HANKOOK WELDTEK

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Rev. 04 // Nov. 2016

Welding Consumables Guide Book

HANKOOK WELDTEK

DNV·GL

MANAGEMENT SYSTEM CERTIFICATE

Certificate No.:	Initial Certification Date:	Valid:
89162-2010-AQ-KOR-RvA(Rev.1)	2 December, 2010	5 December, 2014 – 2 December, 2016

This is to certify that the management system of

HANKOOK WELDTEK CO., LTD.

31, Myeongnyesandan 1-ro, Jangan-eup, Gijang-gun, Busan, Korea

has been found to conform to Quality Management System standard(s):
ISO 9001:2008, KS Q ISO 9001:2009

This certificate is valid for the following Scope:
Manufacture of Covered Electrodes for Mild Steel, Flux Cored Wires for Gas Shielded and Self-Shielded Metal Arc Welding of Miled Steel, High Strength Steel and Low Temperature Service Steel

Place and date:
Seoul 15 December, 2014

MGMT. SYS.
RvA C 024

For the issuing office:
DNV GL - Business Assurance
18th Floor, Kyobo Building, 1, Jong-ro, Jongno-gu, Seoul, Republic of Korea. Tel. : +82 2 723 7596

In Kyoon Ahn
Management Representative

HANKOOK WELDTEK

Welding Consumables Guide Book

HANKOOK WELDTEK

About Us

HANKOOK WELDTEK CEO GREETINGS

Since the establishment of HANKOOK WELDTEK Co., Ltd. in 2009, we specialized in manufacturing high-quality welding materials, based on professional production systems and skilled manpower.

With a business principle of striving to exceed customer expectations, we will become a valuable business partner that you can count on.

With innovation, the desire, and the passion to become a leader in the industry, HANKOOK WELDTEK will change the way business is done.

Our values are forward thinking and are always adaptive to the constant demands of the changing world.

We guarantee to continually improve processes, develop leading industry experts, and pioneer innovative technologies.

As the world recovers from the economic crisis,
we have a vision and plan in place to dominate the industry internationally in leaps and bounds.

Thank you very much.

HISTORY >>>

2009.07 Established HANKOOK WELDTEK CO., LTD
2010.07 Started to produce Flux Cored Wire.
2010.12 Approved by ISO 9001 (DNV)
2011.01 Expanded Flux Cored Wire Facilities (4,000ton/year)
2011.12 Approved by KS (KS D 7104 YFW-C50DX)
2012.02 Started to produce Pail Pack
2012.04 Approved by ABS, DNV
2012.10 Expanded Flux Cored Wire Facilities (6,000ton/year)
2012.11 Approved by KS (KS D 7104 YFW-C602X)
2013.05 Approved by KR, NK, GL, BV, LR, DNV, ABS, CCS
2014.05 Approved by RINA
2014.10 Busan factoruy expenmsion and relocation
2015.05 Approved by CE
2015.09 Approved by JIS

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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 covered 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-ciruit-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-lever 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 repaired or replaced with new one.

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

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 potion 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

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 glover for welding, long sleeve shirts, foot covers, leather aprons, etc.
- Do not touch weldments while they are hot.

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 torch to your face.

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 handing them.
- Follow the handling instructions shown on the surface of the pail pack wire packges 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.

• caution •

1. HANKOOK WELDTEK CO., LTD. does not accept responsibility for error or information which is found to be misleading.

2. Suggestions for, or descriptions of, the end use or application of products, or methods of working are for information only and HANKOOK WELDTEK CO., LTD., accepts no liability in respect thereof.

3. Prior to using products supplied or manufactured by HANKOOK WELDTEK CO., LTD., the purchaser should ensure that the products are suitable for the work being welded.

FLUX CORED ARC WELDING WIRES

Mild steel & 490MPa high tensile steels

High tensile steels

Self Shielded

Weather proof steels

Low-temperature steels

Heat-resistant, Low alloy steels

Stainless steels

INCONEL

Hardfacing

WT-71

For 490MPa high tensile steel

KS D7104 YFW-C50DR
AWS A5.36 E71T1-C1A2-CS1-H8
JIS Z3313 T49J0T1-1CA-U H10

Applications

WT-71 is designed for welding of 50kgf/mm² class high tensile steel. All position welding of building, shipbuilding, bridges, machineries, vehicles, offshore structures and general fabrications.

Characteristics on Usage

- WT-71 is titania type flux cored wire for all position welding with CO_2.
- Compared with solid wire, good X-ray safety, spatter loss is low, bead appearance is beautiful and arc is soft with good stability.
- Slag covering is uniform with good removal.
- WT-71 has very efficient welding due to higher deposition rate.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- One-side welding defects such as hot cracking may occur with wrong welding parameter such as high welding speed.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S
0.04	1.29	0.55	0.013	0.010

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
548	580	28	76

Welding position

Approved by

KS, ABS, DNV, KR, NK, LR, BV, GL, CCS, JIS, RINA, CE

WT-71LF

For 490MPa high tensile steel

KS D7104 YFW-C50DR
AWS A5.36 E71T1-C1A2-CS1-H8
JIS Z3313 T492T1-1C/MA-U H10

Applications

WT-71LF is designed for welding of 50kgf/mm² high tensile steel. All position welding of building, shipbuilding, bridges, machineries, vehicles, offshore structures and general fabrications.

Characteristics on Usage

- WT-71LF is the most widely used titania type flux cored wire for all position welding with CO_2 shielding gas.
  As deposition rate is higher than solid wire and manual metal arc electrode, highly efficient welding can be performed.
  It provides low fume generation and has good impact strength at low temperatures.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- One-side welding defects such as hot cracking may occur with wrong welding parameter such as high welding speed.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S
0.04	1.35	0.55	0.02	0.01

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
521	576	28	75

Welding position

WT-70

For 490MPa high tensile steel

KS D7104 YFW-C50DR
AWS A5.20 E70T-1C/1M
JIS Z3313 T49J0T15-0C/MA-U H10

Applications

WT-70 is designed for welding of 50kgf/mm² class high tensile steel. Building, shipbuilding, bridges, machineries, vehicles, offshore structures and general fabrications.

Characteristics on Usage

- WT-70 has very efficient welding due to higher deposition rate.
- It is used for joining from mild tensile steels to 590MPa class high tensile steels, and is suitable for both fillet and butt welds.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S
0.05	1.43	0.64	0.012	0.011

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
538	580	27	66

Welding position

WT-70T9

For 490MPa high tensile steel

KS D7104 YFW-C502M
AWS A5.36 E70T1-C1A3-CS1-H8
JIS Z3313 T493T15-0CA H10

Applications

WT-70T9 is designed for welding of 50kgf/mm^2 high tensile steel with outstanding mechanical properties.

Characteristics on Usage

- Typical applications include building, shipbuilding, bridges, machineries, vehicles, offshore structures and general fabrications.
- It is a flux cored wire for Flat & H-Fillet efficient welding with CO_2 shielding gas.
- It has better CVN toughness at low temperatures.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- One-side welding defects such as hot cracking may occur with wrong welding parameter such as high welding speed.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S
0.04	1.48	0.52	0.014	0.010

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-30℃)
500	580	27	74

Welding position

WT-70C

For 490MPa high tensile steel

KS D7104 YFW-A50DM
AWS A5.18 E70C-6M
JIS Z3313 T493T15-0MA-H5

Applications

WT-70C is designed for welding of 50kgf/mm² high tensile steel with outstanding mechanical properties.

Characteristics on Usage

- Typical applications include building, shipbuilding, bridges, machineries, vehicles, offshore structures and general fabrications.
- It is a metal cored wire for Flat & H-Fillet efficient welding with Ar+20~25%CO_2 shielding gas.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- One-side welding defects such as hot cracking may occur with wrong welding parameter such as high welding speed.
- Shielding gas should be used Ar+20~25%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S
0.048	1.50	0.65	0.017	0.013

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-30℃)
495	550	27	67

Welding position

WT-70Z

Metal-Cored Type

AWS A5.18 E70C-G

Applications

Welding of galvanized steel sheets in the field of automobile manufacturing and galvanized steel in the structure of ships or construction as well.

Characteristics on Usage

- WT-70Z is designed for the welding of low carbon and low alloy galvanized steel sheets.
- It has the high deposition rates due to the higher weldability than a solid wire.
- Especially it has good anti-porosity to zinc-primer plate and mill scale plate in fillet welding.

Notes on Usage

- Shielding gas should be used 100%CO_2.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S
0.09	1.33	0.45	0.022	0.013

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (0℃)
544	595	29	76

Welding position

WT-70T5

For 490MPa high tensile steel

KS D7104 YFW-A502B
AWS A5.36 E70T1-C1A4-CS1-H4
JIS Z3313 T493T5-0MA-H5

Applications

WT-70T5 is designed for welding of 50kgf/mm² class high tensile steel, low alloy steel. Building, shipbuilding, bridges, machineries, vehicles, offshore structures and general fabrications.

Characteristics on Usage

- Wire is a fully basic type of flux cored wire for flat and horizontal position welding.
- It has good CVN toughness at low temperatures and weldability is excellent with lower crack susceptibility.

Notes on Usage

- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used Ar+ 20~25%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S
0.05	1.24	0.50	0.015	0.012

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-40℃)
465	540	29	125

Welding position

WT-81

For 590MPa high tensile steel

KS D7104 YFW-C602R
AWS A5.36 E81T1-C1A3-Ni1-H4
JIS Z3313 T573T1-1CA-N2 H5

Applications

WT-81 is designed for welding of 590MPa high tensile steel with slow freezing slag system. Typical applications include machineries, shipbuilding, offshore structures, bridges and general fabrications.

Characteristics on Usage

- WT-81 is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- One-side welding defects such as hot cracking may occur with wrong welding parameter such as high welding speed.
- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Ni	Mo
0.03	1.27	0.48	0.014	0.011	0.97	0.20

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-30℃)
551	625	28	70

Welding position

WT-80

For 590MPa high tensile steel

KS D7104 YFW-C602R
AWS A5.36 E80T1-C1A3-Ni1-H4
JIS Z3313 T573T1-0CA-N2 H5

Applications

WT-80 is designed for welding of 590MPa high tensile steel.
Typical applications include machineries, shipbuilding, offshore structures, bridges and general fabrications.

Characteristics on Usage

- It has very efficient welding due to higher deposition rate particularly and also has easy slag removal.
- It is used for joining from mild tensile steels to 590MPa class high tensile steels, and is suitable for both fillet and butt welds.
- Overall welding characteristics except tensile strength is very similar with the WT-70.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Ni
0.03	1.22	0.38	0.014	0.011	0.94

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-30℃)
573	623	28	82

Welding position

WT-91

For 620MPa high tensile steel

KS D7104 YFW-C602R
AWS A5.36 E91T1-C1AG-G-H4
JIS Z3313 T624T1-1CAP-N2 H5

Applications

WT-91 is designed for welding of 620MPa high tensile steel for low temperature service. Typical industrial applications include shipbuilding, machinery, piping, bridge, structural fabrication and building.

Characteristics on Usage

- WT-91 is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- One-side welding defects such as hot cracking may occur with wrong welding parameter such as high welding speed.
- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Ni	Mo
0.05	1.24	0.42	0.012	0.010	0.97	0.21

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
588	652	26	105

Welding position

WT-90

For 620MPa high tensile steel

KS D7104 YFW-C602R
AWS A5.36 E90T1-C1AG-G-H4
JIS Z3313 T624T1-0CAP-N2 H5

Applications

WT-90 is designed for welding of 620MPa high tensile steel.
Typical applications include machineries, shipbuilding, offshore structures, bridges and general fabrications.

Characteristics on Usage

- It has very efficient welding due to higher deposition rate particularly and also has easy slag removal.
- It is used for joining from mild tensile steels to 620MPa class high tensile steels, and is suitable for both fillet and butt welds.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Ni	Mo
0.05	1.32	0.42	0.012	0.011	0.92	0.17

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
563	634	26	86

Welding position

WT-100K3

AWS A5.36 E100T1-M21A2-K3-H4

For 70kgf/mm2 high tensile steel

Applications

WT-100K3 is designed for welding of 690MPa high tensile steel for low temperature service. Typical applications include pipe line, wear resistance steel such as API 5L, X70, X80, EN 10208-2 L480, L550, EN 10137-2 S550, S620.

Characteristics on Usage

- Wire is a titania type of flux cored wire for flat and horizontal position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used Ar+20~25%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Ni	Mo
0.03	1.70	0.45	0.012	0.009	1.53	0.36

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
682	712	20	125

Welding position

WT-111K3

For 80kgf/mm2 high tensile steel

AWS A5.36 E111T1-C1A2-K3-H4
JIS Z3313 T762T1-1MA-N3M2 H5

Applications

WT-111K3 is designed for welding of 760MPa high tensile steel with outstanding mechanical properties.
Typical applications include high tensile steels that will be used a low temperature environment.

Characteristics on Usage

- Wire is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.
- It provides excellent impact values at low temperature.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 100%CO_2 or Ar+20~25%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Ni	Mo
0.04	1.78	0.36	0.011	0.005	2.03	0.36

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
767	802	20	114

Welding position

WT-115

For 80kgf/mm2 high tensile steel

AWS A5.36 E110T5-M21A5-K4-H4
JIS Z3313 T765T5-0MA-N4C1M2 H5

Applications

WT-115 is designed for welding of 760MPa high tensile steel with outstanding mechanical properties.
Typical applications include low alloy steel, quenched and tempered high strength steels.

Characteristics on Usage

- Wire is a fully basic type of flux cored wire for flat and horizontal position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used Ar+20~25%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	Cr	Ni	Mo
0.03	1.47	0.35	0.46	1.96	0.41

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-50℃)
811	856	19	51

Welding position

WT-71GS

For 490MPa high tensile steel (Self-Shielded)

KS D7104 YFW-S50GB
AWS A5.36 E71TG-ZAZ-GS-H8
JIS Z3313 T49TG-1NS-G

Applications

WT-71GS is designed for welding of 50kgf/mm² class high tensile steel and self-shielded wire to facilitate welding outdoors.
It is used where light structures, short assembly welds, other general fabrications and galvanized steel fixtures, gate etc.

Characteristics on Usage

- It has good arc stability, low spatter generation, high efficiency, good bead shape and slag removal.

Notes on Usage

- It has to use DCEN (electrode negative).
- Do not use shielding gas.

Sizes Available and Recommended Currents (DC -)

Position \ Dia(mmØ)		1.2	1.6
F	Amp	120~180A	240~280A
HF			
V-up, OH		100~160A	

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	P	S	Al
0.15	0.65	0.2	0.013	0.006	2.1

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
495	534	24

Welding position

WT-71T11

For 490MPa high tensile steel (Self-Shielded, multi pass)

KS D7104 YFW-S50GB
AWS A5.36 E71T11-ZAZ-CS3-H8
JIS Z3313 T49T7-1NA

Applications

WT-71T11 is designed for welding of 50kgf/mm^2 class high tensile steel and self-shielded wire to facilitate welding outdoors.
(ASTM A36 Gr.All; A109 Gr. All; A283 Gr. A, B, C, D; A284 C,D;A285 Gr. A, B, C;A288 Gr. 1; A372 type I;A500 Gr. All; A501 Gr. All)

Characteristics on Usage

- It has good arc stability, low spatter generation, high efficiency, good bead shape and slag removal.

Notes on Usage

- It has to use DCEN (electrode negative).
- Do not use shielding gas.

Sizes Available and Recommended Currents (DC -)

Position \ Dia(mmØ)		1.2	1.6
F	Amp	120~180A	240~280A
HF			
V-up, OH		100~160A	

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	P	S
0.15	0.65	0.2	0.013	0.006

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
512	565	22

Welding position

WT-71T8

AWS A5.36 E71T8-ZAZ-CS3-H8

For 490MPa high tensile steel (Self-Shielded)

Applications

Structural fabrication, including those subject to seismic requirements.
Ship and barge fabrication, General plate fabrication.

Characteristics on Usage

- Self shielded: easiest equipment arrangement.
- Due to new production technology and formulation: welder friendly wire with wide range of parameter settings.
- Forgiving arc, with increased penetration gives better quality welds with great bead appearance.
- High deposition rate, even in out of position welding.
- Good impact values.

Notes on Usage

- It has to use DCEN (electrode negative)
- Do not use shielding gas.

Sizes Available and Recommended Currents (DC –)

Position \ Dia(mmØ)		1.2	1.6
F	Amp	120~180A	240~280A
HF			
V-up, OH		100~160A	

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S	Al
0.15	0.65	0.21	0.011	0.002	0.58

Typical Mechanical Properties of All-Weld Metal

Y.S N/mm^2	T.S N/mm^2	EL (%)
452	576	26

Welding position

WT-71W

For atmospheric corrosion resisting steel

KS D7109 YFA-50W
JIS Z3320 YFA-50W

Applications

WT-71W is designed all position welding of 490MPa weather-proof steels.

Characteristics on Usage

- The weld metal contain Cr- Ni- Cu alloys and has good weather-proof properties.
- It is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- One-side welding defects such as hot cracking may occur with wrong welding parameter such as high welding speed.
- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~300A	180~340A	200~380A
HF		180~300A	180~340A	200~380A
V-up, OH		160~260A	160~280A	180~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Ni	Cu
0.05	1.10	0.53	0.014	0.011	0.55	0.48	0.42

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
510	580	28	42

Welding position

WT-81W

For atmospheric corrosion resisting steel

KS D7109 YFA-58W
AWS A5.36 E81T1-C1A3-W2-H8
JIS Z3320 YFA-58W

Applications

WT-81W is designed all position welding of 560MPa weather-proof steels.

Characteristics on Usage

- The weld metal contain Cr- Ni- Cu alloys and has good weather-proof properties.
- It is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- One-side welding defects such as hot cracking may occur with wrong welding parameter such as high welding speed.
- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~300A	180~340A	200~380A
HF		180~300A	180~340A	200~380A
V-up, OH		160~260A	160~280A	180~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Ni	Cu
0.04	1.20	0.54	0.014	0.011	0.54	0.58	0.45

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-30℃)
550	630	28	50

Welding position

WT-71T9

For 490MPa low temperature service steel

KS D7104 YFL-C503R
AWS A5.36 E71T9-C1A3-CS1-H4
JIS Z3313 T494T1-1CA-UH5

Applications

WT-71T9 is designed for welding of 490MPa a low temperature steels.
It can be used in a variety of applications including railcar, automotive, machinery, shipbuilding, bridges, heavy equipment etc.

Characteristics on Usage

- It is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.
- Its design achieves low temperature impacts and can be used in semiautomatic and automatic applications.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- One-side welding defects such as hot cracking may occur with wrong welding parameter such as high welding speed.
- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Ni
0.04	1.34	0.48	0.014	0.008	0.04

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-30℃)
510	585	28	121

Welding position

WT-71SR

For 490MPa low temperature service steel

KS D7104 YFL-C504R
AWS A5.36 E71T12-C1A4-CS2-H4
JIS Z3313 T494T1-1CAP H5

Applications

WT-71SR is designed for welding of 490MPa a low temperature steels.(NACE/API steel) It can be used in a variety of applications including railcar, automotive, machinery, shipbuilding, bridges, heavy equipment etc.

Characteristics on Usage

- It is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.
- It is design good impact value at low temperatures down to -40℃ in PWHT conditions.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- One-side welding defects such as hot cracking may occur with wrong welding parameter such as high welding speed.
- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Ni
0.05	1.21	0.41	0.011	0.009	0.40

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-40℃)	PWHT
552	598	26	142	AW
521	576	27	138	620℃×2hr

Welding position

Approved by

JIS, CE, ABS, DNV

WT-80K2

For 590MPa low temperature service steel

KS D7104 YFL-C506M
AWS A5.36 E80T1-C1A3-K2-H4
JIS Z3313 T556T1-0CA-N3-U H5

Applications

WT-80K2 is designed for welding of 590MPa high tensile steel for low temperature service. Typical applications include offshore structures, LNG and LPG carriers and storage tank.

Characteristics on Usage

- It is a metal type of flux cored wire for flat and horizontal position welding.
- The weld metal contain about 1.5%Ni, so good impact value at low temperatures down to -60℃.
- It features good porosity resistance and easy slag removal and deposition rate is higher than a titania type.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Ni
0.04	1.49	0.42	0.013	0.010	1.50

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-60℃)
550	630	26	55

Welding position

WT-81K2

For 590MPa low temperature service steel

KS D7104 YFL-C506R
AWS A5.36 E81T1-C1A3-K2-H4
JIS Z3313 T556T1-1CA-N3-U H5

Applications

WT-81K2 is designed for welding of 590MPa high tensile steel for low temperature service. Typical applications include offshore structures, LNG and LPG carriers and storage tank.

Characteristics on Usage

- It is a titania type of flux cored wire for all-position welding.
- The weld metal contain about 1.5%Ni, so good impact value at low temperatures down to -60℃.
- It features good porosity resistance and easy slag removal.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Ni
0.05	1.05	0.38	0.013	0.010	1.50

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-60℃)
540	610	28	70

Welding position

WT-91K2

For 620MPa low temperature service steel

KS D7104 YFW-C604R
AWS A5.36 E91T1-C1A2-K2-H4
JIS Z3313 T624T1-1CA-N3M1-U H5

Applications

WT-91K2 is designed for welding of 620MPa high tensile steel for low temperature service. Typical applications include offshore structures, LNG and LPG carriers and storage tank.

Characteristics on Usage

- It is a titania type of flux cored wire for all-position welding.
- The weld metal contain about 1.5%Ni, so good impact value at low temperatures down to -60℃.
- It features good porosity resistance and easy slag removal.

Notes on Usage

- Proper preheating(50~150℃) and interpass temperature must be used in order to release diffusible hydrogen which may cause cracking in weld metal when electrodes are used for medium and heavy plates.
- Shielding gas should be used 100%CO_2.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Ni
0.05	1.24	0.38	0.013	0.011	1.55

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-60℃)
603	645	27	83

Welding position

WT-81A1

For heat-resisting steel (0.5%Mo)

KS D7121 YFM-C
AWS A5.36 E81T1-C1PZ-A1-H8
JIS Z3318 YFM-C

Applications

WT-81A1 is designed for welding of 0.5% Mo steel used for high pressure vessels, oil refining industries, steam pipes of boilers etc.

Characteristics on Usage

- It is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.
- The weld metal contain about 0.5% Mo, so it has good crack and heat resistance.

Notes on Usage

- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 100%CO_2.
- Preheat at 150~200℃ and PWHT at 620℃.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Mo
0.06	0.84	0.46	0.016	0.011	0.52

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	PWHT
550	625	23	AW
543	612	25	620℃×1hr

Welding position

WT-81B2

For heat-resisting steel (1.25%Cr-0.5%Mo)

KS D7121 YF1CM-C
AWS A5.36 E81T1-C1PZ-B2-H8
JIS Z3318 YF1CM-C

Applications

WT-81B2 is designed for welding of 1.25%Cr-0.5%Mo steel used for high pressure vessels, oil refining industries, steam pipes of boilers etc.

Characteristics on Usage

- It is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.
- The weld metal contain about 1.25%Cr, 0.5%Mo, so it has good crack and heat resistance.

Notes on Usage

- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 100%CO_2.
- Preheat at 150~200℃ and PWHT at 690℃.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Mo
0.07	0.82	0.42	0.016	0.015	1.18	0.51

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	PWHT
600	680	21	AW
569	648	22	690℃×1hr

Welding position

WT-85B2

For heat-resisting steel (1.25%Cr-0.5%Mo)

KS D7121 YF1CM-G
AWS A5.36 E80T5-C1PZ-B2-H8
JIS Z3318 YF1CM-G

Applications

WT-85B2 is designed for welding of 1.25%Cr-0.5%Mo steel used for high pressure vessels, oil refining industries, steam pipes of boilers etc.

Characteristics on Usage

- It is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.
- The weld metal contain about 1.25%Cr, 0.5%Mo, so it has good crack and heat resistance.

Notes on Usage

- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 75%Ar-25%CO_2.
- Preheat at 150~200℃ and PWHT at 690℃.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Mo
0.07	0.85	0.48	0.014	0.013	1.15	0.52

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)	PWHT
562	680	23	AW
532	627	24	690℃×2hr

Welding position

WT-81B6

5%Cr-0.5%Mo 내열강용

AWS A5.36 E81T1-M21PZ-B6-H8
JIS Z3318 T55 T1-1M-5CM

Applications

WT-81B6 is designed for welding of 5%Cr-0.5% Mo steel used for high pressure vessels, Oil refining industries, steam pipes of boilers etc.

Characteristics on Usage

- It is a titania type of flux cored wire for all-position welding.
- It has excellent creep rupture strength, easy slag removal and good weld soundness.
- The weld metal contain about 5%Cr, 0.5% Mo, so it has good crack and heat resistance.

Notes on Usage

- Gas flow rate is proper 15~25mℓ.
- Shielding gas should be used Ar+20~25%CO_2.
- Preheat at 150~200℃ and PWHT at 745℃.

Size Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.6
F	Amp	200~340A	300~420A
HF		200~340A	300~420A
V-up, OH		160~260A	200~300A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Mo
0.05	0.44	0.58	0.07	0.010	4.55	0.48

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S N/mm^2	T.S N/mm^2	EL (%)	PWHT
558	672	21	745℃ X 2hr

Welding position

WT-91B3

2.25%Cr-1.0%Mo 내열강용

KS D7121 YF2CM-C
AWS A5.36 E91T1-C1PZ-B3-H8
JIS Z3318 YF2CM-C

Applications

WT-91B3 is designed for welding of 2.25%Cr-1.0%Mo steel used for high pressure vessels, oil refining industries, steam pipes of boilers etc.

Characteristics on Usage

- It is a titania type of flux cored wire for all-position welding.
- It provides smooth arc, low spatter levels, good weldability and good bead appearance.
- The weld metal contain about 2.25%Cr, 1.0%Mo, so it has good crack and heat resistance.

Notes on Usage

- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used 100%CO_2.
- Preheat at 150~300℃ and PWHT at 690℃.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Mo
0.06	0.62	0.48	0.019	0.010	2.30	1.05

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	PWHT
620	705	18	AW
590	660	22	690℃ X 1hr

Welding position

WT-91B9

AWS A5.36 E91T1-M21PZ-B9-H8

For heat-resisting steel (9%Cr-1%Mo-V)

Applications

WT-91B9 is designed for welding of 9%Cr-1%Mo-V steel used for high pressure vessels, oil refining industries etc.

