

SMAW/MMA Electrodes



Welding Notes

1. Recommending low electrical current (low heat input and low dilution rate) of avoiding sensitization due to carbonate chromium precipitation in the HAZ (Heat Affected Zone).
2. To control the welding current within the recommended range for avoiding of core wire overheat and coating peeling off.
3. Short arc welding technique to prevent N_2 and O_2 into arc creating blow hole and alloy elements burning loss, excessive spatter occurrence and detrimental of weld metal microstructure.
4. To keep weaving width 3 times of core wire diameter as maximum while necessary.
5. Recommending to use jigs, fixtures or proper welding sequence to limit welding deformation.
6. $200\sim 250^{\circ}\text{C} \times 1 \text{ hr}$ baking prior to use. Proper cleaning of welding groove or joint surface before welding and complete removal of spatter after welding.
7. To follow welding parameter described in welding procedure specification (groove type, weldment thickness, welding current and voltage range, etc) to guaranty the quality.
8. Recommending pre-heat and inter-pass temperatures table :

Steel Type	Pre-heat Temperature	Inter pass Temperature
Austenite Type	15°C (60°F)	150°C (300°F)
Martensite Type	200°C (400°F)	310°C (600°F)
Ferrite Type	150°C (300°F)	260°C (500°F)

9. The polarity illustration :
DCEP (DC+): Electrode positive or DC reverse polarity.
DCEN (DC-): Electrode negative or DC straight polarity.

G307

AWS A5.4 E307-16
JIS Z 3221 ES307-16**Product Features:**

- More higher Mn content than 308, austenite structure weld metal.
- High work hardening tendency, no magnetism.
- Good crack resistance, easy slag removal and less spatter loss.
- High welding performance, good arc stability.

Applications:

- Suitable for dissimilar metal welding on manganese steel to carbon steel castings or forgings.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo
0.08	0.40	4.25	9.8	19.62	0.70

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
630	42

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~120	115~150	165~200
Vertical / overhead position	50~75	75~105	95~130	—

© Note: Refer to Page C8 welding notes.

G308

AWS A5.4 E308-16
JIS Z 3221 ES308-16**Product Features:**

- Lime Titanium oxide type stainless steel covered electrode.
- All deposited weld metal contains approximately 19%Cr,9%Ni content elements to get austenite structure.
- Easy slag removal and less spatter loss.
- Good crack and corrosion resistance.

Applications:

- Suitable for welding of SUS304, 302 and 305 stainless steels.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo
0.04	0.81	0.77	9.70	19.19	0.03

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
576	45.2

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.0/250	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	30~55	60~85	85~120	100~140	140~180
Vertical / overhead position	30~50	50~70	75~105	95~130	—

© Note: Refer to Page C8 welding notes.

G308L

AWS A5.4 E308L-16
JIS Z 3221 ES308L-16

Product Features:

- Low carbon lime Titanium oxide type covered electrode for low carbon content stainless steel.
- Good arc stability, easy slag removal and less spatter loss.
- Good bead appearance, crack resistance and corrosion resistance.

Applications:

- Suitable for welding of low carbon content 18Cr-8Ni stainless steel such as SUS304 and 304L.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo
0.03	0.80	0.66	9.80	19.3	0.02

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
556	47.7

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.0/250	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	30~55	60~85	85~120	115~150	150~200
Vertical / overhead position	30~50	50~70	75~105	95~130	—

© Note: Refer to Page C8 welding notes.

G308M

AWS A5.4 E308-26
JIS Z 3221 ES308-26

Product Features:

- High welding efficiency, austenite structure type stainless steel covered electrode.
- Mild steel cored wire for standing higher welding current and heat.
- Good arc stability and good for flat and horizontal welding positions.

Applications:

- Suitable for welding of SUS304, 302,305 stainless steel.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr
0.05	0.56	0.69	9.80	19.10

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
585	42

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/400	5.0/450
Flat position	80~110	110~150	150~190	180~260

© Note: Refer to Page C8 welding notes.



