

The Taper Thread Gauges for Graphite Electrodes

1. Taper threads in Graphite Electrodes and nipples

Graphite electrodes and nipples are used primarily in electric arc furnace steel manufacturing. Graphite electrodes can provide high levels of electrical conductivity and capability of sustaining the extremely high levels of generated heat. Graphite electrodes are also used in the refinement of steel and similar smelting process.

Graphite Electrodes



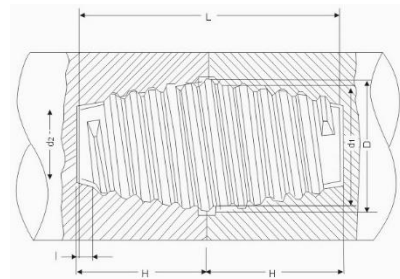
Graphite Electrodes and Nipples



Graphite Electrodes installed with nipples nipples



Sketch for electrodes connected by



Graphite electrodes are connected by nipples, both end of each electrode is supplied with internal taper thread, nipples come with external taper thread for connection inserts. The taper thread is not only the key for connection of two graphite electrodes, but also it supports strong current, especially high power(HP) and ultra high power(UHP) electric arc furnaces need higher requirement to taper thread machining.

The connection detail is as above sketch, the taper thread is the key for this connection.

Due to thread connection, there are always electrode broken or overheating accidents, that means how to check taper thread in graphite electrodes and nipples is the most important quality control processing.

The taper thread gauges for electrode and nipple are mainly used for efficiently and accurately comprehensive calibration.

2. Taper thread parameters

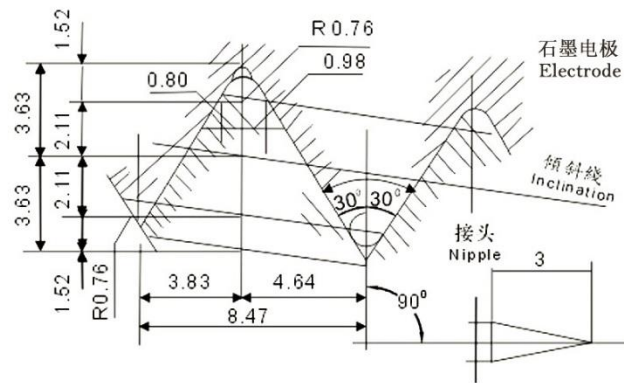
The special thread for graphite electrode parameters:

Flank angle: 60°

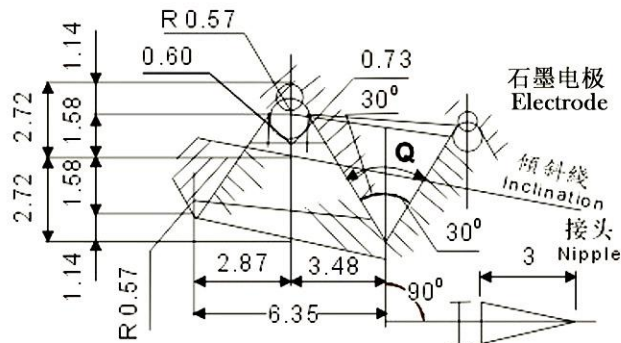
Thread taper: 1:3

TPI: 3, or 4

The thread form as below:



Thread Form: 3TPI, 4TPF



Thread Form: 4TPI, 4TPF

3. Taper thread gauges for Electrodes and nipples

The taper thread gauges for graphite electrode are used for general calibration of electrodes and nipples, normally there are taper working gauges and master gauges.

Two taper working plug gauges are used for calibrating electrodes, three taper working ring gages are used for calibrating nipples. One master ring gauges are used for calibrating working plug gauges, one master plug gauges are used for calibrating working ring gauges, there 7pcs gauges for one size graphite electrode.



4. Working plug and master ring gauges for graphite electrode internal thread

Working plug gauges calibrate the thread taper, pitch diameter and the coaxiality between outside electrode and internal taper thread.

4.1 Features for working plug gauges

a. Working gauges will be consisted of two plug gauges: big end plug gauge(PB) and small end plug gauge(PA) as below pictures.



