Ground Rod

There are several main objectives providing for well-designed grounding system. First priority is personal safety which followed by protection equipment, signal reference quality, return path for faults and surges, and static dissipation.

In order to follow these objectives, all components shall be meet up to international standards as IEC 62561-2, UL 467. Grounding system must be maintained in a low permanent resistance under adverse conditions for the expected lifetime of Grounding System.

Ground Rods, Conductors, and Connectors in Grounding Network are subjected to severe corrosion to acidic and high concession of salt environment. In case of high mechanical stress is due to the electromagnetic force, and also rapid thermal heating is due to the high current magnitude during fault conditions.

Ground Rod Selection

When choosing which material types to use for a ground rod, the best way is to consider the installation location by measuring soil pH whether if it is acidic, neutral or alkaline.

- If it is acidic (pH < 6), the recommended selection is stainless steel ground rod.
- If it is neutral (pH between 6 - 8), the recommended selection is copper bonded ground rod (254 micron).
- If it is alkaline (pH > 8), the recommended selection is solid copper ground rod. In case of hard soil condition, the recommended selection is copper bonded ground rod 375 or 508 micron.

Copper-Bond Ground

- Earth rods are made from high tensile low carbon steel.
- Each rod is made by molecularly bonding 99.9 % pure electrolytic copper.
- Molecular bond to nickel-sealed high strength steel core
- The copper layer whose minimum thickness 254 micron met to UL standard
- High tensile steel core 450 N/mm^2 and ensurer a long life span.

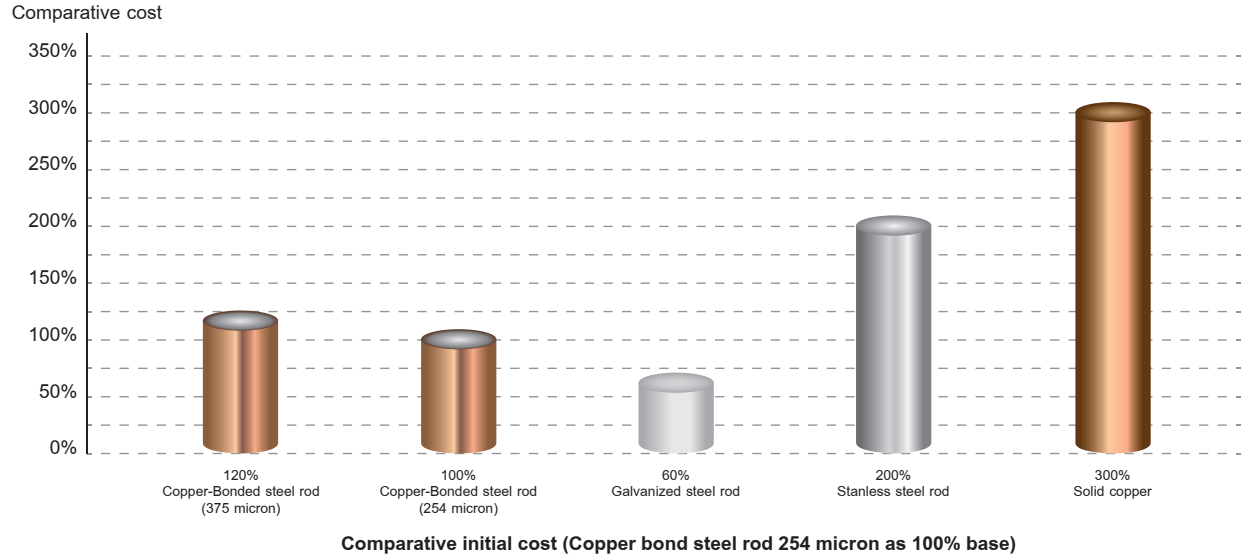
Solid Copper

- High investment and high resistance to corrosion
- Low resistivity
- Solid Copper Ground Rod must be prepared a hole which deep down equal with length rod for protect bending (can’t be hammering rod).