G308L-15

AWS A5.4 E308L-15
JIS Z 3221 ES308L-15

Product Features:

- Basic coating of stainless steel electrodes has outstanding welding performance for vertical and overhead positions.
- Austenite weld metal contains adequate ferrite to obtain a balance of both crack and corrosive resistance.

Applications:

- Welding of low carbon content 18Cr-8Ni stainless steel such SUS 304 and 304L .

◎ Note: 1.250~300°C x 1hr baking prior to use.
2.Refer to Page C8 welding notes.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr
0.03	0.52	1.43	9.77	18.70

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %	FN
582	49.6	4

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~110	115~140	150~190
Vertical / overhead position	50~75	75~100	95~130	—

G309

AWS A5.4 E309-16
JIS Z 3221 ES309-16

Product Features:

- All deposited weld metal contains approximately 23%Cr-13%Ni elements stainless steel covered electrode.
- Austenite weld metal contains adequate ferrite numbers to get very low crack sensitivity.
- Good heat and corrosion resistance.

Applications:

- Welding of SUS 309S stainless steel.
- Welding of Carbon steel or other high hardening alloy steels to stainless steel.
- Cladding or welding of stainless steel to carbon steel or low alloy steel.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr
0.05	0.72	1.20	13.40	23.70

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
612	37

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~120	115~150	150~200
Vertical / overhead position	50~70	75~105	95~120	—

◎ Note: Refer to Page C8 welding notes.

G309L

AWS A5.4 E309L-16
JIS Z 3221 ES309L-16

Product Features:

- All deposited weld metal contains approximately 23%Cr-13%Ni elements type covered electrode for low carbon content stainless steel.
- Austenite weld metal contains adequate ferrite numbers to provide low crack sensitivity.
- Good heat and corrosion resistance.

Applications:

- Welding of SUS 309L stainless steel.
- Welding of Carbon steel or other high hardening alloy steels to stainless steel (low carbon).
- Cladding or welding of stainless steel (low carbon) to carbon steel or low alloy steel.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr
0.03	0.72	1.20	13.40	23.70

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
570	39

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~120	115~150	165~200
Vertical / overhead position	50~70	75~105	95~130	—

© Note: Refer to Page C8 welding notes.

G309L-15

AWS A5.4 E309L-15
JIS Z 3221 ES309L-15

Product Features:

- Basic coating of stainless steel electrodes for 309L stainless steel has outstanding welding performance for vertical and overhead positions.
- Austenite weld metal provides a controlled ferrite content to get low crack sensitivity.
- All deposited weld metal contains 23%Cr-13%Ni low carbon contene to get good heat and corrsion resistance.

Applications:

- Suitable for welding of SUS 309L stainless steel, cladding or welding of stainless to carbon or low alloy steel or dissimilar-metal joint .

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr
0.03	0.38	1.50	13.69	22.72

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
584	39.6

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~110	115~140	150~190
Vertical / overhead position	50~75	75~100	95~130	—

© Note: 1.250~300°C x 1hr baking prior to use.
2.Refer to Page C8 welding notes.



G309LMo

AWS A5.4 E309LMo-16
JIS Z 3221 ES309LMo-16

Product Features:

- Lime titanium oxide type covered electrode for low carbon content stainless steel
- All deposited weld metal contains approximately 2.5%Mo to get better strength, acid and heat resistance than 309L .
- Adequate Ferrite content to provide low crack sensitivity.

Applications:

- Welding of SUS 309MoL stainless steels.
- Cladding or welding of SUS316, 316L stainless steel to carbon steel or low alloy steel.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo
0.03	0.63	1.25	12.94	22.89	2.4

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
650	40

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	50~85	85~120	115~150	150~190
Vertical / overhead position	50~80	75~105	95~130	—

© Note: Refer to Page C8 welding notes.

G310

AWS A5.4 E310-16
JIS Z 3221 ES310-16

Product Features:

- Lime titanium oxide type stainless steel covered electrode.
- All deposited full austenite structure weld metal contains approximately 25%Cr, 20%Ni elements to get good corrosion/heat resistance, better toughness than high hardening tendency 13%Cr steel.

