--------------|-------------------------------|-----------------------|
| C | 0.03 | 0.10 |
| Si | 0.37 | 0.50 |
| Mn | 0.28 | 0.50 |
| P | 0.01 | 0.02 |
| S | 0.003 | 0.015 |
| Ni | 63.3 | 58.0min. |
| Cr | 21.6 | 20.0~23.0 |
| Mo | 8.6 | 8.0~10.0 |
| Cu | 0.01 | 0.50 |
| Fe | 1.8 | 5.0 |
| Nb+Ta | 3.57 | 3.15~4.15 |
| Ti | 0.11 | 0.40 |

Note: ^a Single values are maximum.

Welding parameters (A)

| φ mm | 1F, 1G, 2F, 2G | 3G uphill |
|------|----------------|-----------|
| 1.2 | 150~210 | 130~180 |

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 472 | - |
| TS (MPa) | 752 | 690min. |
| EI on 4d (%) | 38 | 25min. |
| IV 0°C (J) | 67 | - |

Approvals

| | |
|------------|-------------------------|
| ABS | MG UP (ENiCrMo3T1-4) |
| BV | |

DW-NC276

Flux cored wire

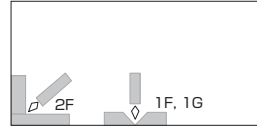
Features: • Suitable for Ni-based alloy of C276 and super austenitic stainless steel

Classification: AWS A5.34 ENiCrMo4T0-4

Shielding gas: Ar-CO₂

Polarity: DCEP

Welding Positions:



Packaging data

| φ mm | Spool | |
|-----------|------------------|--------|
| 1.2 | 12.5kg | 12.7kg |
| Volume mm | 295W, 110H, 295L | |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.02 |
| Si | 0.2 | 0.2 |
| Mn | 0.6 | 1.0 |
| P | 0.01 | 0.03 |
| S | <0.01 | 0.03 |
| Ni | 57.3 | Bal. |
| Cr | 14.8 | 14.5~16.5 |
| Mo | 16.9 | 15.0~17.0 |
| Cu | 0.07 | 0.50 |
| Fe | 5.6 | 4.0~7.0 |
| W | 3.7 | 3.0~4.5 |
| Co | 0.3 | 2.5 |
| V | 0.06 | 0.35 |

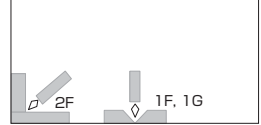
Welding parameters (A)

| φ mm | 1F, 1G, 2F |
|------|------------|
| 1.2 | 150~220 |

Note: ^aSingle values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|---------------------|---------|----------|
| 0.2%YS (MPa) | 466 | - |
| TS (MPa) | 719 | 690min. |
| EI on 4d (%) | 46 | 25min. |
| IV 0°C (J) | 63 | - |

DW-N70S**Flux cored wire****Features:** • Suitable for 9% Ni steel**Classification:** AWS -**Shielding gas:** Ar-CO₂**Polarity:** DCEP**Welding Positions:****Packaging data**

| ϕ mm | Spool |
|------------------|------------------|
| 1.2 | 12.5kg |
| Volume mm | 295W, 110H, 295L |

Composition (all-weld metal mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.05 | 0.10 |
| Si | 0.2 | 0.8 |
| Mn | 5.8 | 5.0~8.0 |
| P | 0.003 | 0.020 |
| S | 0.003 | 0.015 |
| Ni | 62.4 | 58.0min. |
| Cr | 16.7 | 15.0~18.0 |
| Mo | 10.9 | 9.0~11.0 |
| Cu | <0.1 | 0.5 |
| Fe | 1.2 | 10.0 |
| Nb | 2.1 | 1.5~3.0 |
| Ti | 0.2 | 1.0 |

Note: ^a Single values are maximum.**Welding parameters (A)**

| ϕ mm | 1F, 1G, 2F |
|-----------|------------|
| 1.2 | 180~230 |

All-weld mechanical properties

| | Typical | Guaranty |
|----------------------|---------|----------|
| 0.2%YS (MPa) | 425 | 400min. |
| TS (MPa) | 716 | 690min. |
| EI on 4d (%) | 46 | 27min. |
| IV -196°C (J) | 106 | 45min. |

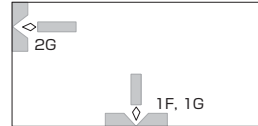
Solid wire

- Features:**
- Inconel 82 type filler wire
 - Suitable for Inconel, Incoloy, dissimilar-metal joints and overlaying on carbon steel

Classification: AWS A5.14 ERNiCr-3

Shielding gas: Ar

Polarity: DCEP

Welding Positions:**Packaging data**

| ϕ mm | Spool |
|------------------|------------------|
| 1.2 | 10kg |
| Volume mm | 240W, 110H, 240L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.03 | 0.10 |
| Si | 0.22 | 0.50 |
| Mn | 3.0 | 2.5~3.5 |
| P | <0.01 | 0.03 |
| S | 0.002 | 0.015 |
| Ni | 72.0 | 67.0min. |
| Cr | 20.0 | 18.0~22.0 |
| Ti | 0.28 | 0.75 |
| Fe | 1.7 | 3.0 |
| Nb+Ta | 2.6 | 2.0~3.0 |
| Cu | 0.01 | 0.50 |

Note: ^a Single values are maximum.

Welding parameters (A)

| ϕ mm | 1F, 1G, 2G |
|-----------|------------|
| 1.2 | 80~200 |

All-weld mechanical properties

| | Typical |
|----------------------|---------|
| 0.2%YS (MPa) | 370 |
| TS (MPa) | 660 |
| EI on 4d (%) | 41 |
| IV -196°C (J) | 140 |

Filler rod and wire

| | |
|------------------------------|--|
| Features: | ▪ Suitable for Inconel and Incoloy, dissimilar-metal joints and overlaying |
| Classification: | AWS A5.14 ERNiCr-3 |
| Shielding gas: | Ar |
| Identification color: | 1st Purple |
| Polarity: | DCEN |

Packaging data

| ϕ mm | Spool | | Tube | |
|------------------|------------------|----|-----------------|---------|
| | kg | kg | Length mm | g/piece |
| 1.2 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.0 | - | 5 | 1,000 | 26 |
| 2.4 | - | 5 | 1,000 | 37 |
| Volume mm | 240W, 110H, 240L | | 40W, 35H, 1015L | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.03 | 0.10 |
| Si | 0.20 | 0.50 |
| Mn | 2.9 | 2.5~3.5 |
| P | 0.001 | 0.03 |
| S | 0.002 | 0.015 |
| Ni | 72.9 | 67.0min. |
| Cr | 20.1 | 18.0~22.0 |
| Ti | 0.30 | 0.75 |
| Fe | 1.4 | 3.0 |
| Nb+Ta | 2.6 | 2.0~3.0 |
| Cu | <0.01 | 0.50 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical |
|----------------------|---------|
| 0.2%YS (MPa) | 370 |
| TS (MPa) | 680 |
| EI on 4d (%) | 40 |
| IV -196°C (J) | 150 |

Filler rod and wire

| | |
|------------------------------|--|
| Features: | ▪ Suitable for Inconel 625, dissimilar-metal joints and overlaying |
| Classification: | AWS A5.14 ERNiCrMo-3 |
| Shielding gas: | Ar |
| Identification color: | 1st Brown |
| Polarity: | DCEN |

Packaging data

| Ø mm | Spool | Tube | | |
|------------------|------------------|-----------------|-----------|---------|
| | kg | kg | Length mm | g/piece |
| 0.9 | 10 | - | - | - |
| 1.2 | 10 | - | - | - |
| 1.6 | - | 5 | 1,000 | 16 |
| 2.4 | - | 5 | 1,000 | 37 |
| Volume mm | 240W, 110H, 240L | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|--------------|---------|-----------------------|
| C | 0.01 | 0.10 |
| Si | 0.08 | 0.50 |
| Mn | 0.05 | 0.50 |
| P | <0.01 | 0.02 |
| S | 0.001 | 0.015 |
| Ni | 63.6 | 58.0min. |
| Cr | 21.9 | 20.0~23.0 |
| Mo | 9.0 | 8.0~10.0 |
| Nb+Ta | 3.55 | 3.15~4.15 |
| Al | 0.21 | 0.40 |
| Ti | 0.21 | 0.40 |
| Fe | 1.4 | 5.0 |
| Cu | 0.02 | 0.50 |

All-weld mechanical properties

| | Typical |
|---------------------|---------|
| 0.2%YS (MPa) | 480 |
| TS (MPa) | 770 |
| EI on 4d (%) | 41 |

Note: ^a Single values are maximum.

Filler rod and wire

| | |
|------------------------------|----------------------------|
| Features: | ▪ Suitable for 9% Ni steel |
| Classification: | AWS A5.14 ERNiMo-8 |
| Shielding gas: | Ar |
| Identification color: | 1st Orange |
| Polarity: | DCEN |

Packaging data

| ϕ mm | Spool | | | Tube | | |
|------------------|------------------|------------------|----|-----------------|-----------|---------|
| | kg | | | kg | Length mm | g/piece |
| 1.2 | 10 | 15 | 20 | 5 | 1,000 | 11 |
| 1.6 | 10 | 15 | - | 5 | 1,000 | 19 |
| 2.0 | - | - | - | 5 | 1,000 | 29 |
| 2.4 | - | - | - | 5 | 1,000 | 42 |
| Volume mm | 240W, 110H, 240L | 285W, 110H, 285L | | 40W, 35H, 1015L | | |

Composition (rod and wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.10 |
| Si | 0.02 | 0.50 |
| Mn | <0.1 | 1.0 |
| P | 0.001 | 0.015 |
| S | 0.001 | 0.015 |
| Ni | 69.8 | 60.0min. |
| Cr | 2.0 | 0.5~3.5 |
| Mo | 19.1 | 18.0~21.0 |
| W | 3.0 | 2.0~4.0 |
| Fe | 5.6 | 10.0 |
| Cu | 0.01 | 0.50 |

Note: ^a Single values are maximum.

All-weld mechanical properties

| | Typical | Guaranty |
|----------------------|---------|----------|
| 0.2%YS (MPa) | 460 | - |
| TS (MPa) | 730 | 660min. |
| EI on 4d (%) | 47 | 25min. |
| IV -196°C (J) | 160 | - |

Approvals

| | |
|-----------|-------------|
| NK | KSWL92G (I) |
|-----------|-------------|

PF-N4/US-709S**PREMIARC™****Flux and wire combination**

- Features:**
- Hastelloy type consumables
 - Suitable for horizontal and horizontal fillet welding of 9%Ni steel

Classification: AWS A5.14 ERNiMo-8

Type of flux: Bonded

Redrying of flux: 200~300°Cx1h

Polarity: DCEP

Packaging data

| Flux | Mesh | Can | | |
|-----------|-------|------------------|------------------|-----------------|
| PF-N4 | 12x65 | 20kg | | |
| Volume mm | | 240W, 350H, 240L | | |
| Wire | φ mm | Spool | | Coil |
| US-709S | 1.2 | - | 15kg | - |
| | 1.6 | 10kg | 15kg | - |
| | 2.4 | 10kg | 15kg | 25kg |
| Volume mm | | 240W, 110H, 240L | 285W, 110H, 285L | 430W, 90H, 430L |

Composition (wire mass%)

| | Typical | Guaranty ^a |
|-----------|---------|-----------------------|
| C | 0.02 | 0.10 |
| Si | 0.03 | 0.50 |
| Mn | 0.04 | 1.0 |
| P | 0.003 | 0.015 |
| S | 0.001 | 0.015 |
| Ni | Bal. | 60.0min. |
| Cr | 2.0 | 0.5~3.5 |
| Mo | 18.9 | 18.0~21.0 |
| Cu | 0.01 | 0.50 |
| W | 3.0 | 2.0~4.0 |
| Fe | 5.6 | 10.0 |

Note: ^a Single values are maximum.

Composition (all weld metal mass%)

| | Typical |
|-----------|---------|
| C | 0.03 |
| Si | 0.82 |
| Mn | 0.4 |
| Ni | 66.1 |
| Cr | 1.7 |
| Mo | 18.1 |
| W | 2.7 |
| Fe | 9.5 |

All weld mechanical properties

| | Typical | Guaranty |
|----------------------|---------|----------|
| 0.2%YS (MPa) | 434 | - |
| TS (MPa) | 712 | 650min. |
| EI on 4d (%) | 53 | 30min. |
| IV -196°C (J) | 88 | - |

Approvals

| | |
|-----------|---------------|
| BV | UP (ERNiMo-8) |
| NK | KAWL92M |

Highly Efficient Welding Processes

FCB™ Process

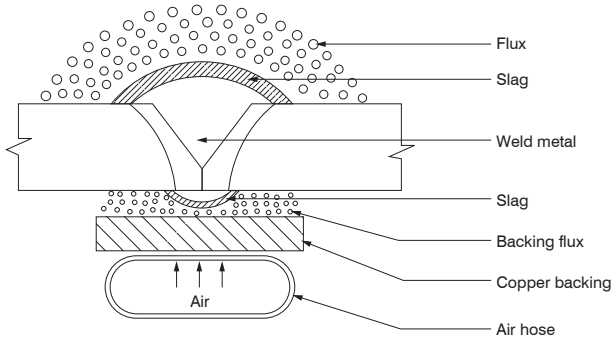
FA-B

Electrogas Arc Welding

FCB™ Process

Principles:

FCB™ is an automatic one-side submerged arc welding process by which a uniform reverse side bead can be obtained. Welding is conducted from the surface side of the welding groove after supplying the backing flux, on the copper backing and pushing up the copper backing to the reverse side of the groove by the pressurized air hose.



Features:

The combination of the backing flux and copper plate provides better contact onto the reverse side of the groove, which can accommodate a fluctuation of root gap and wide welding conditions to ensure consistent reverse bead without excessive melt through.

Applications:

Plate-to-plate butt welding for shipbuilding

| Typical welding consumables | | | |
|-----------------------------|---------|-------|--------------|
| Type of steel | Flux | Wire | Backing flux |
| TMCP | PF-I55E | US-36 | PF-I50R |

Note: Redrying of flux: 200~300°Cx1h, Backing flux must not be dried by heating

Packaging data

Flux: **PF-I55E**

| Mesh size | Type | Weight (kg) |
|-----------|---|-------------|
| 10x48 | Aluminum-laminated kraft paper package, Can | 20 |

Backing Flux: **PF-I50R**

| Mesh size | Type | Weight (kg) |
|-----------|------|-------------|
| 10x65 | Can | 20 |

Wire: **US-36**

| ϕ mm | Coil (kg) | W x H x L |
|-----------|-----------|---------------|
| 4.8 | 25 | 430, 90, 430 |
| | 75 | 740, 110, 740 |
| | 150 | 840, 110, 840 |
| 6.4 | 25 | 430, 90, 430 |
| | 78 | 740, 110, 740 |
| | 159 | 840, 110, 840 |

Approvals: PF-I55E / US-36 / PF-I50R

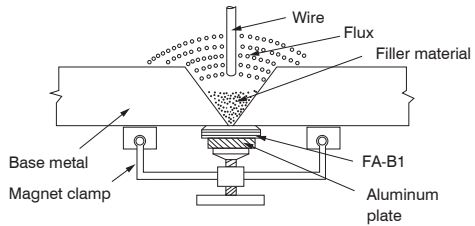
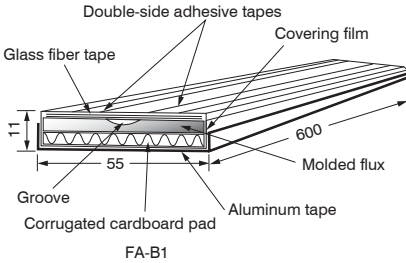
| Number of electrodes | 2 | 3 | 4 |
|----------------------|---------|-----------|------------|
| ABS | - | 3Y, 3Y400 | 3Y, 3Y400 |
| LR | 3A, 3YA | 3A, 3YA | 3Y40A |
| DNV | - | III Y | - |
| NK | KAW53SP | KAW53Y40 | KAW53Y40SP |
| CCS | 3Y | 3Y | 3Y |
| GL | 3Y | 3Y | - |
| KR | 3YSR | 3YSR | - |

○: Subject to satisfactory procedure test by user

FA-B

Principles:

FA-B1 is a flexible backing material suitable for the simplified one-side welding process shown below. It consists of glass fiber tapes, a refractory molded flux, a corrugated cardboard pad, a cover film and double-side adhesive tapes. It is attached the reverse side of the base metal by the adhesive tapes and fixed with an aluminum plate and magnet clamps.



Features:

- (1) FA-B1 features good flexibility to assure close contact to the base metal. It can accommodate the weld joint misalignment, distortion and dissimilar-thickness transition of the weld joint.
- (2) The shape of reverse side bead are stable and can be obtained wider tolerance in welding conditions.

Applications:

Curved shell plates, deck plates, bottom plates, tank top plates of ships, steel deck plates of bridges, and other one-side welding

Typical welding consumables

| Type of steel | Flux | Wire | Filler material | Backing material |
|-----------------|---------|-------|-----------------|------------------|
| Mild steel | MF-38 | US-36 | RR-2 | FA-B1 |
| | PF-I52E | | | |
| 490MPa HT steel | MF-38 | US-49 | RR-2 | FA-B1 |
| | PF-I52E | US-36 | | |

Note: Redrying conditions: **FA-B1** and **RR-2** must not be dried by heating
PF-I52E: 200~300°Cx1h, **MF-38**: 150~350°Cx1h

Packaging data

Flux: PF-I52E

| Mesh | Type | Weight (kg) | Package |
|-------|--------|-------------|---------------------------------|
| 10x48 | Bonded | 20 | Al-laminated paper package, Can |

Flux: MF-38

| Mesh | Type | Weight (kg) | Package |
|-------|-------|-------------|---------|
| 12x65 | Fused | 25 | Can |

Wire: US-36 / US-49

| ϕ mm | Coil (kg) | W x H x L |
|-----------|-----------|---------------|
| 4.8 | 25 | 430, 90, 425 |
| | 75 | 735, 110, 735 |
| | 150 | 820, 110, 820 |
| 6.4 | 25 | 430, 90, 425 |
| | 78 | 745, 110, 745 |
| | 159 | 840, 110, 840 |

Backing materials: FA-B1

| Joint type | Length (mm) | Pieces / carton |
|------------|-------------|-----------------|
| Standard | 600 | 40 |
| Transition | 600 | 30 |
| Mismatch | 600 | 30 |

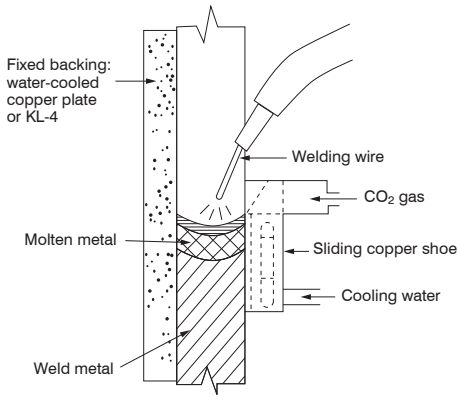
Approvals: PF-I52E / US-36 / RR-2 / FA-B1

| Number of wires | Single | Tandem |
|-----------------|--------|-------------|
| ABS | - | 3*, 3Y* |
| DNV | - | IIIY |
| BV | - | A3YM |
| NK | KAW53 | KAW53Y40SMP |
| CR | 3Y | 3Y |
| CCS | 3Y | 3Y |

Electrogas Arc Welding

Principles:

Electrogas arc welding (EGW) is vertical-up butt welding. SEGARC is an automatic vertical welding process suitable for EGW. This process uses SEG-2Z equipment with the combination of a flux-cored wire, a sliding copper shoe, and a fixed backing.