Big end plug gauge (PB)



Small end plug gauge (PA)

- b. Two types for small end working plug gauge: Supplied with or without taper disc. The plug gauge with taper disc can get the taper value from this gauge directly, the one without taper disc can calculate the taper value through upper face distance between two plug gauges after screwing into the electrodes.
- c. The dial indicator in the big end thread plug gauge (PB) is used for big end pitch diameter of internal thread for graphite electrode.
- d. The dial indicator can be used for checking the coaxiality between outside of electrode and internal taper thread.
- e. Master ring gauge calibrate the working plug gauges, and then working gauge check the graphite electrode.

4.2 Usage of working plug gauges

a. Working plug gauge calibration

After each parameter passing calibration for working plug gauges (PA and PB), then working plug gauges need to be calibrated by master ring gauges.

Regarding the working plug gauge with taper disc type, first screw the small end plug gauge PA into the master ring, then big end plug gauge, adjust the taper disc on PA gauge, will show the actual taper value from PB indicator after master ring calibrate the working plug. Also, indicator in PB will calibrate the PD via big end of master ring.

Regarding the plug gauge without taper disc, the value calibrated by master ring will be given in the calibration report including the set gauge block, which can be used in the checking electrodes.

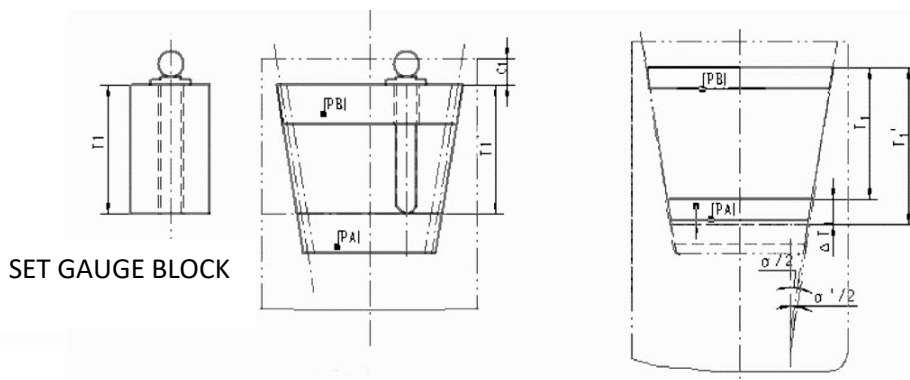


Figure 1

Figure 2

b. Checking graphite electrode by working plug gauges

b.1. Measuring the internal thread taper of electrode

Plug gauge with taper disc:

Working plug gauge is already calibrated before shipping, just screw two plug gauges into electrode via certain torque,

Plug gauge without taper disc:

Adjust indicator to zero via set gauge block, then screw two plug gauges into electrode separately via certain torque, then get the value from indicator ΔT (see Figure 1 & 2, actual $T1' = \Delta T + T1$), then calculate the taper of internal thread.

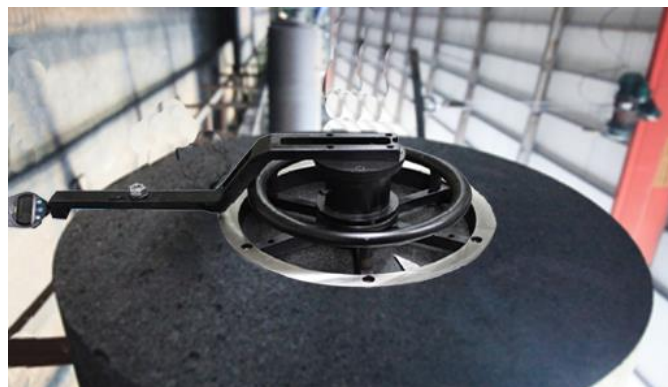
b.2. Measuring the pitch diameter of electrode's internal thread

Screw the calibrated working plug gauge PB into the electrode, measure the C1 value between upper face and end of electrode via indicator as Figure 1, then can calculate the big end PD of internal thread.



b.3. Measuring coaxiality of internal thread and electrode outer surface

Turn round of calibrated indicator along with the outside of electrode, the difference between maximum and minimum values will be the coaxiality tolerance between internal thread axis and outside of electrode.



