COIDAN
GRAPHITE PRODUCTS LTD

# GRAPHITE ELECTRODES


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# GRAPHITE ELECTRODES

## Introduction

Graphite is produced artificially by using carbon and selected binding materials such as pitch or tar. The specific characteristics of graphite are:

- Low electrical resistivity
- Good lubrication properties
- High thermal conductivity
- High thermal shock resistance
- Chemically stable

## Graphite Manufacture

The basic production steps in the manufacture of graphite electrodes comprise the following:

- Forming
- Baking
- Impregnation
- Graphitising
- Machining

## Forming

The coke is crushed into specific particle sizes, depending on the final diameter and the individual application of the electrode. To bind the coke particles, controlled amounts of pitch are added. The resulting plastic mix is extruded through a forming press and cut into specified lengths, making the “green electrodes”.

## Baking

The baking process is carried out at temperatures of 800°C - 1200°C. The pitch is carbonizing at this point and about 40% of the pitch evaporates.

## Impregnation

Bulk density and other physical properties can be improved by further pitch impregnation. All Coidan electrodes are impregnated in this way. This is why the regular power grade achieves minimum bulk density of 1,62 g/cm$^3$.

## Graphitising

The graphitising process takes place at approximately 2800°C - 3200°C. The amorphous carbon is transformed into graphite.

## Machining

Finally the electrodes are machined to specified dimensions according to IEC 60239:2005 standard.

# GRAPHITE ELECTRODES

## Technical Data *

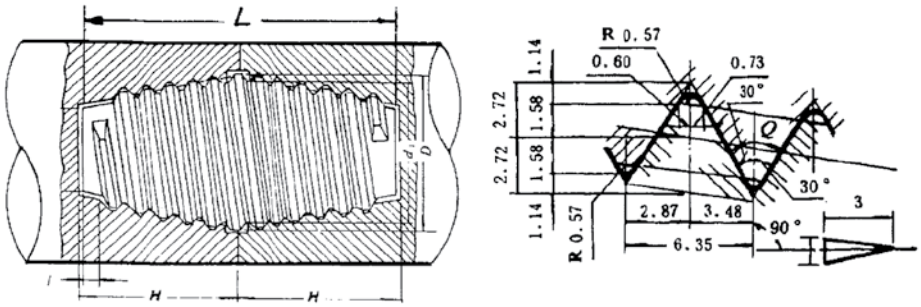
| DESCRIPTION | | UNIT | HIGH POWER TYPE HP | HIGH POWER TYPE HP | SUPER HIGH POWER TYPE SHP | ULTRA HIGH POWER TYPE UHP | ULTRA HIGH POWER TYPE UHP |
|---|---|---|---|---|---|---|---|
| Diameter of Electrode | | mm | 200-300 | 350-500 | 250-450 | 250-300 | 350-600 |
| Sp. El. Resistivity | max. | $\mu\Omega m$ | | | | | |
| Electrode | | | 6.5 | 6.5 | 5.8 | 6.0 | 5.8 |
| Nipple | | | 5.0 | 5.0 | 4.8 | 4.5 | 4.5 |
| Bending Strength | min. | | | | | | |
| Electrode | | MPa | 9.0 | 9.0 | 11.0 | 12.0 | 10.0 |
| Nipple | | | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 |
| Modulus of Elasticity | max. | | | | | | |
| Electrode | | GPa | 8.0 | 12.0 | 14.0 | 14.0 | 9.0 |
| Nipple | | | 14.0 | 14.0 | 18.0 | 18.0 | 15.0 |
| CTE | max. | | | | | | |
| Electrode | | $10^{-6}/K$ | 2.0 | 2.0 | 2.0 | 1.3 | 1.3 |
| Nipple | | | 2.4 | 1.3 | 1.9 | 1.6 | 1.3 |
| Ash | max. | % | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Bulk Density | min. | | | | | | |
| Electrode | | $g/cm^3$ | 1.65 | 1.65 | 1.68 | 1.68 | 1.68 |
| Nipple | | | 1.73 | 1.73 | 1.74 | 1.74 | 1.75 |

* These technical data are actual data acc. to manufacturers' CERTIFICATES OF QUALITY.
These values are typical and may vary ± 5%.