Applications:

- Welding of SUS310 stainless steel.
- Welding of Cr-Mo steel.
- Welding of 13%Cr steel.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo
0.10	0.33	1.63	21.73	27.28	0.07

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
569	38.8

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~120	115~150	150~200
Vertical / overhead position	50~75	75~105	95~130	—

© Note: Refer to Page C8 welding notes.

G310Mo

AWS A5.4 E310Mo-16
JIS Z 3221 ES310Mo-16

Product Features:

- G310Mo is a lime-titanium type stainless steel electrode. It has good crack resistance and usability. The weld metals provide excellent corrosion, acid, and heat resistance, and the tensile strength is good in as-welded condition.

Applications:

- It is suitable for welding of heat resisting castings, type 316 clad steels or for the overlay of carbon steels.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	P	S	Ni	Cr	Mo
0.07	0.41	1.55	0.019	0.010	20.7	26.8	2.40

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
602	38

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter (mm)		2.6	3.2	4.0	5.0
Length (mm)		300	350	350	350
Current (Amp)	F	60~85	85~120	115~150	150~200
	V,OH	50~75	75~105	95~130	—

© Note: Refer to Page C8 welding notes.

G312

AWS A5.4 E312-16
JIS Z 3221 ES312-16

Product Features:

- All deposited weld metal contains approximately 29%Cr-9%Ni elements with higher ferrite content than others.
- Higher Cr content in weld metal than others to get good oxidation and crack resistance.

Applications:

- Welding of 29%Cr-9%Ni stainless steel castings.
- Suitable for dissimilar metal welding of stainless steel to low alloy steel or high Ni stainless steels.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr
0.10	0.80	1.11	10.26	28.8

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
819	23.3

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~120	110~150	150~200
Vertical / overhead position	50~75	75~105	95~120	—

© Note: Refer to Page C8 welding notes.



G316

AWS A5.4 E316-16
JIS Z 3221 ES316-16**Product Features:**

- Lime titanium oxide type covered electrode for 316 stainless steel, deposited weld metal contains approximately 18%Cr-12%Ni-2%Mo elements.
- Austenite structure weld metal, good heat, corrosion and crack resistance.
- Weld metal contains Mo element to get good crevice corrosion resistance.

Applications:

- Suitable for welding of severe acid and high heat resistance required SUS316 stainless steel.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo
0.04	0.70	0.85	12.29	18.0	2.37

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
580	41.2

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.0/250	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	30~50	60~85	85~120	110~150	150~200
Vertical / overhead position	30~50	50~75	75~105	95~120	—

© Note: Refer to Page C8 welding notes.

G316L

AWS A5.4 E316L-16
JIS Z 3221 ES316L-16**Product Features:**

- Lime titanium oxide type covered electrode for 316 low carbon content stainless steel, deposited weld metal contains approximately 18%Cr-12%Ni-2%Mo elements.
- Austenite structure weld metal, good heat, corrosion and crack resistance, better inter-granular corrosion resistance than 316.
- Weld metal contains Mo element to get good crevice corrosion resistance.

Applications:

- Suitable for welding of severe acid and high heat resistance required SUS316L stainless steel.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo
0.02	0.71	0.63	12.38	17.91	2.37

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
560	41.7

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.0/250	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	30~50	60~85	85~120	110~150	150~200
Vertical / overhead position	30~50	50~70	75~105	95~130	—

© Note: Refer to Page C8 welding notes.

G316L-15

AWS A5.4 E316L-15
JIS Z 3221 ES316L-15

Product Features:

- Basic coating of stainless steel electrodes for 316 stainless steel has outstanding welding performance for vertical and overhead positions.
- Austenite weld metal contains adequate ferrite to obtain good heat, crack and corrosive resistance.
- Weld metal contains Mo element to get good crevice corrosive resistance.