Features:

- (1) High deposition rates (e.g., 180g/min at 380A) provide high welding efficiency.
- (2) Lightweight, compact-size equipment makes it easy to set up.
- (3) Wire extension can be controlled constant against varied welding conditions.
- (4) Welding line can be located either on the left side (Standard) or, by re-assembling, the right side of the tracking rail.
- (5) With use of the oscillator (Option), it can be conducted maximum thickness 32 mm.
- (6) The carriage can be detached at any place from the tracking rail.

Applications:

- (1) Side shells, bulkheads, and hoppers in bulk carriers
- (2) Girder webs of box type and I-plate type in bridge
- (3) Press machine, storage tanks, large pipes, etc.

Welding consumables

| Type of steel | Product names | Backing material |
|--|---------------|------------------|
| MS & 490MPa HT steel | DW-S43G | KL-4 |
| MS & 490MPa HT steel for low temperature service | DW-S1LG | KL-4 |
| 550 to 610MPa HT steel | DW-S60G | KL-4 |

Note: Polarity: DCEP, SG: CO₂

Packaging data

| ϕ mm | Spool |
|-----------|-------|
| 1.6 | 20kg |

Typical composition of weld metal (%)

| Product names | DW-S43G | DW-S1LG | DW-S60G |
|---------------|---------|---------|---------|
| C | 0.08 | 0.05 | 0.08 |
| Si | 0.35 | 0.25 | 0.32 |
| Mn | 1.63 | 1.6 | 1.67 |
| P | 0.014 | 0.009 | 0.01 |
| S | 0.01 | 0.007 | 0.008 |
| Ni | 0.02 | 1.4 | 0.71 |
| Mo | 0.17 | 0.13 | 0.25 |
| Ti | 0.02 | 0.05 | 0.03 |

Typical properties of weld metal

| Product names | DW-S43G | DW-S1LG | DW-S60G |
|---------------------|-----------|------------|-----------|
| 0.2%YS (MPa) | 470 | 500 | 520 |
| TS (MPa) | 600 | 615 | 650 |
| El on 4d (%) | 27 | 25 | 26 |
| IV (J) | -20°C: 62 | -60°C: 100 | -20°C: 65 |

Approvals: DW-S43G/KL-4/CO₂

| | |
|------------|-----------|
| ABS | ○ |
| LR | 3, 3Y1 |
| DNV | IIIY |
| BV | AV3, AV3Y |
| NK | KEW53 |
| GL | 3YV |
| KR | 3YV |
| CCS | 3Y |
| CR | 3Y |

Approvals: DW-S1LG/KL-4/CO₂

| | |
|------------|--------------------|
| ABS | ○ |
| LR | 4Y2, 5Y402 |
| DNV | VY, NV2-4L, NV4-4L |
| GL | 6Y40V |

○: Subject to satisfactory procedure test by user

Appendix

Redrying Conditions
Package Specifications
Unit conversion Tables
F-No. and A-No.
AWS
EN

Redrying Conditions

Stick electrodes

| Applicable steel | AWS Class. | Typical | Redrying temperature (°C) | Redrying time (hour.) | Holding temperature (°C) |
|---------------------------------------|--|--|---------------------------|-----------------------|--------------------------|
| Mild | E6019 E6013 E7024 | B-10, B-14, B-17, Z-44, RB-26, B-33, KOBÉ-7024 | 70-100 | 0.5-1 | - |
| | E7016 | LB-26, LB-52U | 300-350 | 0.5-1 | 100-150 |
| Weather proof | E7016-G | LB-W52 | 300-350 | 1 | 100-150 |
| | | LB-W52B | 350-400 | | |
| High tensile or low temperature | - | LT-B50 | 70-100 | 0.5-1 | - |
| | E7016 E7018 E7048 E7016-G E7018-1 E9016-G E8016-G E8016-C1 E9018-G E10016-G E11018-G E11016-G E7016-C2L | LB-52, LB-52-18, LB-52T, LB-76, LT-B52A | 300-350 | 0.5-1 | 100-150 |
| | | LB-52A, LB-7018-1, LB-55NS, LB-57, LB-62, LB-62D, LB-62L, LB-62U, LB-65L, LB-67L, LB-106, LB-70L, LB-116, LB-80L, LB-78VS, LB-88VS, LB-98VS, LB-52NS, NB-1SJ, NB-3J | 350-400 | 1 | 100-150 |
| | | LB-62UL, LB-80UL, LB-88LT | 350-430 | 1 | 100-150 |
| Heat-resistant | E7016-A1 E9016-G E8016-B2 E9016-B3 E9016-G E8016-B8 E9015-B9 E9016-B9 E7015-B2L E8018-B2 E8015-B3L E9018-B3 E8016-B6 | BL-96, CM-2CW, CM-5, CM-9, CM-95B9, CM-96B9, CM-9Cb, CM-A76, CM-A96, CM-A96MB, CM-A96MBD, CM-A106, CM-A106N, CM-A106ND, CM-A106H, CM-A106HD, CM-B95, CM-B98, CM-B105, CM-B108, CR-12S | 325-375 | 1 | 100-150 |

Stick electrodes

| Applicable steel or metal | Product names | Redrying temperature (°C) | Redrying time (hour) | Holding temperature (°C) |
|---------------------------|--|---------------------------|----------------------|--------------------------|
| stainless steel | NC-xxx | 150-200 | 0.5-1 | 100-150 |
| | CR-40, CR-40Cb | 300-350 | 0.5-1 | 100-150 |
| Hardfacing | HF-240, HF-330 | 70-100 | 0.5-1 | - |
| | HF-12, HF-13, HF-30, HF-260, HF-350, HF-450, HF-500, HF-600, HF-650, HF-700, HF-800K | 300-350 | 0.5-1 | 100-150 |
| | HF-11, HF-16, HF-950 | 150-200 | 0.5-1 | 100-150 |
| Cast iron | CI-A3 | 300-350 | 0.5-1 | 100-150 |
| | CI-A1, CI-A2 | 70-100 | 0.5-1 | - |
| Ni alloy | ME-L34 | 150-200 | 0.5-1 | 100-150 |
| | NI-C1S, NI-C70A, NI-C70S, NI-C625, NI-C703D | 200-250 | 0.5-1 | 100-150 |

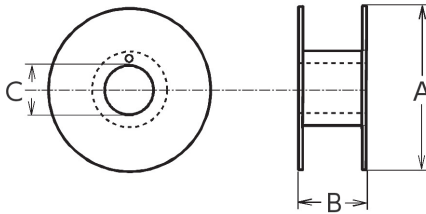
Fluxes

| Type | Product names | Redrying temperature (°C) | Redrying time (hour) | Holding temperature (°C) |
|--------|--|---------------------------|----------------------|--------------------------|
| Fused | G-50, G-60, G-80, MF-38 MF-53, MF-300 MF-38 G-80, MF-27, MF-38 G-50, MF-30 | 150-350 | 1 | 100-150 |
| Bonded | PF-H55E, PF-I52E, PF-I55E, PF-H55AS PF-H203, F-H55AS PF-H55LT, PF-200 PF-200S, PF-500 PF-200D, PF-500D, PF-90B9 PF-N3, PF-N4 | 200-300 | 1 | 100-150 |
| | PF-H80AK, PF-H80AS | 250-350 | 1 | 100-150 |

Package Specifications

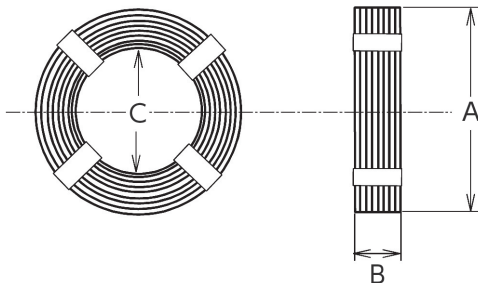
Spoiled wires

| kg | Diameter A (mm) | Width B (mm) | Diameter C (mm) |
|-------------|-----------------|--------------|-----------------|
| 10 | 225 | 102 | 52 |
| 12.5 & 12.7 | 280 | 103 | 52 |
| 15 | 280 | 102 | 52 |
| Solid 20 | 270 | 103 | 52 |
| 20 | 280 | 103 | 52 |



Coiled wires

| kg | Diameter A (mm) | Width B (mm) | Diameter C (mm) |
|-------------------|-----------------|--------------|-----------------|
| 12.5 | 375 | 64 | 305 |
| 25 (Except 4.8 φ) | 410 | 80 | 310 |
| 25 (4.8 φ) | 405 | 77 | 310 |
| 75 | 750 | 115 | 640 |
| 150 | 825 | 115 | 640 |
| 159 | 835 | 115 | 640 |



Package Specifications

Arrow Pack

1. Principles:

Arrow Pack is a drum of large amounts of wires. The wire is spooled to be elastically twisted in the drum so that the wire can be pulled out straight without rotation of the drum. The wire makes good tracking on a welding seam. The use of Arrow Pack wires can reduce the downtime for changing wires when compared with spooled wires, which is effective particularly for robotic welding and other automatic welding.

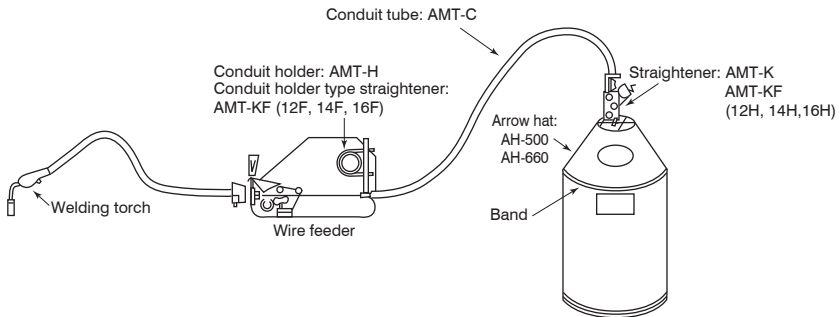
2. Package specifications:

| Solid wire | | | |
|------------|-------------|--------------------------|--------------|
| ϕ mm | Weight (kg) | Volume *a (mm) | Suitable Hat |
| 0.8 | 100 | 530 ϕ \times 500H | AH-500 |
| 0.9 | 250 | 530 ϕ \times 820H | |
| 1.0 | | | |
| 1.4 | | | |
| 1.2 | 300 | | |
| 1.4 | 400 | 680 ϕ \times 770H | AH-660 |
| 1.6 | | | |

| Flux-cored wire | | | |
|-----------------|-------------|--------------------------|--------------|
| Wire size (mm) | Weight (kg) | Volume *a (mm) | Suitable Hat |
| 1.2 1.4 | 250 | 530 ϕ \times 820H | AH-500 |
| 1.6 | 350 | 680 ϕ \times 770H | AH-660 |

*a: Volume, including the hanging bracket

3. Arrangement



Conversions for Temperature

| °F | °C | °F | °C | °F | °C | °F | °C | °F | °C | °F | °C |
|--------|-------|-----|-------|-----|------|-----|-------|------|-------|------|------|
| -459.4 | -273 | -10 | -23.3 | 86 | 30.0 | 174 | 78.9 | 430 | 221.1 | 1240 | 671 |
| -440 | -262 | 0 | -17.8 | 88 | 31.1 | 176 | 80.0 | 440 | 226.7 | 1260 | 682 |
| -430 | -257 | 2 | -16.7 | 90 | 32.2 | 178 | 81.1 | 450 | 232.2 | 1280 | 693 |
| -420 | -251 | 4 | -15.6 | 92 | 33.3 | 180 | 82.2 | 460 | 237.8 | 1300 | 704 |
| -410 | -246 | 6 | -14.4 | 94 | 34.4 | 182 | 83.3 | 470 | 243.3 | 1320 | 716 |
| -400 | -240 | 8 | -13.3 | 96 | 35.6 | 184 | 84.4 | 480 | 248.9 | 1340 | 727 |
| -390 | -234 | 10 | -12.2 | 98 | 36.7 | 186 | 85.6 | 490 | 254.4 | 1360 | 738 |
| -380 | -229 | 12 | -11.1 | 100 | 37.8 | 188 | 86.7 | 500 | 260.0 | 1380 | 749 |
| -370 | -223 | 14 | -10.0 | 102 | 38.9 | 190 | 87.8 | 520 | 271.1 | 1400 | 760 |
| -360 | -218 | 16 | -8.9 | 104 | 40.0 | 192 | 88.9 | 540 | 282.2 | 1420 | 771 |
| -350 | -212 | 18 | -7.8 | 106 | 41.1 | 194 | 90.0 | 560 | 293.3 | 1440 | 782 |
| -340 | -207 | 20 | -6.7 | 108 | 42.2 | 196 | 91.1 | 580 | 304.4 | 1460 | 793 |
| -330 | -201 | 22 | -5.6 | 110 | 43.3 | 198 | 92.2 | 600 | 315.6 | 1480 | 804 |
| -320 | -196 | 24 | -4.4 | 112 | 44.4 | 200 | 93.3 | 620 | 326.7 | 1500 | 816 |
| -310 | -190 | 26 | -3.3 | 114 | 45.6 | 202 | 94.4 | 640 | 337.8 | 1520 | 827 |
| -300 | -184 | 28 | -2.2 | 116 | 46.7 | 204 | 95.6 | 660 | 348.9 | 1540 | 838 |
| -290 | -179 | 30 | -1.1 | 118 | 47.8 | 206 | 96.7 | 680 | 360.0 | 1560 | 849 |
| -280 | -173 | 32 | 0.0 | 120 | 48.9 | 208 | 97.8 | 700 | 371.1 | 1580 | 860 |
| -270 | -168 | 34 | 1.1 | 122 | 50.0 | 210 | 98.9 | 720 | 382.2 | 1600 | 871 |
| -260 | -162 | 36 | 2.2 | 124 | 51.1 | 212 | 100.0 | 740 | 393.3 | 1620 | 882 |
| -250 | -157 | 38 | 3.3 | 126 | 52.2 | 214 | 101.1 | 760 | 404.4 | 1640 | 893 |
| -240 | -151 | 40 | 4.4 | 128 | 53.3 | 216 | 102.2 | 780 | 415.6 | 1660 | 904 |
| -230 | -146 | 42 | 5.6 | 130 | 54.4 | 218 | 103.3 | 800 | 426.7 | 1680 | 916 |
| -220 | -140 | 44 | 6.7 | 132 | 55.6 | 220 | 104.4 | 820 | 437.8 | 1700 | 927 |
| -210 | -134 | 46 | 7.8 | 134 | 56.7 | 230 | 110.0 | 840 | 448.9 | 1720 | 938 |
| -200 | -129 | 48 | 8.9 | 136 | 57.8 | 240 | 115.6 | 860 | 460.0 | 1740 | 949 |
| -190 | -123 | 50 | 10.0 | 138 | 58.9 | 250 | 121.1 | 880 | 471.1 | 1760 | 960 |
| -180 | -118 | 52 | 11.1 | 140 | 60.0 | 260 | 126.7 | 900 | 482.2 | 1780 | 971 |
| -170 | -112 | 54 | 12.2 | 142 | 61.1 | 270 | 132.2 | 920 | 493.3 | 1800 | 982 |
| -160 | -107 | 56 | 13.3 | 144 | 62.2 | 280 | 137.8 | 940 | 504.4 | 1820 | 993 |
| -150 | -101 | 58 | 14.4 | 146 | 63.3 | 290 | 143.3 | 960 | 515.6 | 1840 | 1004 |
| -140 | -96 | 60 | 15.6 | 148 | 64.4 | 300 | 148.9 | 980 | 527 | 1860 | 1016 |
| -130 | -90 | 62 | 16.7 | 150 | 65.6 | 310 | 154.4 | 1000 | 538 | 1880 | 1027 |
| -120 | -84 | 64 | 17.8 | 152 | 66.7 | 320 | 160.0 | 1020 | 549 | 1900 | 1038 |
| -110 | -79 | 66 | 18.9 | 154 | 67.8 | 330 | 165.6 | 1040 | 560 | 1920 | 1049 |
| -100 | -73 | 68 | 20.0 | 156 | 68.9 | 340 | 171.1 | 1060 | 571 | 1940 | 1060 |
| -90 | -68 | 70 | 21.1 | 158 | 70.0 | 350 | 176.7 | 1080 | 582 | 1960 | 1071 |
| -80 | -62 | 72 | 22.2 | 160 | 71.1 | 360 | 182.2 | 1100 | 593 | 1980 | 1082 |
| -70 | -57 | 74 | 23.3 | 162 | 72.2 | 370 | 187.8 | 1120 | 604 | 2000 | 1093 |
| -60 | -51 | 76 | 24.4 | 164 | 73.3 | 380 | 193.3 | 1140 | 616 | | |
| -50 | -45.6 | 78 | 25.6 | 166 | 74.4 | 390 | 198.9 | 1160 | 627 | | |
| -40 | -40.0 | 80 | 26.7 | 168 | 75.6 | 400 | 204.4 | 1180 | 638 | | |
| -30 | -34.4 | 82 | 27.8 | 170 | 76.7 | 410 | 210.0 | 1200 | 649 | | |
| -20 | -28.9 | 84 | 28.9 | 172 | 77.8 | 420 | 215.6 | 1220 | 660 | | |

$$^{\circ}\text{F} = \left(\frac{9}{5} \times ^{\circ}\text{C}\right) + 32$$

$$^{\circ}\text{C} = \frac{5}{9} \times (^{\circ}\text{F} - 32)$$

Conversions for Tensile Stress

ksi → MPa (Extracted from ASTM E380)

1 ksi = 6.89476 MPa

| ksi | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------------|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | MPa | | | | | | | | | |
| 0 | - | 6.89 | 13.79 | 20.68 | 27.58 | 34.47 | 41.37 | 48.26 | 55.16 | 62.05 |
| 10 | 68.95 | 75.84 | 82.74 | 89.63 | 96.53 | 103.42 | 110.32 | 117.21 | 124.11 | 131.00 |
| 20 | 137.90 | 144.80 | 151.68 | 158.58 | 165.47 | 172.37 | 179.26 | 186.16 | 193.05 | 199.95 |
| 30 | 206.84 | 213.74 | 220.63 | 227.53 | 234.42 | 241.32 | 248.21 | 255.11 | 262.00 | 268.90 |
| 40 | 275.79 | 282.69 | 289.58 | 296.47 | 303.37 | 310.26 | 317.16 | 324.05 | 330.95 | 337.84 |
| 50 | 344.74 | 351.63 | 358.53 | 365.42 | 372.32 | 379.21 | 386.11 | 393.00 | 399.90 | 406.79 |
| 60 | 413.69 | 420.58 | 427.47 | 434.37 | 441.26 | 448.16 | 455.05 | 461.95 | 468.84 | 475.74 |
| 70 | 482.63 | 489.53 | 496.42 | 503.32 | 510.21 | 517.11 | 524.00 | 530.90 | 537.79 | 544.69 |
| 80 | 551.58 | 558.48 | 565.37 | 572.26 | 579.16 | 586.05 | 592.95 | 599.84 | 606.74 | 613.63 |
| 90 | 620.53 | 627.42 | 634.32 | 641.21 | 648.11 | 655.00 | 661.90 | 668.79 | 675.69 | 682.58 |
| 100 | 689.48 | | | | | | | | | |