## Current Carrying Capacities / Ampere

| NOMINAL DIAMETER | | HP-ELECTRODE | | SHP-ELECTRODE | | UHP-ELECTRODE | |
|---|---|---|---|---|---|---|---|
| inch | mm | electric arc furnace max. | ladle furnace max. | electric arc furnace max. | ladle furnace max. | electric arc furnace max. | ladle furnace max. |
| 8 | 200 | 10000 | | | | 13000 | 19000 |
| 9 | 225 | 11000 | | | | 14500 | 21000 |
| 10 | 250 | 13000 | | 15000 | | 17000 | 24000 |
| 12 | 300 | 17000 | 23000 | 19500 | 26000 | 22000 | 30000 |
| 14 | 350 | 23000 | 30000 | 25500 | 33500 | 28000 | 37000 |
| 16 | 400 | 27000 | 37000 | 31500 | 41000 | 36000 | 45000 |
| 18 | 450 | 34000 | 46000 | 39000 | 49500 | 44000 | 53000 |
| 20 | 500 | 42000 | 54000 | 47500 | 58000 | 53000 | 62000 |
| 22 | 550 | | | | | 64000 | |
| 24 | 600 | | | | | 75000 | |

# GRAPHITE ELECTRODES




## Dimensions of Truncated Cone Nipples (4TPI)*

| DIAMETER | | NIPPLE | | | SOCKET | |
|---|---|---|---|---|---|---|
| inch | mm | Typ | Dia max. | length | Dia max. | length |
| 8 | 200 | 122 T4 N | 122.24 | 177.8 | 123.38 | 94.9 |
| 9 | 225 | 139 T4 N | 139.70 | 177.8 | 140.84 | 94.9 |
| 10 | 250 | 152 T4 N | 152.40 | 190.5 | 153.54 | 101.3 |
| 12 | 300 | 177 T4 N | 177.80 | 215.9 | 178.94 | 114.0 |
| 14 | 350 | 203 T4 N | 203.20 | 254.0 | 204.34 | 133.0 |
| 16 | 400 | 222 T4 N | 222.25 | 304.8 | 223.39 | 158.4 |
| 16 | 400 | 222 T4 L | 222.25 | 355.6 | 223.39 | 183.8 |
| 18 | 450 | 241 T4 N | 241.30 | 304.8 | 242.44 | 158.4 |
| 18 | 450 | 241 T4 L | 241.30 | 355.6 | 242.44 | 183.8 |
| 20 | 500 | 269 T4 N | 269.88 | 355.6 | 271.02 | 183.8 |
| 20 | 500 | 269 T4 L | 269.88 | 457.2 | 271.02 | 234.6 |
| 22 | 550 | 298 T4 N | 298.45 | 355.6 | 299.59 | 183.8 |
| 22 | 550 | 298 T4 L | 298.45 | 457.2 | 299.59 | 234.6 |
| 24 | 600 | 317 T4 N | 315.50 | 355.6 | 318.64 | 183.8 |
| 24 | 600 | 317 T4 L | 317.50 | 457.2 | 318.64 | 234.6 |

* Nipples are provided with pitch pins.