Applications:

- Suitable for welding of high acid and high heat resistance required SUS 316 and 316L.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo
0.03	0.40	1.37	11.47	18.16	2.31

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %	FN
575	48.8	4

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~110	115~140	150~190
Vertical / overhead position	50~75	75~100	95~130	—

© Note: 1.250~300°C x 1hr baking prior to use.
2.Refer to Page C8 welding notes.

G317

AWS A5.4 E317-16
JIS Z 3221 ES317-16

Product Features:

- Lime titanium oxide type covered electrode for stainless steel, deposited weld metal contains approximately 18%Cr-12%Ni-3.5%Mo elements.
- Weld metal contain higher Mo to get better pitting, crevice corrosion and heat resistance than 316.

Applications:

- Suitable for welding of SUS 317.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo
0.03	0.83	0.69	12.69	19.05	3.81

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
602	51.7

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.0/250	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	30~50	60~85	85~120	115~150	150~200
Vertical / overhead position	30~50	50~75	75~105	95~130	—

© Note: Refer to Page C8 welding notes.



G347

AWS A5.4 E347-16
JIS Z 3221 ES347-16**Product Features:**

- Austenite weld metal contains adequate ferrite to get low crack sensitivity.
- Weld metal contains Nb element to get good inter-granular corrosion resistance.
- Good high temperature creep strength, acid and heat resistance.

Applications:

- Welding of SUS321 to 304L, 309,309S.
- Welding of SUS347, 348 to 304L, 308, 309, 310S, 316, 317 and 321, etc.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Nb
0.04	0.89	0.79	9.50	19.28	0.49

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
643	37.6

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~120	115~150	150~200
Vertical / overhead position	50~70	75~105	95~130	—

© Note: Refer to Page C8 welding notes.

G410

AWS A5.4 E410-16
JIS Z 3221 ES410-16**Product Features:**

- Martensite structure weld metal, self-hardening and good magnetism at room temperature.
- Good oxidation and corrosion resistance.
- 840~870°C Post Weld Heat treatment to improve ductility and good corrosion resistance.

Applications:

- Suitable for welding of 13%Cr martensite stainless steels such as SUS410, 420J, 420J2.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Cr
0.09	0.83	0.35	12.83

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
542	29

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~120	115~150	150~200
Vertical / overhead position	50~75	75~105	95~130	—

© Note: Refer to Page C8 welding notes.

Product Features:

- Lime Titanium oxide type covered electrode for duplex stainless steel.
- Weld metal contains approximately 22% Cr- 9%Ni- 3% Mo-0.15N elements.
- High tensile strength, good pitting, stress corrosion and crack resistance.

Applications:

- Suitable for welding of duplex stainless steel contains 22%Cr such as SUS 2205.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo	N
0.03	0.58	0.77	9.4	22.9	3.2	0.16

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %
856	26

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~85	85~115	115~150	150~200
Vertical / overhead position	50~75	75~95	95~130	—

© Note: Refer to Page C8 welding notes.

Product Features:

- Basic coating of stainless steel electrodes has outstanding welding performance for vertical and overhead positions.
- Weld metal contains approximately 22% Cr- 9%Ni- 3% Mo-0.15N elements.
- High tensile strength, good pitting, stress corrosion and crack resistance.

Applications:

- Suitable for welding of duplex stainless steel contains 22%Cr such as SUS 2205.

Typical chemical composition of all-weld metal (wt%)

C	Si	Mn	Ni	Cr	Mo	N
0.037	0.45	1.05	8.92	22.3	3.1	0.158

Typical mechanical properties of all-weld metal

Tensile Strength N/mm ²	Elongation %	FN
817	31	33

Size (mm) & recommended welding parameters (A) AC or DC+

Diameter / Length	2.6/300	3.2/350	4.0/350	5.0/350
Flat position	60~80	85~100	110~140	140~170
Vertical / overhead position	50~70	75~90	100~130	—

© Note: 1.250~300°C x 1hr baking prior to use.
2.Refer to Page C8 welding notes.