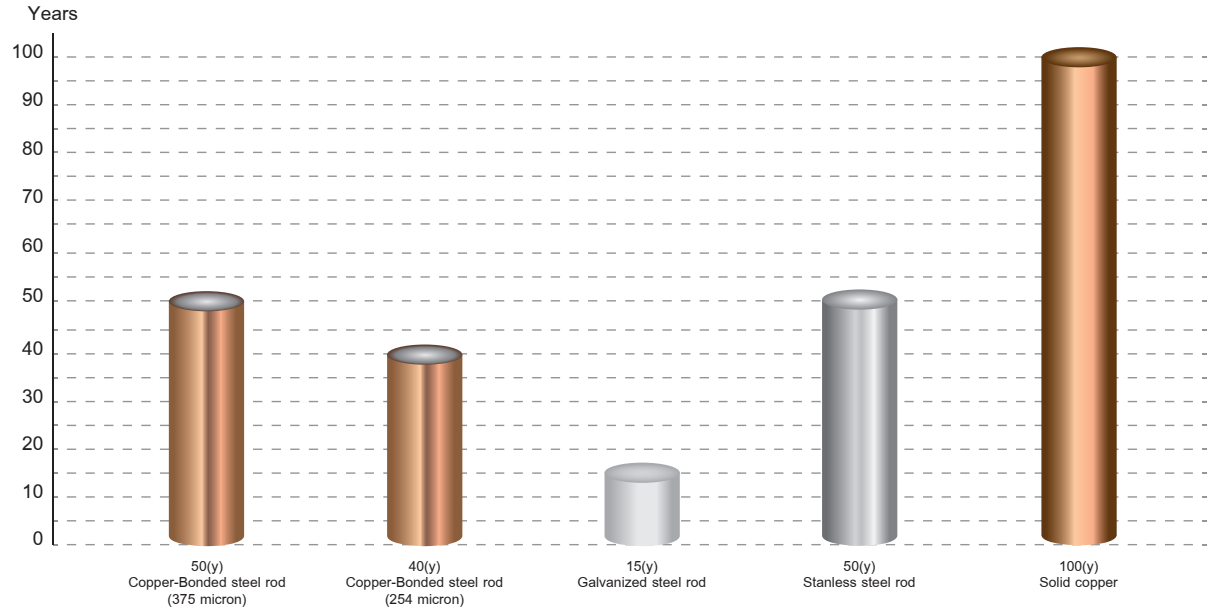
Stainless steel (316L)

- High investment and high resistance to corrosion
- High Strength

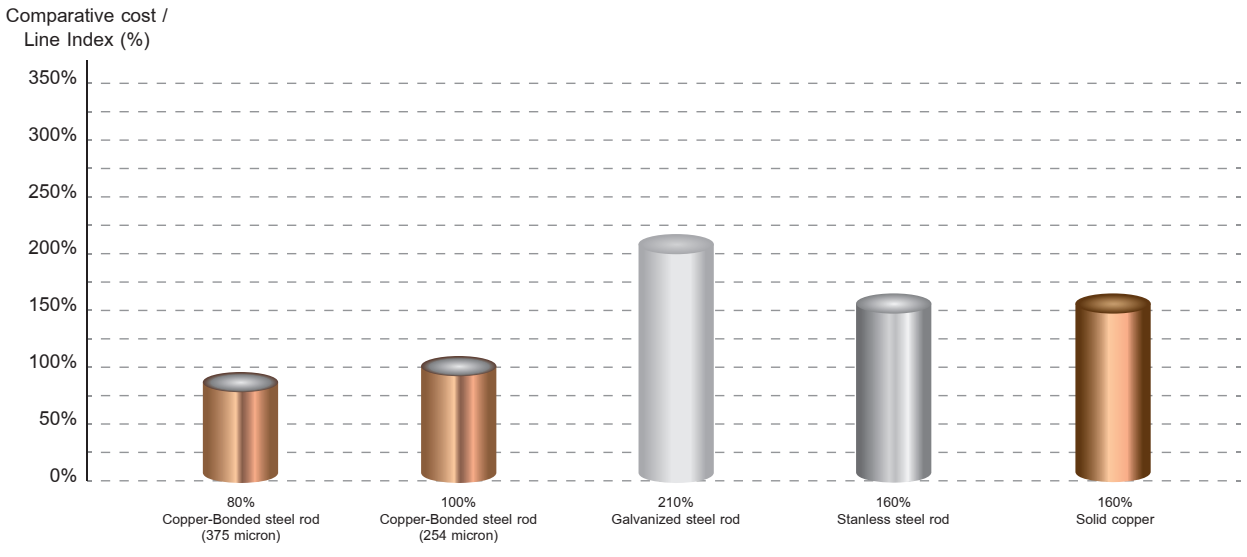
Ground Rod



Comparative initial cost (Copper bond steel rod 254 micron as 100% base)



Expected Average Service Life



Comparative Annual cost (Lower is Better)

Ground Rod Selection

There are two main factors for choosing Ground Rod.