Characteristics on Usage

- It is a titania type of flux cored wire for all-position welding.
- It has easy slag removal and good weld soundness.
- The weld metal contain about 9%Cr-1%Mo-V, so excellent creep rupture strength.

Notes on Usage

- Gas flow rate is proper 20~25ℓ/min.
- Shielding gas should be used Ar+20~25%CO_2.
- Preheat at 200~300℃ and PWHT at 760℃.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.4	1.6
F	Amp	180~340A	200~360A	200~420A
HF		180~340A	200~360A	200~420A
V-up, OH		120~220A	140~260A	160~280A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	Cr	Ni	Mo	V	Nb
0.09	0.66	0.20	9.1	0.49	1.0	0.20	0.05

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)	PWHT
635	710	22	760℃×2hr

Welding position

WT-307P

AWS A5.22 E307T-1(4)

For 13%Mn steels, cladding carbon steels

Applications

WT-307P is designed for welding dissimilar steels, 13%Mn steels with reduced weldability and for cladding carbon steels.

Characteristics on Usage

- WT-307P is a metal cored wire with a hot cracking resistant austenitic weld metal.
- The weld metal has an excellent crack resistance, even when welding steels with very poor weldability.
- This wire is designed for welding dissimilar steels, 13Mn steels with reduced weldability and for cladding carbon steels. Can also be used as a buffer layer prior to hard surfacing.

Notes on Usage

- The shielding gas should be used Ar or Ar+2~5%O_2 for welding.
- Welders for solid wire can be used but as wire is softer than solid wire, pay full attention to adjust feeding roller and do not tighten them excessively.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	170~270	25~30	10~20
1.6	200~350	25~30	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : Ar)

C	Mn	Si	P	S	Cr	Ni	Mo
0.08	4.09	0.81	0.022	0.009	19.01	9.45	0.15

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : Ar)

Y.P MPa	T.S MPa	EL(%)	IV J (-20℃)
476	594	40	86

Welding position

WT-308L(P)

For 18%Cr-8%Ni stainless steel

KS D3612 YF308LC
AWS A5.22 E308LT0(1)-1(4)
JIS Z3323 TS308L-FB0(1)

Applications

WT-308L(P) is designed for the welding of low carbon 18%Cr-8%Ni stainless steels.

Characteristics on Usage

- WT-308L is a titania type of flux cored wire for flat and horizontal position welding.
- WT-308LP is a titania type of flux cored wire for all-position welding.
- It provides the excellent usability with stable arc, less spattering, good bead appearance, better slag removal, and less quantity of welding fume comparable to solid wire.
- The weld metal contains optimum ferrite contents in their austenitic structures. Therefore their weldability is excellent with lower crack susceptibility.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	130~240	25~30	10~20
1.6	170~290	25~30	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

	C	Mo	Si	P	S	Cr	Ni	Ferrite No
WT-308L	0.03	1.35	0.65	0.020	0.010	19.6	9.6	8
WT-308LP	0.03	1.38	0.62	0.022	0.009	19.8	9.8	10

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

	Y.S MPa	T.S MPa	EL(%)	IV J (-20℃)
WT-308L	431	570	40	48
WT-308LP	422	572	41	46

Welding positions

Approved by

ABS, DNV, BV, LR, JIS, CE

WT-309L(P)

For 22%Cr-12%Ni stainless steel

KS D3612 YF309LC
AWS A5.22 E309LT0(1)-1(4)
JIS Z3323 TS309L-FB0(1)

Applications

WT-309L(P) is designed for the welding of dissimilar metals such as stainless steels and carbon steels or stainless steels and low alloy steels.

Characteristics on Usage

- WT-309L is a titania type of flux cored wire for flat and horizontal position welding.
- WT-309LP is a titania type of flux cored wire for all-position welding.
- It provides the excellent usability with stable arc, less spattering, good bead appearance, better slag removal, and less quantity of welding fume comparable to solid wire.
- The weld metal contains optimum ferrite contents in their austenitic structures, Therefore their weldability is excellent with lower crack susceptibility.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	150~280	25~33	10~20
1.6	200~350	25~33	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

	C	Mn	Si	P	S	Cr	Ni	Ferrite No
WT-309L	0.035	1.30	0.75	0.022	0.009	22.80	12.30	18
WT-309LP	0.029	1.33	0.64	0.019	0.011	23.30	12.80	20

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

	Y.S MPa	T.S MPa	EL(%)	IV J (-20℃)
WT-309L	432	590	37	50
WT-309LP	436	593	38	48

Welding positions

Approved by

ABS, DNV, BV, JIS, CE

WT-309MoL

For 22%Cr-12%Ni-2%Mo stainless steel

KS D3612 YF309MoLC
AWS A5.22 E309LMoT1-1(4)
JIS Z3323 TS309LMo-FC1

Applications

Main uses are for the applications of resistance to heat and corrosion and for the joining of stainless steels to mild or low alloy steels.

Characteristics on Usage

- WT-309MoL is a titania type of flux cored wire for all-position welding.
- It provides the excellent usability with stable arc, less spattering, good bead appearance, better slag removal, and less quantity of welding fume comparable to solid wire.
- Weld metals contain comparatively much more ferrite in their austenitic, therefore they provide better weldability together with superior heat resistance, and corrosion resistance.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	150~300	24~33	10~20
1.6	200~400	24~30	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Ni	Mo	Ferrite No
0.035	1.20	0.60	0.017	0.010	22.80	13.30	2.50	20

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.P MPa	T.S MPa	EL(%)	IV J (-20℃)
550	680	33	40

Welding positions

WT-M309L

For 22%Cr-12%Ni stainless steel

KS D3612 YF309LG
AWS A5.22 E309LT0-G
JIS Z3323 TS309L-MA0

Applications

Main uses are for thin plate stainless steels and for the welding of automotive mufflers in 22%Cr-12%Ni stainless steels.

Characteristics on Usage

- WT-M309L is a metal type stainless steel flux cored wire for welding of 22%Cr-12%Ni steel, heat resistant cast steel and for the joining of chrome nickel clad steels to Cr-Mo steel or mild steel. This wire is designed for flat and horizontal fillet welding.
- It is weld metal contains ferrite in austenitic structure, it gives excellent weldability, good corrosion and heat resistance.

Notes on Usage

- The shielding gas should be used Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	170~270	25~30	10~20
1.6	200~350	25~30	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Ni
0.03	1.71	0.55	0.020	0.009	24.1	12.6

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)	IV J (-20℃)
440	575	42	58

Welding positions

WT-310

AWS A5.22 E310T0-1(4)

For 25%Cr-20%Ni stainless steel

Applications

WT-310 is designed for MAG welding of 310S stainless steels.

Characteristics on Usage

- WT-310 is a titania type of flux cored wire for flat and horizontal position welding.
- It provides the excellent usability with stable arc, less spattering, good bead appearance, better slag removal, and less quantity of welding fume comparable to solid wire.
- The weld metal provide better weldability together with superior heat resistance, and corrosion resistance.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	130~200	25~33	10~20
1.6	170~250	25~33	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Ni	Mo
0.17	1.83	0.61	0.020	0.006	25.5	21.1	0.08

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.P MPa	T.S MPa	EL(%)	IV J (-20℃)
470	610	34	45

Welding positions

WT-312

For dissimilar joints, buffer layer

AWS A5.22 E312T1-1(4)
JIS Z3323 TS312-FC1

Applications

WT-312 is designed for MAG welding of 30%Cr-9%Ni stainless steels and it is used for joining dissimilar steels, steels with reduced weldability and buffer layer prior to hardfacing (rolls, forging dies, hotwork tools, dies for plastics and so on)

Characteristics on Usage

- WT-312 is a titania type of flux cored wire for all-position welding.
- It provides the excellent usability with stable arc, less spattering, good bead appearance as the same as that of a sold MIG wire.
- It has resistance to stress corrosion and highly insensitive to dilution and good scaling resistance up to 1150℃.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.
- When heat input is excessive, base metal will be bended or distorted due to the bad heat conductivity. Therefore perform welding with selecting proper heat input.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	130~220	25~30	10~20
1.6	170~250	25~30	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Ni	Mo
0.10	1.20	0.70	0.024	0.006	28.3	9.4	0.10

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.P MPa	T.S MPa	EL(%)
610	780	25

Welding positions

WT-316L(P)

For 18%Cr-12%Ni-2%Mo stainless steel

KS D3612 YF316LC
AWS A5.22 E316LT0(1)-1(4)
JIS Z3323 TS316L-FB0(1)

Applications

WT-316L(P) is designed for MAG welding of 18%Cr-12%Ni-2%Mo stainless steels or for the welding of dissimilar joints of stainless steels.

Characteristics on Usage

- WT-316L is a titania type of flux cored wire for flat and horizontal position welding.
- WT-316LP is a titania type of flux cored wire for all-position welding.
- Wire has low spatter, easy slag removal and good weld soundness.
- The weld metal contains optimum ferrite contents in their austenitic structures. Therefore their weldability is excellent with lower crack susceptibility.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	130~240	25~30	10~20
1.6	170~290	25~30	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

품명	C	Mn	Si	P	S	Cr	Ni	Mo	Ferrite No
WT-316L	0.030	1.42	0.62	0.020	0.011	18.56	12.39	2.3	8
WT-316LP	0.031	1.33	0.60	0.021	0.010	18.61	12.44	2.5	7

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

	Y.P MPa	T.S MPa	EL(%)	IV J (-20℃)
WT-316L	425	575	42	55
WT-316LP	422	578	42	58

Welding positions

Approved by

ABS, DNV, JIS, CE

WT-317L

For 18%Cr-12%Ni-3%Mo stainless steel

KS D3612 YF317LC
AWS A5.22 E317LT1-1(4)
JIS Z3323 TS317-FC1

Applications

WT-317L is designed for the welding of low carbon 18%Cr-12%Ni-2%Mo and 19%Cr-13%Ni-3%Mo stainless steels.

Characteristics on Usage

- WT-317L is a titania type of flux cored wire for all-position welding.
- It has self-detaching slag, spray-like arc transfer, excellent weldability and increased creep resistance at elevated temperature.
- It contains higher levels of Mo for increased corrosion-resistance when compared to the WT-316L.
- The weld metal contains optimum ferrite contents in their austenitic structures, Therefore their weldability is excellent with lower crack susceptibility.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	130~220	24~33	10~20
1.6	170~250	24~33	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Ni	Mo
0.03	1.20	0.80	0.021	0.009	18.4	12.5	3.4

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.P MPa	T.S MPa	EL(%)	IV J (-20℃)
460	600	34	35

Welding positions

WT–347

For 18%Cr–8%Ni–Nb stainless steel

KS D3612 YF347C
AWS A5.22 E347T1–1
JIS Z3323 TS347–FC1

Applications

WT–347 is designed for the welding of 19%Cr–9%Ni–Nb stainless steels.

Characteristics on Usage

- WT–347 is a titania type of flux cored wire for all–position welding.
- It has low spatter generation, easy slag removal and good weld soundness.
- Nb component improves the resistance to intergranular corrosion of the weld metal.
- The weld metal contains optimum ferrite contents in their austenitic structures. Therefore their weldability is excellent with lower crack susceptibility.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	130~220	25~30	10~20
1.6	170~250	25~30	15~25

Typical Chemical Composition of All–Weld–Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Ni	Nb
0.027	1.00	0.90	0.021	0.006	18.5	9.5	0.4

Typical Mechanical Properties of All–Weld–Metal (Shielding gas : CO_2)

Y.P MPa	T.S MPa	EL(%)	IV J (–60℃)
430	590	37	50

Welding positions

WT-904L

For 20%Cr-25%Ni-4.5%Mo-1.5%Cu stainless steel

Applications

Welding of 20%Cr-25%Ni-4.5%Mo-1.5%Cu stainless steel.
EN ISO 17633-A : 20 25 5 Cu NLP M21 2I.

Characteristics on Usage

- Rutile flux cored stainless steel wire for gas shielded arc welding.
- Attractive bead appearance, very good penetration and high productivity.
- Excellent X-ray soundness.
- Specifically designed for out-of-position welding.
- Maximum productivity for completion of vertical welds.
- Welded with classical economical Ar-CO_2 mixtures.

Notes on Usage

- Use Ar+15~25% CO_2 gas.
- Gas flow rate is proper 20~25ℓ /min.

Size Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	120~220	24~33	10~20
1.6	150~250	24~33	15~25

Typical Chemical Composition of All-Weld Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Ni	Cu	Mo
0.02	1.6	0.43	0.02	0.006	20.6	25.2	1.36	4.8

Typical Mechanical Properties of All-Weld Metal (Shielding gas : MIX)

T.S (MPa)	EL (%)	CVN-Impact Value J (-196℃)
609	38	59

Welding positions

WT-2209

AWS A5.22 E2209T1-1(4)
JIS Z3323 TS2209-FB1

For 22%Cr-9%Ni-2%Mo-0.15%N Duplex stainless steel

Applications

WT-2209 is designed for the welding of 23%Cr-9%Ni-3%Mo duplex stainless steels and this principal area of application is chemical plant and shipbuilding as well as nuclear plant industries.

Characteristics on Usage

- WT-2209 is a titania type of flux cored wire for all-position welding.
- It has low spatter generation, easy slag removal and good weld soundness.
- It is excellent in pitting corrosion resistance and stress corrosion cracking resistance.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	120~220	24~33	10~20
1.6	150~250	24~33	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Ni	Mo	N	Ferrite No
0.030	0.80	0.60	0.020	0.007	22.40	8.6	2.9	0.12	48

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	IV J (-20℃)
685	800	27	54

Welding positions

WT-2553

AWS A5.22 E2553T1-1(4)
JIS Z3323 TS329J4L-FC1

For 25%Cr-9%Ni-3%Mo-Cu-N Super Duplex stainless

Applications

WT-2553 is designed for the welding of 25%Cr-9%Ni-3%Mo-Cu super duplex stainless steels and this typical application is chemical plant and shipbuilding as well as nuclear plant industries. (UNS S32520, UNS S32550, S32750, S32900, JIS 329J4L)

Characteristics on Usage

- WT-2553 is a rutile type of flux cored wire for all-position welding.
- It has low spatter generation, easy slag removal and good weld soundness.
- It is excellent in pitting corrosion resistance and stress corrosion cracking resistance.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	120~220	24~33	10~20
1.6	150~250	24~33	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	Cr	Ni	Mo	Cu	N	Ferrite No
0.030	0.91	0.55	25.4	9.1	3.6	1.9	0.15	55

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	IV J (-20℃)
710	860	25	46

Welding positions

WT-2594

A5.22 E2594T1-1(4)

For 25%Cr-9%Ni-4%Mo-Cu-N Super Duplex stainless

Applications

WT-2594 is designed for the welding of 25%Cr-9%Ni-4%Mo-Cu super duplex stainless steels and this typical application is chemical plant and shipbuilding as well as nuclear plant industries. (UNS S32750, UNS S32760, S32900)

Characteristics on Usage

- WT-2594 is a rutile type of flux cored wire for all-position welding.
- It has low spatter generation, easy slag removal and good weld soundness.
- It is excellent in pitting corrosion resistance and stress corrosion cracking resistance.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	120~220	24~33	10~20
1.6	150~250	24~33	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	Cr	Ni	Mo	Cu	N
0.03	0.90	0.54	26.8	8.9	4.1	0.09	0.24

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	IV J (-20℃)
715	880	24	51

Welding positions

WT-409Ti

AWS A5.22 E409T0-G
JIS Z3323 TS409-MA0

For 13%Cr-Ti stainless steel(Muffler)

Applications

WT-409Ti is a metal type flux cored wire designed for the horizontal fillet welding of AISI 409 ferrite stainless steels.

Characteristics on Usage

- This wire has been specifically formulated for use in the welding of automotive exhaust systems and mufflers.
- It benefits from being spatter free and without slag formation when used with argon or argon oxygen mixed shielding gas.
- High speed welding can be carried out with this product on thin plate material without burning through.

Notes on Usage

- The shielding gas should be used Ar or Ar+2%O_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	180~340	24~33	10~20
1.6	200~400	24~33	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Ti
0.032	0.54	0.62	0.014	0.012	11.30	0.90

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)
410	520	25

Welding positions

WT-410

AWS A5.22 E410T1-1(4)
JIS Z3323 TS410-FB1

For 13%Cr stainless steel(Hardfacing)

Applications

WT-410 is designed for MAG welding of martensite stainless alloys of the 13%Cr types and for surfacing of sealing faces of valves for gas, water, and steam piping system at service temperatures up to 450℃.

Characteristics on Usage

- WT-410 is a metal type of flux cored all-position welding.
- It is suitable for the first layer of corrosion resistant weld claddings.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.
- Preheat at 150~300℃ and PWHT at 750℃.

Size Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	180~340	24~33	10~20
1.6	200~400	24~33	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Ni	Mo
0.04	0.62	0.53	0.020	0.009	13.1	0.3	0.02

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	PWHT
370	530	31	750℃ X 1Hr

Welding positions

WT-410NiMo

AWS A5.22 E410NiMoT1-1(4)
JIS Z3323 TS410NiMo-FB1

For 13%Cr-4%Ni-Mo stainless steel(Hardfacing)

Applications

WT-410NiMo is designed for MAG welding of soft-martensite stainless alloys of the 13%Cr-4%Ni-Mo types.

Characteristics on Usage

- WT-410NiMo is a titania type flux cored wire for all position welding.
- It features very good ductility, CVN toughness and crack resistance.
- Arc stability is excellent, so spatter loss is low and slag covering is uniform with good removability.

Notes on Usage

- The shielding gas should be used 100%CO_2 or Ar+20~25%CO_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.
- Preheat at 150~300℃ and PWHT at 600℃.

Size Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	180~340	24~33	10~20
1.6	200~400	24~33	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Cr	Ni	Mo	Cu
0.06	0.85	0.55	0.022	0.012	12.3	4.4	0.42	0.02

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	PWHT
780	900	18	600℃ X 1Hr

Welding positions

WT-430

For 17%Cr-Ti stainless steel(Muffler)

AWS A5.22 E430T1-G
JIS Z3323 TS430-MA1

F
C
A
W

Applications

WT-430 is designed for MAG welding of ferrite stainless alloys of the 17%Cr-Ti types and for automotive exhaust fabricators such as front pipe, bellows, flange, etc.

Characteristics on Usage

- WT-430 is a metal type of flux cored wire for high speed welding.
- This wire gives excellent bead appearance and provides the operator with a soft stable arc and very low spatter levels thus giving enhanced cosmetic appearance.
- It provide higher corrosion resistance, heat resistance due to high alloy designs and also suitable for surfacing of sealing faces of gas, water and steam valves.

Notes on Usage

- The shielding gas should be used Ar+2%O_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Size Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Voltage(V)	Electrode extension(mm)
1.2	180~340	24~33	10~20
1.6	200~400	24~33	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Ti
0.032	0.52	0.55	0.014	0.008	16.3	0.9

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)
452	532	26

Welding positions

WT-436

For 17%Cr stainless steel(Muffler)

Applications

WT-436 is a metal cored wire for horizontal, fillet and flat position welding of 409,430 and 436 type stainless steels as found in ferrite stainless steels automotive mufflers.

Characteristics on Usage

- WT-436 is a metal type of flux cored wire for high speed welding.
- This wire gives excellent bead appearance and provides the operator with a soft stable arc and very low spatter levels thus giving enhanced cosmetic appearance.
- It is also suitable for surfacing of sealing faces of gas, water and steam valves.

Notes on Usage

- The shielding gas should be used Ar+2%O_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Sizes Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Electrode extension(mm)
1.2	200~270	10~20
1.6	220~350	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Mo	Ti
0.022	0.41	0.40	0.009	0.012	17.0	1.09	0.60

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)
395	487	23

Welding positions

WT-439

For 17%Cr-Ti stainless steel(Muffler)

Applications

WT-439 is a metal cored wire designed for flat and horizontal fillet welding of AISI 439 ferrite stainless steels.

Characteristics on Usage

- WT-439 is a metal type of flux cored wire for high speed welding.
- This wire gives excellent bead appearance and provides the operator with a soft stable arc and very low spatter levels thus giving enhanced cosmetic appearance.
- It has the high tensile strength at the high temperature atmosphere.

Notes on Usage

- The shielding gas should be used Ar+2%O_2 for welding.
- Gas flow rate is proper 20~25ℓ/min.

Size Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Electrode extension(mm)
1.2	200~270	10~20
1.6	220~350	15~25

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Ti
0.034	0.46	0.32	0.012	0.008	17.50	0.30

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)
480	510	22

Welding positions

WT-625

Inconel 625, Incoloy 825

A5.34 ENiCrMo3T1-1/4

Applications

WT-625 is designed for welding of Inconel 600 + 625 and Nickel alloys, 9% Nickel steels. (LNG storage tank manufacture, desulfurization, Heat exchanger, Building of chemical carrier)

Characteristics

- It can be used for surfacing of 9% Ni steels or dissimilar welding of Inconel to stainless steels.
- The weld metal has high strength at room and elevated temperatures and has exceptional corrosion resistance.

Notes on Usage

- Use Ar+20~25% CO_2 gas.
- Gas flow rate is proper 20~25ℓ/min.

Size Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Electrode extension(mm)
1.2	200~270	10~20
1.6	220~350	15~25

Typical Chemical Composition of All-Weld Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Ni	Mo	Cu	Nb+Ta	Fe	Nb
0.03	0.34	0.40	0.003	0.005	21.8	62.5	8.52	0.13	3.4	0.7	3.42

Typical Mechanical Properties of All-Weld Metal (Shielding gas : MIX)

T.S (MPa)	EL (%)	CVN-Impact Value J (-196℃)
758	35	65

Welding positions

WT-276

A5.34 ENiCrMo4T1-4

Hastelloy C-276

Applications

Pumps, valves, pipework and vessels for use in aggressive environments in chemical process plants, also in equipment for flue gas desulphurization and critical equipment in offshore oil and gas production.

Characteristics

- It can be used for surfacing steels and dissimilar welding of nickel alloys, steels and stainless steels.
- The weld metal has excellent resistance on pitting and crevice corrosion.

Notes on Usage

- Use Ar+20~25% CO_2 gas.
- Gas flow rate is proper 20~25ℓ /min.

Size Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Electrode extension(mm)
1.2	200~270	10~20
1.6	220~350	15~25

Typical Chemical Composition of All-Weld Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Ni	Mo	Cu	W	Fe	Co	V
0.02	0.58	0.18	0.008	0.006	14.8	57.3	16.9	0.07	3.7	5.6	0.3	0.06

Typical Mechanical Properties of All-Weld Metal (Shielding gas : MIX)

T.S (MPa)	EL (%)	CVN-Impact Value J (0℃)
726	38	62

Welding positions

WT-82

A5.34 ENiCr3T1-4

INCONEL 600, 601, 690 Incoloy 800, 800HT

Applications

LNG and LPG storage plant, boilers of thermal power station.

Characteristics

- It can be used for dissimilar welding of Inconel 600 with steels or stainless steels.
- The weld metal has high strength and good corrosion resistance at elevated temperatures.

Notes on Usage

- Use Ar+20~25% CO_2 gas.
- Gas flow rate is proper 20~25ℓ /min.

Size Available and Recommended Currents (DC +)

Dia(mmØ)	Current(A)	Electrode extension(mm)
1.2	200~270	10~20
1.6	220~350	15~25

Typical Chemical Composition of All-Weld Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S	Cr	Ni	Cu	Nb+Ta	Fe	Ti
0.04	3.3	0.23	0.01	0.006	21.2	70.6	0.01	2.3	1.5	0.3

Typical Mechanical Properties of All-Weld Metal (Shielding gas : MIX)

T.S (MPa)	EL (%)	CVN-Impact Value J (-196℃)
655	43	62

Welding positions

FOR HARDFACING

	Hardness of weld metal (HV)	Typical Chemical Composition of All-Weld Metal (wt%)							
		C	Si	Mn	P	S	Cr	Mo	W
WT-250H	255	0.07	0.50	1.58	0.018	0.011	1.30	0.002	
Characteristics on Usage		- It is highly recommendable to use on wear plate and weld metal's hardness should be over							
WT-350H	360	0.12	0.45	1.36	0.015	0.011	1.30	0.21	
Characteristics on Usage		- It is highly recommendable to use on wear plate and weld metal's ardness should be over							
WT-450H	452	0.12	0.45	1.36	0.012	0.010	1.30	0.20	
Characteristics on Usage		- It is highly recommendable to use on wear plate and weld metal's hardness should be over							
WT-600H	605	0.34	2.80	0.50	0.013	0.008	6.50	0.51	
Characteristics on Usage		- It is highly recommendable to use on wear plate and weld metal's hardness should be over							
WT-700H	710	0.40	3.20	0.60	0.012	0.010	7.00		0.80
Characteristics on Usage		- It is highly recommendable to use on wear plate and weld metal's hardness should be over Hv 700.							
WT-800H	804	0.43	3.40	0.55	0.013	0.011	7.50		1.00
Characteristics on Usage		- It is highly recommendable to use on wear plate and weld metal's hardness should be over Hv 800							
WT-900B	895	1.63	0.44	0.64	0.011	0.018	10.5	0.05	B : 6.3
Characteristics on Usage		- It is highly recommendable to use on wear plate and weld metal's hardness should be over Hv 900							

Notes on Usage

100% CO_2 (15~25ℓ /min) DCEP(DC+)

Welding Position

SOLID WIRE

Mild steel & 490MPa high tensile steels

WM-70A

WM-70

WM-70G

WM-80

WM-70A

For mild steel and 490MPa tensile strength steel

KS D7025 YGW16
AWS A5.18 ER70S-3
JIS Z3312 YGW16

Applications

Butt and fillet welding of vehicles, buildings, ships, machinery, etc.

Characteristics on Usage

- WM-70A is a solid wire designed for all position welding and high speed welding of steel sheets can be performed easily by short-circuiting welding.
- Arc is stable and spatter loss is low.

Notes on Usage

- Shielding gas should be used Ar+20~25%CO_2.
- Use wind screen against wind.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		0.9	1.2	1.6
F, HF	Amp	50~220A	100~350A	200~400A
V-up		50~140A	80~160A	120~250A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : MIX)

C	Mn	Si	P	S
0.07	1.15	0.65	0.015	0.010

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : MIX)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
461	558	29	82

Welding position

WM-70

For mild steel and 490MPa tensile strength steel

KS D7025 YGW12
AWS A5.18 ER70S-6
JIS Z3312 YGW12

Applications

Butt and fillet welding of steel structures such as vehicles, machinery and bridges.