5. Working ring gauges and master plug gauge for checking nipples

There are three working ring gauges: reference ring gauge RA, big end ring gauge RC and small end ring gauge RB, RB and RC ring gauges calibrate nipples on the base of reference ring gauge RA.

5.1 Features of working ring gauges

a. Working ring gauges have one reference ring gauge RA, big end ring gauge RC and small end ring gauge RB.



b. Master plug gauge calibrate working ring gauges, and master plug gauge is solid type.



c. Screw big end ring gauge RC and reference ring gauge RA into two end of nipples separately, the big end PD of nipple external thread and coaxiality of two end of nipples can be calculated by the distance of two ring gauge upper surface.

d. Screw reference ring gauge RA and small end ring gauge RB into one end of nipple, the taper of nipple external thread can be calculated via the upper surface distance of two ring gauges.

5.2 Usage of working ring gauges

a. Working ring gauges calibration

All ring gauges are passed the parameter calibration before delivery, and also according to certain torque, all ring gauges are calibrated by master plug gauge, PD and taper already calibrated via master plug gauge and set gage block, and detail shown in the report.

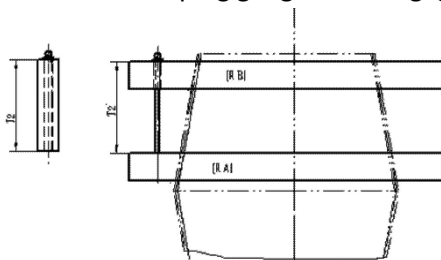


Figure 3

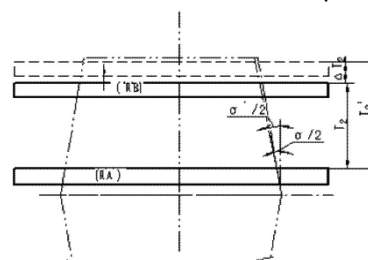


Figure 4

b. Taper measuring of nipple

Set indicator to zero via set gage block T2, and then screw reference ring gage RA and small end ring gage RB into one end of nipple, get the $\Delta T2$ value(see Figure 3 & 4, actual $T2' = \Delta T2 + T2$), then calculate the taper according to report and actual $T2'$).

c. PD measuring and two end coaxiality of nipple thread

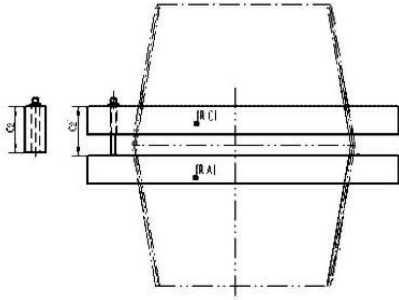


Figure 5

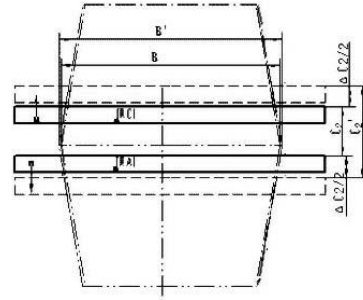


Figure 6

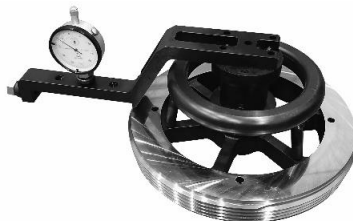
c.1 Screw the reference ring gage RA and big end ring gage RC into two end of nipple, set indicator to zero via set gauge block, then get $\Delta C2$ (See Figure 5 & 6, actual $C2' = \Delta C2 + C2$), calculate the actual PD for the nipple thread.

c.2 Input the indicator to four holes in the upper surface of ring gauges separately, the difference between maximum and minimum values from indicator is the one end coaxiality of nipple.

All gauges as below pictures, customer can order by one set per size (7pcs each set), or can order separately as working ring gauges, working plug gauges, master ring or master plug gauges, please contact us at sales@chinabestools.com or call us at +86-13805420684 (Wechat at same number).



