Instructions on How to Properly Use SEC Graphite Electrodes

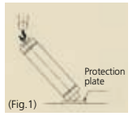
It is possible to avoid abnormal oxidation and breakages by using the electrodes correctly. Correct handling also helps to decrease the consumption rate and increase productivity.

1. Storage and Handling of Electrodes

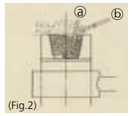
- Store the electrode in a place avoiding dust and high temperatures.
- Check the load height and apply a ratchet.
- Unpack the electrodes immediately before use, in order to protect the electrodes from dust and screw loss/damage during transport.
- Handle the thread and the end section of the electrodes with care.
- When lifting the electrodes, always use a special lifting plug matching the socket.

2. Connection of Electrodes

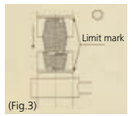
- Place a soft protective board below the connecting electrode by using the special lifting plug. Avoid dragging when lifting. (Fig.1)
- SEC CARBON delivers the electrodes with the nipple already attached. To use an electrode which has been delivered without the nipple attached, thoroughly remove any dust around the socket and the nipple of the electrode you wish to connect, and then carefully screw in the nipple.
- Make sure to thoroughly airblow dust with air from the socket of the electrode you wish to connect (in order of ⓐ, ⓑ). (Fig.2)
- Position the connecting electrode perpendicular to the edge of the other electrode, lower it gently and rotate to connect. When the upper and lower ends are 20mm to 30mm from each other, clean it again with air. (Fig.3,4,5)
- When re-clamping the electrodes after connection is completed, avoid clamping between limit marks.
- Tighten the electrode according to the recommended tightening torque chart.(*1)
- When using a connecting machine, handle in accordance with the instruction manual for the machine.



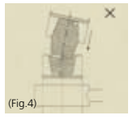
(Fig.1)

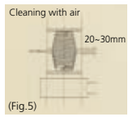


(Fig.2)



(Fig.3)


(Fig.4)



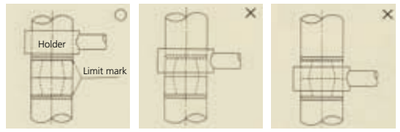
(Fig.5)

Recommended Tightening Torque Chart (*1)

Nominal diameter mm(inch)	Tightening torque	
	N・m	kgf・m
750(30)	7,159	730
700(28)	5,982	610
600(24)	4,217	430
550(22)	3,628	370
500(20)	3,040	310
450(18)	2,452	250
400(16)	1,863	190
350(14)	1,471	150
300(12)	981	100
250(10)	588	60
200(8)	314	32
175(7)	216	22
150(6)	147	15

3. After Connection

Avoid clamping between limit marks when re-clamping the electrodes for adjustment.

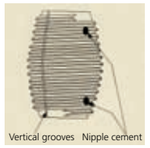


4. Preventing Electrode Connections from Loosening

In principle, SEC CARBON applies nipple cement to electrodes with diameter of 350mm (14 inches) or more. When heated, nipple cement melts and flows into the gap between the nipple and the socket, and at approximately 500℃, carbonizes and solidifies to prevent loosening.

5. Vertical Grooves in Nipple

The vertical grooves in the nipple are designed to remove fine dust which cannot be eliminated by cleaning with air.



6. Electrode Lifting Plug and Tightening Tool

Please periodically check the electrode lifting plug and tightening tool for damages in the thread, cracks in welded areas and the body, deformation of the body, and damages to the handle. SEC CARBON manufactures electrode lifting plugs and tightening tools according to buyers' specific needs.

GRAPHITE ELECTRODES INSTRUCTIONS

Supervised by PL Countermeasure Committee, Japan Carbon Association

Before using the electrodes, carefully read this Instructions together with Material Safety Date Sheets(MSDS), if they are provided, to use correctly.

WARNING

1) When transporting and unloading:

- ●Since the electrode is heavy, dropping or swinging it may cause physical injury or damage to the equipment.
  - ・When the electrode is being lifted or on a fork lift, never enter just under and around it.

2) During storage:

- ●Do not stack crates too high. Otherwise, they may collapse to cause physical injury.
  - ・Make the stacking height as low as possible.