- Material
- Size

Material Selection

BS 7430 standard contains the following corrosion protection recommendations:

- Stainless steel has the best resistant to corrosion with normal resistivity but has a relatively high price
- Solid Copper Rod is very resistant to corrosion with very low resistivity but has a very high price.
- Copper Bond Rod (254 micron) is resistant to corrosion with a low resistivity, and is very strong. Because the core is steel, but cheap

Corrosion resistance and Price

		Soil Copper	Copper Bond	Galvanized Steel	Stainless Steel	
Soil-pH	Acidic (pH < 6)	●●●	●●●	●●●●	●●	Corrosion Rate
	Neutral (pH 6 to 8)	●	●	●	●	
	Alkaline (pH > 8)	●●	●●	●●●	●	
Price		Very High	Normal	Low	High	
Age		100 Year	40-60 Year*	15 Year	50 Year	

Note : BS 7430 : 2011,Table 9, Page 59

*Copper Bond 254 micron = 40 year, 375 micron = 50 year, 508 micron = 60 year

The corrosion characteristics of each material compared to the soil (●)

● = indicate corrosion resistance generally unaffected

●● = indicate corrosion resistance only slightly reduced

●●● = indicate corrosion resistance moderately reduced

●●●● = indicate corrosion resistance considerably reduced

Sizing

The selection of material, configuration and cross-sectional area of ground rods shall be in accordance to IEC 62561-2 (Requirements for Conductors and Earth Electroded)

Material, configuration and cross-sectional area of earth electrodes

Material	Configuration	Cross-sectional area [a]			Recommended dimensions
		Earth rod mm^2	Earth conductor mm^2	Earth plate cm^2	
Copper, Tin plated copper [f]	Stranded		≥ 50 [i]		1, 7 mm strand diameter
	Solid round		≥ 50		8 mm diameter
	Solid tape		≥ 50		2 mm thick
	Solid round	≥ 176			15 mm diameter
	Pipe	≥ 110			20 mm diameter with 2 mm wall thickness
	Solid plate			≥ 2 500	500 mm x 500 mm and 1, 5 mm thick [g]
	Lattice plate [g]			≥ 3 600	600 mm x 600 mm consisted of 25 mm x 2 mm section for tape or 8 mm diameter for round conductor
Copper-Bonded steel	Solid round	≥ 150 h			14 mm diameter if 250 µm minimum radial copper coating with 99.9% copper content
	Solid round		≥ 50		8 mm diameter if 250 µm minimum radial copper coating of 99.9% copper content
	Solid round [l]		≥ 78		10 mm diameter if 250 µm minimum radial copper coating of 99.9% copper content
	Solid tape [l]		≥ 90		3 mm thick if 250 µm minimum copper coating of 99.9% copper content
Stainless steel [j]	Solid round		≥ 78		10 mm diameter
	Solid round	≥ 176 h			15 mm diameter
	Solid tape		≥ 100		2 mm thick

Note: For the application of the earth electrodes, see IEC 62305-3.

a Manufacturing tolerance : -3%.

b Threads, where utilized, shall be machined prior to galvanizing.

c The copper shall be intrinsically bonded to the steel. The coating can be measured using an electronic coating measuring thickness instrument.

d Lattice plate constructed with a minimum total conductor length of 4, 8 m.

e Different profiles are permitted with a cross section of 290 mm^2 and a minimum thickness of 3 mm, e.g. cross profile.

f Hot dipped or electroplated; minimum thickness coating of 1 µm. There is no requirement to measure the tin plated copper because it is for aesthetic reasons only.

g In some countries, the cross-sectional area may be reduced to ≥ 1 800 cm^2 and the thickness to ≥ 0, 8 mm.

h In some countries, the cross-sectional area may be reduced to 125 mm^2.

i The cross-sectional area of stranded conductors is determined by the resistance of the conductor according to IEC 60228.

j Chomium ≥ 16%, nickel ≥ 5%, molybdenum ≥ 2%, carbon ≤ 0.08%.