Characteristics on Usage

- WM-70 is a solid wire designed for all position welding by short-circuiting type transfer.
- As the deposition efficiency is high and penetration is deep, highly efficient welding can be performed.

Notes on Usage

- Shielding gas should be used 100%CO_2, Ar+20~25%CO_2.
- Use wind screen against wind.
- Keep distance between tip and base metal 6~15mm for less than 250A, and 15~25mm for more than 250A of welding current.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		0.9	1.2	1.6
F, HF	Amp	50~220A	100~350A	200~400A
V-up		50~140A	80~160A	120~250A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S
0.07	1.43	0.77	0.015	0.018

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
445	542	28	74

Welding position

WM-70G

For mild steel and 490MPa tensile strength steel

KS D7025 YGW15
AWS A5.18 ER70S-G
JIS Z3312 YGW15

Applications

Butt and fillet welding of ships, steel structures and machinery.

Characteristics on Usage

- WM-70G is a solid wire for flat and fillet welding and is to be used with a high current welding with Ar+CO_2 mixed gas.
- As this wire contains special elements, its weldability and impact values are excellent.

Notes on Usage

- Shielding gas should be used 100%CO_2, Ar+20~25%CO_2.
- Use wind screen against wind.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.6
F, HF	Amp	200~350A	300~500A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S
0.05	1.52	0.79	0.013	0.018

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
455	568	28	85

Welding position

WM-80

For mild steel and 590MPa tensile strength steel

KS D7025 YGW21
AWS A5.18 ER80S-G
JIS Z3312 G 57A 1 U C 3M1T

Applications

Butt and fillet welding of steel structures and using 550MPa or 600MPa tensile steels such as construction machinery, buildings and pressure vessels.

Characteristics on Usage

- WM-80 is a solid wire for flat and horizontal fillet welding position. As the deposition rate is very high, highly efficient welding can be performed.
- As the wire contains special elements, its bead appearance is excellent.

Notes on Usage

- Shielding gas should be used 100%CO_2.
- Use wind screen against wind.

Sizes Available and Recommended Currents (DC +)

Position \ Dia(mmØ)		1.2	1.6
F, HF	Amp	200~350A	250~400A

Typical Chemical Composition of All-Weld-Metal (wt%) (Shielding gas : CO_2)

C	Mn	Si	P	S	Mo	Ti
0.06	1.82	0.80	0.018	0.008	0.025	0.015

Typical Mechanical Properties of All-Weld-Metal (Shielding gas : CO_2)

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-20℃)
575	660	25	110

Welding position

MIG WIRE

Stainless steels
INCONEL

WMS-308

For 18%Cr-8%Ni Stainless steel

KS D7026 Y308
AWS A5.9 ER308
JIS Z3321 Y308

Characteristics on Usage

MIG welding of 18%Cr-8%Ni steel for chemical industries such as oil, medical, fertilizer and textile industries and for nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.04	1.60	0.46	19.88	9.62

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
442	611	40

WMS-308L

저탄소 18%Cr-8%Ni 스테인리스강용

KS D7026 Y308L
AWS A5.9 ER308L
JIS Z3321 Y308L

Characteristics on Usage

MIG welding of low carbon 18%Cr-8%Ni steel for chemical industries such as oil, medical, fertilizer and textile industries and for nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.01	1.72	0.48	19.68	9.66

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
396	584	43

WMS-308LSi

AWS A5.9 ER308LSi

For Low carbon 18%Cr-8%Ni Stainless steel

Characteristics on Usage

MIG welding of low carbon 18%Cr-8%Ni steel for chemical industries such as oil, medical, fertilizer and textile industries and for nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.01	1.66	0.85	19.64	9.98

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
374	580	42

WMS-309

KS D7026 Y309
AWS A5.9 ER309
JIS Z3321 Y309

For 22%Cr-12%Ni Stainless steel

Characteristics on Usage

MIG welding of 22%Cr-12%Ni steel, heat resistant cast steel clad side of 18%Cr-8%Ni clad steel and stainless steel to Cr-Mo steel or carbon steel.

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	Cr	Ni
0.05	1.55	0.44	23.22	13.28

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
422	612	41

WMS-309L

For Low carbon 22%Cr-12%Ni Stainless steel

KS D7026 Y309L
AWS A5.9 ER309L
JIS Z3321 Y309L

Characteristics on Usage

MIG welding of 22%Cr-12%Ni steel, heat resistant cast steel clad side of 18%Cr-8%Ni clad steel and stainless steel to Cr-Mo steel or carbon steel.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.01	1.64	0.45	23.10	13.78

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
428	587	42

WMS-310

For 25%Cr-20%Ni Stainless steel

KS D7026 Y310
AWS A5.9 ER310
JIS Z3321 Y310

Characteristics on Usage

MIG welding of 25%Cr-20%Ni stainless steel, welding on the clad side of stainless clad steel. Welding of dissimilar metals.

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	Cr	Ni
0.01	1.60	0.41	26.43	20.94

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
380	605	40

WMS-312

For 29%Cr-9%Ni Stainless steel

KS D7026 Y312
AWS A5.9 ER312
JIS Z3321 Y312

Characteristics on Usage

Mig Welding of 29%Cr-9%Ni stainless steel and dissimilar metals

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.11	1.84	0.42	30.54	8.78

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
434	728	30

WMS-316

For 18%Cr-12%Ni-Mo Stainless steel

KS D7026 Y316
AWS A5.9 ER316
JIS Z3321 Y316

Characteristics on Usage

MIG welding of 18%Cr-12%Ni-2%Mo stainless steel for chemical industries and nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo
0.04	1.62	0.44	19.42	12.16	2.32

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
418	584	38

WMS-316L

For Low carbon 18%Cr-12%Ni-Mo Stainless

KS D7026 Y316L
AWS A5.9 ER316L
JIS Z3321 Y316L

Characteristics on Usage

MIG welding of low carbon 18%Cr-12%Ni-2%Mo stainless steel for chemical industries and nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo
0.02	1.61	0.52	18.94	11.81	2.28

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
432	576	39

WMS-625

Inconel 625, Incoloy 825

KS D7045 YNiCrMo-3
AWS A5.14 ERNiCrMo-3
JIS Z3334 YNiCrMo-3

Characteristics on Usage

WMS-625 is designed for welding of Inconel 600 + 625 and Nickel alloys, 9% Nickel steels. (LNG storage tank manufacture, desulfurization, Heat exchanger, Building of chemical carrier)

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo
0.01	0.03	0.08	22.24	63.80	8.67

Typical Mechanical Properties of All-Weld-Metal

T.S MPa	EL(%)
769	40

WMS-276

Hastelloy C-276

KS D7045 YNiCrMo-4
AWS A5.14 ERNiCrMo-4
JIS Z3334 YNiCrMo-4

Characteristics on Usage

Pumps, valves, pipework and vessels for use in aggressive environments in chemical process plants, also in equipment for flue gas desulphurization and critical equipment in offshore oil and gas production.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo	W
0.01	0.50	0.04	15.84	57.64	16.02	3.67

Typical Mechanical Properties of All-Weld-Metal

T.S MPa	EL(%)
752	33

WMS-82

INCONEL 600, 601, 690 Incoloy 800, 800HT

KS D7045 YNiCr-3
AWS A5.14 ERNiCr-3
JIS Z3334 YNiCr-3

Characteristics on Usage

LNG and LPG storage plant, boilers of thermal power station.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Fe	Nb+Ta
0.02	3.05	0.10	20.29	71.85	1.07	2.42

Typical Mechanical Properties of All-Weld-Metal

T.S MPa	EL(%)
652	38

WMS-CuNi

Monel 450, Cupronickel

KS D7044 YCuNi-3
AWS A5.7 ERCuNi
JIS Z3341 YCuNi-3

Characteristics on Usage

Used for welding desalination plant, evaporators, etc in salt and sea water processing system.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cu	Ni	Ti
0.01	0.79	0.08	Rem	30.74	0.32

Typical Mechanical Properties of All-Weld-Metal

T.S MPa	EL(%)
344	30

WMS-CuNi9

UNS 69200, Cupronickel

KS D7044 YCuNi-1
JIS Z3341 YCuNi-1

Characteristics on Usage

Used for welding of offshore oil/gas, and petrochemical process industries.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cu	Ni	Ti	Fe
0.03	0.85	0.03	Rem	10.48	0.32	0.30

Typical Mechanical Properties of All-Weld-Metal

T.S MPa	EL(%)
374	38

TIG WIRE

Mild steel & 490MPa high tensile steels

Stainless steels

INCONEL

WTS-50

For mild steels and 490MPa tensile strength steel

KS D7140 YGT50
AWS A5.18 ER70S-G
JIS Z3316 YGT50

Characteristics on Usage

Butt and fillet welding of carbon steel for pressure vessels, tubes for nuclear reactors, ships, penstock and aluminum-killed steel for low temperature service.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	P	S
0.07	1.52	0.84	0.012	0.014

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-30℃)
488	582	30	118

WTS-506

For mild steels and 490MPa tensile strength steel

KS D7140 YGT50
AWS A5.18 ER70S-6
JIS Z3316 YGT50

Characteristics on Usage

Butt and fillet welding of carbon steel for pressure vessels, tubes for nuclear reactors, ships, penstock and aluminum-killed steel for low temperature service.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	P	S
0.07	1.54	0.81	0.012	0.015

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)	CVN-Impact Value J (-30℃)
492	586	31	104

WTS-2209

AWS A5.9 ER2209

For Duplex stainless steels

Characteristics on Usage

Used for welding of offshore oil/gas, chemical and petrochemical process industries, e.g. pipework systems, flowlines, risers, manifolds etc.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo
0.01	1.67	0.40	22.68	8.72	3.09

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
600	815	36

WTS-308

KS D7026 Y308
AWS A5.9 ER308
JIS Z3321 Y308

For 18%Cr-8%Ni Stainless steel

Characteristics on Usage

TIG welding of 18%Cr-8%Ni steel for chemical industries such as oil, medical, fertilizer and textile industries and for nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.04	1.84	0.42	19.80	9.72

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
402	578	42

WTS-308H

AWS A5.9 ER308H

For 18%Cr-8%Ni Stainless steel

Characteristics on Usage

TIG welding of low carbon 18%Cr-8%Ni steel for chemical industries such as oil, medical, fertilizer and textile industries and for nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.05	2.04	0.44	19.80	9.78

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
368	587	41

WTS-308L

KS D7026 Y308L
AWS A5.9 ER308L
JIS Z3321 Y308L

For Low carbon 18%Cr-8%Ni Stainless steel

Characteristics on Usage

TIG welding of low carbon 18%Cr-8%Ni steel for chemical industries such as oil, medical, fertilizer and textile industries and for nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.02	1.88	0.38	19.74	9.78

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
394	581	43

WTS-308LSi

AWS A5.9 ER308LSi

For Low carbon 18%Cr-8%Ni Stainless steel

Characteristics on Usage

TIG welding of low carbon 18%Cr-8%Ni steel for chemical industries such as oil, medical, fertilizer and textile industries and for nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.01	1.68	0.85	19.64	9.98

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
374	580	42

WTS-309

KS D7026 Y309
AWS A5.9 ER309
JIS Z3321 Y309

For 22%Cr-12%Ni Stainless steel

Characteristics on Usage

TIG welding of 22%Cr-12%Ni steel and a variety welding stainless with mild steel.
Clad steel side of 18%Cr-8%Ni clad steel.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.05	1.55	0.42	23.14	13.09

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
422	608	40

WTS-309L

For Low carbon 22%Cr-12%Ni Stainless steel

KS D7026 Y309L
AWS A5.9 ER309L
JIS Z3321 Y309L

Characteristics on Usage

TIG welding of low carbon 22%Cr-12%Ni steel and a variety welding stainless with mild steel.
Clad steel side of 18%Cr-8%Ni clad steel.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.01	1.64	0.46	23.10	13.78

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
410	590	42

WTS-309LSi

For Low carbon 22%Cr-12%Ni Stainless steel

AWS A5.9 ER309LSi

Characteristics on Usage

TIG welding of low carbon 22%Cr-12%Ni steel and a variety welding stainless with mild steel.
Clad steel side of 18%Cr-8%Ni clad steel.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.01	1.84	0.90	23.10	13.64

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPpa	EL(%)
412	545	42

WTS-310

For 25%Cr-20%Ni Stainless steel

KS D7026 Y310
AWS A5.9 ER310
JIS Z3321 Y310

Characteristics on Usage

TIG welding of 25%Cr-20%Ni steel.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.10	1.60	0.41	26.73	20.84

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
375	576	42

WTS-312

For 29%Cr-9%Ni Stainless steel

KS D7026 Y312
AWS A5.9 ER312
JIS Z3321 Y312

Characteristics on Usage

TIG Welding of 29%Cr-9%Ni stainless steel and dissimilar metals.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.11	1.82	0.41	30.63	8.94

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
512	786	26

WTS-316

For 18%Cr-12%Ni-Mo Stainless steel

KS D7026 Y316
AWS A5.9 ER316
JIS Z3321 Y316

Characteristics on Usage

TIG welding of 18%Cr-12%Ni-2%Mo stainless steel for chemical industries and nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo
0.04	1.60	0.44	19.23	12.12	2.26

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
418	574	40

WTS-316L

For Low carbon 18%Cr-12%Ni-Mo Stainless steel

KS D7026 Y316L
AWS A5.9 ER316L
JIS Z3321 Y316L

Characteristics on Usage

TIG welding of low carbon 18%Cr-12%Ni-2%Mo stainless steel for chemical industries and nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo
0.02	1.68	0.42	18.64	11.82	2.24

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
426	566	40

WTS-316LSi

AWS A5.9 ER316LSi

For Low carbon 18%Cr-12%Ni-Mo Stainless steel

Characteristics on Usage

TIG welding of low carbon 18%Cr-12%Ni-2%Mo stainless steel for chemical industries and nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo
0.01	1.55	0.88	18.62	11.64	2.51

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
422	569	36

WTS-317L

KS D7026 Y317L
AWS A5.9 ER317L
JIS Z3321 Y317L

For Low carbon 20%Cr-14%Ni-Mo Stainless steel

Characteristics on Usage

TIG welding of low carbon 20%Cr-14%Ni-3.5%Mo stainless steel for chemical industries and nuclear reactors.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo
0.01	1.64	0.38	19.06	13.54	3.10

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
396	564	35

WTS-347

For 20%Cr-10%Ni-Nb Stainless steel

KS D7026 Y347
AWS A5.9 ER347
JIS Z3321 Y347

Characteristics on Usage

TIG Welding of 18%Cr-8%Ni-Nb(SUS 347) and 18%Cr-8%Ni-Ti(SUS321) stainless steel

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Nb+Ta
0.05	1.55	0.41	19.04	9.12	0.68

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
404	628	40

WTS-410

For 12%Cr Stainless steel

KS D7026 Y410
AWS A5.9 ER410
JIS Z3321 Y410

Characteristics on Usage

TIG Welding of 13%Cr stainless steel (STS 403, STS 410)

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.01	0.36	0.32	12.61	0.20

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
332	538	37

WTS-420

For 12%Cr Stainless steel

AWS A5.9 ER420

Characteristics on Usage

TIG Welding of 12%Cr martensite stainless steels. (AISI 420)

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.33	0.42	0.38	12.56	0.15

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)
334	514	21

WTS-430

For 16%Cr Stainless steel

KS D7026 Y430
AWS A5.9 ER430
JIS Z3321 Y430

Characteristics on Usage

TIG Welding of 16%Cr ferrite stainless steel (AISI 409, 430Ti, 431, ASTM A176)

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni
0.01	0.39	0.32	16.64	0.24

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa	T.S MPa	EL(%)	PWHT
324	536	37	760℃ X 2Hr

WTS-625

Inconel 625, Incoloy 825

KS D7045 YNiCrMo-3
AWS A5.14 ERNiCrMo-3
JIS Z3334 YNiCrMo-3

Characteristics on Usage

WTS-625 is designed for welding of Inconel 600 + 625 and Nickel alloys, 9% Nickel steels. (LNG storage tank manufacture, desulfurization, Heat exchanger, Building of chemical carrier)

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo	Nb
0.01	0.03	0.08	22.24	63.80	8.67	3.42

Typical Mechanical Properties of All-Weld-Metal

T.S MPa	EL(%)
778	41

WTS-276

Hastelloy C-276

KS D7045 YNiCrMo-4
AWS A5.14 ERNiCrMo-4
JIS Z3334 YNiCrMo-4

Characteristics on Usage

Pumps, valves, pipework and vessels for use in aggressive environments in chemical process plants, also in equipment for flue gas desulphurization and critical equipment in offshore oil and gas production.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Mo	W
0.01	0.50	0.04	15.84	57.64	16.02	3.67

Typical Mechanical Properties of All-Weld-Metal

T.S MPa	EL(%)
746	33

WTS-82

INCONEL 600, 601, 690 Incoloy 800, 800HT

KS D7045 YNiCr-3
AWS A5.14 ERNiCr-3
JIS Z3334 YNiCr-3

Characteristics on Usage

LNG and LPG storage plant, boilers of thermal power station.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cr	Ni	Fe	Nb+Ta
0.02	3.08	0.11	20.32	71.91	1.05	2.48

Typical Mechanical Properties of All-Weld-Metal

T.S MPa	EL(%)
649	39

WTS-CuNi

Monel 450, Cupronickel

KS D7044 YCuNi-3
AWS A5.7 ERCuNi
JIS Z3341 YCuNi-3

Characteristics on Usage

Used for welding desalination plant, evaporators, etc in salt and sea water processing system.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cu	Ni	Ti
0.01	0.80	0.08	Rem	30.70	0.30

Typical Mechanical Properties of All-Weld-Metal

T.S MPa	EL(%)
348	30

WTS-CuNi9

UNS 69200, Cupronickel

KS D7044 YCuNi-1

JIS Z3341 YCuNi-1

Characteristics on Usage

Used for welding of offshore oil/gas, and petrochemical process industries.

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	Cu	Ni	Ti	Fe
0.02	0.85	0.04	Rem	10.46	0.31	0.30

Typical Mechanical Properties of All-Weld-Metal

T.S MPa	EL(%)
370	37

SMAW

Mild steel & 490MPa high tensile steels

For Low Alloy Heat Resistant Steel

For Low Temperature Service Steel

For Cast Iron

Stainless steels

INCONEL

W 4301

For 420MPa mild steel

KS D7004 E4301
AWS A5.1 E6019
JIS Z3211 E4319

Applications

Welding of such parts, where the highest reliability is required, such as strength members of ship hulls, high pressure vessels and buildings.

Characteristics

- W 4301 is ilmenite type covered electrode which is designed for better weldability in particular.
- Welding of such parts, where the highest reliability is required, such as strength members of ship hulls, high pressure vessels and buildings.
- W 4301 is lime–titania type electrodes for all–position welding, which has excellent usability.
- Its crack resistibility and X–ray soundness are excellent.
- The most excellent mechanical properties and also suitable for welding of structural steels of heavy section about 25mm thickness.

Notes on Usage

- Pay attention not to exceed the range of proper currents in case of welding structures which require weld metal of high X–ray soundness.
- Dry the electrodes at 70~100℃ for 30~60 minutes before use. Excessive moisture absorption lowers usability and may result in some porosities.
- Excessive drying before use causes less penetration and overheating of the electrode.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0	6.0
Length (mm)		300	350	350	400	400	450
Current (A)	F	35~55	50~85	80~130	120~180	170~250	240~310
	V–up & OH	30~50	45~70	60~110	110~150	130~200	–

Typical Chemical Composition of All–Weld Metal (wt%)

C	Mn	Si	P	S
0.08	0.42	0.13	0.015	0.014

Typical Mechanical Properties of All–Weld–Metal

Y.S (MPa)	T.S (MPa)	EL (%)	CVN–Impact Value J (–20℃)
400	470	32	100

Welding positions

W 6013

For 420MPa mild steel

KS D7004 E4313
AWS A5.1 E6013
JIS Z3211 E4313

Applications

Welding of shells of railway vehicles, cars and other steel sheet structures and general light structural steels.

Characteristics

- W 6013 is a high titania type electrode which provides good usability in all positions.
- The arc is stable with little spatter and the lustrous bead can be obtained.
- W 6013 is suitable for welding steel sheets and light structures because of shallow penetration.

Notes on Usage

- Pay attention not to exeed the range of proper currents. Welding with excessive current not only lowers X-ray soundness, but also causes increase of spatter, under-cut.
- Dry the electrodes at 70~100℃ for 30~60 minutes before use. Excessive moisture absorption lowers usability and may result in some porosities.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0	6.0
Length (mm)		300	350	350	400	400	450
Current (A)	F	30~65	45~100	60~130	105~170	150~230	200~280
	V-up & OH	30~65	45~90	60~110	100~150	125~200	–

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S
0.06	0.43	0.29	0.018	0.012

Typical Mechanical Properties of All-Weld Metal

Y.S (MPa)	T.S (MPa)	EL (%)
430	480	28

Welding positions

W 7016

For 490MPa High tensile steel

KS D7006 E5016
AWS A5.1 E7016
JIS Z3211 E4916

Applications

Welding of 50kgf/mm^2 class high tensile strength steel of ships, bridges structure and pressure vessels.

Characteristics

- Excellent crack resistance even in the welding of difficult to weld steels.
- W 7016 is a low hydrogen type electrode with excellent crack resistance.

Notes on Usage

- Remove dirts such as oil and scale from the groove.
- Dry the electrodes at 300~350℃ for 30~60 minutes before use.
- Keep the arc as short as possible.
- Take the backstep method or strike the arc on a small steel plate prepared to prevent blowholes at the arc starting.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.6	3.2	4.0	5.0	6.0
Length (mm)		350	350	400	400	450
Current (A)	F	55~85	90~130	130~180	180~240	250~310
	V-up & OH	50~80	80~120	110~170	150~200	–

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S
0.08	1.05	0.62	0.014	0.010

Typical Mechanical Properties of All-Weld-Metal

Y.S (MPa)	T.S (MPa)	EL (%)	CVN-Impact Value J (-30℃)
490	560	31	150

Welding positions

W 7018

For 490MPa high tensile steel

KS D7006 E5016
AWS A5.1 E7018
JIS Z3211 E4916

Applications

Welding of 50kgf/mm^2 class high tensile strength steel of ships, bridges and structure.

Characteristics

- W 7018 is iron powder low hydrogen type electrode for all–position welding.
- Its usability is the best with direct current application as well as alternating current application.

Notes on Usage

- Remove dirts such as oil and scale from the groove.
- Dry the electrodes at 350~400℃(662~752℉) for 60 minutes before use.
- Keep the arc as short as possible
- Take the backstep method or strike the arc on a small steel plate prepared to prevent blowholes at the arc starting.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.6	3.2	4.0	5.0	6.0
Length (mm)		350	350	400	400	450
Current (A)	F	60~100	90~130	130~180	180~240	250~300
	V–up & OH	50~80	80~120	110~170	150~200	–

Typical Chemical Composition of All–Weld Metal (wt%)

C	Mn	Si	P	S
0.07	1.10	0.55	0.017	0.011

Typical Mechanical Properties of All–Weld Metal

Y.S (MPa)	T.S (MPa)	EL (%)	CVN–Impact Value J (–30℃)
505	575	30	125

Welding positions

W 8016.B2

For 1.25%Cr–0.5%Mo steel

KS D7022 DT2316
AWS A5.5 E8016–B2
JIS Z3223 DT2316

Applications

W 8016.B2 can be used for welding of 1.25%Cr–0.5%Mo steel for super–heat tubes, steam pipes and heaters of boilers for thermo–electric power plant and equipment of oil refining industries.

Characteristics on Usage

- W 8016.B2 is a low hydrogen type electrode and is usable in all positions.
- It is suitable for welding 1.25%Cr–0.5%Mo steel pipes and high carbon Cr–Mo steel.

Notes on Usage

- Dry the electrodes at 350~400℃(662~752℉) for 60 minutes before use.
- Preheat at 150~300℃ and postheat at 670~730℃.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.6	3.2	4.0	5.0	6.0
Length (mm)		350	350	400	400	450
Current (A)	F	55~90	90~130	130~180	180~240	250~300
	V–up & OH	50~80	80~120	110~170	–	–

Typical Chemical Composition of All–Weld Metal (%)

C	Mn	Si	P	S	Cr	Mo
0.07	0.71	0.51	0.012	0.001	1.24	0.52

Typical Mechanical Properties of All–Weld Metal

Y.S (MPa)	T.S (MPa)	EL (%)	PHWT
541	634	28	690℃ X 1hr S · R

Welding positions

W 9016.B3

For 2.25%Cr-HoMo Steel

KS D7022 DT2416
AWS A5.5 E9016-B3
JIS Z3223 DT2416

Applications

W 9016.B3 can be used for welding of 2.25%Cr-1%Mo steel used for super heat tubes and steam pipes of boilers for electric power plant and marine use, equipment for oil refining industries and high temperature synthetic chemical industries.

Characteristics

- W 9016.B3 is a low hydrogen type electrode suitable for all position welding.
- W 9016.B3 provides the weld metal of 2.25%Cr-1%Mo.

Notes on Usage

- Dry the electrodes at 350~400℃ for about one hour before use.
- Preheat at 200~350℃ and postheat at 680~730℃.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.6	3.2	4.0	5.0	6.0
Length (mm)		350	350	400	400	450
Current (A)	F	55~90	90~130	130~180	180~240	250~300
	V-up & OH	50~80	80~120	110~170	–	–

Typical Chemical Composition of All-Weld Metal (%)

C	Mn	Si	P	S	Cr	Mo
0.07	0.80	0.55	0.020	0.010	2.28	1.05

Typical Mechanical Properties of All-Weld Metal

Y.S (MPa)	T.S (MPa)	EL (%)	PHWT
564	686	24	690℃ X 1hr S · R

Welding positions

W 7016N

For 490MPa Low temperature steel

KS D7023 DL5016-6AP0
AWS A5.5 E7016-G
JIS Z3211 E4916-GAP

Applications

Welding of mild steel and 50kgf/mm^2 class high tensile strength weather proof steels for buildings, bridges and cars.

Characteristics

- W 7016N is an extra low hydrogen type electrode for all position welding of aluminum-killed steel and TMCP steel used at low temperature.
- X-ray soundness and mechanical properties of weld metal are excellent.
- Weld metal is 0.5%Ni-Ti-B type, and has better notch toughness at -60℃ and CTOD properties at temperature down to -30℃.