3) During usage:

- ●When lifting the electrode and electrode column, they may drop or swing to cause physical injury or damage to the equipment.
  - ・During lifting, never enter just under and around them.
  - ・Do not use any electrode whose threads or end faces are broken.
  - ・On connecting, clean the joint by air-blowing, securely center, and tighten with the proper tightening torque.
  - ・On holding an electrode, avoid its socket portion. Hold the electrode outside a limit mark(indicated on the socket).
  - ・To prevent the joint from becoming dirty, use a column cap.
  - ・Do not use any column with the loose joint.
- ●Since it conducts electricity and heat well, the electrode may give an electricshock or cause a burn.
  - ・During operation, keep off the furnace. When you are compelled to enter, always wear heat resistant, insulating protective clothing, gloves, etc.

4) On handling broken electrodes:

- ●On taking out a broken electrode from the furnace, you may drop or swing it to cause physical injury or damage to the equipment.
  - ・On taking it out the furnace, do not use wire. Use a chain or tongs with chains instead.
  - ・During lifting, never enter just under the electrode and around it.
- ●On cutting a broken electrode(including a nipple and nipple cement), dust occurs, and it may hurt the lungs, bronchi, and eyeballs by inhalation and adhesion.
  - ・Use a dustproof mask and a dust collector. Also, always gargle after the operation is over.
  - ・If you have the feeling of physical disorder, consult a doctor.
  - ・Use dustproof goggles.
  - ・If dust should enter the eye, wash it with a large amount of water for fifteen or more minutes, and consult an eye specialist.

CAUTION

1) During usage:

- ●On unpacking, a rolling of the electrode or a splash of a steel belt after cutting may hurt the body.
  - ・Always use the stoppers to prevent from rolling, and work on the safe side.
  - ・Always wear protectors such as a helmet and safety shoes.
- ●Since the electrode has self-lubricating properties, you are likely to slip on it to fall to the ground.
  - ・Do not step on any bare electrode.

2) On handling broken electrode:

- ●The broken electrode may be at high temperatures even if it is black, not to speak of when it is red-hot, to cause a burn or fire.
  - ・During handling, always wear heat resistant protective clothing and the like.
  - ・Do not leave any combustible material in a broken electrode yard.
- ●Since graphite dust has self-lubricating properties, you are likely to slip to fall to the ground.
  - ・Clean well the floor, staircases and the like not to deposit graphite dust.
- ●Deposited dust may cause leak or short-circuit, leading to fire.
  - ・Remove the deposited dust.
- ●Wasted stock, worked powder, remainder material and products used cause environmental pollution.
  - ・Properly dispose of various waste in accordance with rules in your country or the guidance of the administrative organ.

GRAPHITE ELECTRODE LIFTING PLUG INSTRUCTIONS

Supervised by PL Countermeasure Committee, Japan Carbon Association

Before using the electrodes, carefully read this Instructions to use them correctly.

WARNING

- ●On lifting an electrode or an electrode column, they may drop or swing to cause physical injury or damage to the equipment.
  - ・Never lift any electrode having the maximum usable load or more. The maximum usable load is stamped on the lifting plugs. Using a double-pin type lifting plug, never lift one or more electrodes.
  - ・Never use any lifting plug having different thread size from that of an electrode.
  - ・On setting a lifting plug to an electrode socket, check that it is done completely.
  - ・Never use any lifting plug for which abnormality such as damaged thread, and cracked body or suspension lug has been recognized.
- ●A rusty or damaged lifting plug may cause the electrode to drop.
  - ・For storage of lifting plugs, select a dry, dust-free location.
  - ・Periodically inspect and maintain the lifting plugs.
    Inspect→cracks, damaged thread, corroded state, etc.
    Maintain→apply grease to threaded portion, repair thread, and the like.
  - ・Do not apply any abrupt load to the lifting plug.
  - ・Use proper wire, chain, and the like.

CAUTION

- ●Thermal expansion of the lifting plug may destroy the electrode socket.
  - ・Do not operate with the lifting plug(Plug made of metal)mounted thereto.

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The SEC CARBON Kyoto Plant has obtained ISO9001 QMS certification and ISO 14001 EMS certification.

12022000

GRAPHITE ELECTRODE

Contributing to an Environmentally Friendly Society and Supporting Steel Making

SEC CARBON

Graphite Electrodes that support arc furnaces around the world.