MPa → ksi (Extracted from BS350 Part 2)

1 MPa = 0.145038 ksi

| MPa | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------------|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | ksi | | | | | | | | | |
| 0 | - | 0.145 | 0.290 | 0.435 | 0.580 | 0.725 | 0.870 | 1.015 | 1.160 | 1.305 |
| 10 | 1.450 | 1.595 | 1.740 | 1.886 | 2.031 | 2.176 | 2.321 | 2.466 | 2.611 | 2.756 |
| 20 | 2.901 | 3.046 | 3.191 | 3.336 | 3.481 | 3.626 | 3.771 | 3.916 | 4.061 | 4.206 |
| 30 | 4.351 | 4.496 | 4.641 | 4.786 | 4.931 | 5.076 | 5.221 | 5.366 | 5.511 | 5.656 |
| 40 | 5.802 | 5.947 | 6.092 | 6.237 | 6.382 | 6.527 | 6.672 | 6.817 | 6.962 | 7.107 |
| 50 | 7.252 | 7.397 | 7.542 | 7.687 | 7.832 | 7.977 | 8.122 | 8.267 | 8.412 | 8.557 |
| 60 | 8.702 | 8.847 | 8.992 | 9.137 | 9.282 | 9.427 | 9.572 | 9.718 | 9.863 | 10.008 |
| 70 | 10.153 | 10.298 | 10.443 | 10.588 | 10.733 | 10.878 | 11.023 | 11.168 | 11.313 | 11.458 |
| 80 | 11.603 | 11.748 | 11.893 | 12.038 | 12.183 | 12.328 | 12.473 | 12.618 | 12.763 | 12.908 |
| 90 | 13.053 | 13.198 | 13.344 | 13.489 | 13.634 | 13.779 | 13.924 | 14.069 | 14.214 | 14.359 |
| 100 | 14.504 | | | | | | | | | |

Conversions for Impact Energy

ft -lbf → J (Extracted from BS350 Part 2)

1 ft -lbf = 1.35582 J

| ft -lbf | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | J | | | | | | | | | |
| 0 | - | 1.36 | 2.71 | 4.07 | 5.42 | 6.78 | 8.13 | 9.49 | 10.85 | 12.20 |
| 10 | 13.56 | 14.91 | 16.27 | 17.63 | 18.98 | 20.34 | 21.69 | 23.05 | 24.40 | 25.76 |
| 20 | 27.12 | 28.47 | 29.83 | 31.18 | 32.54 | 33.90 | 35.25 | 36.61 | 37.96 | 39.32 |
| 30 | 40.67 | 42.03 | 43.39 | 44.74 | 46.10 | 47.45 | 48.81 | 50.17 | 51.52 | 52.88 |
| 40 | 54.23 | 55.59 | 56.94 | 58.30 | 59.66 | 61.01 | 62.37 | 63.72 | 65.08 | 66.44 |
| 50 | 67.79 | 69.15 | 70.50 | 71.86 | 73.21 | 74.57 | 75.93 | 77.28 | 78.64 | 79.99 |
| 60 | 81.35 | 82.70 | 84.06 | 85.42 | 86.77 | 88.13 | 89.48 | 90.84 | 92.20 | 93.55 |
| 70 | 94.91 | 96.26 | 97.62 | 98.97 | 100.33 | 101.69 | 103.04 | 104.40 | 105.75 | 107.11 |
| 80 | 108.47 | 109.82 | 111.18 | 112.53 | 113.89 | 115.25 | 116.60 | 117.96 | 119.31 | 120.67 |
| 90 | 122.02 | 123.38 | 124.74 | 126.09 | 127.45 | 128.80 | 130.16 | 131.51 | 132.87 | 134.23 |
| 100 | 135.58 | | | | | | | | | |

J → ft -lbf (Extracted from BS350 Part 2)

1 J = 0.737563 ft -lbf

| J | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------------|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | ft - lbf | | | | | | | | | |
| 0 | - | 0.738 | 1.475 | 2.213 | 2.950 | 3.688 | 4.425 | 5.163 | 5.901 | 6.638 |
| 10 | 7.376 | 8.113 | 8.851 | 9.588 | 10.326 | 11.063 | 11.801 | 12.539 | 13.276 | 14.014 |
| 20 | 14.751 | 15.489 | 16.226 | 16.964 | 17.702 | 18.439 | 19.177 | 19.914 | 20.652 | 21.389 |
| 30 | 22.127 | 22.864 | 23.602 | 24.340 | 25.077 | 25.815 | 26.552 | 27.290 | 28.027 | 28.765 |
| 40 | 29.503 | 30.240 | 30.978 | 31.715 | 32.453 | 33.190 | 33.928 | 34.665 | 35.403 | 36.141 |
| 50 | 36.878 | 37.616 | 38.353 | 39.091 | 39.828 | 40.566 | 41.304 | 42.041 | 42.779 | 43.516 |
| 60 | 44.254 | 44.991 | 45.729 | 46.466 | 47.204 | 47.942 | 48.679 | 49.417 | 50.154 | 50.892 |
| 70 | 51.629 | 52.367 | 53.105 | 53.842 | 54.580 | 55.317 | 56.055 | 56.792 | 57.530 | 58.267 |
| 80 | 59.005 | 59.743 | 60.480 | 61.218 | 61.955 | 62.693 | 63.430 | 64.168 | 64.906 | 65.643 |
| 90 | 66.381 | 67.118 | 67.856 | 68.593 | 69.331 | 70.068 | 70.806 | 71.544 | 72.281 | 73.019 |
| 100 | 73.756 | | | | | | | | | |

Conversions for Hardness

| Vickers Hardness (DPH) | Brinell hardness 10mm ball 3000kg load | | Tensile Strength MPa (approx.) |
|------------------------|--|-----------------------|--------------------------------|
| | Standard ball | Tungsten carbide ball | |
| 940 | - | - | - |
| 920 | - | - | - |
| 900 | - | - | - |
| 880 | - | 767 | - |
| 860 | - | 757 | - |
| 840 | - | 745 | - |
| 820 | - | 733 | - |
| 800 | - | 722 | - |
| 780 | - | 710 | - |
| 760 | - | 698 | - |
| 740 | - | 684 | - |
| 720 | - | 670 | - |
| 700 | - | 656 | - |
| 690 | - | 647 | - |
| 680 | - | 638 | - |
| 670 | - | 630 | - |
| 660 | - | 620 | - |
| 650 | - | 611 | - |
| 640 | - | 601 | - |
| 630 | - | 591 | - |
| 620 | - | 582 | - |
| 610 | - | 573 | - |
| 600 | - | 564 | - |
| 590 | - | 554 | 2095 |
| 580 | - | 545 | 2020 |
| 570 | - | 535 | 1981 |
| 560 | - | 525 | 1952 |
| 550 | 505 | 517 | 1912 |
| 540 | 496 | 507 | 1863 |
| 530 | 488 | 497 | 1824 |
| 520 | 480 | 488 | 1795 |
| 510 | 473 | 479 | 1755 |
| 500 | 465 | 471 | 1706 |
| 490 | 456 | 460 | 1657 |
| 480 | 448 | 452 | 1618 |
| 470 | 441 | 442 | 1569 |
| 460 | 433 | 433 | 1530 |
| 450 | 425 | 425 | 1500 |
| 440 | 415 | 415 | 1461 |
| 430 | 405 | 405 | 1412 |
| 420 | 397 | 397 | 1373 |

| Vickers Hardness (DPH) | Brinell hardness 10mm ball 3000kg load | | Tensile Strength MPa (approx.) |
|------------------------|--|-----------------------|--------------------------------|
| | Standard ball | Tungsten carbide ball | |
| 410 | 388 | 388 | 1334 |
| 400 | 379 | 379 | 1285 |
| 390 | 369 | 369 | 1245 |
| 380 | 360 | 360 | 1206 |
| 370 | 350 | 350 | 1177 |
| 360 | 341 | 341 | 1128 |
| 350 | 331 | 331 | 1098 |
| 340 | 322 | 322 | 1069 |
| 330 | 313 | 313 | 1030 |
| 320 | 303 | 303 | 1010 |
| 310 | 294 | 294 | 981 |
| 300 | 284 | 284 | 951 |
| 295 | 280 | 280 | 941 |
| 290 | 275 | 275 | 922 |
| 285 | 270 | 270 | 902 |
| 280 | 265 | 265 | 892 |
| 275 | 261 | 261 | 873 |
| 270 | 256 | 256 | 853 |
| 265 | 252 | 252 | 843 |
| 260 | 247 | 247 | 824 |
| 255 | 243 | 243 | 804 |
| 250 | 238 | 238 | 794 |
| 245 | 233 | 233 | 775 |
| 240 | 228 | 228 | 765 |
| 230 | 219 | 219 | 736 |
| 220 | 209 | 209 | 696 |
| 210 | 200 | 200 | 667 |
| 200 | 190 | 190 | 637 |
| 190 | 181 | 181 | 608 |
| 180 | 171 | 171 | 579 |
| 170 | 162 | 162 | 549 |
| 160 | 152 | 152 | 520 |
| 150 | 143 | 143 | 490 |
| 140 | 133 | 133 | 451 |
| 130 | 124 | 124 | 431 |
| 120 | 114 | 114 | 392 |
| 110 | 105 | 105 | - |
| 100 | 95 | 95 | - |
| 95 | 90 | 90 | - |
| 90 | 86 | 86 | - |
| 85 | 81 | 81 | - |

Note: These conversions are excerpted from the relevant JIS and ASTM standards, which are based on the data of carbon steels. Therefore, weld metals may exhibit different conversions more or less particularly in the case of alloyed weld metals with higher hardness.

F-No. Grouping and A-No. Classification (A part is extracted)

Note: The F-No. grouping and A-No. classification of welding consumables shown below are excerpted from ASME Sec. IX 2010 Edition. The F No. and A No. of KOBELCO products are shown in the "List of Welding Consumables" listed at pages from 10 to 21.

F-No. grouping of welding consumables

| F No. | ASME Specification | AWS Classification |
|-------|--|--|
| 1 | SFA-5.1 | EXX20, EXX22, EXX24, EXX27, EXX28 |
| 1 | SFA-5.4 | EXXX(X)-26 |
| 1 | SFA-5.5 | EXX20-X, EXX27-X |
| 2 | SFA-5.1 | EXX12, EXX13, EXX14, EXX19 |
| 2 | SFA-5.5 | E(X)XX13-X |
| 3 | SFA-5.1 | EXX10, EXX11 |
| 3 | SFA-5.5 | E(X)XX10-X, E(X)XX11-X |
| 4 | SFA-5.1 | EXX15, EXX16, EXX18, EXX18M, EXX48 |
| 4 | SFA-5.4 Other than austenitic and duplex | EXXX(X)-15, EXXX(X)-16, EXXX(X)-17 |
| 4 | SFA-5.5 | E(X)XX15-X, E(X)XX16-X, E(X)XX18-X, E(X)XX18M, E(X)XX18M1, E(X)XX45 |
| 5 | SFA-5.4 Austenitic and duplex | EXXX(X)-15, EXXX(X)-16, EXXX(X)-17 |
| 6 | SFA-5.2, SFA-5.9, SFA-5.17, SFA-5.18, SFA-5.20, SFA-5.22, SFA-5.23, SFA-5.25, SFA-5.26, SFA-5.28, SFA-5.29 | All classifications |
| 6 | SFA-5.30 | INMs-X, IN5XX, IN3XX(X) |
| 41 | SFA-5.11 | ENi-1 |
| 41 | SFA-5.14 | ERNi-1 |
| 41 | SFA-5.30 | IN61 |
| 42 | SFA-5.11 | ENiCu-7 |
| 42 | SFA-5.14 | ERNiCu-7, ERNiCu-8 |
| 42 | SFA-5.30 | IN60 |
| 43 | SFA-5.11 | ENiCr-4, ENiCrFe-1, ENiCrFe-2, ENiCrFe-3, ENiCrFe-4, ENiCrFe-7, ENiCrFe-9, ENiCrFe-10, ENiCrFe-12, ENiCrCoMo-1, ENiCrMo-2, ENiCrMo-3, ENiCrMo-4, ENiCrMo-5, ENiCrMo-6, ENiCrMo-7, ENiCrMo-10, ENiCrMo-12, ENiCrMo-13, ENiCrMo-14, ENiCrMo-17, ENiCrMo-18, ENiCrMo-19, ENiCrWMo-1 |

(Continued)

| F No. | ASME Specification | AWS Classification |
|-------|--------------------|---|
| 43 | SFA-5.14 | ERNiCr-3, ERNiCr-4, ERNiCr-6, ERNiCrFe-5, ERNiCrFe-6, ERNiCrFe-7, ERNiCrFe-7A, ERNiCrFe-8, ERNiCrFe-11, ERNiCrFe-12, ERNiCrFeAl-1, ERNiCrCoMo-1, ERNiCrMo-2, ERNiCrMo-3, ERNiCrMo-4, ERNiCrMo-7, ERNiCrMo-10, ERNiCrMo-13, ERNiCrMo-14, ERNiCrMo-16, ERNiCrMo-17, ERNiCrMo-18, ERNiCrMo-19, ERNiCrMo-20, ERNiCrMo-21, ERNiCrWMo-1 |
| 43 | SFA-5.30 | IN82, IN62, IN6A, IN52 |
| 43 | SFA-5.34 | All classifications |
| 44 | SFA-5.11 | ENiMo-1, ENiMo-3, ENiMo-7, ENiMo-8, ENiMo-9, ENiMo-10, ENiMo-11 |
| 44 | SFA-5.14 | ERNiMo-1, ERNiMo-2, ERNiMo-3, ERNiMo-7, ERNiMo-8, ERNiMo-9, ERNiMo-10, ERNiMo-11, ERNiMo-12 |
| 45 | SFA-5.11 | ENiCrMo-1, ENiCrMo-9, ENiCrMo-11 |
| 45 | SFA-5.14 | ERNiCrMo-1, ERNiFeCr-1, ERNiCrMo-8, ERNiCrMo-9, ERNiCrMo-11 |
| 46 | SFA-5.11 | ENiCrFeSi-1 |
| 46 | SFA-5.14 | ERNiCrFeSi-1, ERNiCoCrSi-1 |

A-No. classification of ferrous weld metal

| A No. | Types of weld deposit | Chemical composition (mass %) | | | | | |
|-------|-----------------------|-------------------------------|-------------|-----------|-------------|-----------|------|
| | | C | Cr | Mo | Ni | Mn | Si |
| 1 | Mild steel | 0.20 | - | - | - | 1.60 | 1.00 |
| 2 | C-Mo | 0.15 | 0.50 | 0.40-0.65 | - | 1.60 | 1.00 |
| 3 | Cr (0.4-2%)-Mo | 0.15 | 0.40-2.00 | 0.40-0.65 | - | 1.60 | 1.00 |
| 4 | Cr (2-4%)-Mo | 0.15 | 2.00-4.00 | 0.40-1.50 | - | 1.60 | 2.00 |
| 5 | Cr (4-10.5%)-Mo | 0.15 | 4.00-10.50 | 0.40-1.50 | - | 1.20 | 2.00 |
| 6 | Cr-Martensitic | 0.15 | 11.00-15.00 | 0.70 | - | 2.00 | 1.00 |
| 7 | Cr-Ferritic | 0.15 | 11.00-30.00 | 1.00 | - | 1.00 | 3.00 |
| 8 | Cr-Ni | 0.15 | 14.50-30.00 | 4.00 | 7.50-15.00 | 2.50 | 1.00 |
| 9 | Cr-Ni | 0.30 | 19.00-30.00 | 6.00 | 15.00-37.00 | 2.50 | 1.00 |
| 10 | Ni to 4% | 0.15 | - | 0.55 | 0.80-4.00 | 1.70 | 1.00 |
| 11 | Mn-Mo | 0.17 | - | 0.25-0.75 | 0.85 | 1.25-2.25 | 1.00 |
| 12 | Ni-Cr-Mo | 0.15 | 1.50 | 0.25-0.80 | 1.25-2.80 | 0.75-2.25 | 1.00 |

Note: Single values are maximum.

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Carbon Steel Electrodes for Shielded Metal Arc Welding

Classification system

E ① ② — ③ ④ ⑤ [Ex.] E60 10 E70 16-1 H8 R

E: Stick electrodes

①: All-weld metal tension test requirements & chemical composition requirements

| Classification | | Tensile strength (ksi) | Yield strength at 0.2% offset (ksi) | Elongation on 4d (%) |
|----------------|--------------------|------------------------|-------------------------------------|----------------------|
| E 60 | 10 | 60min. | 48min. | 22min. |
| | 11 | 60min. | 48min. | 22min. |
| | 12 | 60min. | 48min. | 17min. |
| | 13 | 60min. | 48min. | 17min. |
| | 18 | 60min. | 48min. | 22min. |
| | 19 | 60min. | 48min. | 22min. |
| | 20 | 60min. | 48min. | 22min. |
| E 70 | 27 | 60min. | 48min. | 22min. |
| | 14 | 70min. | 58min. | 17min. |
| | 15 | 70min. | 58min. | 22min. |
| | 16 | 70min. | 58min. | 22min. |
| | 18 | 70min. | 58min. | 22min. |
| | 24 | 70min. | 58min. | 17min. |
| | 27 | 70min. | 58min. | 22min. |
| | 28 | 70min. | 58min. | 22min. |
| | 48 | 70min. | 58min. | 22min. |
| | 18M ⁽⁴⁾ | Note ⁽²⁾ | 53~72 ⁽³⁾ | 24min. |

Note: (1) Single values are maximum. N.S. means Not Specified.