Notes on Usage

- Dry the electrodes at 350~400℃(662~752℉) for 60 minutes before use.
- Keep the arc as short as possible
- Pay attention not to exceed proper heat-input because excessive heat-input causes deterioration of impact values of all-weld metal.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.6	3.2	4.0	5.0	6.0
Length (mm)		350	350	400	400	450
Current (A)	F	55~85	90~130	130~180	180~240	250~310
	V-up & OH	50~80	80~120	110~170	150~200	-

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S	Ni
0.06	1.15	0.35	0.013	0.010	0.50

Typical Mechanical Properties of All-Weld Metal

Y.S (MPa)	T.S (MPa)	EL (%)	CVN-Impact Value J	
			-45℃	-60℃
490	560	31	150	110

Welding positions

W 8016G

For low temperature service steel

AWS A5.5 E8016-G
JIS Z3211 E5516-GAP

Applications

Welding of aluminum-killed steel for low temperature used for LPG tankers and LPG storage tanks.

Characteristics on Usage

- W 8016G is an extra low hydrogen type electrode for all position welding of aluminum-killed steel and TMCP steel used at low temperature.
- The weld metal contains about 1.6%Ni.
- Notch toughness of weld metal at low temperature (-40 ~ -50℃) is stable and good.

Notes on Usage

- Pay attention not to exceed proper heat-input because excessive causes deterioration of impact values of weld metal.
- Dry the electrodes at 350~400℃ for about one hour before use.
- Adopt back step method or strike the arc on a small steel plate prepared for this particular purpose to prevent blowholes at the arc starting.
- Keep the arc as short as possible.

Sizes Available and Recommended Currents (AC or DC ±)

Size mm (in)	2.6 (3/32)	3.2 (1/8)	4.0 (5/32)	5.0 (3/16)
Length mm(in)	350 (14)	350 (14)	400 (16)	400 (16)
F	55~85	90~130	130~180	190~240
V-up, OH	50~80	80~115	120~170	150~200

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S	Ni
0.06	1.05	0.50	0.010	0.009	1.61

Typical Mechanical Properties of All-Weld Metal

Y.S (N/mm^2)	T.S (N/mm^2)	EL (%)	CVN-Impact Value J (-46℃)	Heat Treatment
530	612	29	110	AW
511	600	32	120	620℃ X 1hr S · R

Welding positions

W 8016C1

For low temperature service steel

KS D7023 DL5016-6AP2
AWS A5.5 E8016-C1
JIS Z3211 E5516-N5 APL

Applications

W 8016C1 is designed for welding of 2.5%Ni steel used in machinery for low temperature.

Characteristics

- W 8016C1 is a low hydrogen, all position electrode depositing weld metal comprising 2.5%Ni.
- Good X-ray soundness and good usability.
- Excellent impact value at -60℃.

Notes on Usage

- Preheat at 50~100℃. The temperature varies in accordance with the plate thickness and steel kind.
- Dry the electrodes at 350~400℃ for about one hour before use.
- Adopt back step method or strike the arc on a small steel plate prepared for this particular purpose to prevent blowholes at the arc starting.
- If each welded pass becomes thicker than acceptable level by high amperage or low speed ratio manipulation, the impact values and yield points will decrease.

Sizes Available and Recommended Currents (AC or DC ±)

Size mm (in)	2.6 (3/32)	3.2 (1/8)	4.0 (5/32)	5.0 (3/16)	6.0 (15/64)
Length mm(in)	350 (14)	350 (14)	400 (16)	400 (16)	450 (18)
F	55~90	90~130	130~190	190~240	250~300
V-up, OH	50~80	80~120	120~170	-	-

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S	Ni
0.06	0.92	0.44	0.011	0.006	2.39

Typical Mechanical Properties of All-Weld Metal

Y.S (N/mm^2)	T.S (N/mm^2)	EL (%)	CVN-Impact Value J (-60℃)	Heat Treatment
518	625	30	115	AW
492	578	33	126	620℃ X 1hr S · R

Welding positions

W 8016C2

For low temperature service steel

KS D7023 DL5016-10AP3
AWS A5.5 E8016-C2
JIS Z3211 E4916-N7APL

Applications

W 8016C2 is designed for welding of 3.5%Ni steel(ASTM A203 Gr. D,E) used for pressure vessels, storage tanks.

Characteristics on Usage

- W 8016C2 is an all positions extra low hydrogen type electrode for 3.5% Ni steel be used at low temperature (lowest −100℃)
- Good toughness of all-weld metal at low temperature.

Notes on Usage

- Preheat at 50~100℃ and postheat at 600~620℃. The preheat temperature varies in accordance with the plate thickness and the kind of steels.
- Dry the electrodes at 350~400℃ for about one hour before use.
- Adopt back step method or strike the arc on a small steel plate prepared for this particular purpose to prevent blowholes at the arc starting.
- Keep the arc as short as possible.

Size Available and Recommended Currents (AC or DC ±)

Size mm (in)	2.6 (3/32)	3.2 (1/8)	4.0 (5/32)	5.0 (3/16)	6.0 (15/64)
Length mm(in)	350 (14)	350 (14)	400 (16)	400 (16)	450 (18)
F	55~90	90~130	130~190	190~240	250~300
V-up, OH	50~80	80~120	120~170	150~200	-

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S	Ni
0.05	0.54	0.38	0.010	0.009	3.52

Typical Mechanical Properties of All-Weld Metal

Y.S (N/mm^2)	T.S (N/mm^2)	EL (%)	CVN-Impact Value J (−75℃)	Heat Treatment
542	628	31	78	620℃ X 1hr S · R

Welding positions

W-NF

For repairing of cast iron products

KS D7008 DFC NiFe
AWS A5.15 E NiFe-Cl
JIS Z3252 DFC NiFe

Applications

Welding of aluminum-killed steel for low temperature used for LPG tankers and LPG storage tanks.

Characteristics

- W-NF is a graphite type coated electrode whose weld metal has the composition of 55%Ni-45%Fe.
- As the hardening of fusion zone in cast iron is small and the coefficient of thermal expansion of the weld metal is about same as that of cast iron, mechanical properties and crack resistibility of the weld metal are good.

Notes on Usage

- Clean base metal before welding.
- If there is a possibility that cracking spreads, make the stopholes at both ends of repairing part.
- It is not necessary preheating and postheating in general but satisfactory results can be obtained by preheating at 100~200℃ in accordance with kind, shape and size of base metal.
- Keep the weld metal length less than 50mm(2 inch) to disperse welding heat.

Sizes Available and Recommended Currents (AC or DC ±)

Size mm (in)	2.6 (3/32)	3.2 (1/8)	4.0 (5/32)
Length mm(in)	350 (14)	350 (14)	400 (16)
F	60~90	80~120	120~150

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S	Ni	Fe
0.95	0.82	0.35	0.007	0.006	55.2	Rem

Typical Mechanical Properties of All-Weld Metal

T.S (N/mm^2)	Hardness (HRB)
568	91

Welding positions

W-NC

For repairing of cast iron products

KS D7008 DFC Ni
AWS A5.15 E Ni-CI
JIS Z3252 DFC Ni

Applications

Repairing and filling up of cavities of various kinds of cast iron products such as cylinder covers, motorbeds, casings and gears. Repairing of meehanite cast iron, alloy cast iron and malleable cast iron.

Characteristics on Usage

- W-NC is a graphite type coated electrode, depositing weld metal consisting of almost nickel.
- Hardening of heat affected zone is small and machining of the welds is comparatively easy.
- Therefore it is suitable for welding alloy cast iron of poor weldability, malleable cast iron and hydraulically pressured parts as well as common cast iron.

Notes on Usage

- Clean base metal before welding.
- If there is a possibility that cracking spreads, make the stopholes at both ends of repairing part.
- It is not necessary preheating and postheating in general but satisfactory results can be obtained by preheating at 100~200℃ in accordance with kind, shape and size of base metal.
- Keep bead length less than 50mm to disperse welding heat. Adopt back step, stepping stone or symmetry method by turns.

Sizes Available and Recommended Currents (AC or DC ±)

Size mm (in)	2.6 (3/32)	3.2 (1/8)	4.0 (5/32)
Length mm(in)	350 (14)	350 (14)	400 (16)
F	60~90	80~120	120~150

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S	Ni	Fe
0.84	0.34	0.30	0.002	0.002	Rem	1.9

Typical Mechanical Properties of All-Weld Metal

T.S (N/mm^2)	Hardness (HRB)
456	76

Welding positions

W-EST

For repairing of cast iron products

KS D7008 DFC Fe
AWS A5.15 E St
JIS Z3252 DFC Fe

Applications

Repairing of various kinds of cast iron produtcs.

Characteristics

- W-EST is a graphite type coated electrode, depositing weld metal consisting of pure iron.
- It is designed for welding of cast iron when machining of the deposit is not required.
- Hardness of the bonded area will be higher than that with nickel type electrode.

Notes on Usage

- Clean base metal before welding.
- If there is a possibility that cracking spreads, make the stopholes at both ends of repairing part.
- It is not necessary preheating and postheating in general but satisfactory results can be obtained by preheating at 100~200℃ in accordance with kind, shape and size of base metal.
- Keep the weld metal length less than 50mm(2 inch) to disperse welding heat.

Sizes Available and Recommended Currents (AC or DC ±)

Size mm (in)	2.6 (3/32)	3.2 (1/8)	4.0 (5/32)
Length mm(in)	350 (14)	350 (14)	400 (16)
F	60~90	80~120	120~150

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S
1.36	0.50	0.65	0.018	0.006

Typical Mechanical Properties of All-Weld Metal

T.S (N/mm^2)	Hardness (HRB)
512	480

Welding positions

W 308

For 18%Cr–8%Ni Stainless steel

KS D7014 E308–16
AWS A5.4 E308–16
JIS Z3221 ES308–16

Applications

Welding of 18%Cr–8%Ni steel

Characteristics on Usage

- W 308 is a lime–titania type electrode for 18%Cr–8%Ni steel with good usability.
- Its weld metal has austenitic structure, crack resistibility is good.
- Furthermore, its heat and corrosion resistibility are also good.

Notes on Usage

- Keep the arc as short as possible and use currents as low as possible.
- Dry the electrodes at 250~300℃(482~572℉) for 60~90 minutes before use.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current (A)	F	30~50	50~80	70~115	100~150	150~200
	V–up & OH	25~45	45~75	60~110	95~140	–

Typical Chemical Composition of All–Weld Metal (wt%)

C	Mn	Si	P	S	Cr	Ni
0.04	1.00	0.80	0.017	0.007	19.1	9.71

Typical Mechanical Properties of All–Weld Metal

T.S (MPa)	EL (%)
600	47

Welding positions

W 308L

For Low carbon 18%Cr–8%Ni Stainless steel

KS D7014 E308L–16
AWS A5.4 E308L–16
JIS Z3221 ES308L–16

Applications

Welding of extra–low carbon 18%Cr–8%Ni stainless steel such as AISI 304L

Characteristics

- W 308L has extra–low carbon austenitic structure which contains suitable ferrite.
- Crack resistibility is good and intergranular corrosion resistibility is superior to that of W 308.
- It is quite efficient because its burn–off rate and deposition rate are high because comparatively high amperage can be used.

Notes on Usage

- Keep the arc as short as possible and use currents as low as possible.
- Dry the electrodes at 250~300℃(482~572℉) for 60~90 minutes before use.
- Remove dirts such as oil and dust from the groove.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current (A)	F	30~50	50~80	70~115	100~150	150~200
	V–up & OH	25~45	45~75	60~110	95~140	–

Typical Chemical Composition of All–Weld Metal (wt%)

C	Mn	Si	P	S	Cr	Ni
0.02	1.00	0.74	0.018	0.007	19.4	9.62

Typical Mechanical Properties of All–Weld Metal

T.S (MPa)	EL (%)
590	48

Welding positions

W 309

For 22%Cr–12%Ni Stainless steel

KS D7014 E309–16
AWS A5.4 E309–16
JIS Z3221 ES309–16

Applications

Welding of 22%Cr–12%Ni steel and heat resistant cast steel Clad steel side welding of 304.
Welding of stainless steel to carbon steel or low alloy steel.

Characteristics

- W 309 is a lime–titania type electrode.
- As the deposited weld metal contains ferrite in austenitic structure, its crack resistance is good
- As weld metal contains much quantity of alloying elements and has stable austenitic structure, W 309 is suitable for welding of the part which is affected by the dilution of mother plate.

Notes on Usage

- Keep the arc as short as possible and use currents as low as possible.
- Dry the electrodes at 250~300℃(482~572℉) for 60~90 minutes before use.
- Pay attention that the dilution of mother plate should not be excessive.

SMAW

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current (A)	F	30~50	50~80	70~115	100~150	140~190
	V–up & OH	25~45	45~75	60~110	90~140	–

Typical Chemical Composition of All–Weld Metal (wt%)

C	Mn	Si	P	S	Cr	Ni
0.07	1.00	0.79	0.017	0.007	24.2	12.62

Typical Mechanical Properties of All–Weld Metal

T.S (MPa)	EL (%)
600	39

Welding positions

W 309L

For Low Carbon 22%Cr–12%Ni Stainless steel

KS D7014 E309L–16
AWS A5.4 E309L–16
JIS Z3221 ES309L–16

Applications

Welding of 22%Cr–Ni steel Welding of dissimilar metals and build–up welding of stainless steel on carbon steel or low alloy steel.

Characteristics

- W 309L is lime–titania type electrodes for all–position welding, which has excellent usability
- As the all–weld metal contains extra low carbon and high content of delta ferrite, its corrosion and heat resistibility are also good.

Notes on Usage

- Keep the arc as short as possible and use currents as low as possible.
- Dry the electrodes at 250~300℃(482~572℉) for 60~90 minutes before use.
- Pay attention that the dilution of mother plate should not be excessive.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current (A)	F	30~50	50~80	70~115	100~150	140~190
	V–up & OH	25~45	45~75	60~110	90~140	–

Typical Chemical Composition of All–Weld Metal (wt%)

C	Mn	Si	P	S	Cr	Ni
0.03	1.00	0.80	0.016	0.006	24.21	12.62

Typical Mechanical Properties of All–Weld Metal

T.S (MPa)	EL (%)
595	43

Welding positions

W 309Mo

For 22%Cr-12%Ni-Mo Stainless steel

KS D7014 E309Mo-16
AWS A5.4 E309Mo-16
JIS Z3221 ES309Mo-16

Applications

Welding of AISI(SUS) 316 to carbon steel. Clad steel side welding to AISI (SUS) 316.

Characteristics

- W 309Mo is a lime-titania type electrode.
- Its heat and corrosion resistibility are good.
- The slag removability and welded metal appearance are good.

Notes on Usage

- Keep the arc as short as possible and use currents as low as possible.
- Dry the electrodes at 250~300℃(482~572℉) for 60~90 minutes before use.
- Pay attention that the dilution of mother plate should not be excessive.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current (A)	F	30~50	50~80	70~115	100~150	140~190
	V-up & OH	25~45	45~75	60~110	90~140	-

Typical Chemical Composition of All-Weld Metal (wt%)

C	Mn	Si	P	S	Cr	Ni	Mo
0.07	1.30	0.79	0.017	0.007	23.25	12.6	2.31

Typical Mechanical Properties of All-Weld Metal

T.S (MPa)	EL (%)
640	35

Welding positions

W 309MoL

For Low Carbon 22%Cr–12%Ni–Mo Stainless steel

KS D7014 E309MoL–16
AWS A5.4 E309LMo–16
JIS Z3221 ES309LMo–16

Applications

Welding of extra–low carbon 22%Cr–12%Ni–2.5%Mo stainless steel.

Characteristics

- W 309MoL is a lime–titania type electrode.
- As the all–weld metal contains extra low carbon and high content of delta ferrite, its corrosion and heat resistibility are also good.
- The slag removability and welded metal appearance are good.

Notes on Usage

- Keep the arc as short as possible and use currents as low as possible.
- Dry the electrodes at 250~300℃(482~572℉) for 60~90 minutes before use.
- Pay attention that the dilution of mother plate should not be excessive.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current (A)	F	30~50	50~80	70~115	100~150	140~190
	V–up & OH	25~45	45~75	60~110	90~140	–

Typical Chemical Composition of All–Weld Metal (wt%)

C	Mn	Si	P	S	Cr	Ni	Mo
0.03	1.32	0.75	0.023	0.008	23.21	12.98	2.31

Typical Mechanical Properties of All–Weld Metal

T.S (MPa)	EL (%)
650	36

Welding positions

W 316

For 18%Cr–12%Ni–Mo Stainless steel

KS D7014 D316–16
AWS A5.4 E316–16
JIS Z3221 ES316–16

Applications

Welding of 18%Cr–12%Ni–3%Mo stainless steel, 13%Cr steel, 17%Cr steel and high toughness steel when postheating is not recommended use for welding between dissimilar metal like carbon steel and stainless steel.

Characteristics

- W 316 is a lime–titania type electrode provided with a good usability and weldability.
- As the all–weld metal has an austenite structure including Mo., the corrosion resistance against sulfide acid, phosphoric acid and acetic acid is excellent.

Notes on Usage

- Keep the arc as short as possible and use currents as low as possible.
- Dry the electrodes at 250~300℃(482~572℉) for 60~90 minutes before use.
- Remove dirts such as oil and scale from the groove.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current (A)	F	30~50	50~80	70~115	100~150	140~190
	V–up & OH	25~45	45~75	60~110	90~140	–

Typical Chemical Composition of All–Weld Metal (wt%)

C	Mn	Si	P	S	Cr	Ni	Mo
0.03	0.90	0.77	0.030	0.029	18.7	12.3	2.5

Typical Mechanical Properties of All–Weld Metal

T.S (MPa)	EL (%)
590	49

Welding positions

W 316L

For Low carbon 18%Cr–12%Ni–Mo Stainless steel

KS D7014 D316L–16
AWS A5.4 E316L–16
JIS Z3221 ES316L–16

Applications

Welding of extra–low carbon 18%Cr–12%Ni–Mo (316L stainless steel)

Characteristics

- Extra–low carbon weld metal provided with a good usability and weldability
- As extra–low carbon weld metal can be obtained, intergranular corrosion resistibility is superior to that of W 316.

Notes on Usage

- Keep the arc as short as possible and use currents as low as possible.
- Dry the electrodes at 250~300℃(482~572℉) for 60~90 minutes before use.
- Remove dirts such as oil and scale from the groove.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current (A)	F	30~50	50~80	70~115	100~150	140~190
	V–up & OH	25~45	45~75	60~110	90~140	–

Typical Chemical Composition of All–Weld–Metal (wt%)

C	Mn	Si	P	S	Cr	Ni	Mo
0.02	1.00	0.73	0.018	0.010	18.4	12.2	2.3

Typical Mechanical Properties of All–Weld Metal

T.S (MPa)	EL (%)
584	48

Welding positions

W 310

For 25%Cr–20%Ni Stainless steel

KS D7014 D310–16
AWS A5.4 E310–16
JIS Z3221 ES310–16

Applications

Welding of AISI(STS)310S stainless steel.
Fabrication and repair of furnace linings, furnace grates, burners.

Characteristics

- W 310 is a lime–titania type electrode for all–position welding, depositing weld metal of perfect austenitic structure.
- Good mechanical property and heat resistance of the depodited weld metal.
- W 310 has high toughness in all welding condition.

Notes on Usage

- Keep the arc as short as possible and use currents as low as possible.
- Dry the electrodes at 250~300℃(482~572℉) for 60~90 minutes before use.
- Beware of cracking

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current (A)	F	30~50	50~80	70~115	100~150	140~190
	V–up & OH	25~45	45~75	60~110	90~140	–

Typical Chemical Composition of All–Weld–Metal (wt%)

C	Mn	Si	P	S	Cr	Ni
0.11	1.75	0.38	0.022	0.009	26.1	20.8

Typical Mechanical Properties of All–Weld–Metal

T.S (MPa)	EL (%)
588	40

Welding positions

W 312

For 29%Cr–9%Ni Stainless steel

KS D7014 D312–16
AWS A5.4 E312–16
JIS Z3221 ES312–16

Applications

Bond welding of dissimilar metals such as stainless steel, carbon steel and low alloy steel.
Welding of stainless clad steel.

Characteristics

- It is a lime–titania type electrode, has an excellent usability and weldability. Chemical composition of all–weld metal is 29%Cr–9%Ni.
- Owing to the austenite structure containing large contents of ferrite, W 312 has a good crack resistibility.
- It is used for welding dissimilar metals and under laying welding of hardsurfacing.

Notes on Usage

- Keep the arc as short as possible and use currents as low as possible.
- Dry the electrodes at 250~300℃(482~572℉) for 60~90 minutes before use.
- Preheat the base metal at over 200℃(392℉) to prevent cracking in welding of high alloyed steel, having good hardenability such as tool steel.

Sizes Available and Recommended Currents (AC or DC ±)

Dia. (mm)		2.0	2.6	3.2	4.0	5.0
Length (mm)		250	300	350	350	350
Current (A)	F	30~50	50~80	70~115	100~150	140~190
	V–up & OH	25~45	45~75	60~110	90~140	–

Typical Chemical Composition of All–Weld Metal (wt%)

C	Mn	Si	P	S	Cr	Ni
0.10	1.49	0.40	0.022	0.010	29.2	9.5

Typical Mechanical Properties of All–Weld Metal

T.S (MPa)	EL (%)
802	27

Welding positions

W 625

Inconel 625, Incoloy 825

KS D7021 DNiCrMo-3
AWS A5.11 ENiCrMo-3
JIS Z3224 DNiCrMo-3

Applications

W-625 is designed for welding of Inconel 600 + 625 and Nickel alloys, 9% Nickel steels. (LNG storage tank manufacture, desulfurization, Heat exchanger, Building of chemical carrier)

Characteristics

- Suitable in pressure vessel fabrication for −196℃ to 550℃, otherwise up to the scaling resistance temperature of 1200℃.
- The weld metal has high strength at room and elevated temperatures and has exceptional corrosion resistance.
- It is useful for many dissimilar joints involving inconel alloys, incoloy alloys, stainless steels, low-alloy steel, and carbon steel.

Notes on Usage

- Use recommended current range. if not it will be much spatters and undercut.
- Keep the arc as short as possible.
- Weaving width should be within two and a half times electrode's diameter.
- When the electrodes have absorbed moisture, dry them at 250~280℃ for 30~60 minutes before use.

Sizes Available and Recommended Currents (DC +)

Size mm (in)		3.2 (1/8)	4.0 (5/32)
Length mm(in)		350 (14)	400 (16)
Amp	F	90~120	120~150
	V-up & OH	80~110	100~140

Typical Chemical Composition of All-Weld Metal(%)

C	Mn	Si	P	S	Cr	Ni	Mo	Cu	Nb+Ta	Fe
0.03	0.7	0.52	0.002	0.003	21.9	61.6	8.4	0.13	3.7	2.2

Typical Mechanical Properties of All-Weld Metal

T.S (MPa)	EL (%)	CVN-Impact Value J (−196℃)
772	40	68

Welding positions

W 276

Hastelloy C-276

KS D7021 DNiCrMo-4
AWS A5.11 ENiCrMo-4
JIS Z3224 DNiCrMo-4

Applications

Pumps, valves, pipework and vessels for use in aggressive environments in chemical process plants, also in equipment for flue gas desulphurization and critical equipment in offshore oil and gas production.

Characteristics

- It can be used for surfacing steels and dissimilar welding of nickel alloys, steels and stainless steels.
- The weld metal has excellent resistance on pitting and crevice corrosion.

Notes on Usage

- Use recommended current range. if not it will be much spatters and undercut.
- Keep the arc as short as possible.
- Weaving width should be within two and a half times electrode's diameter.
- When the electrodes have absorbed moisture, dry them at 250~280℃ for 30~60 minutes before use.

Sizes Available and Recommended Currents (DC +)

Size mm (in)		3.2 (1/8)	4.0 (5/32)
Length mm(in)		350 (14)	400 (16)
Amp	F	80~120	120~150
	V&OH	75~110	100~140

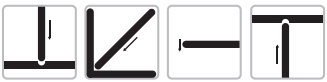
Typical Chemical Composition of All-Weld Metal(%)

C	Mn	Si	P	S	Cr	Ni	Cu	W	Fe	Mo
0.01	0.62	0.16	0.006	0.005	15.2	59.1	0.08	3.6	5.5	15.8

Typical Mechanical Properties of All-Weld Metal

T.S (MPa)	EL (%)	CVN-Impact Value J (0℃)
728	39	65

Welding positions



W 182

Inconel 600, Incoloy 800

KS D7021 DNiCrFe-3
AWS A5.11 ENiCrFe-3
JIS Z3224 DNiCrFe-3

Applications

W 182 is designed for Welding of INCONEL(INCONEL 600, INCOLOY 800), dissimilar welding of INCONEL and carbon steel, stainless steel, INCONEL and nickel alloy, 9%Ni.

Characteristics

- These weld metals have no directly equivalent parent materials, although the composition is related to INCONEL 600.
- Mn and Nb are added to give high resistance to hot cracking, tolerance to dilution by many combinations of nickel-base and ferrous alloys.

Notes on Usage

- Use recommended current range. if not it will be much spatters and undercut.
- Keep the arc as short as possible.
- Weaving width should be within two and a half times electrode's diameter.
- When the electrodes have absorbed moisture, dry them at 250~280℃ for 30~60 minutes before use.

Sizes Available and Recommended Currents (DC +)

Size mm (in)		3.2 (1/8)	4.0 (5/32)
Length mm(in)		350 (14)	400 (16)
Amp	F	80~120	120~150
	V&OH	75~110	100~140

Typical Chemical Composition of All-Weld Metal(%)

C	Mn	Si	P	S	Cr	Ni	Cu	Nb+Ta	Fe
0.04	6.2	0.6	0.003	0.005	16.2	69.2	0.13	1.8	4.9

Typical Mechanical Properties of All-Weld Metal

T.S (MPa)	EL (%)
651	40

Welding positions

www.hkweldtek.com

Submerged Arc Welding Consumables

Mild steel & 490MPa high tensile steels

Stainless steels

ESW

WF-774 X WS-14

TYPE : Basic

KS B0531 S502-H
AWS A5.17 F7A4×EM14
JIS Z3183 S502-H

Applications

Horizontal welding of oil storage tanks, ships, bridges, Pressure vessels, penstocks, boilers and structural steels.