Fully utilizing the outstanding properties of graphite such as "high conductivity", "high resistance to extreme temperatures", and "high thermal shock resistance". Through our unique manufacturing and processing techniques, we have created a graphite electrode for use in arc furnaces for steel making.
SEC Carbon graphite electrodes are shipped not only throughout Japan, but exported around the world. Graphite electrodes contribute to the stable operations of arc furnaces, which continue to become larger in scale and consume more electricity. The graphite electrodes also contribute to reducing costs and are highly acclaimed among users around the world.
Keeping an eye on the global trend, we will continue to manufacture high quality graphite electrodes that match user needs and preserve the trust that we have built.

Overseas sales network
Graphite electrodes from SEC Carbon are active in countries all over the world.

Asia
China
Korea
Taiwan
Thailand
Malaysia
Singapore
Indonesia
Philippines
India
Turkey
Iran
Saudi Arabia

Europe
Germany
Italy
Russia
Slovakia

The Americas
USA
Venezuela
Mexico
Argentina

Oceania
Australia

Africa
Egypt

Contributing to an Environmentally Friendly Society and Supporting Steel Making

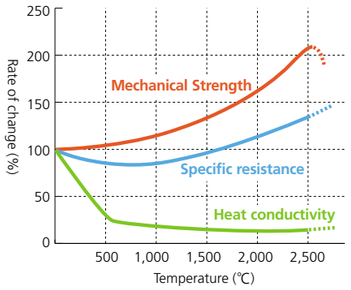
High Current Carrying Capacity

By using selected high quality materials, the electrodes manufactured with our unparalleled technique have a high current carrying capacity and a low contact resistance at the connection sections. This allows stable use even in extreme current operations.

High Thermal Shock Resistance

In order to reflect the outstanding thermal shock resistance of graphite as much as possible in the product, we carefully select our raw materials and conduct extensive research into manufacturing conditions to reduce the coefficient of thermal expansion. Through this we manufacture electrodes that resist sudden heating and cooling.

Thermal dependencies of each characteristic



Outstanding Resistance to Breakage

We manufacture extremely strong electrodes with outstanding resistance to breakage that can endure the large shocks and vibration that occur during the operation of an electric arc furnace.

Adaptability to Operating Conditions

Through understanding of each customer's operating condition, we shall manufacture the best suited quality to each customer's operating conditions and deliver the electrodes according to customer's requirements.

Commitment to Quality and Concern for the Environment

We promoted efforts to obtain the certification of ISO 9000 series from the early stages and obtained ISO 9001 certification for all products manufactured at the Kyoto Plant.
SEC CARBON has obtained certification of the international standard for environment management system, ISO 14001. Promoting environmentally friendly activities in all aspects including product development, evaluation, sales and technical services, we proactively contribute to regional and global environmental preservation.

JQA-0379 Kyoto Plant
JQA-EM0678 Kyoto Plant

Thorough and strict control of all production processes. Reliable quality is only possible through SECC's all-in-one system.

SEC Carbon's graphite electrodes are manufactured at the Kyoto Plant in Fukuchiyama city.
The Kyoto Plant performs all processes on site from storing and pulverizing of coke, the raw material, to mixing, forming, baking and processing to form the final product. In addition, all processes have strict and thorough quality controls.
This unique all-in-one system that we have established leads to an unwavering methodology.

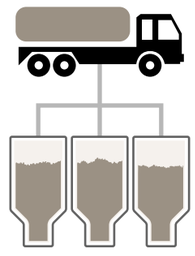
Manufactured at Kyoto Plant, a manufacturing and development hub, which boasts comprehensive facilities

Since its completion in 1974, the Kyoto Plant continues to operate as the main factory for SEC Carbon. The approximately 500,000 square meter grounds are home to the highest level of large scale manufacturing equipment in the industry.

Kyoto Plant

The control center that controls all processes

Raw Materials

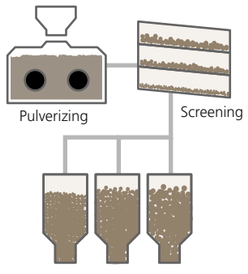


High quality raw materials are purchased and stored in warehouses

Procure the most suitable raw materials for each product usage by taking advantage of the features of coke.
Store each raw material separately according to grades and supply source.