Working plug PA



Working plug PB



Master ring



Working ring RA, RB and RC



Master plug

Table 1 – Dimensions of pins and sockets of electrodes (4TPI)

Nominal diameter of electrode	Designation of joint	Pitch diameter of socket	Major diameter of pin	Length of pin	Depth of socket	Length of thread (socket)
		d_4	d_1	l_1	l_2	l_3
mm		mm				
75	45T4N	42,88	46,04	76,20	44,10	40,10
100	69T4N	66,69	69,85	101,60	56,80	52,80
130	79T4N	76,22	79,38	127,00	69,50	65,50
150	92T4N	88,92	92,08	139,70	75,90	71,90
175	107T4N	104,79	107,95	165,10	88,60	84,60
200	122T4N	119,08	122,24	177,80	94,90	90,90
225	139T4N	136,54	139,70	177,80	94,90	90,90
250	152T4N	149,24	152,40	190,50	101,30	97,30
300	177T4N	174,64	177,80	215,90	114,00	110,00
350	203T4N	200,04	203,20	254,00	133,00	129,00
350	203T4L	200,04	203,20	304,80	158,40	154,40
400	222T4N	219,09	222,25	304,80	158,40	154,40
400	222T4L	219,09	222,25	355,60	183,80	179,80
450	241T4N	238,14	241,30	304,80	158,40	230,60
450	241T4L	238,14	241,30	355,60	183,80	179,80
500	269T4N	266,72	269,88	355,60	183,80	179,80
500	269T4L	266,72	269,88	457,20	234,60	230,60
550	298T4N	295,29	298,45	355,60	183,80	179,80
550	298T4L	295,29	298,45	457,20	234,60	230,60
600	317T4N	314,34	317,50	355,60	183,80	179,80
600	317T4L	314,34	317,50	457,20	234,60	230,60
650	355T4N	352,44	355,60	457,20	234,60	230,60
650	355T4L	352,44	355,60	558,80	285,40	281,40
700	374T4N	371,49	374,65	457,20	234,60	230,60
700	374T4L	371,49	374,65	558,80	285,40	281,40
750	406T4N ^a	403,24	406,40	609,60	310,80	306,80

Table 2 – Dimensions of pins and sockets of electrodes (3TPI)

Nominal diameter of electrode	Designation of joint	Pitch diameter of socket	Major diameter of pin	Length of pin	Depth of socket	Length of thread (socket)
		d_4	d_1	l_1	l_2	l_3
mm		mm				
225	139T3N	135,49	139,70	203,20	107,60	103,60
250	155T3N	151,36	155,57	220,00	116,00	112,00
300	177T3N	172,95	177,16	270,90	141,50	137,50
350/400	215T3N	211,69	215,90	304,80	158,40	154,40
350/400	215T3L	211,69	215,90	355,60	183,80	179,80
400/450	241T3N	237,09	241,30	338,70	175,30	171,30
400/450	241T3L	237,09	241,30	355,60	183,80	179,80
500	273T3N	268,84	273,05	355,60	183,80	179,80
500	273T3L	268,84	273,05	457,20	234,60	230,60
550	298T3L	294,24	298,45	457,20	234,60	230,60

Common Specification for Electrodes and Gauge Set

4TPI

Nominal diameter of electrode(mm)	IEC Code	Gauge set order#
75	45T4N	45T4
100	69T4N	69T4
130	79T4N	79T4
150	92T4N	92T4
175	107T4N	107T4
200	122T4N	122T4
225	139T4N	139T4
250	152T4N	152T4
300	177T4N	177T4
350	203T4N	203T4
350	203T4L	
400	222T4N	222T4
400	222T4L	
450	241T4N	241T4
450	241T4L	
500	269T4N	269T4
500	269T4L	
550	298T4N	298T4
550	298T4L	
600	317T4N	317T4
600	317T4L	
650	355T4N	355T4
650	355T4L	
700	374T4N	374T4
700	374T4L	
750	406T4N	406T4

3TPI

Nominal diameter of electrode(mm)	IEC Code	Gauge set order#
225	139T3N	139T3
250	155T3N	155T3
300	177T3N	177T3
350/400	215T3N	215T3
350/400	215T3L	
400/450	241T3N	241T3
400/450	241T3L	
500	273T3N	273T3
500	273T3L	
550	298T3L	298T3