(2) Nominal 70ksi

(3) For 3/32in.(2.4mm) electrodes, the maximum yield strength shall be 77ksi

(4) For mostly military applications

| | C | Si | Mn | P | S | Ni | Cr | Mo | V | Combined Limit for Mn+Ni+Cr+Mo+V |
|--|------|------|-----------|-------|-------|------|------|------|------|----------------------------------|
| | 0.20 | 1.00 | 1.20 | N.S. | N.S. | 0.30 | 0.20 | 0.30 | 0.08 | N.S. |
| | 0.20 | 1.00 | 1.20 | N.S. | N.S. | 0.30 | 0.20 | 0.30 | 0.08 | N.S. |
| | 0.20 | 1.00 | 1.20 | N.S. | N.S. | 0.30 | 0.20 | 0.30 | 0.08 | N.S. |
| | 0.20 | 1.00 | 1.20 | N.S. | N.S. | 0.30 | 0.20 | 0.30 | 0.08 | N.S. |
| | 0.03 | 0.40 | 0.60 | 0.025 | 0.015 | 0.30 | 0.20 | 0.30 | 0.08 | N.S. |
| | 0.20 | 1.00 | 1.20 | N.S. | N.S. | 0.30 | 0.20 | 0.30 | 0.08 | N.S. |
| | 0.20 | 1.00 | 1.20 | N.S. | N.S. | 0.30 | 0.20 | 0.30 | 0.08 | N.S. |
| | 0.20 | 1.00 | 1.20 | N.S. | N.S. | 0.30 | 0.20 | 0.30 | 0.08 | N.S. |
| | 0.15 | 0.90 | 1.25 | 0.035 | 0.035 | 0.30 | 0.20 | 0.30 | 0.08 | 1.50 |
| | 0.15 | 0.90 | 1.25 | 0.035 | 0.035 | 0.30 | 0.20 | 0.30 | 0.08 | 1.50 |
| | 0.15 | 0.75 | 1.60 | 0.035 | 0.035 | 0.30 | 0.20 | 0.30 | 0.08 | 1.75 |
| | 0.15 | 0.75 | 1.60 | 0.035 | 0.035 | 0.30 | 0.20 | 0.30 | 0.08 | 1.75 |
| | 0.15 | 0.90 | 1.25 | 0.035 | 0.035 | 0.30 | 0.20 | 0.30 | 0.08 | 1.50 |
| | 0.15 | 0.75 | 1.60 | 0.035 | 0.035 | 0.30 | 0.20 | 0.30 | 0.08 | 1.75 |
| | 0.15 | 0.90 | 1.60 | 0.035 | 0.035 | 0.30 | 0.20 | 0.30 | 0.08 | 1.75 |
| | 0.15 | 0.90 | 1.60 | 0.035 | 0.035 | 0.30 | 0.20 | 0.30 | 0.08 | 1.75 |
| | 0.12 | 0.80 | 0.40~1.60 | 0.030 | 0.020 | 0.25 | 0.15 | 0.35 | 0.05 | N.S. |

②: All-weld metal Charpy V-notch impact requirements

| Classification | | Impact value | | | Welding position ⁽¹⁾ | Type of current |
|----------------|-----|--|------------------|-----------------|---------------------------------|--------------------------------|
| | | Limits for 3 out of 5 specimens ⁽²⁾ | | | | |
| | | Temp. (°F) | average (ft-lbf) | single (ft-lbf) | | |
| E 60 | 10 | -20 | 20min. | 15min. | F, V, OH, H | DCEP |
| | 11 | | | | | AC or DCEP |
| | 12 | Not specified | | | F, V, OH, H | AC or DCEN |
| | 13 | | | | | AC, DCEP or DCEN |
| | 18 | -20 | 20min. | 15min. | F, V, OH, H | AC or DCEP |
| | 19 | 0 | 20min. | 15min. | F, V, OH, H | AC, DCEP or DCEN |
| | 20 | Not specified | | | H-Fil, F | AC or DCEN AC, DCEP or DCEN |
| | 22 | | | | F, H-Fil | AC or DCEN |
| 27 | -20 | 20min. | 15min. | H-Fil, F | AC or DCEN AC, DCEP or DCEN | |
| E 70 | 14 | Not specified | | | F, V, OH, H | AC, DCEP or DCEN |
| | 15 | -20 | 20min. | 15min. | F, V, OH, H | DCEP |
| | 16 | | | | | AC or DCEP |
| | 18 | | | | F, V, OH, H | AC or DCEP |
| | 24 | Not specified | | | H-Fil, F | AC, DCEP or DCEN |
| | 27 | -20 | 20min. | 15min. | H-Fil, F | AC or DCEN AC, DCEP or DCEN |
| | 28 | 0 | 20min. | 15min. | H-Fil, F | AC or DCEP |
| | 48 | -20 | 20min. | 15min. | F, OH, H, V-down | AC or DCEP |
| | 18M | All five specimens ⁽³⁾ | | | F, V, OH, H | DCEP |
| -20 | | 50min. | 40min. | | | |

Note: (1) Welding position: F: Flat, H: Horizontal, H-Fil: Horizontal fillet, V-down: Vertical down
V: Vertical, OH: Overhead

(2) Both the highest and lowest values obtained shall be disregarded in computing the average. Two of these remaining three values shall equal or exceed 20ft-lbf.

(3) All five values obtained shall be used in computing the average. Four of the five values shall equal, or exceed, 50 ft-lbf.

③: Requirements for low temperature impact value (Option)

| Classification | Additional Designator | Impact Requirements | | |
|------------------|-----------------------|----------------------|------------------------|-----------------------------|
| | | 3 out of 5 specimens | | |
| | | Temp. (°F) | Average, Min. (ft-lbf) | Single value, Min. (ft-lbf) |
| E 7016 E 7018 | 1 | -50 | 20 | 15 |
| E 7024 | | 0 | 20 | 15 |

④: Diffusible hydrogen limits for weld metal (Option)

| Classification | Diffusible Hydrogen Designator | Diffusible hydrogen content, Average mL/100g deposited metal, Max |
|--|--------------------------------|---|
| E 7018M | None | 4 |
| E 7015 E 7016 E 7018 E 7028 E 7048 | H16 H8 H4 | 16 8 4 |

⑤: Absorbed moisture content limits in electrode coverings (Option)

| Electrode Designation | Limit of moisture content (wt.%), Max | |
|---|---------------------------------------|---------------|
| | As-received or Conditioned | As-exposed |
| E 7015 E 7016 E 7016-1 E 7018 E 7018-1 E 7028 E 7048 | 0.6 | Not specified |
| E 7015R E 7016R E 7016-1R E 7018R E 7018-1R E 7028R E 7048R | 0.3 | 0.4 |
| E 7018M | 0.1 | 0.4 |

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Low-Alloy Steel Electrodes for Shielded Metal Arc Welding

Classification system

E ① ② – ③ [Ex.] E 70 16 – A1
E 100 18 – D2

E : Stick electrodes

①: All-weld-metal tensile strength and related requirements⁽¹⁾

| Classification | TS, Min. (ksi) | EI, Min. (%) | IV, Min. ⁽²⁾ (ft-lb) |
|----------------|-------------------|------------------------------|---|
| 70 | 70 75 | 11-24 according to class. | Av. 20 Each 15 at specific temperature depending on classification |
| 80 | 80 | | |
| 90 | 90 | | |
| 100 | 100 | | |
| 110 | 110 | | |
| 120 | 120 | | |

Note (1) PWHT is specified depending on classification.

(2) Not specified for EXXX-A1, -BX, -BXL, and -G

②: Type of covering, welding position, and related requirements

| Classification | Type of covering | Welding position | Type of current |
|----------------|-------------------------------------|------------------|------------------|
| 10 | High cellulose sodium | F, V, OH, H | DCEP |
| 11 | High cellulose potassium | | AC or DCEP |
| 13 | High titania potassium | F, V, OH, H | AC, DCEP or DCEN |
| 15 | Low hydrogen sodium | F, V, OH, H | DCEP |
| 16 | Low hydrogen potassium | | AC or DCEP |
| 18 | Low hydrogen potassium, iron powder | F, V, OH, H | AC or DCEP |
| 20 | High iron oxide | H-Fil | AC or DCEN |
| | | F | AC, DCEP or DCEN |
| 27 | High iron oxide, iron powder | H-Fil | AC or DCEN |
| | | F | AC, DCEP or DCEN |

Note: 1. F: Flat, V: Vertical,

OH: Overhead, H-Fil: Horizontal fillet

H: Horizontal

③: Chemical composition of all-weld metal

| Classification | Chemical composition (%) | | | | | | | | |
|------------------------|--------------------------|-----------|-----------|------|------|------|-----------|-----------|---------|
| | C | Mn | Si | P | S | Ni | Cr | Mo | Others |
| Cr-Mo steel electrodes | | | | | | | | | |
| E7010-A1 | 0.12 | 0.60 | 0.40 | 0.03 | 0.03 | - | - | 0.40-0.65 | - |
| E7011-A1 | | | 0.60 | | | | | | |
| E7020-A1 | | | 0.60 | | | | | | |
| E7015-A1 | | | 0.90 | | | | | | |
| E7016-A1 | | | 0.80 | | | | | | |
| E7018-A1 | | | 0.40 | | | | | | |
| E7027-A1 | 1.00 | 0.40 | | | | | | | |
| E8016-B1 | 0.05-0.12 | 0.90 | 0.60 | 0.03 | 0.03 | - | 0.40-0.65 | 0.40-0.65 | - |
| E8018-B1 | | | 0.80 | | | | | | |
| E8015-B2 | 0.05-0.12 | 0.90 | 1.00 | 0.03 | 0.03 | - | 1.00-1.50 | 0.40-0.65 | - |
| E8016-B2 | | | 0.60 | | | | | | |
| E8018-B2 | | | 0.80 | | | | | | |
| E7015-B2L | 0.05 | 0.90 | 1.00 | 0.03 | 0.03 | - | 1.00-1.50 | 0.40-0.65 | - |
| E7016-B2L | | | 0.60 | | | | | | |
| E7018-B2L | | | 0.80 | | | | | | |
| E9015-B3 | 0.05-0.12 | 0.90 | 1.00 | 0.03 | 0.03 | - | 2.00-2.50 | 0.90-1.20 | - |
| E9016-B3 | | | 0.60 | | | | | | |
| E9018-B3 | | | 0.80 | | | | | | |
| E8015-B3L | 0.05 | 0.90 | 1.00 | 0.03 | 0.03 | - | 2.00-2.50 | 0.90-1.20 | - |
| E8018-B3L | | | 0.80 | | | | | | |
| E8015-B4L | 0.05 | 0.90 | 1.00 | 0.03 | 0.03 | - | 1.75-2.25 | 0.40-0.65 | - |
| E8016-B5 | 0.07-0.15 | 0.40-0.70 | 0.30-0.60 | 0.03 | 0.03 | - | 0.40-0.60 | 1.00-1.25 | V: 0.05 |
| E8015-B6 | 0.05-0.10 | 1.0 | 0.90 | 0.03 | 0.03 | 0.40 | 4.0-6.0 | 0.45-0.65 | - |
| E8016-B6 | | | | | | | | | |
| E8018-B6 | | | | | | | | | |
| E9018-B6 | | | | | | | | | |
| E8015-B6L | 0.05 | 1.0 | 0.90 | 0.03 | 0.03 | 0.40 | 4.0-6.0 | 0.45-0.65 | - |
| E8016-B6L | | | | | | | | | |
| E8018-B6L | | | | | | | | | |
| E8015-B7 | 0.05-0.10 | 1.0 | 0.90 | 0.03 | 0.03 | 0.40 | 6.0-8.0 | 0.45-0.65 | - |
| E8016-B7 | | | | | | | | | |
| E8018-B7 | | | | | | | | | |
| E8015-B7L | 0.05 | 1.0 | 0.90 | 0.03 | 0.03 | 0.40 | 6.0-8.0 | 0.45-0.65 | - |
| E8016-B7L | | | | | | | | | |
| E8018-B7L | | | | | | | | | |
| E8015-B8 | 0.05-0.10 | 1.0 | 0.90 | 0.03 | 0.03 | 0.40 | 8.0-10.5 | 0.85-1.20 | - |
| E8016-B8 | | | | | | | | | |
| E8018-B8 | | | | | | | | | |

Note: Single values are maximum.

(Continued)

| Classification | Chemical composition (%) | | | | | | | | |
|--|--------------------------|------|------|-------|-------|------|----------|-----------|---|
| | C | Mn | Si | P | S | Ni | Cr | Mo | Others |
| E8015-B8L E8016-B8L E8018-B8L | 0.05 | 1.0 | 0.90 | 0.03 | 0.03 | 0.40 | 8.0-10.5 | 0.85-1.20 | - |
| E9015-B23 R9016-B23 E9018-B23 | 0.04-0.12 | 1.00 | 0.60 | 0.015 | 0.015 | 0.50 | 1.9-2.9 | 0.30 | W: 1.50-2.00 V: 0.15-0.30 Nb: 0.02-0.10 B: 0.006 Al: 0.04 Cu: 0.25 N: 0.05 |
| E9015-B24 E9016-B24 E9018-B24 | 0.04-0.12 | 1.00 | 0.60 | 0.020 | 0.015 | 0.50 | 1.9-2.9 | 0.80-1.20 | V: 0.15-0.30 Nb: 0.02-0.10 Ti: 0.10 B: 0.006 Al: 0.04 Cu: 0.25 N: 0.07 |
| E9015-B91 ⁽¹⁾ E9016-B91 ⁽¹⁾ E9018-B91 ⁽¹⁾ | 0.08-0.13 | 1.20 | 0.30 | 0.01 | 0.01 | 0.80 | 8.0-10.5 | 0.85-1.20 | V: 0.15-0.30 Cu: 0.25 Al: 0.04 Nb: 0.02-0.10 N: 0.02-0.07 |
| E9015-B92 E9016-B92 E9018-B92 | 0.08-0.15 | 1.20 | 0.60 | 0.020 | 0.015 | 1.00 | 8.0-10.0 | 0.30-0.70 | W: 1.50-2.00 V: 0.15-0.30 Nb: 0.02-0.08 B: 0.006 Al: 0.04 Cu: 0.25 N: 0.03-0.08 |

Note: Single values are maximum. (1) Mn+Ni shall be 1.40% Max.

(Continued)

| Classification | Chemical composition (%) | | | | | | | | |
|------------------------|--------------------------|-----------|------|------|------|-----------|------|-----------|---------------------------------|
| | C | Mn | Si | P | S | Ni | Cr | Mo | Others |
| Ni steel electrodes | | | | | | | | | |
| E8016-C1 | 0.12 | 1.25 | 0.60 | 0.03 | 0.03 | 2.00-2.75 | - | - | - |
| E8018-C1 | | | 0.80 | | | | | | |
| E7015-C1L | 0.05 | 1.25 | 0.50 | 0.03 | 0.03 | 2.00-2.75 | - | - | - |
| E7018-C1L | | | | | | | | | |
| E8016-C2 | 0.12 | 1.25 | 0.60 | 0.03 | 0.03 | 3.00-3.75 | - | - | - |
| E8018-C2 | | | 0.80 | | | | | | |
| E7015-C2L | 0.05 | 1.25 | 0.50 | 0.03 | 0.03 | 3.00-3.75 | - | - | - |
| E7016-C2L | | | | | | | | | |
| E7018-C2L | | | | | | | | | |
| E8016-C3 | 0.12 | 0.40-1.25 | 0.80 | 0.03 | 0.03 | 0.80-1.10 | 0.15 | 0.35 | V: 0.05 |
| E8018-C3 | | | | | | | | | |
| E7018-C3L | 0.08 | 0.40-1.40 | 0.50 | 0.03 | 0.03 | 0.80-1.10 | 0.15 | 0.35 | V: 0.05 |
| E8016-C4 | 0.10 | 1.25 | 0.60 | 0.03 | 0.03 | 1.10-2.00 | - | - | - |
| E8018-C4 | | | 0.80 | | | | | | |
| E9015-C5L | 0.05 | 0.40-1.00 | 0.50 | 0.03 | 0.03 | 6.00-7.25 | - | - | - |
| Ni-Mo steel electrodes | | | | | | | | | |
| E8018-NM1 | 0.10 | 0.80-1.25 | 0.60 | 0.02 | 0.02 | 0.80-1.10 | 0.10 | 0.40-0.65 | V: 0.02 Cu: 0.10 Al: 0.05 |
| E9018-NM2 | 0.04-0.15 | 0.50-1.60 | 0.70 | 0.02 | 0.02 | 1.40-2.10 | 0.20 | 0.20-0.50 | V: 0.05 Cu: 0.10 Al: 0.05 |
| Mn-Mo steel electrodes | | | | | | | | | |
| E8018-D1 | 0.12 | 1.00-1.75 | 0.80 | 0.03 | 0.03 | 0.90 | - | 0.25-0.45 | - |
| E9018-D1 | | | 0.60 | | | | | | |
| E9015-D1 | | | | | | | | | |
| E10015-D2 | 0.15 | 1.65-2.00 | 0.60 | 0.03 | 0.03 | 0.90 | - | 0.25-0.45 | - |
| E10016-D2 | | | 0.80 | | | | | | |
| E10018-D2 | | | | | | | | | |
| E8016-D3 | 0.12 | 1.00-1.80 | 0.60 | 0.03 | 0.03 | 0.90 | - | 0.40-0.65 | - |
| E8018-D3 | | | 0.80 | | | | | | |
| E9018-D3 | | | | | | | | | |

(Continued)

| Classification | Chemical composition (%) | | | | | | | | |
|------------------------------------|--------------------------|-----------|-----------|-------|-------|-----------|-----------|-----------|-----------------------------------|
| | C | Mn | Si | P | S | Ni | Cr | Mo | Others |
| General low-alloy steel electrodes | | | | | | | | | |
| EXX10-G ⁽¹⁾ | - | 1.00min. | 0.80min. | 0.03 | 0.03 | 0.50min. | 0.30min. | 0.20min. | V: 0.10min. Cu: 0.20min. |
| EXX11-G ⁽¹⁾ | | | | | | | | | |
| EXX13-G ⁽¹⁾ | | | | | | | | | |
| EXX15-G ⁽¹⁾ | | | | | | | | | |
| EXX16-G ⁽¹⁾ | | | | | | | | | |
| EXX18-G ⁽¹⁾ | | | | | | | | | |
| E7020-G ⁽¹⁾ | | | | | | | | | |
| E7027-G ⁽¹⁾ | | | | | | | | | |
| Military-similar electrodes | | | | | | | | | |
| E9018-M | 0.10 | 0.60-1.25 | 0.80 | 0.030 | 0.030 | 1.40-1.80 | 0.15 | 0.35 | V: 0.05 |
| E10018-M | 0.10 | 0.75-1.70 | 0.60 | 0.030 | 0.030 | 1.40-2.10 | 0.35 | 0.25-0.50 | V: 0.05 |
| E11018-M | 0.10 | 1.30-1.80 | 0.60 | 0.030 | 0.030 | 1.25-2.50 | 0.40 | 0.25-0.50 | V: 0.05 |
| E12018-M | 0.10 | 1.30-2.25 | 0.60 | 0.030 | 0.030 | 1.75-2.50 | 0.30-1.50 | 0.30-0.55 | V: 0.05 |
| E12018-M1 | 0.10 | 0.80-1.60 | 0.65 | 0.015 | 0.012 | 3.00-3.80 | 0.65 | 0.20-0.30 | V: 0.05 |
| Pipeline steel electrodes | | | | | | | | | |
| E7010-P1 | 0.20 | 1.20 | 0.60 | 0.03 | 0.03 | 1.00 | 0.30 | 0.50 | V: 0.10 |
| E8010-P1 | | | | | | | | | |
| E9010-P1 | | | | | | | | | |
| E8018-P2 | 0.12 | 0.90-1.70 | 0.80 | 0.03 | 0.03 | 1.00 | 0.20 | 0.50 | V: 0.05 |
| E9018-P2 | | | | | | | | | |
| E8045-P2 | | | | | | | | | |
| E9045-P2 | | | | | | | | | |
| E10045-P2 | | | | | | | | | |
| Weathering steel electrodes | | | | | | | | | |
| E7018-W1 | 0.12 | 0.40-0.70 | 0.40-0.70 | 0.025 | 0.025 | 0.20-0.40 | 0.15-0.30 | - | V: 0.08 Cu: 0.30-0.60 |
| E8018-W2 | 0.12 | 0.50-1.30 | 0.35-0.80 | 0.03 | 0.03 | 0.40-0.80 | 0.45-0.70 | - | Cu: 0.30-0.75 |

Note: Single values are maximum.