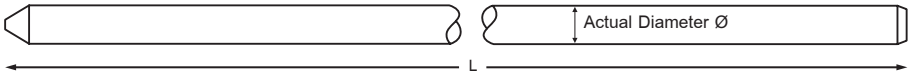
k Shall be embedded in concrete for a minimum depth of 50 mm.

l Due to higher corrosion rate for solid tape earth conductors, it is recommended to use copper-coated steel with a coating of 250 µm.

Copper-Bonded Ground Rod (254 micron)

LISTED
GROUNDING ELECTRODE
32UG

Copper-Bonded ground rod is made by molecularly bonding pure electrolytic copper onto a low carbon, high tensile steel core with exceeding 0.254 mm (254 micron) thick. The material made of 99.9% pure electrolytic copper with high tensile steel. To ensure in safety and quality, it meets UL and IEC standard for grounding and bonding equipments.



Standard Type (UL-Listed)

Code No.	Nominal Diameter (Ø) (in)	Actual Diameter (Ø) (mm)	Length (ft)	Weight (kg)
GRCBU 128	1/2	12.7	8	2.47
GRCBU 1210	1/2	12.7	10	3.08
GRCBU 588	5/8	14.2	8	3.08
GRCBU 5810	5/8	14.2	10	3.80
GRCBU 348	3/4	17.2	8	4.46
GRCBU 3410	3/4	17.2	10	5.58
GRCBU 18	1	23.1	8	8.04
GRCBU 110	1	23.1	10	10.15

Standard Type

Code No.	Nominal Diameter (Ø) (in)	Actual Diameter (Ø) (mm)	Length (ft)	Weight (kg)
GRCBU 124	1/2	12.7	4	1.23
GRCBU 126	1/2	12.7	6	1.85
GRCBU 584	5/8	14.2	4	1.54
GRCBU 586	5/8	14.2	6	2.31
GRCBU 344	3/4	17.2	4	2.23
GRCBU 346	3/4	17.2	6	3.35
GRCBU 14	1	23.1	4	4.30
GRCBU 16	1	23.1	6	6.09

Test Certificate
IEC 62561 Part 2
UL 467

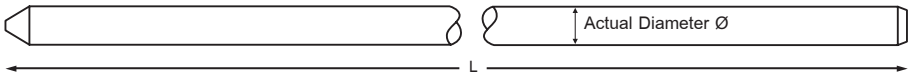
Material
High tensile strength steel
Copper purity > 99.9%

Application
Suitable for disperse current into the earth.

Note : Special Size, Dimeter, Length Copper thickness can be requested.

Copper-Bonded Ground Rod (375 micron)

Copper-Bonded ground rod is made by molecularly bonding pure electrolytic copper onto a low carbon, high tensile steel core with exceeding 0.375 mm (375 micron) thick. The material made of 99.9% pure electrolytic copper with high tensile steel. To ensure in safety and quality, it meets UL and IEC standard for grounding and bonding equipments.



Standard Type

Code No.	Nominal Diameter (Ø) (in)	Actual Diameter (Ø) (mm)	Length (ft)	Weight (kg)
GRCB375 124	1/2	12.9	4	1.12
GRCB375 126	1/2	12.9	6	1.68
GRCB375 128	1/2	12.9	8	2.59
GRCB375 1210	1/2	12.9	10	3.24
GRCB375 584	5/8	14.3	4	1.60
GRCB375 586	5/8	14.3	6	2.24
GRCB375 588	5/8	14.3	8	3.17
GRCB375 5810	5/8	14.3	10	3.97
GRCB375 344	3/4	17.3	4	2.33
GRCB375 346	3/4	17.3	6	3.49
GRCB375 348	3/4	17.3	8	4.72
GRCB375 3410	3/4	17.3	10	5.80
GRCB375 14	1	23.3	4	4.19
GRCB375 16	1	23.3	6	6.29
GRCB375 18	1	23.3	8	8.35
GRCB375 110	1	23.3	10	10.47

Test Certificate
IEC 62561 Part 2
UL 467

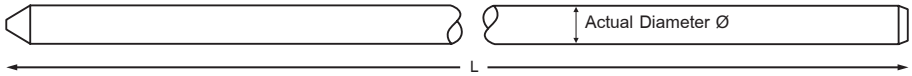
Material
High tensile strength steel
Copper purity > 99.9%

Application
Suitable for disperse current into the earth.

Note : Special Size, Dimeter, Length Copper thickness can be requested.