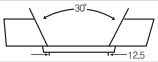
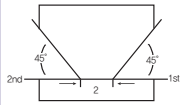
Characteristics on Usage

- Inactive, neutral type bonded flux which is appilcable to all kinds of wire. Impact value of weld metal and crack resistibility are good. Slag detachability in the groove and resistance to porosity are good. Usability in horizontal fillet welding and X-ray performance dre good.

Notes on Usage

- Dry the flux at 300~350℃ (572~662℉) for 60 minutes before use.
- Remove rust, scales, oil, paint, water, dirt and slag of tack welds from the groove to obtain sound weld metal.
- Use welding current and speed as low as possible at the first layer of groove to avoid cracking.
- Preheat at 50~100℃ (122~212℉) according to base metal and plate thickness. Keep interpass temperature at 100~250℃ (212~482℉)

Typical Welding Conditions

Th. (mm)	Dia. (mm)	Groove Design	Pass (Run NO.)		Amp (A)	Volt. (V)	Speed (cm/min)	Remarks
25	4.0		1~13		570	30	40	AWS A5.17
28	3.2		1st	1	450	28	35	Horizontal ML
				2~4	500	26	50	
			2nd	5	450	28	35	
				6~8	500	26	50	

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Si	Mn	P	S	BM	Th.(mm)
0.08	0.31	1.60	0.025	0.019	SS400	25
0.07	0.40	1.53	0.020	0.013	SM490	28

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa(kgf/mm²)	T.S MPa(kgf/mm²)	EL (%)	CVN-Impact Value J (ft · lbs)		BM	Th. (mm)
			-20℃	-51℃		
510 (52)	570 (58)	31	–	110 (11)	SS400	25
–	540 (55)	–	60 (6)	–	SM490	28

WF-772 X WS-12K

TYPE : Basic

KS B0531 S502-H
AWS A5.17 F7A2×EM12K
JIS Z3183 S502-H

Applications

Butt and tlat fillet welding of bridges and API Line-pipe. (longitudinal)

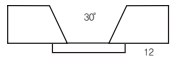
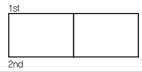
Characteristics on Usage

- S-800P is a basic agglomerated, slightly Si-alloying flux for submerged arc welding, specially for single and multi-pass butt welding of mild, medium and high tensile steels. It provides good bead appearance, better slag removal and high impact value of the weld metal together. It is relatively insensitive to rust and dirt on a base metal, and makes better resistance to pockmark and pit.
  As the consumption of flux is low, it is very economical.

Notes on Usage

- Dry the flux at 300~350℃ (572~662℉) for 60 minutes before use.
- When the flux height is excessive, poor bead appearance may occur.
- Use welding current and speed as low as possible at the first layer of groove to avoid cracking.

Typical Welding Conditions

Th. (mm)	Dia. (mm)	Groove Design	Pass	Amp (A)	Volt (V)	Speed (cm/min)	Remarke
25	4.0		1~15	550	29	40~45	AWS A5.17
44	4.0		1st	500	32	40	Both Side Single-pass
			2st	500	32	40	

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Mn	Si	P	S	BM
0.06	1.67	0.46	0.021	0.014	SS41(25)
0.07	1.52	0.44	0.019	0.013	SM50A(20)

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa(kg/mm²)	T.S MPa(kg/mm²)	EL (%)	CVN-Impact Value J (ft · lbs) 0℃	CVN-Impact Value J (ft · lbs) -29℃	BM (mm)	PWHT
468 (48)	560 (57)	28	70 (7.1)	40 (4.0)	SM41(25)	AW
–	576 (59)	–	50 (5.1)	–	SM50A(20)	

WF-774 X WS-12K

TYPE : Basic

KS B0531 S502-H
AWS A5.17 F7A4×EM12K
JIS Z3183 S502-H

Applications

Multi-layer welding of various kinds of structure such as ship buildings, offshore structures, machinery, pressure vessels, large diameter and heavy wall steel pipe.

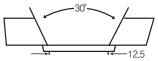
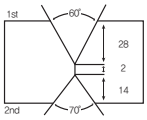
Characteristics on Usage

- It produces the weld metal which has excellent impact value at low temperature service. Single and Multi electrode welding can be performed. It has excellent X-ray characteristics and slag removal, because of insensitivity to rust, scale, primer on the surface to be welded.

Notes on Usage

- Dry the flux at 300~350℃ (572~662℉) for 60 minutes before use.
- When the flux height is excessive, poor bead appearance may occur.
- Use welding current and speed as low as possible at the first layer of groove to avoid cracking.

Typical Welding Conditions

Th. (mm)	Dia. (mm)	Groove Design	Pass		Amp (A)	Volt (V)	Speed (cm/min)	Remarks
25	4.0		1~13		570	30	40	AWS A5.17
44	4.0		1st	1	500	32	40	Both side Multi-pass
				2~14	600	36	50	
			Back gouging					
			2st	14	500	32	40	
				16~23	600	36	50	

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Si	Mn	P	S	BM	Th.(mm)
0.09	0.26	1.40	0.023	0.004	SS400	25
0.08	0.54	1.47	0.025	0.018	BS4360-GR.50D	44

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa(kgf/mm²)	T.S MPa(kgf/mm²)	EL (%)	CVN-Impact Value J (ft · lbs)		BM	Th. (mm)
			-20℃	-51℃		
555 (57)	614 (63)	29	-	60 (6)	SS400	25
510 (52)	580 (59)	28	70 (7)	-	BS4360-GR.50D	44

WF-770 X WS-12K

TYPE : Basic

KS B0531 S502-H
AWS A5.17 F7A0×EM12K
JIS Z3183 S502-H

Applications

Butt and flat fillet welding of buildings, bridges and API Line-pipe. (Longitudinal)

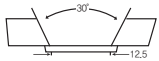
Characteristics on Usage

- It procides good bead appearance, better slag removal and high impact value of the weld metal. It is relatively Insenitive to rust and makes better resistance to pockmark and pit. High impact values in both multi-run and two-run technique. As the consumption of flux is low, it is very economical.

Notes on Usage

- Dry the flux at 300~350℃ (572~662℉) for 60 minutes before use.
- When the flux height is excessive, poor bead appearance may occur.
- Use welding current and speed as low as possible at the first layer of groove to avoid cracking.

Typical Welding Conditions

Th. (mm)	Dia. (mm)	Groove Design	pass (Run NO.)	Amp (A)	Volt (V)	Speed (cm/min)	Remarks
25	4.0		1~13	570	30	40	AWS A5.17

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Si	Mn	P	S	BM	Th.(mm)
0.06	0.52	0.73	0.024	0.016	SS400	25

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa(lbs/in²)	T.S MPa(lbs/in²)	EL (%)	CVN-Impact Value J (ft · lbs)		PWHT	BM	Th. (mm)
			0℃	-18℃			
510 (52)	560 (57)	28.6	42	-	As Welded	SS400	25

WF-770 X WS-L8

TYPE : Basic

KS B0531 S502-H
AWS A5.17 F7A0×EL8
JIS Z3183 S502-H

Applications

Single-layer and multi-layer welding of shipbuilngs.

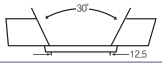
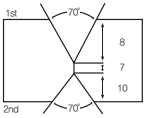
Characteristics on Usage

- As the penetration deep, it is suitable for welding of thick plate in both side single-layer welding. Impact value (or mechanical priperties) of weld metal and crack resistibility are excellent. also applicable to one-side welding. As the consumption of flux is low, It is economical.

Notes on Usage

- Dry the flux at 300~350℃ (572~662℉) for 60 minutes before use.
- Pay attention to welding voltage. Excessive welding voltage causes deterioration of joint properties.
- Add new flux periodically to prevent the weld defects and bad bead appearance which occurs when continuously reusing the flux.
- Weld pass should be limited to 3 or 4 passes. (please inquire of the manufactures when welding more than 5 passes)

Typical Welding Conditions

Th. (mm)	Dia. (mm)	Groove Design	Pass (Run NO.)	Amp (A)	Volt (V)	Speed (cm/min)	Remarks
25	4.0		1~13	570	30	40	AWS A5.17
25	4.8		1st	950	34	40	BS SL
			2nd	1100	37	30	

Typical Chemical Composition of All-Weld-Metal (wt%)

C	Si	Mn	P	S	BM	Th.(mm)
0.07	0.40	1.40	0.028	0.015	SS400	25
0.08	0.32	1.29	0.015	0.014	AH36	25

Typical Mechanical Properties of All-Weld-Metal

Y.S MPa(lbs/in²)	T.S MPa(lbs/in²)	EL (%)	CVN-Impact Value J (ft · lbs)		BM	Th. (mm)
			-20℃	-51℃		
490 (50)	560 (57)	31	–	70 (7)	SS400	25
–	570 (58)	–	40 (4)	–	AH36	44

WF-300

For Srainless steel and duplex stainless steel

Applications

WF 300 is a basic non-alloying agglomerated flux for the submerged arc welding of stainless steels and high-alloyed Cr Ni Mo steels including duplex stainless steels.

Characteristics

- Excellent weldability such as stable arc and easy slag removal.
- Excellent impact value at low temperature down to −196℃.
- The weld metals show good mechanical properties.
- Exceesive flux height may bring out poor bead appearance.
- Redry the flux at 250~350℃ for 60 minutes before use.
- Add new flux periodically when continuously reusing the flux.

Typical Chemical Composition of All-Weld Metal(%)

Wire	C	Mn	Si	Cr	Ni	Mo	N
WS-308L	0.02	1.5	0.6	19.6	9.5	–	–
WS-309L	0.02	1.6	0.5	23.2	13.3	–	–
WS-316L	0.02	1.3	0.6	18.8	11.8	2.3	–
WS-2209	0.02	1.3	0.5	22.3	8.6	3.2	0.1

Typical Mechanical Properties of All-Weld Metal

Wire	Y.S. (MPa)	T.S. (MPa)	El. (%)	IV (J)		Remarks
				−60℃	−196℃	
WS-308L	394	567	41	87	62	As-Welded
WS-309L	428	582	38	98	72	As-Welded
WS-316L	402	568	40	85	66	As-Welded
WS-2209	649	812	36	64	–	As-Welded

WES 625 + WQ-625

For Nickel alloyed Strip Cladding Applications (ESW)

Applications

WES 625 is high-basic agglomerated electrosalg welding flux used in combination with high nikel alloyed stip.

Characteristics

- Excellent bead appearance and slag removal.
- The weld bead has high hot cracking resistance.
- The flux is suitable for weld overlay in petrochemical and nuclear applications.
- Redry the flux at 250~350℃ for 60 minutes before use.
- Add new flux periodically when continuously reusing the flux.

Current condition : DC +

Basicity index : 4.0

Typical Chemical Composition of All-Weld Metal(%)

Strip		C	Mn	Si	Cr	Ni	Mo	Nb
WQ-625	1st layer	0.02	0.09	0.31	19.8	Rem	7.9	2.9
WQ-625	2nd layer	0.02	0.07	0.28	20.7	Rem	8.2	3.2

Packages - Strip

Width (mm)	Thickness (mm)	Type	Weight (kg)
25.4	0.5	Coil	25
50.8	0.5	Coil	50
60	0.5	Coil	50

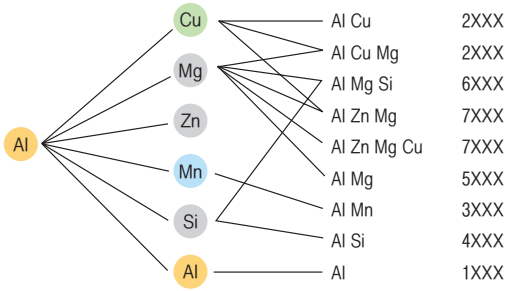
Packages - Flux

Mesh size	Type	Weight (kg)
12x60	Can	20

For Aluminum Based-Alloy

Brand name	AWS	Typical chemical Coum position (%)							
		Si	Fe	Cu	Mn	Mg	Ti	etc	Al
1100	ER1100	Si+Fe :	≦0.95	0.05~0.20	≦ 0.05	–	–		≧ 99.0
2319	ER2319	≦0.20	≦0.30	5.8~6.8	0.20~0.40	≦ 0.02	0.10~0.20		
4043	ER4043	4.5~60			≦ 0.05	≦ 0.05	≦0.20		
4047	ER4047	11.0~13.0	≦0.80	≦0.30	≦ 0.15	≦ 0.10	–		
4643	ER4643	3.6~4.6			≦ 0.05	0.10~0.30	≦0.15		
5180	ER5180	Si+Fe :	≦0.35		0.20~0.70	3.5~4.5	0.06~0.20		Rem
5183	ER5183	≦ 0.40		≦ 0.10	0.50~1.0	4.3~5.2	≦0.15		
5356	ER5356		≦0.40		0.05~0.20	4.5~5.5	0.06~0.20	≧0.15	
5554	ER5554	≦ 0.25			0.50~1.0	2.4~3.0	0.05~0.20		
5556	ER5556					4.7~5.5			
5654	ER5654	Si+Fe :	≦0.45	≦0.05	≦ 0.01	3.1~3.9	0.05~0.15		

shielding gas : Ar
Dia : 1.2~4.8mmØ



APPENDIX

AWS SPECIFICATION FOR WELDING CONSUMABLES

For carbon steel electrodes for flux cored arc welding(AWS A5.20-2005)

AWS Classification	Shielding Gas	Polartiy	Applica-tion	Chemical composition for weld metal %					
				C	Mn	Si	S	P	Cr
E70T-1C[a]	CO_2	DCEP	M	≦0.12	≦1.75	≦0.90	≦0.03	≦0.03	≦0.20
E70T-1M[a]	75~80%Ar+CO_2								
E71T-1C[a]	CO_2								
E71T-1M[a]	75~80%Ar+CO_2								
E70T-5C[a]	CO_2								
E70T-5M[a]	75~80%Ar+CO_2								
E71T-5C[a]	CO_2	DCEP DCEN							
E71T-5M[a]	75~80%Ar+CO_2								
E70T-9C[a]	CO_2	DCEP							
E70T-9M[a]	75~80%Ar+CO_2								
E71T-9C[a]	CO_2								
E71T-9M[a]	75~80%Ar+CO_2								
E70T-12C[a]	CO_2			≦0.12	≦1.60	≦0.90			
E71T-12M[a]	75~80%Ar+CO_2								
E71T-12C[a]	CO_2								
E71T-12M[a]	75~80%Ar+CO_2								
E70T-4	None	DCEN		≦0.30	≦1.75	≦0.60			
E70T-6[a]									
E70T-7									
E71T-7									
E70T-8[a]									
E71T-8[a]									
E70T-11									
E71T-11									

Chemical composition for weld metal %					Tension test			Charpy V-notch impact test	
Ni	Mo	V	Ai	Cu	Tensile Strength ksi	Yield strength at 0.2% offset ksi	Elongation %	TEMP ℉	Average value ft · lbf
≦0.50	≦0.30	≦0.08	≦1.8	≦0.35	70~95	≧58	22	0	≧20
								-20	
					70~90				
					70~95	≧58		None	
								-20	≧20
								None	
								-20	≧20
							≧20	None	

AWS SPECIFICATION FOR WELDING CONSUMABLES

Carbon steel electrodes for flux cored arc welding (AWS A5.20-2005)

AWS Classification	Shielding Gas	Polartiy	Applica-tion	Chemical composition for weld metal %					
				C	Mn	Si	P	S	Cr
E61T-13	N/A	DCEN	S	None					
E70T-2C[b]	CO_2	DCEP							
E70T-2M[b]	75~80%Ar+CO_2								
E71T-2C[b]	CO_2								
E71T-2M[b]	75~80%Ar+CO_2								
E70T-3[b]	None								
E70T-10[b]		DCEN							
E70T-13[b]									
E71T-14[b]									
E6XT-GS[b]	None								
E7XT-GS[b]									
E6XT-G[c]			M	d	≦1.75	≦0.90	≦0.03	≦0.03	≦0.20
E7XT-G[c]									

Remarks a) Electrodes with optional supplemental designations shall meet the lower temperature impact requirements. in case the use of letter "J" as a suffix to a classification requires lower impact temperature, -40℉

b) E7XT-5 and E7XT-5M electrodes have a rutile base slag.
E7XT-9 and E7XT-9M electrodes hace a rutile base slag.

c) M=single or multiple pass:S = single pass only

d) E7XT-13 electrodes can be used in all positions for the root pass on circumferential pipe welds, and E7XT-14 electrodes can be used to make welds at high speed.

e) The total of all elements listed in this table shall not exceed 5 percent.

Chemical composition for weld metal %					Tension test			Charpy V-notch impact test	
Ni	Mo	V	Ai	Cu	Tensile Strength ksi	Yield strength at 0.2% offset ksi	Elongation %	TEMP ℉	Average value ft · lbf
					≧60	None		None	
					≧70				
					≧60				
					≧70				
≦0.50	≦0.30	≦0.08	≦1.80	≦0.35	60~80	≧48	≧22		
					70~95	≧58			

Notes 1.EX0T-X is for flat and horizontal position only:EX1T-X is for all positions.

AWS SPECIFICATION FOR WELDING CONSUMABLES

Stainless steel electrodes for flux cored arc welding and stainless steel flux cored wires for gas tungsten arc welding (AWS A5.22–2007)–1

AWS Classification	Chemical composition for weld metal %						
	C	Cr	Ni	Mo	Cb(Nb)+ Ta	Mn	Si
E307TX–X	≦0.13	18.0~20.5	9.0~10.5	0.5~1.5		3.30~4.75	
E308TX–X	≦0.08	18.0~21.0	9.0~11.0	≦0.5			
E308LTX–X	≦0.04	18.0~21.0	9.0~11.0	≦0.5			
E308HTX–X	0.04~0.08	18.0~21.0	9.0~11.0	≦0.5	–		
E308MoTX–X	≦0.08	18.0~21.0	9.0~11.0	2.0~3.0			
E309TX–X	≦0.04	18.0~21.0	9.0~12.0	2.0~3.0			
E309LCbTX–X	≦0.10	22.0~25.0	12.0~14.0	≦0.5		0.5~2.5	
E309LTX–X	≦0.04	22.0~25.0	12.0~14.0	≦0.5	0.70~1.00		
E309MoTX–X	≦0.04	22.0~25.0	12.0~14.0	≦0.5			
E309LMoTX–X	≦0.12	21.0~25.0	12.0~16.0	2.0~3.0			
E309LNiMoTX–X	≦0.04	21.0~25.0	12.0~16.0	2.0~3.0			≦1.0
E310TX–X	≦0.04	20.5~23.5	15.0~17.0	2.5~3.5			
E312TX–X	≦0.20	25.0~28.0	20.0~22.5	≦0.5	–	1.0~2.5	
E316TX–X	≦0.15	28.0~32.0	8.0~10.5	≦0.5			
E316LTX–X	≦0.08	17.0~20.0	11.0~14.0	2.0~3.0			
E317LTX–X	≦0.04	17.0~20.0	11.0~14.0	2.0~3.0		0.5~2.5	
E347TX–X	≦0.04	18.0~21.0	12.0~14.0	3.0~4.0			
E409TX–X[a]	≦0.08	18.0~21.0	9.0~11.0	≦0.5	8xC%~1.0		
E307TX–X	≦0.10	10.5~13.5	≦0.60	≦0.5		≦0.80	
E307TX–X	≦0.12	11.0~13.5	≦0.60	≦0.5	–	≦1.2	
E410TX–X	≦0.06	11.0~12.5	4.0~5.0	0.40~0.70		≦1.0	

Chemical composition for weld metal %				Tension test		
P	S	N	Cu	Tensile Strength ksi	Elongation %	Heat Treatment
≦0.04	≦0.03	–	≦0.5	≧85	≧30	–
				≧80	≧35	–
				≧75		–
				≧80		–
						–
				≧75		–
				≧80	≧30	–
				≧75		–
						–
				≧80	≧25	–
				≧75		–
						–
				≧80	≧30	–
≦0.03				≧95	≧22	–
≦0.04				≧75	≧30	–
				≧70		–
				≧75	≧20	–
					≧30	–
				≧65	≧15	–
				≧75	≧20	A
				≧110	≧15	B

AWS SPECIFICATION FOR WELDING CONSUMABLES

Stainless steel electrodes for flux cored arc welding and stainless steel flux cored wires for gas tungsten arc welding (AWS A5.22–2007)–2

AWS Classification	Chemical composition for weld metal %						
	C	Cr	Ni	Mo	Cb(Nb)+ Ta	Mn	Si
E410NiTiTX–X[a]	≦0.04	11.0~12.0	3.6~4.5	≦0.5	–	≦0.70	≦0.50
E430TX–X	≦0.10	15.0~18.0	≦0.60			≦1.2	≦1.0
E502TX–X		4.0~6.0	≦0.40	0.45~0.65			
E505TX–X		8.0~10.5		0.85~1.20			
E307T0–3	≦0.13	19.5~22.0	9.0~10.5	0.5~1.5		3.30~4.75	
E308T0–3	≦0.08		9.0~11.0	≦0.5		0.5~2.5	
E308LT0–3	≦0.03						
E308HT0–3	0.04~0.08						
E308MoT0–3	≦0.08	18.0~21.0		2.0~3.0			
E308LMoT0–3	≦0.03		9.0~12.0				
E308HMoT0–3	0.07~0.12	19.0~21.5	9.0~10.7	1.8~2.4		1.25~2.25	0.25~0.80
E309T0–3	≦0.10	23.0~25.5	12.0~14.0	≦0.5	0.70~1.00	0.5~2.5	≦1.0
E309LCbT0–3	≦0.30						
E309LT0–3					–		
E309MoT0–3	≦0.12	21.0~25.0	12.0~16.0	2.0~3.0			
E309LMoT0–3	≦0.04						
E310T0–3	≦0.20	25.0~28.0	20.0~22.5	≦0.5		1.0~2.5	
E312T0–3	≦0.15	28.0~32.0	8.0~10.5			0.5~2.5	
E316T0–3	≦0.08	18.0~20.5	11.0~14.0	2.0~3.0			
E316LT0–3	≦0.03						
E316LKT0–3	≦0.04	17.0~20.0					

Chemical composition for weld metal %				Tension test		
P	S	N	Cu	Tensile Strength ksi	Elongation %	Heat Treatment
≦0.04	≦0.30	–	≦0.5	≧110	≧15	B
				≧65	≧20	C
				≧60		D
						D
				≧85	≧30	–
				≧80	≧35	–
				≧75		–
				≧80		–
						–
				≧75		–
				≧80	≧30	–
						–
				≧75		–
						–
				≧80	≧25	–
				≧70		–
				≧58	≧30	–
				≧95	≧22	–
				≧75	≧30	–
				≧70		–
						–

AWS SPECIFICATION FOR WELDING CONSUMABLES

Stainless steel electrodes for flux cored arc welding and stainless steel flux cored wires for gas tungsten arc welding (AWS A5.22–2007)–3

AWS Classification	Chemical composition for weld metal %						
	C	Cr	Ni	Mo	Cb(Nb)+ Ta	Mn	Si
E317LT0–3[a]	≦0.03	18.5~21.0	13.0~15.0	3.0~4.0	–	0.5~2.5	≦1.0
E347T0–3	≦0.08	19.0~21.5	9.0~11.0	≦0.5	8XC%~1.0		
E409T0–3[a]	≦0.10	10.5~13.5	≦0.60		–	≦0.80	
E410T0–3	≦0.12	11.0~13.5				≦1.0	
E410NiMoT0–3	≦0.06	11.0~12.5	4.0~5.0	0.40~0.70			
E410NiTiT0–3[a]	≦0.04	11.0~12.0	3.6~4.5	≦0.5		≦0.70	≦0.50
E430T0–3	≦0.10	15.0~18.0	≦0.60			≦1.0	≦1.0
E2209TX–X	≦0.04	21.0~24.0	7.5~10.0	2.5~4.0		0.5~2.0	
E2553TX–X		24.0~27.0	8.5~10.5	2.9~3.9		0.5~1.5	≦0.75
EXXXTX–G	Not specified						
R308LT1–5	≦0.30	18.5~21.0	9.0~11.0	≦0.5	–	0.5~2.5	≦1.2
R309LT1–5		22.0~25.0	12.0~14.0				
R316LT1–5		17.0~20.0	11.0~14.0	2.0~3.0			
R347T1–5	≦0.08	18.0~21.0	9.0~11.0	≦0.5	8XC%~1.0		

Remarks a : Ti = 10 X C % ~ 1.5

Notes 1) "EXXXTX–X"elctrodes indicate flux cored wire : "RXXXT1–5" electrods indicate flux cored rods.

Notes 2) The "X" after "T" designates the position of operation. A "0" indicates flat or horizontal operation: B"1" indicates all position operation.

Notes 3) The "X" after "EXXXTX–" or " RXXXTX–" designates the external shielding medium to be employed during welding as follows:
1: CO_2, 3: NONE, 4:75–80% Ar/balance CO_2, 5: Ar

Notes 4) The amount of those elements shall be determined to ensure that their total (excluding iron) does not exceed 0.50%

Chemical composition for weld metal %				Tension test		
P	S	N	Cu	Tensile Strength ksi	Elongation %	Heat Treatment
≦0.04	≦0.03	–	≦0.5	≧75	≧20	–
					≧30	–
				≧65	≧15	–
				≧75	≧20	A
				≧110	≧15	B
≦0.03						B
≦0.04				≧65	≧20	C
		0.08~0.20		≧100		–
		0.10~0.20	1.5~2.5	≧110	≧15	–
Not specified						
≦0.04	≦0.30	–	≦0.5	≧75	≧35	–
					≧30	–
				≧70		–
				≧75		–

Notes 5) The symbols for heat treatment is as follows:

A: The weld test assembly shall be heated to a temperature between 1350 and 1400℉, held for 1hour, then furnace cooled to 600℉ at a rate not to exceed 100℉ per hour, then cooled in air to room temperature.

B: The weld test assembly shall be heated to a temperature between 1100 and 1150℉, held for 1 hour, then cooled in air to room temperature.

C: The weld test assembly shall be heated to a temperature between 1400 and 1450℉, held for 4hour, then furnace cooled to 1100℉ at a rate not to exceed 100℉ per hour, then cooled in air to room temperature.

D: The weld test assembly shall be heated to a temperature between 1550 and 1600℉, held for 2hour, then furnace cooled to 1100℉ at a rate not to exceed 100℉ per hour, then cooled in air to room temperature.