Needle Cokes, one of the raw materials

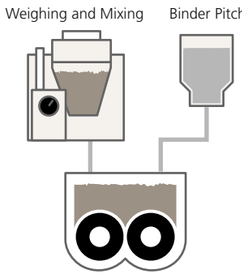
Pulverizing and Screening



Raw material is screened into specified grain sizes and combined according to recipes

Pulverize and screen the coke. Classify the screened coke according to grain size and store it in individual silos.

Kneading

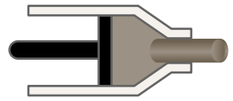


Kneading for a specified time using a kneading machine

Weigh and mix coke according to the mixing standard based on quality design. Knead the mixed coke and binder pitch in the kneader.

Control center

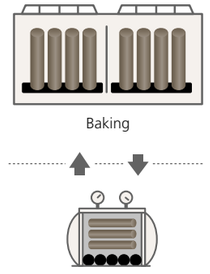
Forming



Forming into a variety of sizes by the extruding press

Kneaded material is formed using an extrusion press. By changing the nozzle on the forming machine, a wide variety of sizes can be formed.

Baking (Pitch Impregnation)

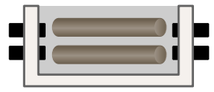


The material is baked and pitch impregnated as needed

Bake the material in order to improve thermal stability, mechanical strength and to give electrical conductivity. Pitch impregnation and re-baking can be applied to make the baked material denser and improve its strength.

Baking

Graphitizing

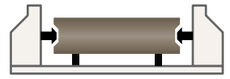


Carbon is crystallized into Graphite through extreme high heat processing

Treat the baked material at extremely high temperatures to change its structure from amorphous carbon to graphite and obtain excellent material properties.

Graphitization furnace

Machining



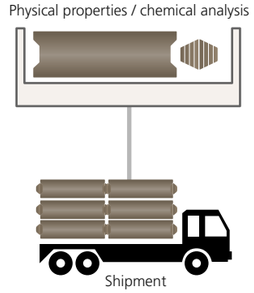
Various processing machines are used and create accurate sizes and shapes

Machine the graphitized material according to the specification of customers.

Machining line of Graphite electrode

Machining line for Nipples

Inspection & Shipping



After testing and inspection, the final product is shipped to the users.

Strict testing and inspections are carried out at each process. Only high quality products that pass these tests and inspections are shipped to our users throughout the country and around the world.

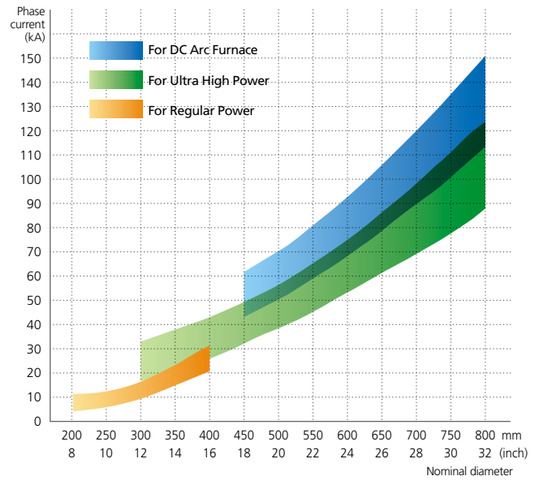
Product inspection of the final product

Shipment

Typical Properties

		AC furnace				DC furnace
Nominal diameter	mm	150~250	300~400		450~800	450~800
	Inch (reference value)	6~10	12~16		18~32	18~32
Grade		Regular power	Regular power	High power	High power	-
Ash content	%	0.2 or less	0.2 or less	0.2 or less	0.2 or less	0.2 or less
Real density	g/cm³	2.21 - 2.24	2.22 - 2.25	2.22 - 2.25	2.22 - 2.25	2.22 - 2.25
Bulk density	g/cm³	1.58 - 1.70	1.58 - 1.70	1.66 - 1.80	1.65 - 1.75	1.66 - 1.75
Total porosity	%	23 - 29	23 - 30	19 - 26	21 - 27	21 - 26
Bending strength	MPa	8.8 - 13.7	7.8 - 12.7	10.8 - 18.6	9.8 - 14.7	9.8 - 14.7
	(kgf/cm²)	90 - 140	80 - 130	110 - 190	100 - 150	100 - 150
Young's modulus	GPa	7.8 - 11.8	6.8 - 10.8	9.8 - 15.7	8.8 - 12.7	8.3 - 12.7
	(kgf/mm²)	800 - 1,200	700 - 1,100	1,000 - 1,500	900 - 1,300	850 - 1,300
Specific resistance	μΩm	5.5 - 7.9	5.5 - 7.9	4.3 - 6.5	4.5 - 6.0	4.4 - 5.5
Coefficient of thermal expansion	10^{-6}/℃	1.1 - 1.7	1.1 - 1.7	0.9 - 1.7	0.8 - 1.5	0.8 - 1.3