## Standard Sizes and Tolerances

| DIAMETER/MM | | | | LENGTH/MM | | |
|---|---|---|---|---|---|---|
| Nominal Diameter | | Actual Diameter | | Nominal Length | | Tolerance |
| inch | mm | max. | min. | HP | UHP | HP/ UHP |
| 8 | 200 | 204 | 201 | 1700 | 1700 | +100/ -75 |
| 9 | 225 | 230 | 225 | 1700 | 1700 | |
| 10 | 250 | 256 | 252 | 1700 | 1700 | |
| 12 | 300 | 307 | 303 | 1800 | 1800 | |
| 14 | 350 | 357 | 353 | 1800 | 1800 | |
| 16 | 400 | 408 | 404 | 1800 | 1800/2000 | |
| 18 | 450 | 459 | 455 | 1800 | 1800/2400 | +/-100 |
| 20 | 500 | 511 | 505 | 1800 | 1800-2400 | |
| 22 | 550 | 562 | 556 | | 1800-2400 | |
| 24 | 600 | 613 | 607 | | 1800-2400 | |

# GRAPHITE ELECTRODES

## Types of Electrodes

The correct type of electrode for varying operating conditions is mainly influenced by the maximum current carrying capacity. The following table shows the different electrode types and their matching current carrying capacities and will provide a rough idea for selection of Coidan electrodes.

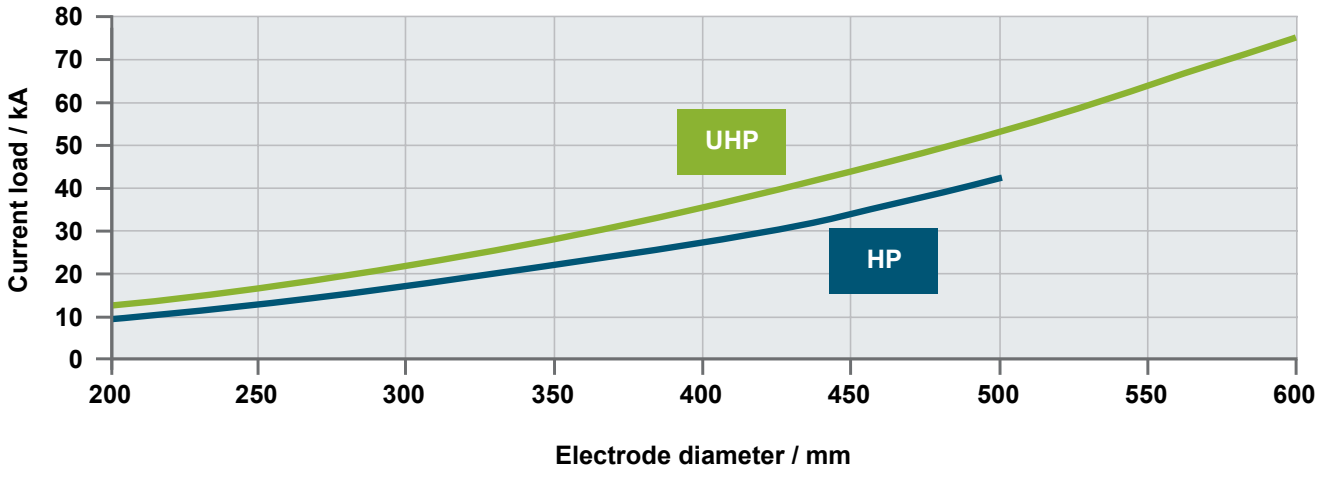
## Type HP:

High power grade is for foundry operations (electric arc furnace: EAF) and for ladle furnaces (LF) and occasionally for electric arc furnace operations, if the furnace parameters are suitable.