- (1) The "G" group shall have the minimum of at least one of the elements listed in this table. The letters "XX" stand for various tensile strength levels of weld metal.



AWS A5.4-2012

Stainless Steel Electrodes for Shielded Metal Arc Welding

Classification system

E ① ② [Ex.] E 308 - 15 E 309 L - 16

E: Stick electrodes

①: All-weld metal chemical composition and related requirements

| Class. | Chemical composition of all-weld metal(%) ^{(1) (2)} | | | | | | | | | | | Mechanical properties of all-weld metal (As-welded) | |
|---------|--|-----------|-----------|-----------|---------------|-----------|------|-------|-------|-----------|---------|---|---------------|
| | C | Cr | Ni | Mo | Nb(Cb) +Ta | Mn | Si | P | S | N | Cu | TS, Min. (ksi) | El., Min. (%) |
| E209 *1 | 0.06 | 20.5-24.0 | 9.5-12.0 | 1.5-3.0 | - | 4.0-7.0 | 1.00 | 0.04 | 0.03 | 0.10-0.30 | 0.75 | 100 | 15 |
| E219 | 0.06 | 19.0-21.5 | 5.5-7.0 | 0.75 | - | 8.0-10.0 | 1.00 | 0.04 | 0.03 | 0.10-0.30 | 0.75 | 90 | 15 |
| E240 | 0.06 | 17.0-19.0 | 4.0-6.0 | 0.75 | - | 10.5-13.5 | 1.00 | 0.04 | 0.03 | 0.10-0.30 | 0.75 | 100 | 15 |
| E307 | 0.04-0.14 | 18.0-21.5 | 9.0-10.7 | 0.5-1.5 | - | 3.30-4.75 | 1.00 | 0.04 | 0.03 | - | 0.75 | 85 | 30 |
| E308 | 0.08 | 18.0-21.0 | 9.0-11.0 | 0.75 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 80 | 30 |
| E308H | 0.04-0.08 | 18.0-21.0 | 9.0-11.0 | 0.75 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 80 | 30 |
| E308L | 0.04 | 18.0-21.0 | 9.0-11.0 | 0.75 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 75 | 30 |
| E308Mo | 0.08 | 18.0-21.0 | 9.0-12.0 | 2.0-3.0 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 80 | 30 |
| E308LMo | 0.04 | 18.0-21.0 | 9.0-12.0 | 2.0-3.0 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 75 | 30 |
| E309 | 0.15 | 22.0-25.0 | 12.0-14.0 | 0.75 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 80 | 30 |
| E309H | 0.04-0.15 | 22.0-25.0 | 12.0-14.0 | 0.75 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 80 | 30 |
| E309L | 0.04 | 22.0-25.0 | 12.0-14.0 | 0.75 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 75 | 30 |
| E309Nb | 0.12 | 22.0-25.0 | 12.0-14.0 | 0.75 | 0.70-1.00 | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 80 | 30 |
| E309Mo | 0.12 | 22.0-25.0 | 12.0-14.0 | 2.0-3.0 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 80 | 30 |
| E309LMo | 0.04 | 22.0-25.0 | 12.0-14.0 | 2.0-3.0 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 75 | 30 |
| E310 | 0.08-0.20 | 25.0-28.0 | 20.0-22.5 | 0.75 | - | 1.0-2.5 | 0.75 | 0.03 | 0.03 | - | 0.75 | 80 | 30 |
| E310H | 0.35-0.45 | 25.0-28.0 | 20.0-22.5 | 0.75 | - | 1.0-2.5 | 0.75 | 0.03 | 0.03 | - | 0.75 | 90 | 10 |
| E310Nb | 0.12 | 25.0-28.0 | 20.0-22.0 | 0.75 | 0.70-1.00 | 1.0-2.5 | 0.75 | 0.03 | 0.03 | - | 0.75 | 80 | 25 |
| E310Mo | 0.12 | 25.0-28.0 | 20.0-22.0 | 2.0-3.0 | - | 1.0-2.5 | 0.75 | 0.03 | 0.03 | - | 0.75 | 80 | 30 |
| E312 | 0.15 | 28.0-32.0 | 8.0-10.5 | 0.75 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 95 | 22 |
| E316 | 0.08 | 17.0-20.0 | 11.0-14.0 | 2.0-3.0 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 75 | 30 |
| E316H | 0.04-0.08 | 17.0-20.0 | 11.0-14.0 | 2.0-3.0 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 75 | 30 |
| E316L | 0.04 | 17.0-20.0 | 11.0-14.0 | 2.0-3.0 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 70 | 30 |
| E316LMn | 0.04 | 18.0-21.0 | 15.0-18.0 | 2.5-3.5 | - | 5.0-8.0 | 0.90 | 0.04 | 0.03 | 0.10-0.25 | 0.75 | 80 | 20 |
| E317 | 0.08 | 18.0-21.0 | 12.0-14.0 | 3.0-4.0 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 80 | 30 |
| E317L | 0.04 | 18.0-21.0 | 12.0-14.0 | 3.0-4.0 | - | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 75 | 30 |
| E318 | 0.08 | 17.0-20.0 | 11.0-14.0 | 2.0-3.0 | 6xC-1.00 | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 80 | 25 |
| E320 | 0.07 | 19.0-21.0 | 32.0-36.0 | 2.0-3.0 | 8xC-1.00 | 0.5-2.5 | 0.60 | 0.04 | 0.03 | - | 3.0-4.0 | 80 | 30 |
| E320LR | 0.03 | 19.0-21.0 | 32.0-36.0 | 2.0-3.0 | 8xC-0.40 | 1.50-2.50 | 0.30 | 0.020 | 0.015 | - | 3.0-4.0 | 75 | 30 |
| E330 | 0.18-0.25 | 14.0-17.0 | 33.0-37.0 | 0.75 | - | 1.0-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 75 | 25 |
| E330H | 0.35-0.45 | 14.0-17.0 | 33.0-37.0 | 0.75 | - | 1.0-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 90 | 10 |
| E347 | 0.08 | 18.0-21.0 | 9.0-11.0 | 0.75 | 8xC-1.00 | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 75 | 30 |
| E349 *2 | 0.13 | 18.0-21.0 | 8.0-10.0 | 0.35-0.65 | 0.75-1.20 | 0.5-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | 100 | 25 |
| E383 | 0.03 | 26.5-29.0 | 30.0-33.0 | 3.2-4.2 | - | 0.5-2.5 | 0.90 | 0.02 | 0.02 | - | 0.6-1.5 | 75 | 30 |
| E385 | 0.03 | 19.5-21.5 | 24.0-26.0 | 4.2-5.2 | - | 1.0-2.5 | 0.90 | 0.03 | 0.02 | - | 1.2-2.0 | 75 | 30 |

Note: *1 V: 0.10~0.30; *2 V: 0.10~0.30, Ti: 0.15max, W: 1.25~1.75

(Continued)

| Class. | Chemical composition of all-weld metal (%) ^{(1) (2)} | | | | | | | | | | Mechanical properties of all-weld metal ⁽³⁾ | | |
|----------|---|-------------|---------|-----------|---------------|-----------|------|------|------|-----------|--|---------------------|------|
| | C | Cr | Ni | Mo | Nb(Cb) +Ta | Mn | Si | P | S | Cu | TS, Min (ksi) | El., Min. (%) | PWHT |
| E409Nb | 0.12 | 11.0-14.0 | 0.6 | 0.75 | 0.50-1.50 | 1.0 | 1.00 | 0.04 | 0.03 | 0.75 | 65 | 20 | c |
| E410 | 0.12 | 11.0-13.5 | 0.7 | 0.75 | - | 1.0 | 0.90 | 0.04 | 0.03 | 0.75 | 65 | 20 | a |
| E410NiMo | 0.06 | 11.0-12.5 | 4.0-5.0 | 0.40-0.70 | - | 1.0 | 0.90 | 0.04 | 0.03 | 0.75 | 110 | 15 | b |
| E430 | 0.10 | 15.0-18.0 | 0.6 | 0.75 | - | 1.0 | 0.90 | 0.04 | 0.03 | 0.75 | 65 | 20 | c |
| E430Nb | 0.10 | 15.0-18.0 | 0.6 | 0.75 | 0.50-1.50 | 1.0 | 1.00 | 0.04 | 0.03 | 0.75 | 65 | 20 | c |
| E630 | 0.05 | 16.00-16.75 | 4.5-5.0 | 0.75 | 0.15-0.30 | 0.25-0.75 | 0.75 | 0.04 | 0.03 | 3.25-4.00 | 135 | 7 | d |
| E16-8-2 | 0.10 | 14.5-16.5 | 7.5-9.5 | 1.0-2.0 | - | 0.5-2.5 | 0.60 | 0.03 | 0.03 | 0.75 | 80 | 35 | None |

| Class. | Chemical composition of all-weld metal (%) ^{(1) (2)} | | | | | | | | | | | | Mechanical properties of all-weld metal ⁽³⁾ | | |
|--------|---|-----------|-----------|---------|---------------|---------|------|-------|-------|-----------|---------|-----------------------------------|--|---------------------|------|
| | C | Cr | Ni | Mo | Nb(Cb) +Ta | Mn | Si | P | S | N | Cu | Others | TS, Min (ksi) | El., Min. (%) | PWHT |
| E2209 | 0.04 | 21.5-23.5 | 8.5-10.5 | 2.5-3.5 | - | 0.5-2.0 | 1.00 | 0.04 | 0.03 | 0.08-0.20 | 0.75 | - | 100 | 20 | None |
| E2307 | 0.04 | 22.5-25.5 | 6.5-10.0 | 0.8 | - | 0.4-1.5 | 1.0 | 0.030 | 0.020 | 0.10-0.20 | 0.50 | - | 100 | 20 | None |
| E2553 | 0.06 | 24.0-27.0 | 6.5-8.5 | 2.9-3.9 | - | 0.5-1.5 | 1.0 | 0.04 | 0.03 | 0.10-0.25 | 1.5-2.5 | - | 110 | 15 | None |
| E2593 | 0.04 | 24.0-27.0 | 8.5-10.5 | 2.9-3.9 | - | 0.5-1.5 | 1.00 | 0.04 | 0.03 | 0.08-0.25 | 1.5-3.0 | - | 110 | 15 | None |
| E2594 | 0.04 | 24.0-27.0 | 8.0-10.5 | 3.5-4.5 | - | 0.5-2.0 | 1.00 | 0.04 | 0.03 | 0.20-0.30 | 0.75 | - | 110 | 15 | None |
| E2595 | 0.04 | 24.0-27.0 | 8.0-10.5 | 2.5-4.5 | - | 2.5 | 1.2 | 0.03 | 0.025 | 0.20-0.30 | 0.4-1.5 | W: 0.4-1.0 | 110 | 15 | None |
| E3155 | 0.10 | 20.0-22.5 | 19.0-21.0 | 2.5-3.5 | 0.75- 1.25 | 1.0-2.5 | 1.00 | 0.04 | 0.03 | - | 0.75 | Co: 18.5-21.0 W: 2.0-3.0 | 100 | 20 | None |
| E33-31 | 0.03 | 31.0-35.0 | 30.0-32.0 | 1.0-2.0 | - | 2.5-4.0 | 0.9 | 0.02 | 0.01 | 0.3-0.5 | 0.4-0.8 | - | 105 | 25 | None |

Note: (1) Single values are maximum.

(2) The total of other elements, except iron, shall not present in excess of 0.5%.

(3) All-weld-metal mechanical properties are obtained after the following PWHT:

- Heat to 1350 to 1400°F (730 to 760°C), hold for one hour, furnace cool at a rate not to exceeding 200°F (110°C) per hour to 600°F (315°C) and air cool to ambient.
- Heat to 1100 to 1150°F (595 to 620°C), hold for one hour, and air cool to ambient.
- Heat to 1400 to 1450°F (760 to 790°C), hold for two hours, furnace cool at a rate not exceeding 100°F (55°C) per hour to 1100°F (595°C) and air cool to ambient.
- Heat to 1875 to 1925°F (1025 to 1050°C), hold for one hour, and air cool to ambient, and then precipitation harden at 1135 to 1165°F (610 to 630°C), hold for four hours, and air cool to ambient.

②: Type of current and welding position

| Classification suffix | Type of current | Welding position |
|-----------------------|-----------------|------------------|
| -15 | DCEP | All |
| -16 | DCEP and AC | All |
| -17 | DCEP and AC | All |
| -26 | DCEP and AC | F, H-Fil |

Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding

Classification system

E ① [Ex.] E NiCu-7

E: Stick electrodes

①: Chemical composition of all-weld metal

| Class. | Wt % ⁽¹⁾ | | | | | | | | | | | | | | | |
|---------------------------|---------------------|---------|-----------|-------|-------|---------|---------|-------------------|----------------|---------|-----------|-----------|------------------------|-----------|------|---------|
| | C | Mn | Fe | P | S | Si | Cu | Ni ⁽²⁾ | Co | Al | Ti | Cr | Nb(Cb) +Ta | Mo | V | W |
| ENi-1 | 0.10 | 0.75 | 0.75 | 0.03 | 0.02 | 1.25 | 0.25 | ≥92.0 | - | 1.0 | 1.0-4.0 | - | - | - | - | - |
| ENiCr-4 | 0.10 | 1.5 | 1.0 | 0.02 | 0.02 | 1.0 | 0.25 | Bal | - | - | - | 48.0-52.0 | 1.0-2.5 | - | - | - |
| ENiCu-7 | 0.15 | 4.0 | 2.5 | 0.02 | 0.015 | 1.5 | Bal | 62.0-69.0 | - | 0.75 | 1.0 | - | - | - | - | - |
| ENiCrFe-1 | 0.08 | 3.5 | 11.0 | 0.03 | 0.015 | 0.75 | 0.50 | ≥62.0 | - | - | - | 13.0-17.0 | 1.5-4.0 ⁽⁴⁾ | - | - | - |
| ENiCrFe-2 | 0.10 | 1.0-3.5 | 12.0 | 0.03 | 0.02 | 0.75 | 0.50 | ≥62.0 | ⁽³⁾ | - | - | 13.0-17.0 | 0.5-3.0 ⁽⁴⁾ | 0.5-2.5 | - | - |
| ENiCrFe-3 | 0.10 | 5.0-9.5 | 10.00 | 0.03 | 0.015 | 1.0 | 0.50 | ≥59.0 | ⁽³⁾ | - | 1.0 | 13.0-17.0 | 1.0-2.5 ⁽⁴⁾ | - | - | - |
| ENiCrFe-4 | 0.20 | 1.0-3.5 | 12.00 | 0.03 | 0.02 | 1.0 | 0.50 | ≥60.0 | - | - | - | 13.0-17.0 | 1.0-3.5 | 1.0-3.5 | - | - |
| ENiCrFe-7 ⁽⁵⁾ | 0.05 | 5.0 | 7.0-12.0 | 0.03 | 0.015 | 0.75 | 0.50 | Bal | ⁽³⁾ | 0.50 | 0.50 | 28.0-31.5 | 1.0-2.5 | 0.5 | - | - |
| ENiCrFe-9 | 0.15 | 1.0-4.5 | 12.00 | 0.02 | 0.015 | 0.75 | 0.50 | ≥55.0 | - | - | - | 12.0-17.0 | 0.5-3.0 | 2.5-5.5 | - | 1.5 |
| ENiCrFe-10 | 0.20 | 1.0-3.5 | 12.00 | 0.02 | 0.015 | 0.75 | 0.50 | ≥55.0 | - | - | - | 13.0-17.0 | 1.0-3.5 | 1.0-3.5 | - | 1.5-3.5 |
| ENiCrFe-12 | 0.10-0.25 | 1.0 | 8.0-11.0 | 0.04 | 0.02 | 1.0 | 0.20 | Bal | 1.0 | 1.5-2.2 | 0.10-0.40 | 24.0-26.0 | - | - | - | - |
| ENiCrFe-13 ⁽⁷⁾ | 0.05 | 1.0 | Bal | 0.020 | 0.015 | 0.75 | 0.30 | 52.0-62.0 | 0.10 | 0.50 | 0.50 | 28.5-31.0 | 2.1-4.0 | 3.0-5.0 | - | - |
| ENiCrFeSi-1 | 0.05-0.20 | 2.5 | 21.0-25.0 | 0.04 | 0.03 | 2.5-3.0 | 0.30 | Bal | 1.0 | 0.30 | - | 26.0-29.0 | - | - | - | - |
| ENiMo-1 | 0.07 | 1.0 | 4.0-7.0 | 0.04 | 0.03 | 1.0 | 0.50 | Bal | 2.5 | - | - | 1.0 | - | 26.0-30.0 | 0.60 | 1.0 |
| ENiMo-3 | 0.12 | 1.0 | 4.0-7.0 | 0.04 | 0.03 | 1.0 | 0.50 | Bal | 2.5 | - | - | 2.5-5.5 | - | 23.0-27.0 | 0.60 | 1.0 |
| ENiMo-7 | 0.02 | 1.75 | 2.25 | 0.04 | 0.03 | 0.2 | 0.50 | Bal | 1.0 | - | - | 1.0 | - | 26.0-30.0 | - | 1.0 |
| ENiMo-8 | 0.10 | 1.5 | 10.0 | 0.02 | 0.015 | 0.75 | 0.50 | ≥60.0 | - | - | - | 0.5-3.5 | - | 17.0-20.0 | - | 2.0-4.0 |
| ENiMo-9 | 0.10 | 1.5 | 7.0 | 0.02 | 0.015 | 0.75 | 0.3-1.3 | ≥62.0 | - | - | - | - | - | 18.0-22.0 | - | 2.0-4.0 |
| ENiMo-10 | 0.02 | 2.0 | 1.0-3.0 | 0.04 | 0.03 | 0.2 | 0.50 | Bal | 3.0 | - | - | 1.0-3.0 | - | 27.0-32.0 | - | 3.0 |
| ENiMo-11 | 0.02 | 2.5 | 2.0-5.0 | 0.04 | 0.03 | 0.2 | 0.5 | Bal | 1.0 | 0.1-0.5 | 0.3 | 0.5-1.5 | 0.5 | 26.0-30.0 | - | - |
| ENiCrMo-1 | 0.05 | 1.0-2.0 | 18.0-21.0 | 0.04 | 0.03 | 1.0 | 1.5-2.5 | Bal | 2.5 | - | - | 21.0-23.5 | 1.75-2.50 | 5.5-7.5 | - | 1.0 |