Current Carrying Capacity



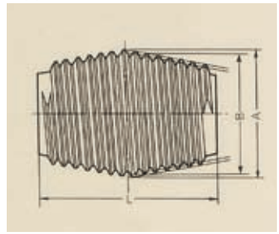
Standard Sizes and Weights

Nominal diameter mm (inch)	Electrode							Nipple		Standard packing		
	Diameter mm		Nominal length mm	Length mm		Standard weight kg		Standard weight kg		Package number	Total weight after packing kg	Packing dimension (pallet) mm width × height × length
	Maximum	Minimum		Maximum	Minimum	High power	Regular power	3TPI	4TPI			
800(32)	816	810	2,700	2,900	2,550	2,450			128*	1	2,600	820×920×3,200
750(30)	765	761	2,700	2,900	2,550	2,139			108*	1	2,270	770×870×3,200
700(28)	714	710	2,700	2,900	2,550	1,852			85*	2	3,894	1,430×830×3,200
			2,400	2,525	2,275	1,572			72		3,330	1,430×830×2,800
			2,100	2,225	1,975	1,410					3,010	1,430×830×2,500
600(24)	613	609	2,700	2,900	2,550	1,382			51*	2	2,880	1,230×720×3,150
			2,400	2,525	2,275	1,186			41		2,490	1,230×720×2,750
			2,100	2,225	1,975	1,047					2,210	1,230×720×2,450
550(22)	562	556	2,400	2,525	2,275	986		37	44*	2	2,080	1,120×650×2,750
			2,100	2,225	1,975	918			36		1,940	1,120×650×2,450
			1,800	1,900	1,700	752					1,610	1,120×650×2,150
500(20)	511	505	2,400	2,525	2,275	832		35	35*	2	1,740	1,020×590×2,700
			2,100	2,225	1,975	730			29		1,540	1,020×590×2,400
			1,800	1,900	1,700	627					1,330	1,020×590×2,100
450(18)	460	454	2,400	2,525	2,275	679		35*	22*	2	1,430	920×540×2,700
			2,100	2,225	1,975	597		29	20		1,260	920×540×2,400
			1,800	1,900	1,700	505					1,080	920×540×2,050
400(16)	409	403	2,400	2,525	2,275	539		22*	18*	2	1,130	820×490×2,700
			2,100	2,225	1,975	459	450	21	16		970	820×490×2,400
			1,800	1,900	1,700	400	385				850	820×490×2,050
350(14)	358	352	2,400	2,525	2,275	417	395	15	12	3	1,300	1,070×440×2,700
			2,100	2,225	1,975	362	345				1,140	1,070×440×2,400
			1,800	1,900	1,700	312	295				990	1,070×440×2,050
			1,500	1,600	1,400	255	241				820	1,070×440×1,750
300(12)	307	302	2,100	2,225	1,975	262	255	8.8	7.5	3	820	920×380×2,250
			1,800	1,900	1,700	235	222				690	920×380×1,900
			1,500	1,600	1,400	189	180				570	920×380×1,600
250(10)	256	251	1,800	1,900	1,700		156	5.5	4.8	3	650	770×340×1,900
			1,500	1,600	1,400		128				400	770×340×1,600
200(8)	205	200	1,800	1,900	1,700		99		2.7	3	310	720×270×1,900
			1,500	1,600	1,400		80				250	720×270×1,600
175(7)	179	174	1,500	1,600	1,400		63		1.9	5	330	900×250×1,600
150(6)	154	148	1,500	1,600	1,400		46		1.1	5	240	770×220×1,600

Notes: 1.*Long Nipple
2. Sizes less than 130mm (5 1/8inches) are manufactured upon request.
3. TPI (Thread per inch) is the number of threads per 25.4mm (1 inch).