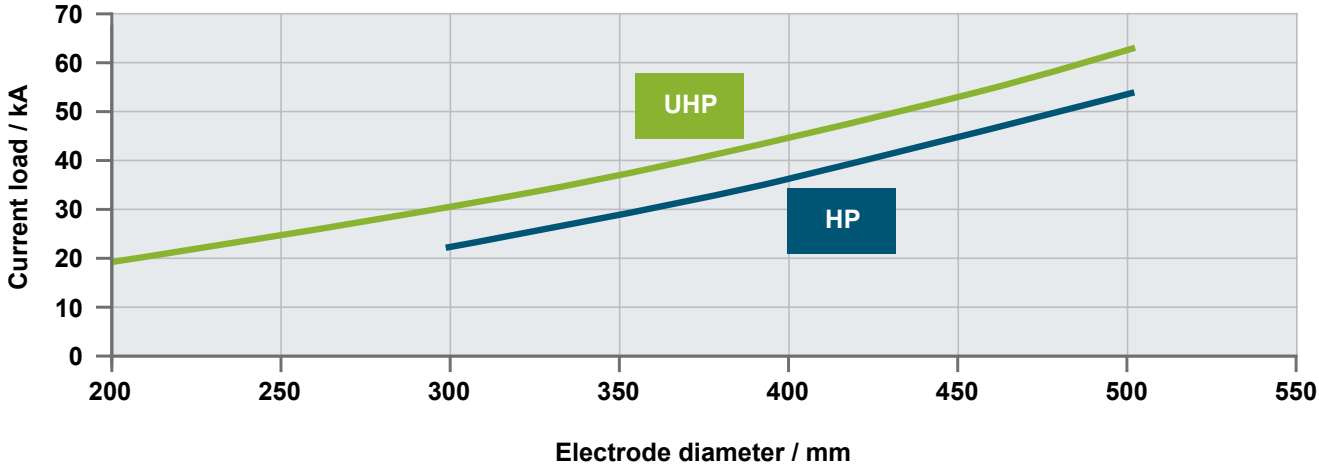
## Type UHP:

Ultra high power grade is suitable for electric arc furnace operations and ladle furnace operations with heavy current loads.

### Maximum current load for EAF




### Maximum current load for LF



# GRAPHITE ELECTRODES

## Storage and handling

Coidan electrodes are produced with tight tolerances to ensure the satisfaction of our customers. To run your furnace without problems you have to take care not to damage any parts of the electrodes. Therefore it is essential to keep the electrodes in their wooden cases until you are ready to use them on the furnace. Damage to end faces and to the threads of the socket can cause failure.

## Installation

Electrodes which are not equipped with preset nipples - first require a nipple inserting. It is essential to ensure the socket and nipple are clean before insertion.

Screw the lifting eye into the empty socket of the electrode and ensure that the socket threads are not damaged.

Protect the opposite end of the electrode and nipple when lifting.

Before assembling the two electrodes - clean the socket of the lower electrode with compressed air.

Put a spacer between the electrodes to prevent damage to the socket and the nipple when lowering the new electrode by crane. Remove the spacer and tighten the joints.

To ensure efficient operation we recommend the following tightening torques. Excessive torque damages the electrode, insufficient torque causes loose joints and hot spots.

Recommended tightening torques

| ELECTRODE DIAMETER / MM | TORQUE / NM |
|---|---|
| 200 | 250 |
| 225 | 350 |
| 250 | 450 |
| 300 | 650 |
| 350 | 850 |
| 400 | 1050 |
| 450 | 1400 |
| 500 | 1900 |
| 550 | 2500 |
| 600 | 3000 |