Copper-Bonded Ground Rod (508 micron)

Copper-Bonded ground rod is made by molecularly bonding pure electrolytic copper onto a low carbon, high tensile steel core with exceeding 0.508 mm (508 micron) thick. The material made of 99.9% pure electrolytic copper with high tensile steel. To ensure in safety and quality, it meets UL and IEC standard for grounding and bonding equipments.



Standard Type

Code No.	Nominal Diameter (Ø) (in)	Actual Diameter (Ø) (mm)	Length (ft)	Weight (kg)
GRCB508 124	1/2	13.2	4	1.13
GRCB508 126	1/2	13.2	6	1.78
GRCB508 128	1/2	13.2	8	2.71
GRCB508 1210	1/2	13.2	10	3.39
GRCB508 584	5/8	14.6	4	1.65
GRCB508 586	5/8	14.6	6	2.48
GRCB508 588	5/8	14.6	8	3.30
GRCB508 5810	5/8	14.6	10	4.14
GRCB508 344	3/4	17.6	4	2.38
GRCB508 346	3/4	17.6	6	3.57
GRCB508 348	3/4	17.6	8	4.79
GRCB508 3410	3/4	17.6	10	6.00
GRCB508 14	1	23.6	4	4.26
GRCB508 16	1	23.6	6	6.40
GRCB508 18	1	23.6	8	8.57
GRCB508 110	1	23.6	10	10.74

Test Certificate
IEC 62561 Part 2
UL 467

Material
High tensile strength steel
Copper purity > 99.9%

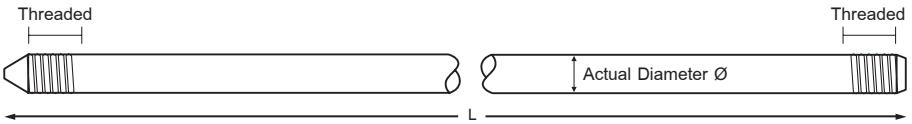
Application
Suitable for disperse current into the earth.

Note : Special Size, Dimeter, Length Copper thickness can be requested.

Copper-Bonded Ground Rod (254 micron)

LISTED
GROUNDING ELECTRODE
32UG

Copper-Bonded ground rod is made by molecularly bonding pure electrolytic copper onto a low carbon, high tensile steel core with exceeding 0.254 mm (254 micron) thick. The material made of 99.9% pure electrolytic copper with high tensile steel. To ensure in safety and quality, it meets UL and IEC standard for grounding and bonding equipments.



Threaded Type (UL-Listed)

Code No.	Nominal Diameter (Ø) (in)	Actual Diameter (Ø) (mm)	Threaded Size (in)	Length (ft)	Weight (kg)
GRCBUT 128	1/2	12.7	1/2	8	2.47
GRCBUT 1210	1/2	12.7	1/2	10	3.08
GRCBUT 588	5/8	14.2	5/8	8	3.08
GRCBUT 5810	5/8	14.2	5/8	10	3.80
GRCBUT 348	3/4	17.2	3/4	8	4.46
GRCBUT 3410	3/4	17.2	3/4	10	5.58
GRCBUT 18	1	23.1	1	8	8.25
GRCBUT 110	1	23.1	1	10	10.15

Threaded Type

Code No.	Nominal Diameter (Ø) (in)	Actual Diameter (Ø) (mm)	Threaded Size (in)	Length (ft)	Weight (kg)
GRCBUT 124	1/2	12.7	1/2	4	1.23
GRCBUT 126	1/2	12.7	1/2	6	1.85
GRCBUT 584	5/8	14.2	5/8	4	1.54
GRCBUT 586	5/8	14.2	5/8	6	2.31
GRCBUT 344	3/4	17.2	3/4	4	2.23
GRCBUT 346	3/4	17.2	3/4	6	3.35
GRCBUT 14	1	23.1	1	4	4.12
GRCBUT 16	1	23.1	1	6	6.09

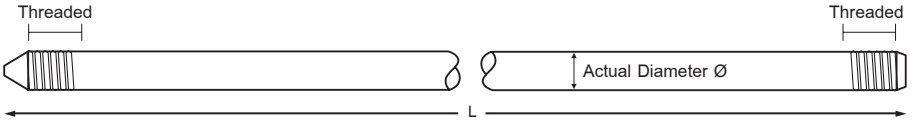
Test Certificate
IEC 62561 Part 2
UL 467

Application
Suitable for disperse current into the earth
to extend the length of ground rod by coupling.