Low-alloy steel electrodes for flux cored arc welding(AWS A5.29-2005)

1. Chemical composition requirements for undiluted weld metal

AWS Classification	Chemical composition for weld metal %										
	C	Mn	P	S	Si	Ni	Cr	Mo	V	Al [a]	Cu
C-Mo steel electrodes											
E7XT5-A1, -A1M	≦0.12	≦1.25	≦0.03	≦0.03	≦0.80	-	-	0.40 ~0.65	-	-	-
E8XT5-A1, -A2M											
Cr-Mo steel electrodes											
E8XT1-B1, -B1M	0.05 ~0.12	≦1.25	≦0.03	≦0.03	≦0.80	-	0.40 ~0.65	0.40 ~0.65	-	-	-
E8XT1-BlL, -B2LM	≦0.05										
E8XT1-B2, -B2M	0.05 ~0.12						1.00 ~1.50				
E8XT5-B2, -B2M											
E8XT1-B2L, -B2LM	≦0.05										
E8XT5-B2L, -B2LM											
E8XT1-B2H, -B2HM	0.10 ~0.15										
E9XT1-B3, -B3M	0.05 ~0.12						2.00 ~2.50	0.90 ~1.20			
E9XT5-B3, -B3M											
E10XT1-B3, -B3M											
E9XT1-B3L, -B3LM	≦0.05										
E9XT1-B3H, -B3HM	0.10 ~0.15										
E8XT5-B6, -B6M	0.05 ~0.12				≦1.0	≦0.40	4.0 ~6.0	0.40 ~0.65			≦0.50
E8XT5-B6L, -B6LM	≦0.05										
E8XT5-B8, -B8M	0.05 ~0.12						8.0 ~10.5	0.85 ~1.20			
E8XT5-B8L, -B8LM	≦0.05		≦0.03								
Ni steel electrodes											
E7XT8-Ni1	≦0.12	≦1.50	≦0.03	≦0.03	≦0.80	8.0 ~1.10	≦0.15	≦0.35	≦0.05	≦1.8	-

AWS Classification	Chemical composition for weld metal %										
	C	Mn	P	S	Si	Ni	Cr	Mo	V	Al [a]	Cu
E7XT6-Ni1	≦0.12	≦1.50	≦0.03	≦0.03	≦0.80	0.80 ~1.10	≦0.15	≦0.35	≦0.05	≦1.8	–
E6XT1-Ni1, Ni1M										–	
E8XT1-Ni1, Ni1M											
E8XT5-Ni1, Ni1M											
E8XT1-Ni2, Ni2M						1.75 ~2.75	–	–	–		
E8XT5-Ni2, Ni2M											
E9XT1-Ni2, Ni2M											
E7XT8-Ni2										≦1.8	
E8XT8-Ni2											
E8XT5-Ni3, Ni3M						2.75 ~3.75				–	
E9XT5-Ni3, Ni3M											
E8XT11-Ni3										≦1.8	
Mn-Mo steel electrodes											
E9XT1-D1, -D1M	≦0.12	1.25 ~2.00	≦0.03	≦0.03	≦0.80	–	–	0.25 ~0.55	–	–	–
E9XT5-D2, -D2M	≦0.15	1.65 ~2.25									
E10XT5-D2, -D2M											
E9XT1-D3C, -D3M	≦0.12	1.00 ~1.75						0.40 ~0.65			
Other low-alloy steel electrodes and rods											
E8XT5-K1, -K1M	≦0.15	0.80 ~1.40	≦0.03	≦0.03	≦0.80	0.80 ~1.10	≦0.15	0.20 ~0.65	≦0.05	–	–
E7XT4-K2		0.50 ~1.75				1.00 ~2.00		≦0.35		≦1.8	
E7XT7-K2											
E7XT8-K2											

AWS SPECIFICATION FOR WELDING CONSUMABLES

AWS Classification	Chemical composition for weld metal %										
	C	Mn	P	S	Si	Ni	Cr	Mo	V	Al [a]	Cu
E8XT1-K2, K2M	≦0.15	0.50 ~1.75	≦0.03	≦0.03	≦0.80	1.00 ~2.00	≦0.15	≦0.35	≦0.05	–	–
E9XT1-K2, K2M											
E8XT5-K2, K2M											
E9XT5-K2, K2M											
E10XT1-K3, K3M		0.75 ~2.25				1.25 ~2.60		0.25 ~0.65			
E11XT1-K3, K3M											
E10XT5-K3, K3M											
E11XT5-K3, K3M											
E11XT1-K4, K4M						1.75 ~2.60	0.20 ~0.60	0.20 ~0.65	≦0.03		
E11XT5-K4, K4M											
E12XT5-K4, K4M											
E12XT1-K5, K5M	0.10 ~0.25	0.60 ~1.60				0.75 ~2.00	0.20 ~0.70	0.15 ~0.55	≦0.05		
E6XT8-K6	≦0.15	0.05 ~1.50				0.40 ~1.00	≦0.20	≦0.15		≦1.8	
E7XT8-K6											
E7XT5-K6, K6M										–	
E10XT1-K7, K7M		1.00 ~1.75				2.00 ~2.75	–	–	–		
E9XT8-K8		1.00 ~2.00			≦0.40	0.50 ~1.50	≦0.20	≦0.20	≦0.05	≦1.8	
E10XT1-K9, K9M	≦0.07	0.50 ~1.50	≦0.015	≦0.015	≦0.60	1.30 ~3.75		≦0.50		–	≦0.06
E8XT1-W2, W2M	≦0.12	0.50 ~1.30	≦0.03	≦0.03	0.35 ~0.80	0.40 ~0.80	0.45 ~0.70	–	–		0.30 ~0.75
EXXTX-G	–	≧0.75 [b]			≧0.80 [b]	≧0.50 [b]	≧0.30 [b]	≧0.20 [b]	≧0.10 [b]	≧1.8 [b]	–

Notes a) Al is specified for self-shielded electrodes only.

b) In order to meet the alloy requirements of the G group. the undiluted weld metal shall have the minimum of at least one of the elements marked * in this table.

2. Mechanical properties for weld metal

AWS Classification	Chemical composition for weld metal %		
	Tensile Strength ksi	Yield strength at 0.2%offset ksi	Elongation %
E6XTX-X, -XM	60~80	≧50	≧22
E7XTX-X, -XM	70~90	≧58	≧20
E8XTX-X, -XM	80~100	≧68	≧19
E9XTX-X, -XM	90~110	≧78	≧17
E10XTX-X, -XM	100~120	≧88	≧16
E10XTX-K9, -K9M	a)	82~97	≧18
E11XTX-X, -XM	110~130	≧98	≧15
E12XTX-X, -XM	120~140	≧108	≧14
EXXXTX-G EXXXTG-X EXXTG-G	As agreed to between purchaser and supplier.		

3. Shielding, polarity

AWS Classification	External shielding	Polarity	Application
EX0T1-X	CO_2	DCEP	M
EX0T1-XM	75~80%Ar+CO_2		
EX1T1-X	CO_2		
EX1T1-XM	75~80%Ar+CO_2		
EX0T4-X	None		
EX0T5-X	CO_2		
EX0T5-XM	75~80%Ar+CO_2		
EX1T5-X	CO_2	DCEP/DCEN[a)]	
EX1T5-XM	75~80%Ar+CO_2		
EX0T6-X	None	DCEP	
EX0T7-X		DCEN	
EX1T7-X			
EX0T8-X			
EX1T8-X			
EXXT1-K9	CO_2	DCEP	
EXXT1-K9M	75~80%Ar+CO_2		
EX0T11-X	None	DCEN	
EX1T11-X			
EX0TG-X	-	Not specified	-
EX1TG-X			

4. Impact requirements and preheat, Interpass and PWHT temperatures

AWS Classification	Charpy V-notch impact test Temp. °F	Preheat and interpass Temperature °F	Postweld Heat treatment Temperature °F
C-Mo steel electrodes			
E7XT5-A1,-A1M	-20	300 ± 25	1150 ± 25
E8XT1-A2,-A1M	-		
Cr-Mo steel electrodes			
E8XT1-B1,-B1M	-	300 ± 25	1275 ± 25
E8XT1-B1L,-B1LM	-		
E8XT2-B2,-B2M	-		
E8XT5-B2,-B2M	-		
E8XT2-B2L,-B2LM	-		
E8XT5-B2L,-B2LM	-		
E8XT1-B2H,-B2HM	-		
E9XT1-B3,-B3M	-		
E9XT5-B3,-B3M	-		
E10XT1-B3,-B3M	-		
E9XT1-B3L,-B3LM	-		
E9XT1-B3H,-B3HM	-		
E8XT5-B6,-B6M	-	400 ± 100	1375 ± 25[a]
E8XT5-B6L,-B6LM	-		
E8XT5-B8,-B8M	-		
E8XT5-B8L,-B8LM	-		
Ni steel electrodes			
E7XT8-Ni1	-20	300 ± 25	1150 ± 25
E7XT6-Ni1	-20		
E6XT1-Ni1-Ni1M	-20		
E8XT1-Ni1-Ni1M	-20		
E8XT5-Ni1-Ni1M	-60		
E8XT1-Ni2-Ni2M	-40		
E8XT5-Ni2-Ni2M	-75		
E9XT1-Ni2-Ni2M	-40		
E7XT8-Ni2	-20		
E8XT8-Ni2	-20		
E8XT5-Ni3-Ni3M	-100		1150 ± 25
E9XT5-Ni3-Ni3M	-100		
E8XT11-Ni3	0		

AWS Classification	Charpy V-notch impact test Temp.°F	Preheat and interpass Temperature °F	Postweld Heat treatment Temperature °F
Mn-Mo steel electrodes			
E9XT1-D1,-D1M	-40	300±25	-
E9XT5-D2,-D2M	-60		1150±25
E10XT5-D2,-D2M	-40		
E9XT1-D3,-D3M	-20		-
Other low-allouy steel electrodes			
E8XT5-K1,-K1M	-40	300±25	-
E7XT4-K2	0		
E7XT7-K2	-20		
E7XT8-K2	-20		
E7XT11-K2	+32		
E8XT1-K2	-20		
E9XT1-K2	0		
E8XT5-K2,-K2M	-20		
E9XT5-K2,-K2M	-60		
E10XT1-K3,-K3M	0		
E11XT1-K3,-K3M	0		
E10XT5-K3,-K3M	-60		
E11XT5-K3,-K3M	-60		
E11XT1-K4,-K4M	0		
E11XT5-K4,-K4M	-60		
E12XT5-K4,-K4M	-60		
E12XT1-K5,-K5M	-		
E6XT8-K6	-20		
E7XT8-K6	-20		
E7XT5-K6,-K6M	-75		
E10XT1-K2,-K7M	-60		
E9XT8-K8	-20		
E10XT1-K9,-K9M	-60		
E8XT-W2,-W2M	-20		
EXXTX-G	-		

Notes 1. Absorbed energy for Charpy V-notch impact test shall be above 20ft-lb

Remarks a : Hold at specified temperature for two hours.

RECOMMENDED FILLER METALS FOR WELDING THE ASTM STEELS

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A1–92	All–Weights	WT–312
A2–90(1997)	All Classes	WT–91B3, WT–312
A3–87(1995)	Grade 1 & 2 Grade 3	WT–71, WT–70, WT–71LF WT–91K2
A27–95	All	WT–70, WT–71LF, WT–71
A36–97a		WT–70, WT–71LF, WT–71 WT–71T11
A53–99b		WT–70, WT–71LF, WT–71
A67–82	Grade 1 Grade 2	WT–91, WT–81W
A74–98		WT–70, WT–71LF, WT–71
A82–97a		WT–70, WT–71LF, WT–71
A105–98		WT–70, WT–71LF, WT–71
A106–99	Grade A, B, C	WT–70, WT–71LF, WT–71
A108–99	1008–1020 1022–1215	WT–70, WT–71LF, WT–71
A109–98a	All	WT–70, WT–71LF, WT–71
A123–97a		WT–71GS
A126–95		WT–312
A128–93(1998)		WT–312
A131–94	A thru DS A, B, D, DS ,AH32, AH36 DH32, DH36, EH32, EH36	WT–70, WT–71LF, WT–71 WT–81K2
A134–96		WT–70, WT–71LF, WT–71
A135–97c	A & BAll	WT–70, WT–71LF, WT–71
A139–96	All	WT–70, WT–71LF, WT–71
A148–93b(1998)	80–40, 80–50 90–60 105–85 115–95	WT–91 WT–91, WT–91K2 WT–91K2 WT–115
A167–99	301, 302, 302B, 304, 305, 308 304L 309, 309S 309Cb 310, 310S 316, 316L 317, 317L 321, 347, 348 XM–15	 WT–308L WT–309L WT–316L WT–317L WT–347
A176–99	430, 420, 422, 431, 442, 446	WT–410, WT–410NiMo, WT–309L
A178–95	A, C, D	WT–70, WT–71LF, WT–71
A179–90a(1996)		WT–70, WT–71LF, WT–71 WT–71T11
A181–95b	60 & 70	WT–70, WT–71LF, WT–71 WT–71T11
A182–98a	F1 F2 F5, F5a F9, F91, F911 F11, F12 F21, F22, F22V, F3VCb F6a, F6b, F6NM	WT–81A1 WT–81B2 WT–309L WT–81B2 WT–91B3 WT–410, WT–410NiMo

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A182–98a	F429, F430 F304, F304H, F304 F304L, F304LN F309H F310, F310H F310MoLN F316, F316H, F316N F316L, F316LN F317 F317L F321, F321H, F347, F347H, F348, F348H F44, F47, F48, F49, F58	 WT–308L WT–316L WT–316L WT–317L WT–347
A192–91(1996)		WT–70, WT–71LF, WT–71 WT–81A1
A193–99	B5 B6, B6X B7, B7M B16 B8, B8A, B8N, B8NA, B8P, B8PA B8C, B8CA, B8T, B8TA B8M, B8MA, B8M2, B8M3, B8MN, B8MNA B8LN, B8LNA B8MLN, B8MLNA B8MLCuN, B8MLCuNA	WT–309L WT–410 WT–81B2 WT–91B3 WT–347 WT–308L WT–316L
A202–93(1998)	A B	WT–81B2 WT–91B3
A203–97	A, B D, E, F	WT–80 WT–80
A204–93(1998)	A, B C	WT–81A1
A209–88		WT–81A1
A210–96		WT–71
A213–99a	T2, T11, T12, T17 T5, T5b, T5c T7, T9 T21 T22 TP201, TP202, TP304, TP304H, TP304N, TP304L, TP304LN TP309Cb, TP309H, TP309HCb, TP309S TP310Cb, TP310H, TP310HCb, TP310HCbN, TP310S TP316, TP316L, TP316H TP316N, TP316LN TP317, TP317L TP321, TP321H, TP347, TP347H, TP347LN, TP347FGH, TP348, TP348H	WT–85B2, WT–81B2 WT–309L WT–309L WT–91B3 WT–309L WT–91B3 WT–308L WT–316L WT–317L WT–347
A214–96		WT–70, WT–71LF WT–71
A216–93(1998)	WCA WCB WCC	WT–70, WT–71LF WT–71 WT–81A1
A217–99	WC1 WC4, WC5, WC6, WC11 WC9 C5 C12, C12A CA15	WT–81A1 WT–85B2, WT–81B2 WT–91B3 WT–309L WT–410
A220–99	All	
A225–93(1998)	Grade C Grade D	 WT–111K3, WT–115

RECOMMENDED FILLER METALS FOR WELDING THE ASTM STEELS

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A234–99	WPB, WPC	WT–71LF, WT–71
	WP1	WT–81A1
	WP11, WP12	WT–85B2, WT–81B2
	WP22	WT–91B3
	WP5	WT–309L
	WP9, WP91, WP911	
	WPR	WT–81W
A225–93(1998)	201, 202, 302, 304, 305	WT–308L
	309S	WT–309L
	309Cb	
	310S	
	310Cb	
	316	WT–316L
	316L	WT–316L
	317	WT–317L
	317L	WT–317L
	321, 347, 348	WT–347
	410	WT–410
	430	
A242–98		WT–71W, WT–81W
A225–93(1998)	210, 202, 304, 305, 304H	WT–308L
	304N	
	304L, 304LN	WT–308L
	309Cb, 309H, 309HCb, 309S	WT–309L
	310Cb, 310H, 310HCb, 310S	
	316, 316H, 316N	WT–316L
	316L, 316LN	WT–316L
	317, 317L	WT–317L
	321, 347, 348, 321H, 347H	WT–347
	348H	
A250–95	T1, T1a, T1b	WT–81A1
	T2	
	T–11, T–12	WT–81B2, WT–85B2
	T–22	WT–91B3
A252–98	All	WT–70
		WT–71LF, WT–71
		WT–71T11
A266–96	1	WT–70
		WT–71LF, WT–71
		WT–71T11
	2,3,4	WT–91
A268–96	TP405, TP410	WT–410
	TP429, TP430, TP430Ti, TP439	
A269–98	304	WT–308L
	304L, 304N	WT–308L
	316	WT–316L
	316L, 316N	WT–316L
	317	WT–317L
	321, 347, 348	WT–347
A270–98a	TP304	
	TP304L	WT–308L
	TP316	WT–316L
	TP316L	WT–316L
A276–98b	201, 202, 302, 304, 308	WT–308L
	304L, 305	
	309	
	309Cb	
	310	
	310Cb	
	316	WT–316L
	316L	WT–316L
	317	WT–317L
	321, 347, 348	WT–347
	403, 405, 410, 414, 421	WT–410
	430	
	446	WT–309L

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A278–93	All	
A283–98	Grade A, B, C Grade D	WT–70, WT–71LF WT–71T11 WT–70, WT–71LF WT–71T11
A285–90(1996)	Grade A, B, C	WT–70, WT–71LF WT–71T11
A288–91(1998)	1 2 3 4 5, 6, 7, 8	WT–70, WT–71LF WT–71T11 WT–115, WT–111K3 WT–111K3
A290–95	A, B C, D E, F G, H I, J K, L	WT–70, WT–71LF, WT–71 WT–81B2 WT–111K3
A291–95	1 2, 3 4 5, 6, 7 9	WT–91 WT–80 WT–111K3 WT–80
A297–97(1998)	HF HH HI, HK HE, HD	WT–308L WT–309L WT–312
A299–97		WT–71LF, WT–71 WT–81B2
A302–97	A B C & D	WT–81A1 WT–91 WT–91
A307–97	A	WT–70, WT–71LF, WT–71
A311–95	1018, 1117 All Others	WT–70, WT–71LF, WT–71
A312–99	TP304, 304N, 304H TP304L, 304LN TP309Cb TP309S, 309H TP310Cb TP316, 316H, 316N TP316L, 316LN TP317 TP317L TP321, 347, 348, 321H, 347H 348H	 WT–308L WT–309L WT–316L WT–316L WT–317L WT–317L WT–347
A314–97	202, 302, 302B, 303, 304 305, 308 309, 309S 309Cb 310, 310S, 314 316 316L 317 321, 347, 348 429, 430, 431 403, 410, 414, 416, 416SE, 420 440A, 440B, 440C 501, 502	 WT–316L WT–316L WT–317L WT–347 WT–309L, WT–410 WT–309L WT–309L
A321–90(1995)		WT–115
A325–97	Type I Type II	WT–71LF, WT–71 WT–111K3, WT–115
A328–98	Plates,Bars,Shapes	WT–71LF, WT–71 WT–71T11

RECOMMENDED FILLER METALS FOR WELDING THE ASTM STEELS

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A333–99	1 & 6 3 & 7 4 8	WT–70, WT–71, WT–71LF WT–80 WT–81K2, WT–81
A334–99	1 & 6 3 & 7 8	WT–70, WT–71, WT–71LF WT–80
A335–99	P1 & P15 P2, P11, P12 P5, P5b, P5c P9, P91, P92 P21, P22	WT–81A1 WT–85B2, WT–81B2 WT–309L WT–91B3
A336–99	F1 F5, F5A F6 F9 F21, F22 F11, F12 F304, 304H, 304N F304L, 304LN F309H F310 F316,F316H F316L F321, 347, 348	WT–81A1 WT–309L WT–309L WT–91B3 WT–85B2, WT–81B2 WT–308L WT–309L WT–316L WT–316L WT–347
A350–99	LF1, JF2, LF6 LF5	WT–91 WT–81K2
A336–99	CF8, CF8A, CF8C, CF10 CF3, CF3A CH8, CH10, CH20 CF–8M, CF10M CK20, HK30, HK40	WT–308L WT–308L WT–309L WT–316L
A352–93(1998)	LCA, LCB LCC LC1 LC2 LC2–1 CA6NM	 WT–81A1 WT–115, WT–111K3 WT–410NiMo
A353–93(1998)		WT–309L
A356–98	Grade 1 Grade 2 Grade 5, 6, 8, 9 Grade 10 Grade12 CA6NM	WT–70, WT–71 WT–81A1 WT–85B2, WT–81B2 WT–91B3 WT–410NiMo
A358–98	304, 304N, 304H 304L, 304LN 309 309Cb 310 310Cb 316, 316N, 316H 316L, 316LN 321, 347, 348	 WT–308L WT–309L WT–316L WT–316L WT–347
A361–85		WT–71 GS
A366–97		WT–70, WT–71LF, WT–71
A369–92	FPA, FPB, FP1 FP2, FP11, FP12 FP21, FP22 FP5, FP7, FP9	WT–70, WT–71LF, WT–71 WT–81A1 WT–85B2, WT–81B2 WT–91B3 WT–309L
A372–99	A B C, E, F, G, H, J D, K L, J Class 110	WT–71LF, WT–70, WT–71 WT–81A1, WT–91 WT–115, WT–111K3, WT–91 WT–115

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A376–98	TP304, TP304N, TP304H TP304LN TP316, TP316N, TP316H TP316LN TP321, TP321H, TP347 TP347H, TP348	 WT–308L WT–316L WT–316L WT–347
A377–95		
A381–96	Y35 thru Y50 Y52 thru Y60 Y65	WT–70, WT–71LF, WT–71, WT–70, WT–71LF, WT–71 WT–91
A387–99	Grade 2, 12, 11 Grade 22(L), 21(L) Grade 5, 7, 9, 91, 911	WT–85B2, WT–81B2 WT–91B3
A389–93(1998)	C–23 C–24	WT–85B2, WT–81B2 WT–91B3
A391–98	All	WT–111K3
A403–99	WP/CR 304, 304N, 304H WP/CR 304L, 304LN WP/CR 309 WP/CR 316, 316N, 316H WP/CR 316L, 316LN WP/CR 317 WP/CR 317L WP/CR 321, 347, 348 321H, 347H	 WT–308L WT–309L WT–316L WT–316L WT–317L WT–317L WT–347
A409–95a	TP304 TP304L TP309S TP309Cb TP310S TP310Cb TP316 TP316L TP317 TP321, 347, 348	 WT–308L WT–309L WT–316L WT–316L WT–317L WT–347
A414–98	Grade A, B, C Grade D, E, F, G	 WT–70, WT–71LF, WT–71
A420–96a	WPL6 WPL9 WPL3 WPL8	WT–70, WT–71LF, WT–71 WT–91 WT–80
A423–95	Grade 1 Grade 2	WT–85B2, WT–81B2, WT–81W WT–91
A424–97		WT–71LF, WT–71
A426–92(1997)	CP1, CP15 CP2, CP11, CP12 CP5, CP5b, CP21 CP7, CP9 CP22	WT–81A1 WT–81B2, WT–85B2 WT–309L WT–309L WT–91B3
A447–93(1998)		WT–309L
A451–93(1997)	CPF3, CPF3A CPF8, CPF8A CPF3M CPF8M CPF10MC CPF8C CPH8, CPH20, CPH10 CPK20	WT–308L WT–316L WT–316L WT–347 WT–309L
A455–90(1996)		WT–70, WT–71LF, WT–71
A463–99a		WT–71GS
A469–94a	Class 1 Class 2 Class 3 Class 4 Class 5, 6, 7	 WT–91 WT–81B2 WT–111K3 WT–111K3, WT–115

RECOMMENDED FILLER METALS FOR WELDING THE ASTM STEELS

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A470–98	2 3 & 5 4, 6, 7, 8, 9	WT–91 WT–91K2 WT–111K3, WT–115
A471–94	10	WT–111K3, WT–115
A473–99	201, 202, 205, 302, 302B, 304 305, 308 303 304L 309, 309S 310, 310S, 314 316 316L 317 321, 347, 348 403, 405, 410, 410S, 414 416, 420 429, 430, 431 440A, 440B, 440C 501, 501A, 501B, 502	 WT–308L, WT–312 WT–308L WT–309L WT–316L WT–316L WT–317L WT–347 WT–410 WT–312
A476–90(1997)		
A478–97	302, 304, 305 304L 309Cb 310Cb 316 316L 317	 WT–308L WT–316L WT–316L WT–317L
A479–99	302, 304, 304H, 304N 304L, 304LN 309S 309Cb 310S 310Cb 316, 316N 316L, 316LN 321, 321H, 347, 348 403, 410, 414, 405 430	 WT–308L WT–309L WT–316L WT–316L WT–347 WT–410
A478–93(1998)	11A, 12A, 16A 1A, 1B, 1C, 2A, 2B, 2C, 4A, 4C, 8A, 9A, 9C, 13A 4B, 4D, 4E, 8B, 8C, 9B 9D, 10A, 11B, 12B, 13B 6A, 6B, 7A, 14A, 10B	WT–91 WT–91K2
A493–95	302, 304, 305 316 384 429, 430 410, 431 440C	WT–308L WT–316L WT–308L WT–410 WT–312
A494–99	M–35–1, M–25S	
A496–97a		WT–70, WT–71LF, WT–71
A497–97		WT–70, WT–71LF, WT–71
A499–89(1997)	Grade 50 Grade 60	WT–70, WT–71LF, WT–71 WT–91K2
A500–99	All	WT–70, WT–71LF, WT–71 WT–71T11
A501–99	All	WT–70, WT–71LF, WT–71 WT–71T11
A508–95	1, 1A, 2Class 1, 3Class 1 2Class 2, 3Class2, 4N Class 3 4N Class 1, 5, Class1 4N Class 2, 5, Class2 22	WT–91K2 WT–115, WT–111K3 WT–91B3