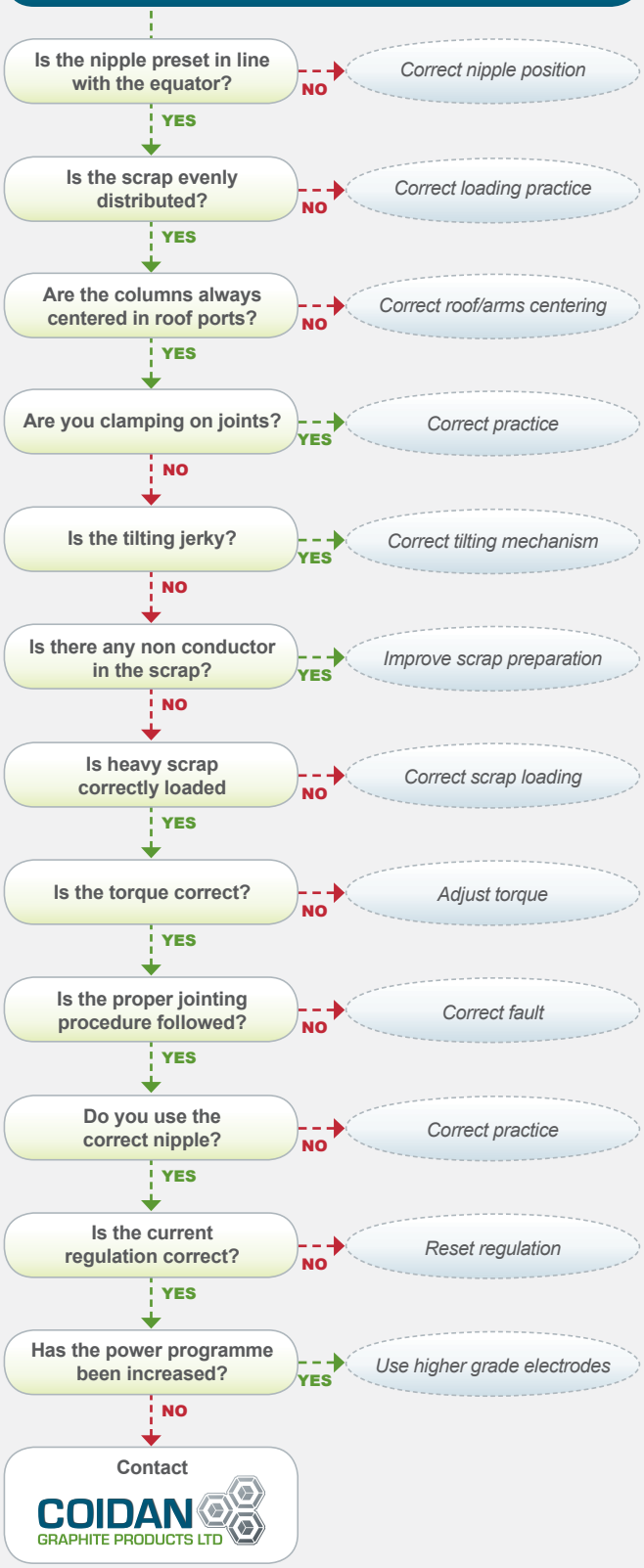
## Re-machining

If you have broken electrodes please feel free to contact us. We will be pleased to supply you with information regarding re-machining and recovery of scrap electrodes.