Note : Special Size, Dimeter, Length Copper thickness can be requested.

Copper-Bonded Ground Rod (375 micron)

Copper-Bonded ground rod is made by molecularly bonding pure electrolytic copper onto a low carbon, high tensile steel core with exceeding 0.375 mm (375 micron) thick. The material made of 99.9% pure electrolytic copper with high tensile steel. To ensure in safety and quality, it meets UL and IEC standard for grounding and bonding equipments.



Threaded Type

Code No.	Nominal Diameter (Ø) (in)	Actual Diameter (Ø) (mm)	Threaded Size (in)	Length (ft)	Weight (kg)
GRCBT375 124	1/2	12.9	1/2	4	1.31
GRCBT375 126	1/2	12.9	1/2	6	1.96
GRCBT375 128	1/2	12.9	1/2	8	2.59
GRCBT375 1210	1/2	12.9	1/2	10	3.24
GRCBT375 584	5/8	14.3	5/8	4	1.60
GRCBT375 586	5/8	14.3	5/8	6	2.40
GRCBT375 588	5/8	14.3	5/8	8	3.17
GRCBT375 5810	5/8	14.3	5/8	10	3.97
GRCBT375 344	3/4	17.3	3/4	4	2.33
GRCBT375 346	3/4	17.3	3/4	6	3.49
GRCBT375 348	3/4	17.3	3/4	8	4.63
GRCBT375 3410	3/4	17.3	3/4	10	5.80
GRCBT375 14	1	23.3	1	4	4.19
GRCBT375 16	1	23.3	1	4	6.29
GRCBT375 18	1	23.3	1	8	8.35
GRCBT375 110	1	23.3	1	10	10.47

Test Certificate
IEC 62561 Part 2

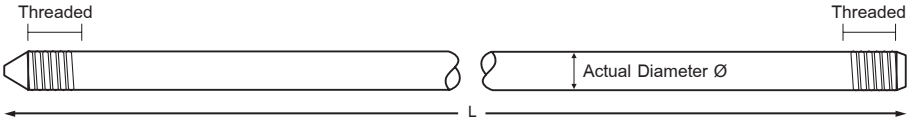
Material
High tensile strength steel
Copper purity > 99.9%

Application
Suitable for disperse current into the earth to extend the length of ground rod by coupling.

Note : Special Size, Dimeter, Length Copper thickness can be requested.

Copper-Bonded Ground Rod (508 micron)

Copper-Bonded ground rod is made by molecularly bonding pure electrolytic copper onto a low carbon, high tensile steel core with exceeding 0.508 mm (508 micron) thick. The material made of 99.9% pure electrolytic copper with high tensile steel. To ensure in safety and quality, it meets UL and IEC standard for grounding and bonding equipments.



Threaded Type

Code No.	Nominal Diameter (Ø) (in)	Actual Diameter (Ø) (mm)	Threaded Size (in)	Length (ft)	Weight (kg)
GRCBT508 124	1/2	13.2	1/2	4	4.26
GRCBT508 126	1/2	13.2	1/2	4	6.40
GRCBT508 128	1/2	13.2	1/2	8	2.71
GRCBT508 1210	1/2	13.2	1/2	10	3.39
GRCBT508 584	5/8	14.6	5/8	4	1.65
GRCBT508 586	5/8	14.6	5/8	6	2.48
GRCBT508 588	5/8	14.6	5/8	8	3.30
GRCBT508 5810	5/8	14.6	5/8	10	4.14
GRCBT508 344	3/4	17.6	3/4	4	2.38
GRCBT508 346	3/4	17.6	3/4	4	3.57
GRCBT508 348	3/4	17.6	3/4	8	4.79
GRCBT508 3410	3/4	17.6	3/4	10	6.00
GRCBT508 14	1	23.6	1	4	4.26
GRCBT508 16	1	23.6	1	6	6.40
GRCBT508 18	1	23.6	1	8	8.57
GRCBT508 110	1	23.6	1	10	10.74

Test Certificate
IEC 62561 Part 2

Material
High tensile strength steel
Copper purity > 99.9%

Application
Suitable for disperse current into the earth
to extend the length of ground rod by coupling.

Note : Special Size, Dimeter, Length Copper thickness can be requested.