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A511–96	MT302, MT304, MT305 MT304L MT309S MT310S MT316 MT316L MT317 MT321, MT347 MT403, MT410, MT414, MT416SE MT431 MT440A MT405 MT429, MT430 MT446–1, MT446–2	WT–308L WT–316L WT–316L WT–317L WT–347 WT–410 WT–312 WT–410NiMo WT–309L
A512–96	All except 1110, 1115, 1117	WT–70, WT–71LF, WT–71
A513–98	1008 thru 1015 1016 thru 1035	WT–70, WT–71LF, WT–71 WT–70, WT–71LF, WT–71
A514–94a	All	WT–115, WT–111K3, WT–91K2
A515–92(1997)	All	WT–70, WT–71LF, WT–71
A516–90(1996)	All	WT–70, WT–71LF, WT–71
A517–93(1998)	All	WT–115, WT–111K3, WT–91K2
A512–96	CA, CC, CC1 CE, CF, AA, AB AC, AD, CF1, CG AE AF	WT–70, WT–71LF, WT–71 WT–70, WT–71LF, WT–71 WT–70 WT–91 WT–115, WT–111K3
A522–956	All	
A523–96	A&B	WT–70, WT–71LF, WT–71
A524–96	I&II	WT–70, WT–71LF, WT–71
A529–96		WT–70, WT–71LF, WT–71
A533–93(1998)	Type A1 Type B1, B2, C1, C2, D1, D2, Type A3, B3, C3, D3	WT–81A1 WT–91K2, WT–91
A537–95	Class 1 Class 2, 3	WT–70, WT–71LF, WT–71 WT–91
A539–99		WT–71LF, WT–71 WT–71T11, WT–71GS
A541–95	1, 1A 1C, 2 Class 1, 3 Class 1 3V, 22 Class 3 2 Class 2, 3 Class 2, 4N Class 3 4N Class 1, 5 Class 1, 22 Class 4 4N Class 2, 5 Class 2, 22 Class 5 11 Class 4	WT–70, WT–71LF, WT–71 WT–91 WT–91B3 WT–111K3, WT–115 WT–81B2
A542–99	1A, 1B, 3A, 3B, 4A, 4B, 4Aa, 4Ab 2A, 2B	WT–91B3 WT–91B3
A543–93(1998)	1B, 1C, 3B, 3C 2B, 2C	WT–115, WT–111K3 WT–111K3
A553–95	Type 1	
A554–98	Same as A511–96 except for following. MT–301 MT–309S–Cb MT–330	WT–308L
A556–96	A2 B2, C2	WT–71LF, WT–71 WT–71T11, WT–71GS WT–71LF, WT–71 WT–71T11, WT–71GS
A562–90(1996)		WT–70, WT–71LF, WT–71 WT–71T11, WT–71GS

RECOMMENDED FILLER METALS FOR WELDING THE ASTM STEELS

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A568–98 A569–98 A570–98	All	WT–70, WT–71LF, WT–71 WT–71T11, WT–71GS
A572–99a	42, 50, 55, 60 65	WT–70, WT–71LF, WT–71 WT–91
A573–93a(1998)	58, 65 70	 WT–91
A575–96	M1008 thru M1025 M1031 & M1044	WT–70, WT–71LF, WT–71 WT–91
A576–90b(1995)	1008 thru 1029 1030 thru 1040 1042 thru 1055 1060 1070, 1078	WT–70, WT–71LF, WT–71 WT–70, WT–71LF, WT–71 WT–91 WT–115, WT–111K3
A581–95b A582–95b	303, 303SE 416, 416SE 430, 430F	WT–308L WT–312, WT–410
A587–96		WT–71LF, WT–71, WT–70
A588–97a	All	WT–81W
A589–96	A & B	WT–70, WT–71LF, WT–71
A591–98		WT–71GS, WT–71T11
A592–89(1994)	A, E, F	WT–115, WT–111K3
A595–98	A, B, C	WT–71LF, WT–71, WT–70
A602–94(1998)	All	WT–71LF, WT–71, WT–70
A606–98	All	WT–81W
A607–98	45, 50 55, 60 65, 70	WT–70, WT–71LF, WT–71 WT–70, WT–71LF, WT–71 WT–91
A608–91a(1998)	HC30, HD50 HE35 HF30 HH30, HH33, HI35 HK30, HK40, HL30, HL40 HW50 HX50	 WT–312 WT–347 WT–309L
A611–97 if copper is specified, use	A, B, C, D E All Grades	WT–70, WT–71LF, WT–71 WT–70, WT–71LF, WT–71 WT–71W, WT–81W
A612–98		WT–91
A615–96a	40 60 75	WT–70, WT–71LF, WT–71 WT–91K2, WT–91 WT–111K3, WT–115
A616–96a	50 60	WT–70, WT–71LF, WT–71 WT–91K2
A617–96a	40 60	WT–70, WT–71LF, WT–71 WT–91K2, WT–91
A618–99	All	WT–70, WT–71LF, WT–71
A620–97 A622–97		WT–70, WT–71LF, WT–71 WT–71T11, WT–71GS
A633–95	A, C, D E	 WT–91
A635–98	1006 thru 1023	WT–70, WT–71LF, WT–71
A649–98a	2, 4, 51 1A2 3 1B2	WT–70, WT–71LF, WT–71 WT–85B2, WT–81B2 WT–91K2
A656–98	50, 60 70 80	WT–70, WT–71LF, WT–71 WT–91 WT–91K2, WT–91

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A659–97	All	WT–70, WT–71LF, WT–71
A660–96	All	WT–70, WT–71LF, WT–71
A662–99	A & B C	WT–70, WT–71LF, WT–71 WT–91
A663–89(1994)	45, 50, 55, 60, 65 70, 75, 80	WT–70, WT–71LF, WT–71 WT–70, WT–71LF, WT–71
A666–99	201, 202, 205, 301, 302, 304, 304N 201L, 301LN, 301L, 301LN, 304L, 304LN 316, 316N 316L	 WT–308L WT–316L WT–316L
A668–96	A, AH, B, BH, C, CH, D, DH E, EH, G, GH F, FH, H, HH J, JH, K, KH L, LH M, ,H, N, NH	WT–70, WT–71LF, WT–71 WT–91 WT–91B3 WT–111K3, WT–115
A668–96	CA55, CB60, CB65, CB70, CC60, CC65, CC70, CD70, CE55 CD80, CE60, CF65, CF70 CF66, CF71 CJ101 thru CJ113 CK75	WT–70, WT–71LF, WT–71 WT–91 WT–80 WT–115 WT–81A1 or WT–81B2, WT–85B2
A672–96	A45, A50, A55, B55, B60, B65 B70, C55, C60, C65, C70, D70 D80, E55, E60 H75, H80 J80, J90, J100 K75, K85, L65, 670, L75, M70 M75, N75	WT–70, WT–71LF, WT–71 WT–81A1 or WT–81B2, WT–85B2 WT–81A1 WT–81B2, WT–85B2
A675–90(1995)	45, 50, 55, 60, 65, 70 75, 80, 90	WT–70, WT–71LF, WT–71 WT–91K2, WT–91
A678–94a	A B C, D	WT–70, WT–71LF, WT–71 WT–81W WT–115
A688–98	TP304 TP304L, TP304LN TP316 TP316L, TP316LN TPXM–29	 WT–308L WT–316L WT–316L
A690–94	All	WT–71W, WT–81W
A691–98	CM–65, CM–70, CM–75 CMSH–70, CMSH–75 CMSH–80 1/2CR, 1CR, 1 · 1/4CR 2 · 1/4CR	WT–81A1 WT–91 WT–81B2, WT–85B2 WT–91B3
A690–94	All	WT–70, WT–71LF, WT–71
A695–90b(1995)	A, B, C, D Grade 35 & 40 A, C, D Grade 45 & 50	WT–70, WT–71LF, WT–71 WT–91
A696–90a(1995)	B C	WT–70, WT–71LF, WT–71 WT–70, WT–71LF, WT–71
A704–96	40 60	WT–70, WT–71LF, WT–71 WT–91K2, WT–91
A706–98	60	WT–91
A707–98	L1, L2, L3 L4 L5 L6	 WT–91 WT–81K2
A709–97b	36, 50 50W, 70W, HPS 70W 100, 100W	WT–70, WT–71LF, WT–71, WT–71W, WT–71T11 WT–81W, WT–91K2 WT–115, WT–111K3

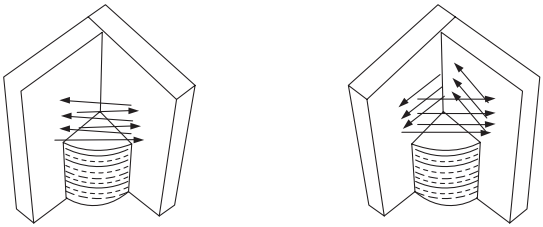
RECOMMENDED FILLER METALS FOR WELDING THE ASTM STEELS

ASTM DESIGNATION	CLASS OR GRADE	Brand Name
A710–95	A1 A2	WT–91K2 WT–70, WT–71LF, WT–71
A714–99	All	WT–81W
A715–98	50,60 70,80	WT–70, WT–71LF, WT–71 WT–91K2
A724–99	All	WT–115
A727–97		WT–81A1
A730–93	A & B	WT–70, WT–71LF, WT–71
A734–87a(1997)	A B	WT–91
A735–99	1, 2 3, 4	WT–80CG
A737–99	B C	WT–91 WT–91K2
A738–90(1996)	A B & C	WT–91, WT–81W WT–91, WT–81W
A739–90a(1995)	B11 B22	WT–85B2, WT–81B2 WT–91B3
A744–98a	CF–8 CF–8M CF–8c CF–3 CF–3M	 WT–316L WT–347 WT–308L WT–316L
A757–90(1996)	A1Q, A2Q B2N, B2Q D1N1, D1N2, D1N3, D1Q1 D1Q2, D1Q3 E1Q, E2N, E3N	WT–70, WT–71LF, WT–71 WT–91B3 WT–111K3
A758–98	All	WT–70, WT–71LF, WT–71
A759–85(1992)		WT–70, WT–71LF, WT–71
A765–98a	I II III IV	WT–91 WT–91 WT–80 WT–81K2
A769–94	36, 40, 45, 50, 60 45W, 50W 80	WT–70, WT–71LF, WT–71 WT–71W, WT–81W WT–91
A771–95	TP316	WT–316L
A774–98 & A778–98	TP304L TP316L TP317L TP321, TP347	WT–308L WT–316L WT–317L WT–347
A782–90(1996)	1 2 3	WT–85B2, WT–81B2 WT–90TB3, WT–91B3
A787–96	All	WT–70, WT–71LF, WT–71
A792–99	All	WT–71GS
A793–96	304 304L 316 316L	 WT–308L WT–316L WT–316L
A795–97	A & B (if Galvanized)	WT–70, WT–71LF, WT–71 WT–71GS
A792–99	All	
A841–98	A, B & C	WT–70, WT–71LF, WT–81K2
A852–97		WT–81W
A871–97	50 60	WT–71W WT–81W

WELDING CONSUMABLES GUIDANCE

1. Welding Techniques

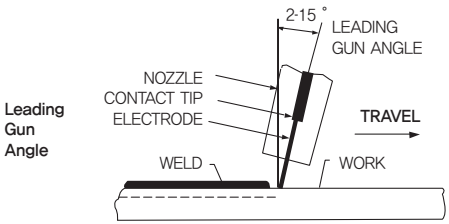
Welding with out products requires a minimum of training. Both stringer and weave techniques are used with WT. The stringer or straight progression weld is usually preferred for thin plate(3/8" and less), since the faster travel speed lowers the heat input and the chance of distortion. The weave technique is more satisfactory for large single pass welds. Two methods of weaving in the vertical position are illustrated in Figure 1.



STRAIGHT WEAVE TRIANGULAR WEAVE

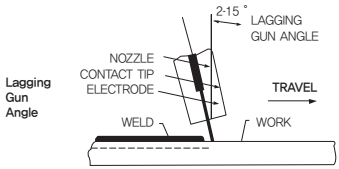
Figure 1

A leading angle is when the welding gun is tilted in the direction of travel. The top section of the gun is 2 ° to 15 ° in advance of the point of welding. The gas shield is then directed into the molten pool.



A portion of the arc is insulated from the base metal by the molten pool when a leading gun angle is used.
Leading gun angles are usually desirable in the flat and horizontal positions.

A lagging angle is when the welding gun is tilted away from the direction of travel. The top section of the gun is 2 ˚ to 15 ˚ behind the point of welding. The gas shield is then directed ahead of the molten pool. A lagging angle is usually preferred for vertical–up welding.



The arc stream plays ahead on a cold base metal when a lagging gun angle is used, reducing the intensity of the heat on the work. This lowers the penetration and helps to prevent burn–thru on thin gauge metals.

Shielding Gas

Out products are designed for use with straight CO_2 or a mixture of argon and CO_2. Arc characteristics, bead shape, weld deposit chemistry, and mechanical properties can be altered by the choice of shielding gas.

Argon atom are easily ionized at the arc, resulting in a highly charged direct path between the electrode and the work piece. The concentration of energy at the arc helps constrict the droplets size of the weld metal, shifting the transfer within the spray mode. A smooth stable arc with a minimum of spatter is the result when the percentage of argon is increased. A common mixture that produces balanced results is 75% Argon and 25% CO_2.

The addition of CO_2 increases the penetration and the most penetration will occur when 100% CO_2 is used. But, as the percentage of CO_2 rises, the arc characteristics become harsher and the spatter levels increase.

Another consideration with carbon dioxide is its activity in the heat of the arc. It will break down into oxygen and carbon monoxide both of which will attract and oxidize certain alloys, such as silicon and manganese, preventing their total transfer into the weld metal.

Some of products are designed for use with 100% CO_2 and the silicon and manganese levels are adjusted to compensate for this oxidation. Argon does not hinder this transfer of alloys, and the use of an Argon/CO_2 mixture will alter the expected chemistry of the weld metal for electrodes designed for 100% CO_2 shielding.

WELDING CONSUMABLES GUIDANCE

Heat Input

The amount of heat energy locally transferred into the weld puddle at the arc is known as heat input. Heat input is function of the combined effects of amperage, voltage and travel speed and is expressed in joules or kilojoules per inch of weld. It can be calculated with the following formula.

$$\text{HEAT INPUT (Joules/Inch of Weld)} = \frac{\text{Amps X Volts X 60}}{\text{Travel Speed(in/min.)}}$$

Heat input influences the cooling rate, and it is the cooling rate which significantly alters the mechanical properties for the weld metal and the heat affected zone. The properties most sensitive to adjustments in heat input are weld metal toughness and yield strength as indicated in the Figures 2, 3 and 4.

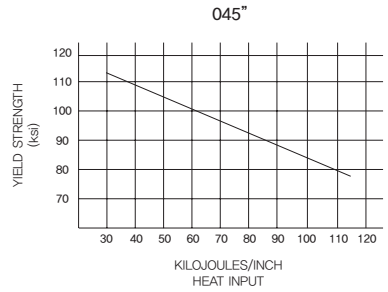


Figure 2.

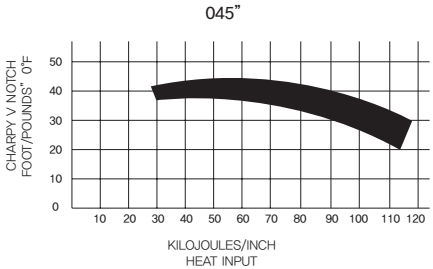


Figure 3.

Figure 4.

Trouble–Shooting

Consistently good welds throughout a wide range of welding conditions are easily obtained when the carriables that affect the flux cored process are understood and controlled. Each variable listed below is important in obtaining a balanced welding condition.

Welding Voltage
Welding Current
Welding Travel Rate
Welding Gun Angle
Contact Tip to Work Distance

When any of these variables is out of adjustment, certain problems may arise. To obtain the best results in correcting these problems, the following suggestions are made :

1. Electrode stubs on work.
   a. Voltage too low
   b. Wire feed too fast.
   c. Poor ground.
2. Arc burn back to contact tip.
   a. Volage too high.
   b. Wire feed speed too low.
   c. Loose or worn feed rolls.
   d. Kinked or clogged welding conduit.
3. Rough arc or heavy spatter.
   a. Improper volt or amps.
   b. Loose or worn contact tip.
   c. Arc blow.
   d. Gun pointing in wrong direction or too much angle in relation to the weld.
   e. Nozzle too far from the work.

4. Erratic wire feed.
   a. Worn or loose contact tip.
   b. Worn feed rolls.
   c. Clogged welding conduit.
   d. Fluctuation of line voltage.
   e. Faulty relay or contactor in control.
6. Weld is undercut.
   a. Voltage too high.
   b. Excessive amperage for plate thickness.
   c. Excessive travel speed.
   d. Wrong gun angle.
5. Weld bead is not uniform.
   a. Wrong volt/amperage setting.
   b. Inconsistent travel speed.
   c. Operator varying nozzle to work distance.
7. Weld metal porosity.
   a. Insufficient gas flow.
   b. Moisture in gas.
   c. Loss of gas due to wind or air currents.
   d. Excessive gas causing turbulence.
   e. Nozzle held too far from work surface.
   f. Contaminant on surface of plate.
   g. Wrong volt/amperage setting.

8. Weld metal cracks.
   a. Wrong electrode for base metal.
   b. Preheat required and not being used.
   c. Stress cracks due to improper procedure.
      Welds should be welded from center out or toward an open end.
   d. Too much heat input(quenched and tempered steels).
   e. The chemistry of the base metal is incorrect or out of specification.
9. Poor bead appearance.
   a. Excessive current.
   b. Travel speed too slow.
   c. Too much gas.
   d. Poor gas coverage.

2. CALCULATING FILLER METAL CONSUMPTION

The number of pounds of welding electrodes or welding wire necessary to complete a given weld joint may be calculated by the formula :

$$P = \frac{WL}{E}$$

Where:

P = Pounds of electrode or wire required
W = Weight per foot of weld metal
L = Length of weld (feet)
E = Deposition efficiency

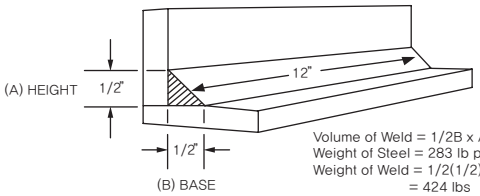
WELDING CONSUMABLES GUIDANCE

WEIGHT PER FOOT OF WELD METAL

Calculating the weight of weld metal requires that we consider the following items

1. Area of the cross–section of the weld.
2. Length of the weld.
3. Volume of the weld in cubic inches.
4. Weight of the weld metal per cubic inch.

In the fillet weld shown below, the area of the cross–section(the triangle) is equal to one half the base times the height, the volume of the weld is equal to the area times the length, and the weight of the weld then, is the volume times the weight of the material (steel) per cubic inch.



CALCULATING THE WEIGHT PER FOOT OF A FILLET WELD

This example is for a fillet weld with no reinforcement.
Similar calculations can be made for butt or lap joint.

DEPOSITION EFFICIENCY

The deposition efficiency of an electrode or welding wire indicates the portion of that product you can expect to be deposited as weld metal. Losses due to slag, spatter, fume and in the case of semi automatic or automatic

welding processes, the ends cut before each weld and the wire left in the feed cable make no process 100% efficient.

For estimates of electrode or wire consumption, the following average values of deposition efficiency may be used.

WELDING CONSUMABLES GUIDANCE

PROCESS	DEPOSITION EFFICIENCY
Submerged Arc	99%
Gas Metal Arc(98%Ar, 2%O_2)	98%
Gas Metal Arc(75%Ar, 25%Co_2)	96%
Gas Metal Arc(100% Co_2)	93%
Metal Cored Wires	93%
Gas Shielded Flux Cored Wires	88%
Self Shielded Flux Cored Wires	82%
*Shielded Metal Arc(Stick 12"long)	59%
*Shielded Metal Arc(Stick 14"long)	62%
*Shielded Metal Arc(Stick 18"long)	66%

*Includes 2" stub loss.

It must be remembered that when deposition tests are perfomed in the laboratory, the depositon efficiency is calculated by the formula :

$$\text{Deposition Efficiency} = \frac{\text{Weight of metal deposited}}{\text{Weight of electrode consumed}}$$

This does not take stub loss into consideration. The chart below shows how the laboratory established efficiency is effected by the length of the stub.

WELDING CONSUMABLES GUIDANCE

STUB LOSS CORRECTION TABLE FOR COATED ELECTRODES
EFFICIENCY INCLUDING STUB LOSS

	Deposition Efficiency	2" STUB	3" STUB	4" STUB	5" STUB
12" ELECTRODE	60%	50.0%	45.0%	40.0%	35.0%
	65%	54.2%	46.7%	43.3%	37.9%
	70%	58.3%	52.5%	46.6%	40.8%
	75%	62.5%	56.2%	50.0%	43.7%
	80%	66.6%	60.0%	53.0%	46.6%
14" ELECTRODE	60%	51.4%	47.1%	42.9%	38.3%
	65%	55.7%	51.1%	46.4%	41.0%
	70%	60.0%	55.0%	50.0%	45.0%
	75%	64.3%	56.9%	53.6%	46.2%
	80%	68.5%	62.8%	57.1%	51.4%
18" ELECTRODE	60%	53.3%	50.0%	46.6%	43.3%
	65%	57.7%	54.2%	50.5%	46.9%
	70%	62.2%	56.3%	54.4%	50.5%
	75%	66.6%	62.5%	56.3%	54.2%
	80%	71.1%	66.6%	62.2%	57.7%

ELECTRODE OF WELDING WIRE CONSUMPTION

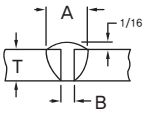
The following tables show the estimated number of pounds of stick electrode or welding wire required per lineal foot of weld for some of the more common weld joints.

HORIZONTAL FILLET WELDS

Fillet Size L	Weld Metal Req'd. Per Foot of Weld (Pounds)	Pounds of Electrode or Wire Required Per Lineal Foot of Weld			
		SMAW-Stick Electrodes"	GMAW-Solid Wire	FCAW-Gas Shielded	Metal Cored Wires
1/8"	.027	.043	.028	.032	.028
3/16"	.060	.097	.063	.070	.065
1/4"	.106	.171	.112	.125	.115
5/16"	.166	.268	.175	.195	.180
3/8"	.239	.385	.252	.282	.260
1/2"	.425	.686	.447	.500	.462
5/8"	.664	1.071	.699	.781	.722
3/4"	.956	1.542	1.010	1.125	1.039
1"	1.698	2.739	1.787	2.000	1.846

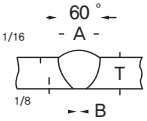
WELDING CONSUMABLES GUIDANCE

SQUARE BUTT JOINT



JOINT DIMENSIONS (INCHES)			Weld Metal Req'd. Per Foot of Weld (Pounds)	Stick Electrode Req'd. Per Foot of Weld. (Pounds) *
T	B	A		
3/16	1/16	3/8	0.093	0.150
1/4	1/16	7/16	0.115	0.185
	3/32		0.142	0.229
5/16	1/16	1/2	0.137	0.220
	3/32		0.165	0.266

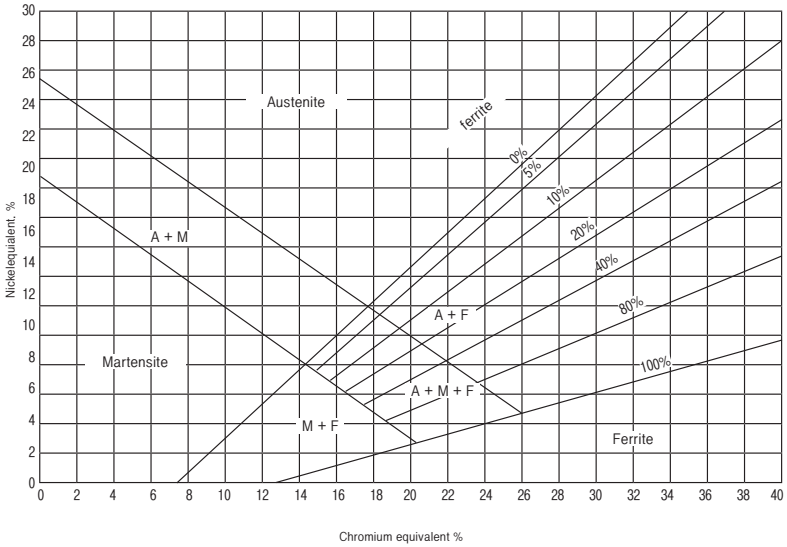
SINGLE-V BUTT JOINT



JOINT DIMENSIONS (INCHES)			Weld Metal Req'd. Per Foot of Weld (Pounds)	Stick Electrode Req'd. Per Foot of Weld. (Pounds) *
T	B	A		
1/4	1/16	5/16	0.127	0.205
5/16	3/32	3/8	0.222	0.358
3/8	1/8	1/2	0.352	0.568
1/2	1/8	5/8	0.523	0.844
5/8	1/8	13/16	0.870	1.403
3/4	1/8	15/16	1.217	1.963
1	1/8	1 1/14	2.104	3.394

* Based on 2 "stubs and losses to slag, spatter and fume.

Schaeffler diagram



Creq = %Cr + 1.4(%Mo) + 0.5(%Nb) + 1.5(%Si) + 2(%Ti)
Nieq = %Ni + 30(%C) + 0.5(%Mn) + 30(%N)

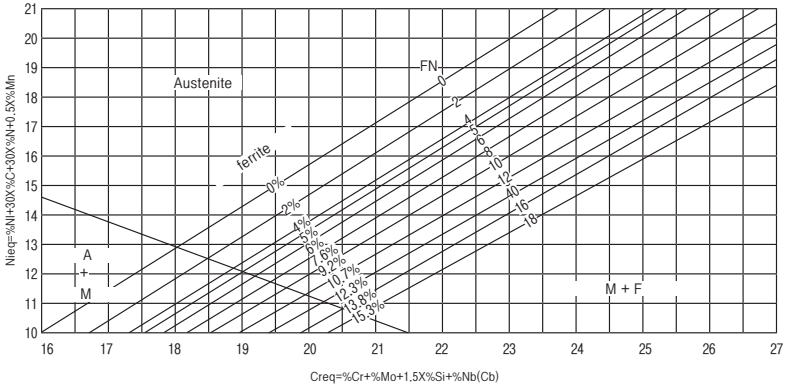
There are several formula for the nickel–and chromium–equivalent, each of them giving a somewhat better result for a particular type of stainless steel. In this case we use the formula as indicated here.

The most important is that a foundry does use formula and check the structure. By doing this they can always evaluate the influence of a fluctuating chemical composition.