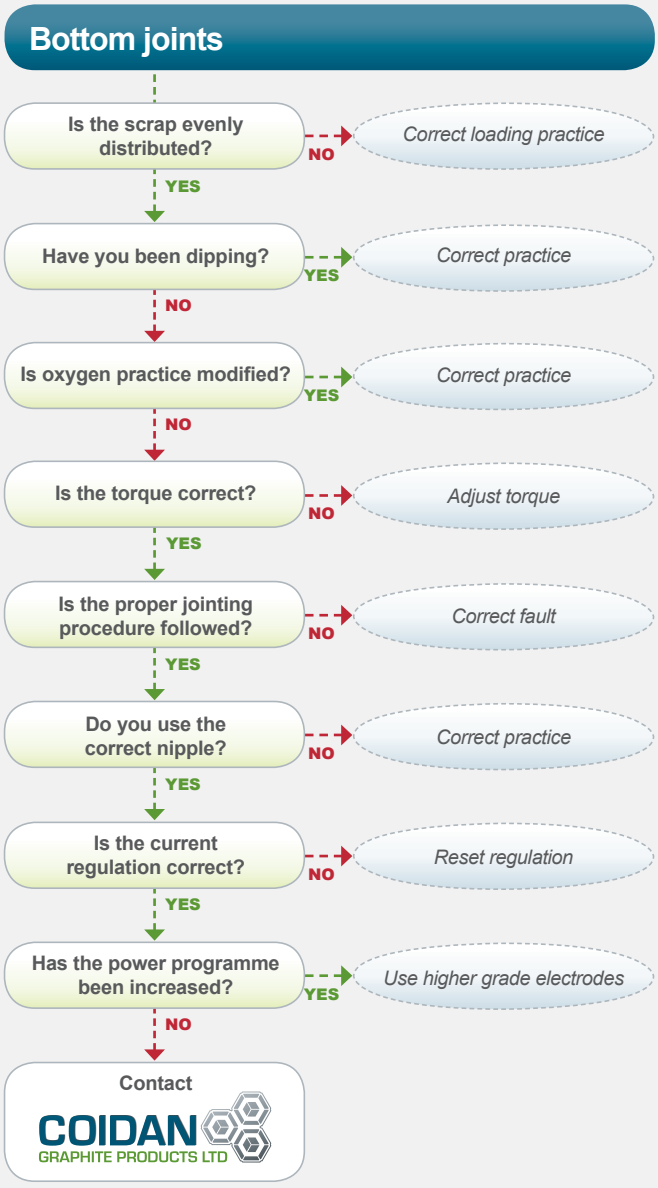
## Trouble Shooting

You should firstly distinguish between a joint- or body-breakage, unscrewing of the electrode or increased consumption rate. The following charts may help you to solve your problem.

### Top joints breaks




### Bottom joints



# GRAPHITE ELECTRODES

## Body breaks

- Is the scrap evenly distributed? — NO → *Correct loading practice*
- YES
- Are the columns always centered in roof ports? — NO → *Correct roof/arms centering*
- YES
- Is the tilting jerky? — YES → *Correct tilting mechanism*
- NO
- Is the current regulation correct? — NO → *Reset regulation*
- YES
- Has the power programme been increased? — YES → *Use higher grade electrodes*
- NO
- Contact COIDAN GRAPHITE PRODUCTS LTD

## Unscrewing

- Is the phase sequence anti clockwise? — NO → *Change phase sequence*
- YES
- Is the torque correct? — NO → *Adjust torque*
- YES
- Is the proper jointing procedure followed? — NO → *Correct fault*
- YES
- Do you use the correct nipple? — NO → *Correct practice*
- YES
- Is the current regulation correct? — NO → *Reset regulation*
- YES
- Has the power programme been increased? — YES → *Use higher grade electrodes*
- NO
- Contact COIDAN GRAPHITE PRODUCTS LTD

## Increased electrode consumption

- Has the production rate decreased? — YES → Contact COIDAN GRAPHITE PRODUCTS LTD
- NO
- Has the energy consumption increased? — YES → Contact COIDAN GRAPHITE PRODUCTS LTD
- NO
- Has the power programme been changed? — YES → Contact COIDAN GRAPHITE PRODUCTS LTD
- NO
- Has the fume exhaust been altered? — YES → *Reset system*
- NO
- Are joint areas overheating? — YES → *Correct jointing procedure/torque*
- NO
- Have the arc tips been dipped? — YES → *Correct practice*
- NO
- Are the arc tips irregular? — YES → *You may have undetected stubs*
- NO
- Are the columns more tapered? — YES → *Check oxygen practice and correct if modified*
- NO
- Contact COIDAN GRAPHITE PRODUCTS LTD

# GRAPHITE ELECTRODES

Please return the completed furnace data sheet.

## FURNACE DATA SHEET

Customer: .....

Address: .....

Telephone: .....

Fax: .....

### Furnace Details:

Furnace: ..... t (effective) EAF / LF

Max. crane hook height: ..... mm

Transformer rating (+ overload %): ..... (+ ..... ) MVA

Power input: ..... MW

Graphite electrode size: Dia ..... x ..... mm

Nipples 4TPI: Standard / Long nipple version

Max. graphite electrode current rating: ..... kA / phase

Secondary voltage: min ..... max ..... V

Energy consumption: ..... kWh/ mt liquid

Production: ..... tonnes / annum

### Type of production scheme:

Tap to tap: ..... min.

Power on time: ..... min.

Castings: ..... / day

Graphite consumption range: ..... kg / t liquid steel

Energy consumption ..... kg/MWh

Average breakages: ..... / month

### Special remarks:

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