(Continued)

| Class. | Wt % ⁽¹⁾ | | | | | | | | | | | | | | | |
|---------------------------|---------------------|---------|-----------|-------|-------|-----------|---------|-------------------|----------------|------|------|-------------|---------------|-----------|------|-----------|
| | C | Mn | Fe | P | S | Si | Cu | Ni ⁽²⁾ | Co | Al | Ti | Cr | Nb(Cb) +Ta | Mo | V | W |
| ENiCrMo-2 | 0.05-0.15 | 1.0 | 17.0-20.0 | 0.04 | 0.03 | 1.0 | 0.50 | Bal | 0.50-2.50 | - | - | 20.5-23.0 | - | 8.0-10.0 | - | 0.2-1.0 |
| ENiCrMo-3 | 0.10 | 1.0 | 7.0 | 0.03 | 0.02 | 0.75 | 0.50 | ≥55.0 | ⁽³⁾ | - | - | 20.0-23.0 | 3.15-4.15 | 8.0-10.0 | - | - |
| ENiCrMo-4 | 0.02 | 1.0 | 4.0-7.0 | 0.04 | 0.03 | 0.2 | 0.50 | Bal | 2.5 | - | - | 14.5-16.5 | - | 15.0-17.0 | 0.35 | 3.0-4.5 |
| ENiCrMo-5 | 0.10 | 1.0 | 4.0-7.0 | 0.04 | 0.03 | 1.0 | 0.50 | Bal | 2.5 | - | - | 14.5-16.5 | - | 15.0-17.0 | 0.35 | 3.0-4.5 |
| ENiCrMo-6 | 0.10 | 2.0-4.0 | 10.0 | 0.03 | 0.02 | 1.0 | 0.50 | ≥55.0 | - | - | - | 12.0-17.0 | 0.5-2.0 | 5.0-9.0 | - | 1.0-2.0 |
| ENiCrMo-7 | 0.015 | 1.5 | 3.0 | 0.04 | 0.03 | 0.2 | 0.50 | Bal | 2.0 | - | 0.70 | 14.0-18.0 | - | 14.0-17.0 | - | 0.5 |
| ENiCrMo-9 | 0.02 | 1.0 | 18.0-21.0 | 0.04 | 0.03 | 1.0 | 1.5-2.5 | Bal | 5.0 | - | - | 21.0-23.5 | 0.5 | 6.0-8.0 | - | 1.5 |
| ENiCrMo-10 | 0.02 | 1.0 | 2.0-6.0 | 0.03 | 0.015 | 0.2 | 0.50 | Bal | 2.5 | - | - | 20.0-22.5 | - | 12.5-14.5 | 0.35 | 2.5-3.5 |
| ENiCrMo-11 | 0.03 | 1.5 | 13.0-17.0 | 0.04 | 0.02 | 1.0 | 1.0-2.4 | Bal | 5.0 | - | - | 28.0-31.5 | 0.3-1.5 | 4.0-6.0 | - | 1.5-4.0 |
| ENiCrMo-12 | 0.03 | 2.2 | 5.0 | 0.03 | 0.02 | 0.7 | 0.50 | Bal | - | - | - | 20.5-22.5 | 1.0-2.8 | 8.8-10.0 | - | - |
| ENiCrMo-13 | 0.02 | 1.0 | 1.5 | 0.015 | 0.01 | 0.2 | 0.50 | Bal | - | - | - | 22.0-24.0 | - | 15.0-16.5 | - | - |
| ENiCrMo-14 | 0.02 | 1.0 | 5.0 | 0.02 | 0.02 | 0.25 | 0.50 | Bal | - | - | 0.25 | 19.0-23.0 | - | 15.0-17.0 | - | 3.0-4.4 |
| ENiCrMo-17 | 0.020 | 0.5 | 3.0 | 0.030 | 0.015 | 0.2 | 1.3-1.9 | Bal | 2.0 | - | - | 22.0-24.0 | - | 15.0-17.0 | - | - |
| ENiCrMo-18 | 0.03 | 0.7 | 12.0-15.0 | 0.03 | 0.02 | 0.6 | 0.3 | Bal | 1.0 | 0.5 | - | 19.0-22.0 | 0.3 | 10.0-13.0 | 0.15 | 1.0-2.0 |
| ENiCrMo-19 ⁽⁶⁾ | 0.02 | 1.5 | 1.5 | 0.03 | 0.02 | 0.2 | 0.5 | Bal | 0.3 | 0.4 | - | 20.0-23.0 | - | 19.0-21.0 | - | 0.3 |
| ENiCrMo-22 | 0.05 | 0.50 | 2.00 | 0.030 | 0.015 | 0.60 | 0.30 | Bal | 1.00 | 0.40 | 0.20 | 32.25-34.25 | 0.50 | 7.0-9.0 | 0.20 | 0.60 |
| ENiCrCoMo-1 | 0.05-0.15 | 0.3-2.5 | 5.0 | 0.03 | 0.015 | 0.75 | 0.50 | Bal | 9.0-15.0 | - | - | 21.0-26.0 | 1.0 | 8.0-10.0 | - | - |
| ENiCrWMo-1 | 0.05-0.10 | 0.3-1.0 | 3.0 | 0.02 | 0.015 | 0.25-0.75 | 0.50 | Bal | 5.0 | 0.50 | 0.10 | 20.0-24.0 | - | 1.0-3.0 | - | 13.0-15.0 |

Note: (1) Single values are maximum. The total of other elements shall not be in excess of 0.50%.

(2) Includes incidental cobalt.

(3) Cobalt—0.12 maximum, when specified by the purchaser.

(4) Tantalum—0.30 maximum, when specified by the purchaser.

(5) Boron is 0.005% maximum and Zr is 0.020% maximum when specified by the purchaser.

(6) N = 0.02-0.15%.

(7) Bis 0.003% max. and Zr is 0.020% max.

AWS A5.15-2006

Welding Electrodes and Rods for Cast Iron

Classification system

E ① [Ex.] E NiFe-CI

E: Electrodes for SMAW or FCAW

①: Chemical composition requirements

| Classification | Chemical composition (%) ⁽¹⁾ | | | | | | | | | | |
|---------------------------|---|---------|------|------|-------|---------|-------------------|----|-------------------|---------|--------|
| | C | Mn | Si | P | S | Fe | Ni ⁽²⁾ | Mo | Cu ⁽³⁾ | Al | Others |
| All-weld metal | | | | | | | | | | | |
| ENi-CI | 2.0 | 2.5 | 4.0 | - | 0.03 | 8.0 | ≥85 | - | 2.5 | 1.0 | 1.0 |
| ENi-CI-A | 2.0 | 2.5 | 4.0 | - | 0.03 | 8.0 | ≥85 | - | 2.5 | 1.0-3.0 | 1.0 |
| ENiFe-CI | 2.0 | 2.5 | 4.0 | - | 0.03 | Bal | 45-60 | - | 2.5 | 1.0 | 1.0 |
| ENiFe-CI-A | 2.0 | 2.5 | 4.0 | - | 0.03 | Bal | 45-60 | - | 2.5 | 1.0-3.0 | 1.0 |
| ENiFeMn-CI | 2.0 | 10-14 | 1.0 | - | 0.03 | Bal | 35-45 | - | 2.5 | 1.0 | 1.0 |
| ENiCu-A | 0.35-0.55 | 2.3 | 0.75 | - | 0.025 | 3.0-6.0 | 50-60 | - | 35-45 | - | 1.0 |
| ENiCu-B | 0.35-0.55 | 2.3 | 0.75 | - | 0.025 | 3.0-6.0 | 60-70 | - | 25-35 | - | 1.0 |
| ENiFeT3-CI ⁽⁴⁾ | 2.0 | 3.0-5.0 | 1.0 | - | 0.03 | Bal | 45-60 | - | 2.5 | 1.0 | 1.0 |
| Core wire | | | | | | | | | | | |
| ESt | 0.15 | 0.60 | 0.15 | 0.04 | 0.04 | Bal | - | - | - | - | - |

Note : (1) Single values are maximum.

(2) Nickel plus incidental cobalt.

(3) Copper plus incidental silver.

(4) No shielding gas shall be used for ENiFeT3-CI.

AWS A5.17-2007, A5.23-2011

A5.17: Carbon Steel Electrodes and Fluxes for Submerged Arc Welding A5.23: Low Alloy Steel Electrodes and Fluxes for Submerged Arc Welding

F ① ② ③ – ④ ⑤ – ⑥ [Ex.] F 6 A 0 – E H14
F 9 A2 – EC M1 – M1

F: Submerged arc welding flux

①: Tension test requirements of all-weld metal⁽¹⁾

| A5.17 A5.23 Code | TS (ksi) | YS (ksi) | El., Min. (%) |
|------------------------|-------------|-------------|------------------|
| 6 | 60-80 | 48 | 22 |
| 7 | 70-95 | 58 | 22 |
| 8 | 80-100 | 68 | 20 |
| 9 | 90-110 | 78 | 17 |
| 10 | 100-120 | 88 | 16 |
| 11 | 110-130 | 98 | 15 |
| 12 | 120-140 | 108 | 14 |
| 13 | 130-150 | 118 | 14 |

③: Impact test requirements⁽¹⁾

| A5.17 A5.23 Code | Temp. (°F) | IV, Min. (ft-lbf) |
|------------------------|---------------|----------------------|
| Z | - | None |
| 0 | 0 | Av. 20 Each 15 |
| 2 | -20 | |
| 4 | -40 | |
| 5 | -50 | |
| 6 | -60 | |
| 8 | -80 | |
| 10 | -100 | |
| 15 | -150 | |

Note (1) PWHT is specified depending on classification for tension and impact testing.

②: Heat treatment

| Code | Designation |
|------|-------------|
| A | As-welded |
| P | PWHT |

④: Type of electrode

| Code | Designation |
|------|-------------|
| E | Solid |
| EC | Composite |

⑤: Chemical composition of wire

| Code | Type | Code | Type | Code | Type |
|---|-----------|--|---------------|--|----------------|
| L8 L8K L12 | Low Mn | A1 A2 A3 A3K A4 | Mo | Ni1 Ni1K Ni2 Ni3 Ni4 Ni5 Ni6 | Ni |
| M11K M12 M12K M13K M14K M15K | Medium Mn | B1 B2 B2H B3 B5 B6 B6H B8 | Cr-Mo | F1 F2 F3 F4 F5 F6 | Other alloying |
| H10K H11K H12K H14 | High Mn | | | M1 M2 M3 M4 M5 M6 W G | |
| G | | | Not Specified | | |

⑥: Chemical composition of weld metal

| Code | Type | Code | Type |
|--|-------|--|----------------|
| A1 A2 A3 A4 | Mo | Ni1 Ni2 Ni3 Ni4 Ni5 | Ni |
| B1 B2 B2H B3 B4 B5 B6 B6H B8 | Cr-Mo | F1 F2 F3 F4 F5 F6 M1 M2 M3 M4 M5 M6 W G | Other alloying |

AWS A5.18-2005, A5.28-2005

A5.18: Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding A5.28: Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding

Classification system

ER (or E) ① ② – ③ ④ ⑤

A5.18: [Ex.] ER 70 S – 2, E 70 C – 3 M, E 70 C – 3 M H16

A5.28: ER 80 S – B2, E 80 C – B2 H16

ER: Electrode or rod

E: Electrode

①: All-weld metal tensile strength and related requirements ⁽¹⁾

| Code | TS, Min. (ksi) | El., Min. (%) | IV, ⁽²⁾ Min. (ft-lb) |
|------|---------------------|---|---|
| 70 | 70 75 (A5.28) | 14-24 according to classification | Average 20 Each 15 at specific temperature |
| 80 | 80 | | |
| 90 | 90 | | |
| 100 | 100 | | |
| 110 | 110 | | |
| 120 | 120 | | |

Note (1) PWHT is specified depending on classification.

(2) Not required for Mo and Cr-Mo type filler wires.

③: Chemical composition of wire or all-weld metal (A 5.18)

| Class. | Suffix | Shielding gas | Type |
|---------|-------------------|--|--------------|
| ER 70 S | 2 | CO ₂ | Carbon steel |
| ER 70 S | 3 | | |
| ER 70 S | 4 | | |
| ER 70 S | 6 | | |
| ER 70 S | 7 | | |
| ER 70 S | G | ⁽²⁾ | |
| E 70 C | 3 | 75-80%Ar/ bal.CO ₂ or CO ₂ | |
| E 70 C | 6 | | |
| E 70 C | G | ⁽²⁾ | |
| E 70 C | GS ⁽¹⁾ | | |

Note : (1) For single pass

(2) As agreed upon between purchaser and supplier

②: Type of electrode

| Code | Designation |
|------|-------------|
| S | Solid |
| C | Composite |

④: Type of shielding gas (A 5.18)

| Code | Designation |
|------|--------------------------|
| C | CO ₂ |
| M | Ar-20-25%CO ₂ |

⑤: Diffusible hydrogen (Option) (A 5.18)

| Code | ml/100g deposited metal |
|------|-------------------------|
| H16 | 16.0max. |
| H8 | 8.0max. |
| H4 | 4.0max. |

③: Chemical composition of wire or all-weld metal (A 5.28)

| Class. | Suffix | Shielding gas | Type of steel |
|---|---|-----------------------|------------------------------|
| ER 70 S | A1 | Ar/1-5%O ₂ | C-0.5Mo |
| E 90 C | D2 | Ar/1-5%O ₂ | 1.5Mn-0.5Mo |
| ER 80 S ER 70 S E 70 C E 80 C | B2 B2L B2L B2 | Ar/1-5%O ₂ | 1.25Cr-0.5Mo |
| ER 90 S ER 80 S E 80 C E 90 C | B3 B3L B3L B3 | Ar/1-5%O ₂ | 2.25Cr-1Mo |
| ER 80 S E 80 C | B6 | Ar/1-5%O ₂ | 5Cr-0.5Mo |
| ER 80 S E 80 C | B8 | Ar/1-5%O ₂ | 9Cr-1Mo |
| ER 90 S E 90 C | B9 | Ar/5%O ₂ | 9Cr-1Mo-0.2V |
| ER 80 S E 80 C ER 80 S E 70 C E 80 C ER 80 S E 80 C | Ni1 Ni1 Ni2 Ni2 Ni2 Ni3 Ni3 | Ar/1-5%O ₂ | Ni |
| ER 80 S | D2 | CO ₂ | Mn-Mo |
| ER 90 S E 90 C | D2 | Ar/1-5%O ₂ | |
| ER 100 S ER 110 S ER 120 S | 1 1 1 | Ar/2%O ₂ | Other low alloy |
| ER xx S E xx C | G ⁽¹⁾ | ⁽¹⁾ | Not specified ⁽²⁾ |

④: Diffusible hydrogen (Option) (A 5.28)

| Additional Designation | ml/100g deposited metal |
|------------------------|-------------------------|
| H16 | 16.0max. |
| H8 | 8.0max. |
| H4 | 4.0max. |
| H2 | 2.0max. |

Note: (1) As agreed upon between purchaser and supplier.

AWS A5.20-2005, A5.29-2010

A5.20: Carbon Steel Electrodes for Flux Cored Arc Welding A5.29: Low Alloy Electrodes for Flux Cored Arc Welding

Classification system

A 5.20 : E ① ② T - ③ ④ - J HZ [Ex.] E 7 1 T - 1 M - J H8

A 5.29 : E ① ② T - ③ - ⑤ ④ - J HZ [Ex.] E 8 1 T 1 - B2 M - J H8

E: Electrodes

①: All-weld metal tensile strength and related requirements⁽¹⁾

| Code | TS (ksi) | IV, Min. (ft-lbf) |
|------|----------|---|
| 6 | 60-80 | Average 20 Each 15 at specific temperature |
| 7 | 70-90 | |
| 8 | 80-100 | |
| 9 | 90-110 | |
| 10 | 100-120 | |
| 11 | 110-130 | |
| 12 | 120-140 | |

Note: (1) PWHT is required depending on classification

②: Welding position ④: Shielding gas

| Code | Designation | Suffix | Designation |
|------|---------------|--------|-----------------|
| 0 | F, H-Fil | M | 75-80%Ar/Bal. |
| 1 | All positions | C | CO ₂ |
| | | None | Self-shield |

⑤: Chemical composition of all-weld metal (A 5.29)

| Suffix | Type | Suffix | Type |
|--------|-------|-----------------|-------|
| A1 | C-Mo | Ni1 | Ni |
| B1 | Cr-Mo | Ni2 | |
| B1L | | Ni3 | |
| B2 | | D1 | Mn-Mo |
| B2L | | D2 | |
| B2L | | D3 | |
| B2H | | Other low-alloy | K1 |
| B3 | | | K2 |
| B3L | | | K3 |
| B3H | | | K4 |
| B6 | | | K5 |
| B6L | K6 | | |
| B6L | K7 | | |
| B8 | K8 | | |
| B8L | K9 | | |
| B9 | W2 | | |
| | G | | |

T: Flux-cored electrodes

③: Usability designator

| Suffix ⁽¹⁾ | Performances (Polarity, Application) |
|-----------------------|---|
| 1 | MAG, Fillet welding (Multi-pass) |
| 2 | MAG, Fillet welding (Single pass) |
| 3 | Self-shielded, DC-EP, High welding speed |
| 4 | Self-shielded, DC-EP, High deposition rate |
| 5 | MAG, High impact value, Good crack resistance |
| 6 | Self-shielded, DC-EP, High impact value |
| 7 | Self-shielded, DC-EN, High deposition rate |
| 8 | Self-shielded, DC-EN, High deposition rate |
| 9 | MAG, DC-EP, Small size: for all positions |
| 10 | Self-shielded, DC-EN, High welding speed |
| 11 | Self-shielded, DC-EN, Good usability |
| 12 | MAG, DC-EP, High impact value |
| 13 | Self-shielded, DC-EN, Root pass welding of pipes |
| 14 | Self-shielded, DC-EN, All positions, High welding speed |
| G | Not specified, For multiple-pass welding |
| GS | Not specified, For single-pass welding |

Note: (1) A 5.29 designates 1, 4, 5, 6, 7, 8, 11 or G only.