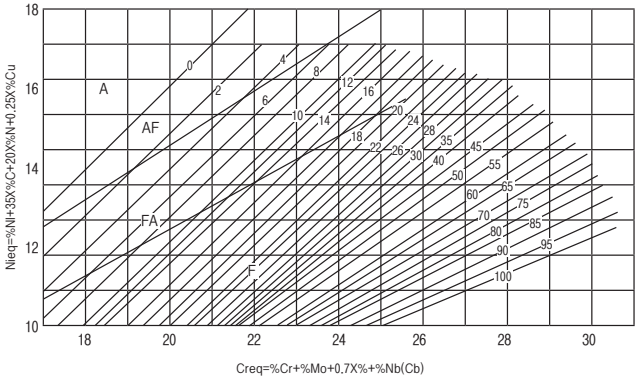
The latest version of Creq and Nieq are:

Creq = %Cr + 1.0(%Mo) + 0.5(%Nb + %Ta) + 1.5(%Si) + 2(%Ti) + (%W + %V + %Al)
Nieq = %Ni + 30(%C) + 0.5(%Mn) + 30(%N) + 0.5(%Co)

Delong Diagram



WRC Diagram



CONVERSION TABLES.

(1) Temperature Conversion table.

℉	℃	℉	℃	℉	℃	℉	℃
−350	−212	56	13.3	182	83.3	820	437.8
−340	−207	58	14.4	184	84.4	840	448.9
−330	−201	60	15.6		85.6	860	460.0
−320	−196	62	16.7	188	86.7		471.1
−310	−190	64	17.8	190	87.8	900	482.2
−300	−184	66	18.9	192	88.9	920	493.3
−290	−179	68	20.2	194	90.0	940	504.4
−280	−173	70	21.1	196	91.1	960	515.6
−270	−168	72	22.2	198	92.2	980	527
−260	−162	74	23.3	200	93.3	1000	538
−250	−157	76	24.4	202	94.4	1020	549
−240	−151	78	25.6	204	95.6	1040	560
−230	−146	80	26.7	206	96.7	1060	571
−220	−140	82	27.8	208	97.8	1080	582
−210	−134	84	28.9	210	98.9	1100	593
−200	−129	86	30.0	212	100.0	1120	604
−190	−123	88	31.1	214	101.1	1140	616
−180	−118	90	32.2	216	102.2	1160	627
−170	−112	92	33.3	218	103.3	1180	638
−160	−107	94	34.4	220	104.4	1200	649
−150	−101	96	35.6	230	110.0	1220	660
−140	−96	98	36.7	240	115.6	1240	671
−130	−90	100	37.8	250	121.1	1260	682
−120	−84	102	38.9	260	126.7	1280	693
−110	−79	104	40.4	270	132.2	1300	704
−100	−73	106	41.1	280	137.8	1320	716
−90	−68	108	42.2	290	143.3	1340	727
−80	−62	110	43.3	300	148.9	1360	738
−70	−57	112	44.4	310	154.4	1380	749
−60	−51	114	45.6	320	160.0	1400	760
−50	−45.6	116	46.7	330	165.6	1420	771
−40	−40.0	118	47.8	340	171.1	1440	727
−30	−34.4	120	48.9	350	176.7	1460	738
−20	−28.9	122	50.0	360	182.2	1480	749
−10	−23.3	124	51.1	370	187.8	1500	760
0	−17.8	126	52.2	380	193.3	1520	827
2	−16.7	128	53.3	390	198.9	1540	838
4	−15.6	130	54.4	400	204.4	1560	849
6	−14.4	132	55.6	410	210.0	1580	860
8	−13.3	134	56.7	420	215.6	1600	871
10	−12.2	136	57.8	430	221.1	1620	882
12	−11.1	138	58.9	440	226.7	1640	893
14	−10.0	140	60.0	450	232.2	1660	904
16	−8.9	142	61.1	460	237.8	1680	916
18	−7.8	144	62.2	470	243.3	1700	927
20	−6.7	146	63.3	480	248.9	1720	938
22	−5.6	148	64.4	490	254.4	1740	949
24	−4.4	150	65.6	500	260.0	1760	960
26	−3.3	152	66.7	520	271.1	1780	971
28	−2.2	154	67.8	540	282.2	1800	982
30	−1.1	156	68.9	560	293.3	1820	993
32	0	158	70.0	580	304.4	1840	1004
34	1.1	160	71.1	600	315.6	1860	1016
36	2.2	162	72.2	620	326.7	1880	1027
38	3.3	164	73.3	640	337.8	1900	1038
40	4.4	166	74.4	660	348.9	1920	1049
42	5.6	168	75.6	680	360.0	1940	1060
44	6.7	170	76.7	700	371.1	1960	1071
46	7.8	172	77.8	720	382.2	1980	1082
48	8.9	174	78.9	740	393.3	2000	1093
50	10.0	176	80.0	760	404.4		
52	11.1	178	81.1	780	415.6		
54	12.2	180	82.2	800	426.7		

$℉ = \frac{9}{5} \times ℃ + 32$ $℃ = \frac{5}{9} (\times ℉ - 32)$

Appendix

CONVERSION TABLES.

(2) Stress conversion table.

1 lbf/in^2=0.000703070kgf/mm^2

1 lbf/in^2	0,000	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
					kgf/mm^2					
0,000	0,000	0,703	1,406	2,109	2,812	3,515	4,128	4,992	5,625	6,328
10,000	7,031	7,734	8,437	9,140	9,843	10,546	11,249	11,952	12,655	13,358
20,000	14,061	14,765	15,468	16,171	16,874	17,577	18,280	18,983	19,686	20,389
30,000	21,092	21,795	22498	23,201	23,904	24,607	25,311	26,014	26,717	27,420
40,000	28,123	28,826	29,529	30,232	30,232	31,638	32,341	33,044	33,747	34,450
50,000	35,154	35,857	36,560	37,263	37,966	38,669	39,372	40,075	40,778	41,481
60,000	42,184	42,887	43,590	44,293	44,997	45,700	46,403	47,106	47,809	48,512
70,000	49,215	49,918	50,621	51,324	52,027	52,730	53,433	54,136	54,840	55,543
80,000	56,246	56,949	57,652	58,355	59,058	59,761	60,464	61,167	61,870	62,573
90,000	63,276	63,979	64,682	65,386	66,089	66,792	67,495	68,198	68,901	69,604
100,000	70,307	71,010	71,713	72,416	73,119	73,822	74,525	75,229	75,932	76,635
110,000	77,338	78,041	78,744	79,447	80,150	80,853	81,556	82,259	82,962	790,696
120,000	84,368	85,072	85,775	86,478	87,181	87,884	88,587	89,290	89,993	97,727
130,000	91,399	92,102	92,805	93,508	94,211	94,914	95,618	96,321	97,024	104,757
140,000	98,430	99,133	99,836	100,539	101,242	101,945	102,648	103,351	104,054	111,788
150,000	105,460	106,164	106,867	107,570	108,273	108,976	109,679	110,382	111,085	
160,000	112,491	113,194	113,897	114,600	115,303	116,007	116,007	117,413	118,116	118,819
170,000	119,522	120,225	120,928	121,631	122,334	123,037	123,037	124,443	125,146	125,850
180,000	126,553	127,256	127,959	128,662	129,365	130,068	130,068	131,474	132,177	132,880
190,000	133,583	134,286	134,989	135,693	136,396	137,099	137,099	138,505	139,208	139,911
200,000	140,614	141,317	142,020	142,723	143,426	144,129	144,129	145,535	146,239	146,942

1 lbf/in^2	100	200	300	400	500	600	700	800	900
kgf/mm^2	0.0703	0.1406	0.2109	0.2812	0.3515	0.4218	0.4922	0.5625	0.6328

kgf/mm^2	lbf/in^2(psi)	N/mm^2(MPa)
1	1422.31	9.80665
7.03X10^{-4}	1	6.895X10^{-3}
0.10197	145.035	1

CONVERSION TABLES.

(3) Impact value conversion table

Conversion factor: 1 ft · lbf=0.138255kgf · m

ft · lbf	0	1	2	3	4	5	6	7	8	9
	kgf · m									
0	0.000	0.138	0.277	0.415	0.553	0.691	0.830	0.968	1.106	1.244
10	1.383	1.152	1.659	1.797	1.936	2.074	2.212	2.350	2.489	2.627
20	2.765	2.903	3.042	3.180	3.318	3.456	3.595	3.733	3.871	4.009
30	4.148	4.286	4.424	4.562	4.701	4.839	4.977	5.115	5.254	5.392
40	5.530	5.669	5.807	5.945	6.083	6.222	6.360	6.498	6.636	6.775
50	6.913	7.051	7.189	7.328	7.466	7.604	7.742	7.881	8.019	8.157
60	8.295	8.434	8.572	8.710	8.848	8.987	9.125	9.263	9.401	9.540
70	9.678	9.816	9.954	10.093	10.231	10.369	10.507	10.646	10.784	10.922
80	11.060	11.199	11.337	11.475	11.613	11.752	11.890	12.028	12.166	12.305
90	12.443	12.581	12.719	12.858	12.996	13.134	13.372	13.411	13.549	13.687
100	13.826	13.964	14.102	14.240	14.379	14.517	14.655	14.793	14.932	15.070
110	15.208	15.346	15.485	15.623	15.761	15.899	16.038	16.176	16.314	16.452
120	16.591	16.729	16.867	17.005	17.144	17.282	17.420	17.558	17.697	
130	17.973	18.111	18.250	18.388	18.526	18.664	18.803	18.941	19.079	19.217
140	19.356	19.494	19.632	19.770	19.909	20.047	20.185	20.323	20.462	20.600
150	20.738	20.877	21.015	21.153	21.291	21.430	21.568	21.706	21.844	21.983
160	22.121	22.259	22.397	22.536	22.674	22.812	22.950	23.098	23.227	23.365
170	23.503	23.642	23.780	23.918	24.056	24.195	24.333	24.471	24.609	24.748
180	24.886	25.024	25.162	25.301	25.439	25.277	25.715	25.854	25.992	26.130
190	26.268	26.407	26.545	26.683	26.821	26.960	27.098	27.236	27.374	27.513
200	27.651	27.789	27.928	28.066	28.204	28.342	28.481	28.619	28.757	28.895

kgf/m	ft · lbf	J
1	7.23275	9.80665
0.13826	1	1.35587
0.10197	0.73754	1

CONVERSION TABLES.

ft · lbf ⟨=⟩ kgf · m

1kgf · m=9.8066N · m(or J)

kgf · m	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
–	N · m(or J)									
1	–	0.9807	1.9613	2.9420	3.9227	4.9033	5.8840	6.8647	7.8453	8.8260
2	9.8066	10.787	11.768	12.749	13.729	14.710	15.691	16.671	17.652	18.633
3	19.613	20.594	21.575	22.555	23.536	24.517	25.497	26.478	27.459	28.439
4	29.420	30.401	31.381	32.362	33.343	34.323	35.304	36.285	37.265	38.249
5	39.227	40.207	41.188	42.169	43.149	44.130	45.111	46.091	47.072	48.053
6	49.033	50.014	50.995	51.975	52.956	53.937	54.917	55.898	56.879	57.859
7	58.840	59.821	60.801	61.782	62.763	63.743	64.724	65.705	66.685	67.666
8	68.647	69.627	70.608	71.589	72.569	73.550	74.531	75.511	76.492	77.473
9	78.453	79.434	80.415	81.395	82.376	83.357	84.337	85.318	86.299	87.279
10	88.260	89.241	90.221	91.202	92.183	93.163	94.144	95.125	96.105	97.086
11	98.066	99.047	100.03	101.01	101.99	102.97	103.95	104.93	105.91	106.89
12	107.87	108.85	109.83	110.82	111.80	112.78	113.76	114.74	115.72	116.70
13	117.68	118.66	119.64	120.62	121.60	122.58	123.56	124.54	125.53	126.51
14	127.49	128.47	129.45	130.43	131.41	132.39	133.37	134.35	135.33	136.31
15	137.29	138.27	139.25	140.24	141.22	142.20	143.18	144.16	145.14	146.12
16	147.10	148.08	149.06	150.04	151.02	152.00	152.98	153.96	154.95	155.93
17	156.91	157.89	158.87	159.85	160.83	161.81	162.79	163.77	164.75	165.73
18	166.71	167.69	168.67	169.66	170.64	171.62	172.60	173.58	174.56	175.54
19	176.52	177.50	178.48	179.46	180.44	181.42	182.40	183.38	184.37	185.35
20	186.33	187.31	188.29	189.27	190.25	191.23	192.21	193.19	194.17	195.15
21	196.13	197.11	198.09	199.07	200.06	201.04	202.02	203.00	203.98	204.96
22	205.94	206.92	207.90	208.88	209.86	210.84	211.82	212.80	213.78	214.77
23	215.75	216.73	217.71	218.69	219.67	220.65	221.63	222.61	223.59	224.57
24	225.55	226.53	227.51	228.49	229.48	230.46	231.44	232.42	233.40	234.38
25	235.36	236.34	237.32	238.30	239.28	240.26	241.24	242.22	243.20	244.19
26	245.17	246.15	247.13	248.11	249.09	250.07	251.05	252.03	253.01	253.99
27	254.97	255.95	256.93	257.91	258.90	259.88	260.86	261.84	262.82	263.80
28	264.78	265.76	266.74	267.72	268.70	269.68	270.66	271.64	272.62	273.61
29	274.59	275.57	276.55	277.53	278.51	279.49	280.47	281.45	282.43	283.41
30	284.39	285.37	286.35	287.33	288.32	289.30	290.28	291.26	292.24	293.22
31	294.20	295.18	296.16	297.14	298.12	299.10	300.08	301.06	302.04	303.03
32	304.01	304.99	305.97	306.95	307.93	308.91	309.89	310.87	311.85	312.83
33	313.81	314.79	315.77	316.75	317.74	318.72	319.70	320.68	321.66	322.64
34	323.62	324.60	325.58	326.56	327.54	328.52	329.50	330.48	331.46	332.45
35	333.43	334.41	335.39	336.37	337.35	338.33	339.31	340.29	341.27	342.25
36	343.23	344.21	345.19	346.17	347.16	348.14	349.12	350.10	351.08	352.06
37	353.04	345.02	355.00	355.98	356.96	357.94	358.92	359.90	360.88	361.87
38	362.85	363.83	364.81	365.79	366.77	367.75	368.73	369.71	370.69	371.67
39	372.65	373.63	374.61	375.59	376.58	377.56	378.54	379.52	380.50	381.48
40	382.46	383.44	384.42	385.40	386.38	387.36	388.34	389.32	390.30	391.29
41	392.27	393.25	394.23	395.21	396.19	397.17	398.15	399.13	400.11	401.09
42	402.07	403.05	404.03	405.01	406.00	406.98	407.96	408.94	409.92	410.90
43	411.88	412.86	413.84	414.82	415.80	416.78	417.76	418.74	419.72	420.71
44	421.69	422.67	423.65	424.63	425.61	426.59	427.57	428.55	429.53	430.51
45	431.49	432.47	433.45	434.43	435.42	436.40	437.38	438.36	439.34	440.32
46	441.30	442.28	443.26	444.24	445.22	446.20	447.18	448.16	449.14	450.13
47	451.11	452.09	453.07	454.05	455.03	456.01	456.99	457.97	458.95	459.93
48	460.91	461.89	462.87	463.85	464.84	465.82	466.80	467.78	468.76	469.74
49	470.72	471.70	472.68	473.66	474.64	475.62	476.60	477.58	478.56	479.55
	480.53	481.51	482.49	483.47	484.45	485.43	486.41	487.39	488.37	489.35

CONVERSION TABLES.

kgf · m	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	N · m(or J)									
50	490.33	491.31	492.29	493.27	494.26	495.24	496.22	497.20	498.18	499.16
51	500.14	501.12	502.10	503.08	504.06	505.04	506.02	507.00	507.98	508.97
52	509.95	510.93	511.91	512.89	513.87	514.85	515.83	516.81	517.79	518.77
53	519.75	520.73	521.71	522.69	523.68	524.66	525.64	526.62	527.60	528.58
54	529.56	530.54	531.52	532.50	533.48	534.46	535.44	536.42	537.40	538.39
55	539.37	540.35	541.33	542.31	543.29	544.27	545.25	546.23	547.21	548.19
56	579.17	550.15	551.13	552.11	553.10	554.08	555.06	556.04	557.02	558.00
57	558.98	559.96	560.94	561.92	562.90	563.88	564.86	565.84	566.82	567.81
58	568.79	569.77	570.75	571.73	572.71	573.69	574.67	575.65	576.63	577.61
59	578.59	579.57	580.55	581.53	582.52	583.50	584.48	585.46	586.44	587.42
60	588.40	589.38	590.36	591.34	592.32	593.30	594.28	595.26	596.24	597.22
61	598.21	599.19	600.17	601.15	602.13	603.11	604.09	605.07	606.05	607.03
62	608.01	608.99	609.97	610.95	611.93	612.92	613.90	614.88	615.86	616.84
63	617.82	618.80	619.78	620.76	621.74	622.73	623.70	624.68	625.66	626.64
64	627.63	628.61	629.59	630.57	631.55	632.53	633.51	634.49	635.47	636.45
65	637.43	638.41	639.39	640.37	641.35	642.34	643.32	644.30	645.28	646.26
66	647.24	648.22	649.20	650.18	651.16	652.14	653.12	654.10	655.08	656.06
67	657.05	658.03	659.01	659.99	660.97	661.95	662.93	663.91	664.89	665.87
68	666.85	667.83	668.81	669.79	670.77	671.76	672.74	673.72	674.70	675.68
69	676.66	677.64	678.62	679.60	680.58	681.56	682.54	683.52	684.50	685.48
70	686.47	687.45	688.43	689.41	690.39	691.37	692.35	693.33	694.31	695.29
71	696.27	697.25	698.23	699.21	700.19	701.18	702.16	703.14	704.12	705.10
72	706.08	707.06	708.04	709.02	710.00	710.98	711.96	712.94	713.92	714.90
73	715.89	716.87	717.82	718.83	719.81	720.79	721.77	722.75	723.73	724.71
74	725.69	726.67	727.65	728.63	729.61	730.60	731.58	732.56	733.54	734.52
75	735.50	736.48	737.46	738.44	739.42	740.40	741.38	742.36	743.34	744.32
76	745.31	746.29	747.27	748.52	749.23	750.21	751.19	752.17	753.15	754.13
77	755.11	756.09	757.07	758.05	759.03	760.02	761.00	761.98	762.96	763.94
78	764.92	765.90	766.88	767.86	768.84	769.82	770.80	771.78	772.76	773.74
79	774.73	775.71	776.69	777.67	778.65	779.63	780.61	781.59	782.57	783.55
80	784.53	785.51	786.49	787.47	788.45	789.44	790.42	791.40	792.38	793.36
81	794.34	795.32	796.30	797.28	798.26	799.24	800.22	801.20	802.18	803.16
82	804.15	805.13	806.11	807.09	808.07	809.05	810.03	811.01	811.99	812.97
83	813.95	814.93	815.91	816.89	817.87	818.86	819.84	820.82	821.80	822.78
84	823.76	824.74	825.72	826.70	827.68	828.66	829.64	830.62	831.60	832.58
85	833.57	834.55	835.53	836.51	837.49	838.47	839.45	840.43	841.41	842.39
86	843.37	844.35	845.33	846.31	847.29	848.28	849.26	850.24	851.22	852.20
87	853.18	854.16	855.14	856.12	857.10	858.08	859.06	860.04	861.02	862.00
88	862.99	863.97	864.95	865.93	866.91	867.89	868.87	869.85	870.83	871.81
89	872.79	873.77	874.75	875.73	876.71	877.70	878.68	879.66	880.64	881.62
90	882.60	883.58	884.56	885.54	886.52	887.50	888.48	889.46	890.44	891.42
91	892.41	893.39	894.37	895.35	896.33	897.31	898.29	899.27	900.25	901.23
92	902.21	903.19	904.17	905.15	906.13	907.12	908.10	909.08	910.06	911.04
93	912.02	913.00	913.98	914.96	915.94	916.92	917.90	918.88	919.86	920.84
94	921.83	922.81	923.79	924.77	925.75	926.73	927.71	928.69	929.67	930.65
95	931.63	932.61	933.59	934.57	935.55	936.54	937.52	938.50	939.48	940.46
96	941.44	942.42	943.40	944.38	945.36	946.34	947.32	948.30	949.28	950.26
97	951.25	952.23	953.21	954.19	955.17	956.15	957.13	958.11	959.09	960.07
98	961.05	962.03	963.01	963.99	964.97	965.96	966.94	967.92	968.90	969.88
99	970.86	971.84	972.82	973.80	974.78	975.76	976.74	977.72	978.70	979.68
100	980.66									

CONVERSION TABLES.

(4) Hardness conversion table.

Vickers Hardness (DPH)	Brinell Hardness 10mm Ball load3000kg			Rockwell Hardness				Shore Hardness	Tensile strength. (kgf/mm^2) (APProx)
	Stand –and Ball	Hult– gren Ball	Tungsten Carbide Ball	A scale	B scale	C scale	D scale		
940	–	–	–	85.6	–	68.0	76.9	97	–
920	–	–	–	85.3	–	67.5	76.5	96	–
900	–	–	–	85.0	–	67.0	76.1	95	–
880	–	–	767	84.7	–	66.4	75.7	93	–
860	–	–	757	84.4	–	65.9	75.3	92	–
840	–	–	745	84.1	–	65.3	74.8	91	–
820	–	–	733	83.8	–	64.7	74.3	90	–
800	–	–	722	83.4	–	64.0	73.8	88	–
780	–	–	710	83.0	–	63.3	73.3	87	–
760	–	–	698	82.6	–	62.5	72.6	86	–
740	–	–	684	82.2	–	61.8	72.1	84	–
720	–	–	670	81.8	–	61.0	71.5	83	–
700	–	615	656	81.3	–	60.1	70.8	81	–
690	–	610	647	81.1	–	59.7	70.5	–	–
680	–	603	638	80.8	–	59.2	70.1	80	–
670	–	597	630	80.6	–	58.8	69.8	–	–
660	–	590	620	80.3	–	58.3	69.4	79	–
650	–	585	611	80.0	–	57.8	69.0	–	–
640	–	578	601	79.8	–	57.3	68.7	77	–
630	–	571	591	79.5	–	56.8	68.3	–	–
620	–	564	582	79.2	–	56.3	67.9	75	–
610	–	557	573	78.9	–	55.7	67.5	–	–
600	–	550	564	78.6	–	55.2	67.0	74	–
590	–	542	554	78.4	–	54.7	66.7	–	210
580	–	535	545	78.0	–	54.1	66.2	72	206
570	–	527	535	77.8	–	53.6	65.8	–	202
560	–	519	525	77.4	–	53.0	65.4	71	199
550	505	512	517	77.0	–	52.3	64.8	–	194
540	496	503	507	76.7	–	51.7	64.4	69	190
530	488	495	497	76.4	–	51.1	63.9	–	186
520	480	487	488	76.1	–	50.5	63.5	67	183
510	473	479	479	75.7	–	49.8	62.9	–	179
500	465	471	471	75.3	–	49.1	62.2	66	174
490	456	460	460	74.9	–	48.4	61.6	–	169
480	448	452	452	74.5	–	47.7	61.3	64	165
470	441	442	442	74.1	–	49.9	60.7	–	160
460	433	433	433	73.6	–	46.1	60.1	62	156
450	425	425	425	73.3	–	45.3	59.4	–	153
440	415	412	415	72.8	–	44.5	58.8	59	149
430	405	405	405	72.3	–	43.6	58.2	–	144
420	397	397	497	71.8	–	42.7	57.5	57	140
410	388	388	388	71.4	–	41.8	56.8	–	136
400	379	379	379	70.8	–	40.8	56.0	55	131
390	369	369	369	70.3	–	39.8	55.2	–	127
380	360	360	360	69.8	(110.0)	38.8	54.4	22	123

CONVERSION TABLES.

Vickers Hardness (DPH)	Brinell Hardness 10mm Ball load3000kg			Rockwell Hardness				Shore Hardness	Tensile. strength. (kgf/mm^2) (APProx)
	Stand –and Ball	Hult– gren Ball	Tungsten Carbide Ball	A scale	B scale	C scale	D scale		
370	350	350	350	69.2	–	37.7	53.6	–	120
360	341	341	341	68.7	(109.0)	36.6	52.8	50	115
350	331	331	331	68.1	–	35.5	51.9	–	112
340	322	322	322	67.6	(108.0)	34.4	51.1	47	109
330	313	313	313	67.0	–	33.3	50.2	–	105
320	303	303	303	66.4	(107.0)	32.2	49.4	45	103
310	294	294	294	65.8	–	31.0	48.4	–	100
300	284	284	284	65.2	(105.0)	29.8	47.5	42	97
295	280	280	280	64.8	–	29.2	47.1	–	96
290	275	275	275	64.5	(104.5)	28.5	46.5	41	94
285	270	270	270	64.2	–	27.8	46.0	–	92
280	265	265	265	63.8	(103.5)	27.1	45.3	40	91
275	256	261	261	63.5	–	26.4	44.9	–	89
270	252	256	256	63.1	(102.0)	25.6	44.3	38	87
265	252	252	252	62.7	–	24.8	43.7	–	86
260	247	247	247	62.4	(101.0)	24.0	43.1	37	84
255	243	243	243	62.0	–	23.1	42.2	–	82
250	238	238	238	61.6	99.5	22.2	41.7	36	81
245	233	233	233	61.2	–	21.3	41.1	–	79
240	228	228	228	60.7	98.1	20.3	0.3	34	78
230	219	219	219	–	96.7	(18.0)	–	33	75
220	209	209	209	–	95.0	(15.7)	–	32	71
210	200	200	200	–	93.4	(13.4)	–	30	68
200	190	190	190	–	91.5	(11.0)	–	29	65
190	181	181	181	–	89.5	(8.5)	–	28	62
180	171	171	171	–	87.1	(6.0)	–	26	59
170	162	162	162	–	85.0	(3.0)	–	25	56
160	152	152	152	–	81.7	(0.0)	–	24	53
150	143	143	143	–	78.7	–	–	22	50
140	133	133	133	–	75.0	–	–	21	46
130	124	124	124	–	71.2	–	–	20	44
120	114	114	114	–	66.7	–	–	–	40
110	105	105	105	–	62.3	–	–	–	–
100	95	95	95	–	56.2	–	–	–	–
95	90	90	90	–	52.0	–	–	–	–
90	86	86	86	–	–	–	–	–	–
85	81	81	81	–	–	–	–	–	–