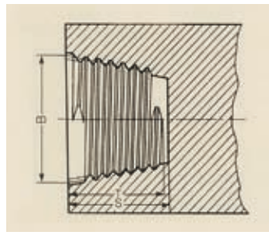
Standard Dimensions of Taper Thread

Nipple Details



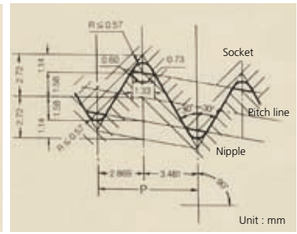
A: Maximum diameter
B: Effective diameter
L: Length

Socket Details

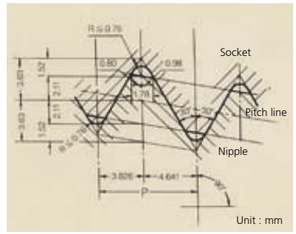


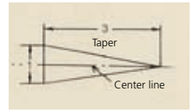
B: Effective diameter
T: Thread length
S: Depth

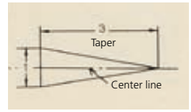
4TPI:Thread details (Pitch 6.350mm)



3TPI:Thread details (Pitch 8.467mm)







4TPI (Pitch 6.350mm)

Thread designation		Nipple		Socket		Effective diameter (B) mm
		Maximum diameter (A) mm	Length (L) mm	Depth (S) mm	Thread length (T) mm	
32T4L	431T4L	431.80	635.00	323.50	319.50	428.64
30T4L	406T4L	406.40	609.60	310.80	306.80	403.24
28T4L	374T4L	374.65	558.80	285.40	281.40	371.49
28T4	374T4N	374.65	457.20	234.60	230.60	371.49
24T4L	317T4L	317.50	457.20	234.60	230.60	314.34
24T4	317T4N	317.50	355.60	183.80	179.80	314.34
22T4L	298T4L	298.45	457.20	234.60	230.60	295.29
22T4	298T4N	298.45	355.60	183.80	179.80	295.29
20T4L	269T4L	269.88	457.20	234.60	230.60	266.72
20T4L	269T4N	269.88	355.60	183.80	179.80	266.72
18T4L	241T4L	241.30	355.60	183.80	179.80	238.14
18T4	241T4N	241.30	304.80	158.40	154.40	238.14
16T4L	222T4L	222.25	355.60	183.80	179.80	219.09
16T4	222T4N	222.25	304.80	158.40	154.40	219.09
14T4	203T4N	203.20	254.00	133.00	129.00	200.04
12T4	177T4N	177.80	215.90	114.00	110.00	174.64
10T4	152T4N	152.40	190.50	101.30	97.30	149.24
9T4	139T4N	139.70	177.80	94.90	90.90	135.54
8T4	122T4N	122.24	177.80	94.90	90.90	119.08
7T4	107T4N	107.95	165.10	88.60	84.60	104.79
6T4	92T4N	92.08	139.70	75.90	71.90	88.92

3TPI (Pitch 8.467mm)

Thread designation		Nipple		Socket		Effective diameter (B) mm
		Maximum diameter (A) mm	Length (L) mm	Depth (S) mm	Thread length (T) mm	
22T3	298T3N	298.45	372.60	192.20	188.20	294.24
20T3	298T3N	298.45	372.60	192.20	188.20	294.24
18T3L	273T3L	273.05	457.20	234.60	230.60	268.84
18T3	273T3N	273.05	355.60	183.80	179.80	268.84
16T3L	241T3L	241.30	355.60	183.80	179.80	237.09
16T3	241T3N	241.30	338.70	175.30	171.30	237.09
14T3	215T3N	215.90	304.80	158.40	154.40	211.69
12T3	177T3N	177.16	270.90	141.50	137.50	172.95
10T3	155T3N	155.57	220.00	116.00	112.00	151.36
9T3	139T3N	139.70	203.20	107.80	103.60	135.49

Note: 1. TPI(Thread per inch) is the number of threads per 25.4mm (1 inch).
2. Thread designations and their details are based on JIS R7201.