For Cast Iron

A guide for selecting welding consumables

Table 1 shows covered electrodes for shielded metal arc welding of cast irons in conjunction with weldability, usability, color matching, and machinability.

Table 1 Welding consumables for cast irons [1]

Brand name	Preheat temperature (℃)	Wettability with base metal	Color matching with base metal	Joint efficiency	X-ray soundness	Machinability of weld metal	Machinability of HAZ
CIA-1	100-300	○	△	◎	○	◎	◎
CIA-2	150-350	◎	△	◎	○	◎	○
CIA-3	350-400	◎	◎	○	○	△	△
CIA-5	100-250	◎	◎	◎	○	○	△

Note (1) ◎: Good, ○: Better, △: Inferior

Tips for better welding results

1) Preparation for base metal:

(1) When cast irons have impregnated oil, the base metal must be heated at 400°C to burn off the oil before welding. Other contaminants should also be removed off before welding.
(2) To repair a defect, it must be removed completely by machining or grinding (arc air gouging is not suitable for cast irons) before welding. The welding groove should have a round bottom for better fusion. Where a crack defect seems to be propagated by machining or grinding, make stop-holes at both ends of the crack.

2) Welding procedure:

(1) The most appropriate preheating temperature depends on the size and thickness of the work; however, Table 1 can be a rule of thumb.
(2) Stringer welding with the maximum bead length of about 50 mm is recommended to prevent overheat, distortion and cracking.
(3) Peening is needed to minimize residual stresses. Just after one bead was laid, it must be peened with a hammer to the extent that the ripple of the bead disappears.
(4) Comparatively small conical groove should be welded in the spiral sequence from the bottom of the groove to the surface of the base metal. Backstep, symmetrical or intermittent sequence is recommended for a long welding line to prevent cracking. The buttering method, in which the surface of the groove is cladded first and the filling passes are laid later, is recommended for a deep groove.

Covered Electrodes for Cast Iron

Brand name	ASME AWS Class.	Type of covering	Pol.	Features	WP		Chemical composition of all-weld metal (%) C	Si	Mn	P	S	Ni	Fe	Others	Mechanical properties of all-weld metal	TS (MPa)	El (%)
CIA-1	A5.15 ENi-CI	Graphite	AC DC-EP	▪Suitable for repairing and joining various kinds of cast irons ▪Excellent welding usability and machinability ▪RC: 70~100℃x0.5~1h	F	Ex	0.99	0.11	0.57	0.002	0.001	Bal.	1.71	-	Ex	480	-
						Gt	≦1.80	≦1.00	≦1.00	≦0.040	≦0.030	≧92.0	≦5.00	-			
CIA-2	A5.15 ENiFe-CI	Graphite	AC DC-EP	▪Suitable for repairing and joining various kinds of cast irons ▪Crack resistibility is excellent ▪RC: 70~100℃x0.5~1h	F	Ex	1.15	0.31	1.96	0.004	0.001	54.8	Bal.	-	Ex	520	-
						Gt	≦2.00	≦2.50	≦2.50	≦0.040	≦0.030	45.0~60.0	Bal.	-			
CIA-3	A5.15 ESt	Low hydrogen	AC DC-EP	▪Suitable for repairing and joining various kinds of cast irons ▪Hardenability of the fusion zone is larger than with Ni-bearing electrodes ▪RC: 300~350℃x0.5~1h	F	Ex	0.04	0.50	0.48	0.006	0.002	-	Bal.	-	Ex	490	33
						Gt	≦0.15	≦1.00	≦0.80	≦0.030	≦0.020	-	Bal.	-			
CIA-5	-	Low hydrogen	AC DC-EP	▪Suitable for repairing and joining various kinds of cast irons ▪RC: 300~350℃x0.5~1h	F	Ex	0.05	0.89	0.03	0.009	0.006	-	Bal.	V: 10.3 Cr: 1.3	Ex	540	34
						Gt	≦0.15	≦1.50	≦0.50	≦0.030	≦0.030	-	Bal.	V: 8.00~11.50 Cr: ≦2.00			

Note: Welding tests are as per AWS. Ex: Example (polarity: AC), Gt: Guaranty (polarity: as specified above)

Diameter and Length (mm)

Dia.	2.6	3.2	4.0	5.0
CIA-1	-	350	350	350
CIA-2	300	300	350	-
CIA-3	300	350	400	-
CIA-5	-	350	400	-