[Option]

J : Satisfies the minimum impact value 27J at -40°C (A5.20) or at a test temperature of 11°C lower (A5.29) than the specified temperature

HZ : Diffusible hydrogen

| Suffix | Diffusible hydrogen, ml/100g deposited metal |
|---------------------|--|
| H16 | 16.0max. |
| H8 | 8.0max. |
| H4 | 4.0max. |
| None ⁽¹⁾ | 8.0max. |

Note (1) A 5.29 only

AWS A5.26-1997

Carbon and Low Alloy Steel Electrodes for Electrogas Welding

Classification system

EG ① ② ③

[Ex.] EG 6 0 T (or S) 1

EG: Electrogas welding electrodes

T: Cored electrodes

S: Solid electrodes

①: Tensile strength of all-weld metal

| Code | TS (ksi) |
|------|----------|
| 6 | 60-80 |
| 7 | 70-95 |
| 8 | 80-100 |

②: Impact value of all-weld metal

| Code | Temp. (°F) | (ft-lbf) |
|------|---------------|----------|
| Z | Not specified | |
| 0 | 0 | 20 |
| 2 | -20 | 20 |

③: Chemical composition

| Class | Suffix | Chemical composition of solid wire (%) ⁽¹⁾ | | | | | | | | | | | |
|-------|--------|---|-----------|-------|-------|-----------|------|-----------|------|-----------|-----------|-----------|--------|
| | | C | Mn | S | P | Si | Ni | Mo | Cu | Ti | Zr | Al | Others |
| EGXXS | 1 | 0.07-0.19 | 0.90-1.40 | 0.035 | 0.025 | 0.30-0.50 | - | - | 0.35 | - | - | - | 0.50 |
| | 2 | 0.07 | 0.90-1.40 | 0.035 | 0.025 | 0.40-0.70 | - | - | 0.35 | 0.05-0.15 | 0.02-0.12 | 0.05-0.15 | 0.50 |
| | 3 | 0.06-0.15 | 0.90-1.40 | 0.035 | 0.025 | 0.45-0.75 | - | - | 0.35 | - | - | - | 0.50 |
| | 5 | 0.07-0.19 | 0.90-1.40 | 0.035 | 0.025 | 0.30-0.60 | - | - | 0.35 | - | - | 0.50-0.90 | 0.50 |
| | 6 | 0.06-0.15 | 1.40-1.85 | 0.035 | 0.025 | 0.80-1.15 | - | - | 0.35 | - | - | - | 0.50 |
| | D2 | 0.07-0.12 | 1.60-2.10 | 0.035 | 0.025 | 0.50-0.80 | 0.15 | 0.40-0.60 | 0.35 | - | - | - | 0.50 |
| | G | Not specified | | | | | | | | | | | |

Note : (1) Single values are maximum.

| Class. | Suffix | Shielding gas | Chemical composition of all-weld metal (%) ⁽¹⁾ | | | | | | | | | | |
|--------|--------|---------------------------------------|---|----------|------|------|-----------|-----------|-----------|-----------|-----------|------|--------|
| | | | C | Mn | P | S | Si | Ni | Cr | Mo | Cu | V | Others |
| EG6XT | 1 | None | ⁽²⁾ | 1.7 | 0.03 | 0.03 | 0.50 | 0.30 | 0.20 | 0.35 | 0.35 | 0.08 | 0.50 |
| EG7XT | 1 | None | ⁽²⁾ | 1.7 | 0.03 | 0.03 | 0.50 | 0.30 | 0.20 | 0.35 | 0.35 | 0.08 | 0.50 |
| EG8XT | 1 | None | ⁽²⁾ | 1.8 | 0.03 | 0.03 | 0.90 | 0.30 | 0.20 | 0.25-0.65 | 0.35 | 0.08 | 0.50 |
| EG6XT | 2 | CO ₂ | ⁽²⁾ | 2.0 | 0.03 | 0.03 | 0.90 | 0.30 | 0.20 | 0.35 | 0.35 | 0.08 | 0.50 |
| EG7XT | 2 | CO ₂ | ⁽²⁾ | 2.0 | 0.03 | 0.03 | 0.90 | 0.30 | 0.20 | 0.35 | 0.35 | 0.08 | 0.50 |
| EGXXT | Ni1 | CO ₂ | 0.10 | 1.0-1.8 | 0.03 | 0.03 | 0.50 | 0.70-1.10 | - | 0.30 | 0.35 | - | 0.50 |
| EGXXT | NM1 | Ar-CO ₂ or CO ₂ | 0.12 | 1.0-2.0 | 0.02 | 0.03 | 0.15-0.50 | 1.5-2.0 | 0.20 | 0.40-0.65 | 0.35 | 0.05 | 0.50 |
| EGXXT | NM2 | CO ₂ | 0.12 | 1.1-2.1 | 0.03 | 0.03 | 0.20-0.60 | 1.1-2.0 | 0.20 | 0.10-0.35 | 0.35 | 0.05 | 0.50 |
| EGXXT | W | CO ₂ | 0.12 | 0.50-1.3 | 0.03 | 0.03 | 0.30-0.80 | 0.40-0.80 | 0.45-0.70 | - | 0.30-0.75 | - | 0.50 |
| EGXXT | G | Not specified | | | | | | | | | | | |

Note : (1) Single values are maximum.

(2) Composition range of carbon not specified for these classifications, but the amount shall be determined and reported.

AWS A5.22-2012

Stainless Steel Flux Cored and Metal Cored Welding Electrodes and Rods

Classification system

E ① T ② - ③ [Ex.] E 308L T 1 - 1
 R ① T ② - ③ [Ex.] R 308L T 1 - 5
 EC ① [Ex.] EC308L

E: Welding electrodes

R: Welding rods

EC: Metal cored electrodes

T: Flux-core electrodes or rods

①: All weld metal composition and related requirements (See A5.22 for self-shielded wires)

| Class. | Chemical composition (%) ^{(1) (2)} | | | | | | | | | | Mechanical properties (As-welded) | |
|-----------|---|-----------|-----------|---------|-----------|-----------|-----------|------|------|------|-----------------------------------|---------------|
| | C | Cr | Ni | Mo | Nb+Ta | Mn | Si | P | S | Cu | TS, Min (ksi) | El., Min. (%) |
| E307 | 0.13 | 18.0-20.5 | 9.0-10.5 | 0.5-1.5 | - | 3.30-4.75 | 1.0 | 0.04 | 0.03 | 0.75 | 85 | 30 |
| E308 | 0.08 | 18.0-21.0 | 9.0-11.0 | 0.75 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 80 | 30 |
| E308H | 0.04-0.08 | 18.0-21.0 | 9.0-11.0 | 0.75 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 80 | 30 |
| E308L | 0.04 | 18.0-21.0 | 9.0-11.0 | 0.75 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| E308Mo | 0.08 | 18.0-21.0 | 9.0-11.0 | 2.0-3.0 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 80 | 30 |
| E308LMo | 0.04 | 18.0-21.0 | 9.0-12.0 | 2.0-3.0 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| E309 | 0.10 | 22.0-25.0 | 12.0-14.0 | 0.75 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 80 | 30 |
| E309H | 0.04-0.10 | 22.0-25.0 | 12.0-14.0 | 0.75 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 80 | 30 |
| E309L | 0.04 | 22.0-25.0 | 12.0-14.0 | 0.75 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| E309Mo | 0.12 | 21.0-25.0 | 12.0-16.0 | 2.0-3.0 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 80 | 25 |
| E309LMo | 0.04 | 21.0-25.0 | 12.0-16.0 | 2.0-3.0 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 25 |
| E309LNiMo | 0.04 | 20.5-23.5 | 15.0-17.0 | 2.5-3.5 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 25 |
| E309LNb | 0.04 | 22.0-25.0 | 12.0-14.0 | 0.75 | 0.70-1.00 | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| E310 | 0.20 | 25.0-28.0 | 20.0-22.5 | 0.75 | - | 1.0-2.5 | 1.0 | 0.03 | 0.03 | 0.75 | 80 | 30 |
| E312 | 0.15 | 28.0-32.0 | 8.0-10.5 | 0.75 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 95 | 22 |
| E316 | 0.08 | 17.0-20.0 | 11.0-14.0 | 2.0-3.0 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| E316H | 0.04-0.08 | 17.0-20.0 | 11.0-14.0 | 2.0-3.0 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| E316L | 0.04 | 17.0-20.0 | 11.0-14.0 | 2.0-3.0 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 70 | 30 |
| E317L | 0.04 | 18.0-21.0 | 12.0-14.0 | 3.0-4.0 | - | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 20 |
| E347 | 0.08 | 18.0-21.0 | 9.0-11.0 | 0.75 | 8xC-1.0 | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| E347H | 0.04-0.08 | 18.0-21.0 | 9.0-11.0 | 0.75 | 8xC-1.0 | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| R308L | 0.03 | 18.0-21.0 | 9.0-11.0 | 0.75 | - | 0.5-2.5 | 1.2 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| R309L | 0.03 | 22.0-25.0 | 12.0-14.0 | 0.75 | - | 0.5-2.5 | 1.2 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| R316L | 0.03 | 17.0-20.0 | 11.0-14.0 | 2.0-3.0 | - | 0.5-2.5 | 1.2 | 0.04 | 0.03 | 0.75 | 70 | 30 |
| R347 | 0.08 | 18.0-21.0 | 9.0-11.0 | 0.75 | 8xC-1.0 | 0.5-2.5 | 1.2 | 0.04 | 0.03 | 0.75 | 75 | 30 |
| EC308L | 0.03 | 19.5-22.0 | 9.0-11.0 | 0.75 | - | 1.0-2.5 | 0.30-0.65 | 0.03 | 0.03 | 0.75 | - | - |
| EC309L | 0.03 | 23.0-25.0 | 12.0-14.0 | 0.75 | - | 1.0-2.5 | 0.30-0.65 | 0.03 | 0.03 | 0.75 | - | - |
| EC316L | 0.03 | 18.0-20.0 | 11.0-14.0 | 2.0-3.0 | - | 1.0-2.5 | 0.30-0.65 | 0.03 | 0.03 | 0.75 | - | - |
| EC309LMo | 0.03 | 23.0-25.0 | 12.0-14.0 | 2.0-3.0 | - | 1.0-2.5 | 0.30-0.65 | 0.03 | 0.03 | 0.75 | - | - |

(Continued)

| Class. | Chemical composition (%) ^{(1) (2)} | | | | | | | | | | Mechanical properties ⁽³⁾ | | |
|----------|---|-----------|---------|-----------|---------|------|-----|------|------|------|--------------------------------------|---------------|------|
| | C | Cr | Ni | Mo | Nb+Ta | Mn | Si | P | S | Cu | TS, Min (ksi) | El., Min. (%) | PWHT |
| E409 | 0.10 | 10.5-13.5 | 0.60 | 0.75 | - | 0.80 | 1.0 | 0.04 | 0.03 | 0.75 | 65 | 15 | None |
| E409Nb | 0.10 | 10.5-13.5 | 0.6 | 1.2 | 8XC-1.5 | 0.80 | 1.0 | 0.04 | 0.03 | 0.5 | 65 | 15 | (c) |
| E410 | 0.12 | 11.0-13.5 | 0.60 | 0.75 | - | 1.2 | 1.0 | 0.04 | 0.03 | 0.75 | 75 | 20 | (a) |
| E410NiMo | 0.06 | 11.0-12.5 | 4.0-5.0 | 0.40-0.70 | - | 1.0 | 1.0 | 0.04 | 0.03 | 0.75 | 110 | 15 | (b) |
| E430 | 0.10 | 15.0-18.0 | 0.60 | 0.75 | - | 1.2 | 1.0 | 0.04 | 0.03 | 0.75 | 65 | 20 | (c) |
| E430Nb | 0.10 | 15.0-18.0 | 0.6 | 0.5 | 0.5-1.5 | 1.2 | 1.0 | 0.04 | 0.03 | 0.5 | 65 | 13 | (c) |

(Continued)

| Class. | Chemical composition (%) ^{(1) (2)} | | | | | | | | | | | Mechanical properties ⁽³⁾ | | |
|--------|---|-----------|----------|---------|---------|------|------|------|-----------|---------|-----|--------------------------------------|---------------|------|
| | C | Cr | Ni | Mo | Mn | Si | P | S | N | Cu | W | TS, Min (ksi) | El., Min. (%) | PWHT |
| E2209 | 0.04 | 21.0-24.0 | 7.5-10.0 | 2.5-4.0 | 0.5-2.0 | 1.0 | 0.04 | 0.03 | 0.08-0.20 | 0.5 | - | 100 | 20 | None |
| E2307 | 0.04 | 22.5-25.5 | 6.5-10.0 | 0.8 | 2.0 | 1.0 | 0.03 | 0.02 | 0.10-0.20 | 0.50 | - | 100 | 20 | None |
| E2553 | 0.04 | 24.0-27.0 | 8.5-10.5 | 2.9-3.9 | 0.5-1.5 | 0.75 | 0.04 | 0.03 | 0.10-0.25 | 1.5-2.5 | - | 110 | 15 | None |
| E2594 | 0.04 | 24.0-27.0 | 8.0-10.5 | 2.5-4.5 | 0.5-2.5 | 1.0 | 0.04 | 0.03 | 0.20-0.30 | 1.5 | 1.0 | 110 | 15 | None |

Note: (1) Single values are maximum.

(2) The total of other elements, except iron, shall not present in excess of 0.50%.

(3) All-weld-metal mechanical properties are obtained after the following PWHT:

a: Heated to 1350 to 1400°F (732 to 760°C), held for 1 hour, then furnace cooled to 600°F (315°C) at a rate not to exceed 100°F (55°C) per hour, then cooled in air to room temperature.

b: Heated to 1100 to 1150°F (593 to 621°C), held for 1 hour, then cooled in air to room temperature.

c: Heated to 1400 to 1450°F (760 to 788°C), held for 4 hours, then furnace cooled to 1100°F (593°C) at a rate not to exceed 100°F (55°C) per hour, then cooled in air to room temperature.

② Position of welding

| Code | Position |
|------|---------------------|
| 0 | Flat and horizontal |
| 1 | All position |

③ External shielding medium and related requirements

| Code | External shielding medium | Welding polarity | Welding process |
|------|-------------------------------|------------------|-----------------|
| 1 | CO ₂ | DCEP | FCAW |
| 3 | None (self-shielded) | DCEP | FCAW |
| 4 | 75-80%Ar/bal. CO ₂ | DCEP | FCAW |
| 5 | 100%Argon | DCEN | GTAW |

AWS A5.34-2013

Nickel-Alloy Electrodes for Flux Cored Arc Welding

Classification system

ENi ① T ② - ③ [Ex.] ENi Cr3 T 0 - 4

TNi ① - ② ③ [Ex.] TNi 6082 - 0 4

E: Welding electrodes

T: Tubular or flux-cored electrodes

①: Weld metal chemical and mechanical requirements

| Classification | | Chemical composition of all-weld metal(%) ^{(1) (2)} | | | | | | | | | |
|----------------|------------|--|---------|--------------------|-------|-------|------|------|-------------------|----------------|------|
| Traditional | ISO format | C | Mn | Fe | P | S | Si | Cu | Ni ⁽³⁾ | Co | Ti |
| Cr3 | 6082 | 0.10 | 2.5-3.5 | 3.0 | 0.03 | 0.015 | 0.50 | 0.50 | 67.0 min. | ⁽⁵⁾ | 0.75 |
| CrFe1 | 6062 | 0.08 | 3.5 | 11.0 | 0.03 | 0.015 | 0.75 | 0.50 | 62.0 min. | - | - |
| CrFe2 | 6133 | 0.10 | 1.0-3.5 | 12.0 | 0.03 | 0.02 | 0.75 | 0.50 | 62.0 min. | ⁽⁵⁾ | - |
| CrFe3 | 6182 | 0.10 | 5.0-9.5 | 10.0 | 0.03 | 0.015 | 1.0 | 0.50 | 59.0 min. | ⁽⁵⁾ | 1.0 |
| Mo13 | 1013 | 0.10 | 2.0-3.0 | 10.0 | 0.020 | 0.015 | 0.75 | 0.5 | 58.0 min. | - | - |
| CrMo2 | 6002 | 0.05-0.15 | 1.0 | 17.0-20.0 | 0.04 | 0.03 | 1.0 | 0.50 | Bal | 0.50-2.50 | - |
| CrMo3 | 6625 | 0.10 | 0.5 | 5.0 ⁽⁴⁾ | 0.02 | 0.015 | 0.50 | 0.50 | 58.0 min. | ⁽⁵⁾ | 0.40 |
| CrMo4 | 6276 | 0.02 | 1.0 | 4.0-7.0 | 0.03 | 0.03 | 0.2 | 0.50 | Bal | 2.5 | - |
| CrMo10 | 6022 | 0.02 | 1.0 | 2.0-6.0 | 0.03 | 0.015 | 0.2 | 0.50 | Bal | 2.5 | - |
| CrCoMo1 | 6117 | 0.05-0.15 | 0.3-2.5 | 5.0 | 0.03 | 0.015 | 0.75 | 0.50 | Bal | 9.0-15.0 | - |

①: Weld metal chemical and mechanical requirements (Continued)

| Classification | | Chemical composition of all-weld metal(%) ^{(1) (2)} | | | | | Mechanical properties of all-weld metal ⁽⁷⁾ | |
|----------------|------------|--|----------------------------|-----------|------|---------|--|---------------|
| Traditional | ISO format | Cr | Nb(Cb) + Ta ⁽⁶⁾ | Mo | V | W | TS, Min (ksi) | El., Min. (%) |
| Cr3 | 6082 | 18.0-22.0 | 2.0-3.0 | - | - | - | 80 | 25 |
| CrFe1 | 6062 | 13.0-17.0 | 1.5-4.0 | - | - | - | 80 | 25 |
| CrFe2 | 6133 | 13.0-17.0 | 0.5-3.0 | 0.5-2.5 | - | - | 80 | 25 |
| CrFe3 | 6182 | 13.0-17.0 | 1.0-2.5 | - | - | - | 80 | 25 |
| Mo13 | 1013 | 4.0-8.0 | - | 16.0-19.0 | - | 2.0-4.0 | 100 | 25 |
| CrMo2 | 6002 | 20.5-23.0 | - | 8.0-10.0 | - | 0.2-1.0 | 90 | 25 |
| CrMo3 | 6625 | 20.0-23.0 | 3.15-4.15 | 8.0-10.0 | - | - | 100 | 25 |
| CrMo4 | 6276 | 14.5-16.5 | - | 15.0-17.0 | 0.35 | 3.0-4.5 | 100 | 25 |
| CrMo10 | 6022 | 20.0-22.5 | - | 12.5-14.5 | 0.35 | 2.5-3.5 | 100 | 25 |
| CrCoMo1 | 6117 | 21.0-26.0 | 1.0 | 8.0-10.0 | - | - | 90 | 25 |

(1) Single values are maximum.

(2) The total of other elements shall not present in excess of 0.50%.

(3) Includes residual cobalt.

(4) Iron is 1.0 maximum when specified by the purchaser.

(5) Cobalt is 0.10 Maximum when specified by the purchaser.

(6) Tantalum is 0.30 maximum when specified by the purchaser.

(7) As-welded condition.

② Welding position

| Code | Welding position |
|-------------|----------------------------|
| 0 | Flat and horizontal fillet |
| 1 | All positions |

③ Shielding gas

| Code | External shielding medium |
|-------------|----------------------------------|
| 1 | CO ₂ |
| 3 | None (self-shielded) |
| 4 | 75-80%Ar/bal. CO ₂ |

Stick electrodes for manual metal arc welding of non-alloy and fine grain steels

Classification (System A)

EN ISO 2560-A-E ① ② ③ ④ ⑤ ⑥ ⑦

[Ex.] EN ISO 2560-A-E 46 3 1Ni B 5 4 H5

E: Designates stick electrodes for manual metal arc welding

①: All-weld metal yield strength and related requirements

| Code | Yield strength or 0.2% offset strength, Min. (N/mm ²) | Tensile strength (N/mm ²) | Elongation (L=5D) Min. (%) |
|------|---|---------------------------------------|----------------------------|
| 35 | 355 | 440-570 | 22 |
| 38 | 380 | 470-600 | 20 |
| 42 | 420 | 500-640 | 20 |
| 46 | 460 | 530-680 | 20 |
| 50 | 500 | 560-720 | 18 |

②: Impact value of all-weld metal

| Code | Test temp. (°C) | Impact absorbed energy Min. (J) |
|------|-----------------|---------------------------------|
| Z | Not required | Average 47 |
| A | +20 | |
| 0 | 0 | |
| 2 | -20 | |
| 3 | -30 | |
| 4 | -40 | |
| 5 | -50 | |
| 6 | -60 | |

③: Chemical composition of all-weld metal

| Code | Chemical composition ⁽¹⁾ (%) | | |
|-----------|---|---------|---------|
| | Mn | Mo | Ni |
| No symbol | 2.0 | - | - |
| Mo | 1.4 | 0.3-0.6 | - |
| MnMo | 1.4-2.0 | 0.3-0.6 | - |
| 1Ni | 1.4 | - | 0.6-1.2 |
| 2Ni | 1.4 | - | 1.8-2.6 |
| 3Ni | 1.4 | - | 2.6-3.8 |
| Mn1Ni | 1.4-2.0 | - | 0.6-1.2 |
| 1NiMo | 1.4 | 0.3-0.6 | 0.6-1.2 |
| Z | Other elements as agreed | | |

Note: (1) Single values are maximums.
 If not specified, Mo<0.2%, Ni<0.3%,
 Cr<0.2%, V<0.05%, Nb<0.05%,
 Cu<0.3%

④: Type of covering

| Code | Type of electrode covering |
|------|----------------------------|
| A | Acid covering |
| C | Cellulose covering |
| R | Rutile covering |
| RR | Rutile thick covering |
| RC | Rutile-cellulosic covering |
| RA | Rutile-acid covering |
| RB | Rutile-basic covering |
| B | Basic covering |

⑤: Weld metal recovery and type of current (Option)

| Code | Nominal electrode efficiency η (%) | Type of current |
|------|---|-----------------|
| 1 | $\eta \leq 105$ | AC, DC |
| 2 | $\eta \leq 105$ | DC |
| 3 | $105 < \eta \leq 125$ | AC, DC |
| 4 | $105 < \eta \leq 125$ | DC |
| 5 | $125 < \eta \leq 160$ | AC, DC |
| 6 | $125 < \eta \leq 160$ | DC |
| 7 | $\eta > 160$ | AC, DC |
| 8 | $\eta > 160$ | DC |

⑥: Welding position (Option)

| Code | Designation |
|------|--|
| 1 | All positions |
| 2 | All positions except vertical down |
| 3 | Flat butt , flat fillet and Horizontal-vertical fillet |
| 4 | Flat butt and fillet |
| 5 | Vertical-down and those specified in the code 3 |

⑦: Diffusible hydrogen (Option)

| Code | Diffusible hydrogen, Max. ml/100g all-weld metal |
|------|--|
| H5 | 5 |
| H10 | 10 |
| H15 | 15 |

EN ISO 17632:2008

Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine-grain steels

Classification (System A)

EN ISO 17632-A - T

[Ex.] EN ISO 17632-A - T 46 3 1Ni B M 4 H5

T: Designates tubular cored electrodes for metal arc welding

①: Yield strength and related requirements

(a) Multiple-layer welding:

Yield strength of all-weld metal

| Code | Yield strength or 0.2% offset strength Min. (N/mm ²) | Tensile strength (N/mm ²) | Elongation (L=5D) Min. (%) |
|------|--|---------------------------------------|----------------------------|
| 35 | 355 | 440~570 | 22 |
| 38 | 380 | 470~600 | 20 |
| 42 | 420 | 500~640 | 20 |
| 46 | 460 | 530~680 | 20 |
| 50 | 500 | 560~720 | 18 |

(b) Single pass welding:

Yield strength of weld joint

| Code | Yield strength of base metal Min. (N/mm ²) | Tensile strength of weld joint Min. (N/mm ²) |
|------|--|--|
| 3T | 355 | 470 |
| 4T | 420 | 520 |
| 5T | 500 | 600 |

②: Impact value of all-weld metal or weld joint

| Code | Test temp. (°C) | Impact absorbed energy Min. (J) |
|------|-----------------|---------------------------------|
| Z | Not required | Average 47 |
| A | +20 | |
| 0 | 0 | |
| 2 | -20 | |
| 3 | -30 | |
| 4 | -40 | |
| 5 | -50 | |
| 6 | -60 | |

③: Chemical composition of all-weld metal

| Code | Chemical composition ⁽¹⁾ (%) | | |
|-------|---|---------|---------|
| | Mn | Ni | Mo |
| - | 2.0 | - | - |
| Mo | 1.4 | - | 0.3-0.6 |
| MnMo | 1.4~2.0 | - | 0.3-0.6 |
| 1Ni | 1.4 | 0.6-1.2 | - |
| 1.5Ni | 1.6 | 1.2-1.8 | - |
| 2Ni | 1.4 | 1.8-2.6 | - |
| 3Ni | 1.4 | 2.6-3.8 | - |
| Mn1Ni | 1.4~2.0 | 0.6-1.2 | - |
| 1NiMo | 1.4 | 0.6-1.2 | 0.3-0.6 |
| Z | Other elements as agreed | | |

Note: (1) Single values are maximum.

Where no specification, Mo<0.2%, Ni<0.5%, Cr<0.2%, V<0.08%, Nb<0.05%, Cu<0.3%, and for non-gas shielded wires, Al<2.0%.

④: Type of cored flux

| Code | Features | Type of welding | Shielding gas |
|------|---------------------------------------|------------------------------|---------------|
| R | Rutile, Slow-freezing slag | Single pass or multiple pass | Required |
| P | Rutile, Fast-freezing slag | | |
| B | Basic | | |
| M | Metal powder | | |
| V | Rutile or basic / Fluorides | Single pass | Not required |
| W | Basic / Fluorides, Slow-freezing slag | Single pass or multiple pass | |
| Y | Basic / Fluorides, Fast-freezing slag | | |
| Z | Other types | | |

⑥: Welding position (Option)

| Code | Designation |
|------|---|
| 1 | All positions |
| 2 | All positions except vertical downward |
| 3 | Flat butt and fillet, Horizontal fillet |
| 4 | Flat butt and fillet |
| 5 | Vertical downward and those specified in the code 3 |

⑤: Shielding gas

| Code | Designation |
|------|---|
| M | Gas mixtures (Gases specified as M2 per EN 439, excepting He) |
| C | CO ₂ (Gases specified as C1 per EN 439) |
| N | Non-gas shielded |

⑦: Diffusible hydrogen (Option)

| Code | Diffusible hydrogen, Max. ml/100g deposited metal |
|------|---|
| H5 | 5 |
| H10 | 10 |
| H15 | 15 |

EN ISO 18276:2006

Tubular cored electrodes for gas-shielded and non-gas shielded metal arc welding of high-strength steels

Classification (System A)

EN ISO 18276-A - T ① ② ③ ④ ⑤ ⑥ ⑦ ⑧

[Ex.] EN ISO 18276-A - T 55 5 Mn1,5Ni B M 4 H5 T

T: Designates tubular cored electrodes for gas-shielded and non-gas shielded metal arc welding

①: All-weld metal yield strength and related requirements

| Code | Yield point or 0.2% offset strength, Min. (N/mm ²) | Tensile strength (N/mm ²) | Elongation (L=5D) (%) |
|------|--|---------------------------------------|-----------------------|
| 55 | 550 | 640-820 | 18 |
| 62 | 620 | 700-890 | 18 |
| 69 | 690 | 770-940 | 17 |
| 79 | 790 | 880-1080 | 16 |
| 89 | 890 | 940-1180 | 15 |

②: Impact value of all-weld metal

| Code | Absorbed energy of 47J, Three-specimen average, ⁽¹⁾ Test temp. (°C) |
|------|--|
| Z | Not specified |
| A | +20 |
| 0 | 0 |
| 2 | -20 |
| 3 | -30 |
| 4 | -40 |
| 5 | -50 |
| 6 | -60 |

Note: (1) One value can be lower than 47J but shall be 32J or higher

③: Chemical composition of all-weld metal

| Code | Chemical composition (%) ⁽¹⁾ | | | |
|------------|---|---------|---------|---------|
| | Mn | Ni | Cr | Mo |
| Z | Elements as agreed | | | |
| MnMo | 1.4-2.0 | - | - | 0.3-0.6 |
| Mn1Ni | 1.4-2.0 | 0.6-1.2 | - | - |
| Mn1, 5Ni | 1.1-1.8 | 1.3-1.8 | - | - |
| Mn2, 5Ni | 1.1-2.0 | 2.1-3.0 | - | - |
| 1NiMo | 1.4 | 0.6-1.2 | - | 0.3-0.6 |
| 1, 5NiMo | 1.4 | 1.2-1.8 | - | 0.3-0.7 |
| 2NiMo | 1.4 | 1.8-2.6 | - | 0.3-0.7 |
| Mn1NiMo | 1.4-2.0 | 0.6-1.2 | - | 0.3-0.7 |
| Mn2NiMo | 1.4-2.0 | 1.8-2.6 | - | 0.3-0.7 |
| Mn2NiCrMo | 1.4-2.0 | 1.8-2.6 | 0.3-0.6 | 0.3-0.6 |
| Mn2Ni1CrMo | 1.4-2.0 | 1.8-2.6 | 0.6-1.0 | 0.3-0.6 |

Note: (1) Single values are maximum.

⑥: Welding position

| Code | Designation |
|------|---|
| 1 | All positions |
| 2 | All positions except vertical downward |
| 3 | Flat butt and fillet, Horizontal fillet |
| 4 | Flat butt and fillet |
| 5 | Vertical downward and those in Code 3 |

④: Type of flux

| Code | Features |
|------|----------------------------|
| R | Rutile, Slow-freezing slag |
| P | Rutile, Fast-freezing slag |
| B | Basic |
| M | Metal powder |
| Z | Others |

⑤: Shielding gas

| Code | Designation |
|------|-----------------|
| M | Gas mixtures |
| C | CO ₂ |

⑦: Diffusible hydrogen

| Code | Diffusible hydrogen, Max. ml/100g deposited metal |
|------|---|
| H5 | 5 |
| H10 | 10 |

⑧: Heat treatment: T: 560-600°C × 1h, FC to 300°C for mechanical tests of all-weld metal

EN ISO 17634:2006

Tubular cored electrodes for gas shielded metal arc welding of creep-resisting steels

Classification (System A)

EN ISO 17634-A - T ① ② ③ ④ ⑤

[Ex.] EN ISO 17634-A - T CrMo1 B M 4 H5

T: Designates tubular cored electrodes for gas shielded metal arc welding

①: Chemical composition and mechanical properties of all-weld metal

| Code | Chemical composition (%) | | |
|--------|--------------------------|-----------|-----------|
| | Cr | Mo | V |
| Mo | - | 0.40-0.65 | - |
| MoL | - | 0.40-0.65 | - |
| MoV | 0.30-0.60 | 0.50-0.80 | 0.25-0.45 |
| CrMo1 | 0.90-1.40 | 0.40-0.65 | - |
| CrMo1L | 0.90-1.40 | 0.40-0.65 | - |
| CrMo2 | 2.00-2.50 | 0.90-1.30 | - |
| CrMo2L | 2.00-2.50 | 0.90-1.30 | - |
| CrMo5 | 4.00-6.00 | 0.40-0.70 | - |
| Z | Elements as agreed | | |

②: Type of flux

| Code | Features |
|------|----------------------------|
| R | Rutile, Slow-freezing slag |
| P | Rutile, Fast-freezing slag |
| B | Basic |
| M | Metal powder |
| Z | Other types |

③: Shielding gas

| Code | Designation |
|------|---|
| M | Gas mixtures (Gases specified as M2 per EN 439, excepting He) |
| C | CO ₂ (Gases specified as C1 per EN 439) |

④: Welding position (Opt.)

| Code | Designation |
|------|---|
| 1 | All positions |
| 2 | All positions except vertical downward |
| 3 | Flat butt and fillet, Horizontal fillet |
| 4 | Flat butt and fillet |
| 5 | Vertical downward and those in Code 3 |

⑤: Diffusible hydrogen (Option)

| Code | Diffusible hydrogen, Max. ml/100g deposited metal |
|------|---|
| H5 | 5 |
| H10 | 10 |

Mechanical properties of all-weld metal

| Code | Proof strength, Min. Rp0.2 (N/mm ²) | Tensile strength, Min. Rm (N/mm ²) | Elongation (L=5D) Min. A (%) | Absorbed energy Kv (J) +20°C | | Heat treatment of all-weld metal | | |
|--------|---|--|------------------------------|-----------------------------------|------------------------|----------------------------------|---------------------------|------------|
| | | | | Average of three values, Min. (J) | Single value, Min. (J) | Preheat and interpass temp. (°C) | PWHT | |
| | | | | | | | Temp. ⁽¹⁾ (°C) | Time (min) |
| Mo/MoL | 355 | 510 | 22 | 47 | 38 | <200 | 570-620 | 60±10 |
| MoV | 355 | 510 | 18 | 47 | 38 | 200-300 | 690-730 | 60±10 |
| CrMo1 | 355 | 510 | 20 | 47 | 38 | 150-250 | 660-700 | 60±10 |
| CrMo1L | 355 | 510 | 20 | 47 | 38 | 150-250 | 660-700 | 60±10 |
| CrMo2 | 400 | 500 | 18 | 47 | 38 | 200-300 | 690-750 | 60±10 |
| CrMo2L | 400 | 500 | 18 | 47 | 38 | 200-300 | 690-750 | 60±10 |
| CrMo5 | 400 | 590 | 17 | 47 | 38 | 200-300 | 730-760 | 60±10 |
| Z | Mechanical properties as agreed | | | | | | | |

Note (1) Cooling speed: 200°C/1h max. to 300°C by FC

EN ISO 17633:2006

Tubular cored electrodes and rods for gas shielded and non-gas shielded metal arc welding of stainless and heat-resisting steels

Classification (System A)

EN ISO 17633-A - T ① ② ③ ④ [Ex.] EN ISO 17633-A - T 19 12 3L R M 4

T: Designates tubular cored electrodes for gas shielded and non-gas shielded metal arc welding

①: chemical composition and mechanical properties of all-weld metal

| Classification | Chemical composition (%) | | | | Proof strength Min. Rp0.2 (N/mm ²) | Tensile strength Min. Rm (N/mm ²) | El. Min. A (L=5D) % | PWHT |
|---|--------------------------|-----------|---------|--------------|---|--|---------------------------------|------|
| | Cr | Ni | Mo | Others | | | | |
| Martensite/ferrite type | | | | | | | | |
| 13 | 11.0-14.0 | - | - | - | 250 | 450 | 15 | (3) |
| 13 Ti | 10.5-13.0 | - | - | Ti (1) | 250 | 450 | 15 | (3) |
| 13 4 | 11.0-14.5 | 3.0-5.0 | 0.4-1.0 | - | 500 | 750 | 15 | (4) |
| 17 | 16.0-18.0 | - | - | - | 300 | 450 | 15 | (5) |
| Austenite type | | | | | | | | |
| 19 9 L | 18.0-21.0 | 9.0-11.0 | - | - | 320 | 510 | 30 | None |
| 19 9 Nb | 18.0-21.0 | 9.0-11.0 | - | Nb (2) | 350 | 550 | 25 | None |
| 19 12 3 L | 17.0-20.0 | 10.0-13.0 | 2.5-3.0 | - | 320 | 510 | 25 | None |
| 19 12 3 Nb | 17.0-20.0 | 10.0-13.0 | 2.5-3.0 | Nb (2) | 350 | 550 | 25 | None |
| 19 13 4 N L | 17.0-20.0 | 12.0-15.0 | 3.0-4.5 | N: 0.08-0.20 | 350 | 550 | 25 | None |
| Austenite-ferrite high corrosion resistant type | | | | | | | | |
| 22 9 3 N L | 21.0-24.0 | 7.5-10.5 | 2.5-4.0 | N: 0.08-0.20 | 450 | 550 | 20 | None |
| Full-austenite high corrosion resistant type | | | | | | | | |
| 18 16 5 N L | 17.0-20.0 | 15.5-19.0 | 3.5-5.0 | N: 0.08-0.20 | 300 | 480 | 25 | None |
| Special type | | | | | | | | |
| 18 8 Mn | 17.0-20.0 | 7.0-10.0 | - | - | 350 | 500 | 25 | None |
| 20 10 3 | 19.5-22.0 | 9.0-11.0 | 2.0-4.0 | - | 400 | 620 | 20 | None |
| 23 12 L | 22.0-25.0 | 11.0-14.0 | - | - | 320 | 510 | 25 | None |
| 23 12 2 L | 22.0-25.0 | 11.0-14.0 | 2.0-3.0 | - | 350 | 550 | 25 | None |
| 29 9 | 27.0-31.0 | 8.0-12.0 | - | - | 450 | 650 | 15 | None |
| Heat resistant type | | | | | | | | |
| 22 12 H | 20.0-23.0 | 10.0-13.0 | - | - | 350 | 550 | 25 | None |
| 25 20 | 23.0-27.0 | 18.0-22.0 | - | - | 350 | 550 | 20 | None |

Note: (1) Ti :10°C%-1.5%

(2) Nb:8°C%-1.1%: Nb can be replaced with Ta up to 20%

(3) 840-870°C × 2h heating, followed by FC to 600°C and later AC

(4) 580-620°C × 2h heating, followed by AC

(5) 760-790°C × 2h heating, followed by FC to 600°C and later AC

②: Type of flux

| Code | Features |
|------|-------------------------------|
| R | Rutile, Slow-freezing slag |
| P | Rutile, Fast-freezing slag |
| M | Metal powder |
| U | Self-shielded |
| Z | Other types |

③: Shielding gas

| Code | Designation |
|------|---|
| M | Gas mixtures (Gases specified as M2 per EN 439, excepting He) |
| C | CO ₂ (Gases specified as C1 per EN 439) |
| N | Self-shielded |

④: Welding position (Option)

| Code | Designation |
|------|---|
| 1 | All positions |
| 2 | All positions except vertical downward |
| 3 | Flat butt and fillet, and horizontal fillet |
| 4 | Flat butt and fillet |
| 5 | Vertical downward and those in Code 3 |



Alphabetical Index

Alphabetical Index

Note:

- (HT): For high tensile strength steel
- (HR): For heat-resistant low-alloy steel
- SAW flux-wire combinations can be accessed from either flux or wire.

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AMERICA

USA:

KOBELCO WELDING OF AMERICA INC.

Tel. (1) 281 240 5600 Fax. (1) 281 240 5625

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