

**REPUBLIC OF IRAQ  
MINISTRY OF ELECTRICITY  
PLANNING AND STUDIES OFFICE**

|                          |             |
|--------------------------|-------------|
| <b>SPECIFICATION NO.</b> | <b>D-47</b> |
|--------------------------|-------------|

**TECHNICAL SPECIFICATION FOR  
BARE OVERHEAD LINE CONDUCTORS**

|                 |                   |
|-----------------|-------------------|
| <b>REVISION</b> | <b>APRIL 2017</b> |
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# Bare Over Head Line Conductors

## 1. SCOPE

This specification covers and includes design, manufacture, testing, supply, packing, of Bare Over Head Line Conductors.

## 2. System and environmental conditions

### 2.1 Low voltage system

Nominal System Voltage 400 / 230 Volts  $\pm$  10%

System Frequency 50 Hz

Type of System Grounding - Neutral Earthed at Distribution Transformer.

### 2.2 Medium voltage system

Nominal System Voltage 11/33 kV

Maximum system Voltage 12 kV/36kV (for electrical clearance purposes)

System Frequency 50 Hz

Type of System Grounding - Neutral resistive/solid earthed (depending on area).

### 2.3 Environmental conditions

The following physical design parameters have been considered as general environmental conditions in Iraq

|                                               |             |                                         |
|-----------------------------------------------|-------------|-----------------------------------------|
| Altitude above sea level – maximum            | m           | 1000                                    |
| Air pressure yearly average                   | millibars   | 1011                                    |
| Pollution level – IEC 60815                   |             | Class III – Heavy<br>Class IV – V heavy |
| Dust storms                                   | days/annual | 30                                      |
| Isoceraunic level                             | days/annual | 25                                      |
| Maximum wind speed (for design purposes)      | km/h        | 140                                     |
| Total rainfall per annual – maximum / minimum | mm          | 600 / 50                                |

## **2.4 Air temperatures**

|                                    |    |     |
|------------------------------------|----|-----|
| Highest maximum for 6 hours a day  | °C | 55  |
| Maximum daily average              | °C | 40  |
| Maximum yearly average             | °C | 30  |
| Minimum                            | °C | -10 |
| Highest one day variation          | °C | 25  |
| Sun temperature in direct sunlight | °C | 80  |

## **2.5 Humidity**

|                                         |   |    |
|-----------------------------------------|---|----|
| Maximum relative humidity at 40 degrees | % | 92 |
| Minimum relative humidity               | % | 12 |
| Yearly average                          | % | 44 |

## **3. Standards and codes**

### **3.1 General**

Except where modified by this Specification, equipment and materials shall be in accordance with IEC (International Electro technical Commission) and ISO (International Standards Organization) Recommendations.

When IEC or ISO Recommendations or DIN, BS, ANSI, ASTM, VDE Standards are referred to, the Edition shall be that current at the Date of Tender, together with any amendments issued to that date.

Additional specific standards are specified for each item or equipment in the corresponding sections of these Technical Specifications.

### **3.2 Basic standards**

The equipment, materials and labour employed in the fabrication, delivery, erection or installation and testing of the parts of the project shall comply with applicable and approved standards. The principal basis for reference shall be the appropriate portions of the latest revision of internationally recognized standards.

## **4. GENERAL REQUIREMENTS**

All drawings, manuals, correspondence and other relevant documentation regarding the Supply shall be in the English Language.

This Document provides only the Technical specification of the equipment to be supplied. Commercial conditions, terms of delivery, time for completion, particulars regarding the delivery final destination, documentation required before the shipment and other relevant information are specified by MoE in the solicitation of tenders.

Supplier shall submit all technical particulars and a description of the equipment offered. Minimum requirement for the documents submitted with the offer:

- ❑ Catalogues/brochures which illustrate in detail the types of equipment offered
- ❑ General arrangement drawings of the equipment/goods
- ❑ Filled Technical Schedules, if part of this Document
- ❑ Details of Manufacturer, country of origin of each particular
- ❑ Other documents stipulated in this Document

## **5. TECHNICAL REQUIREMENTS AND SPECIFICATION**

### **5.1 General**

All the conductor materials shall comply with the requirements of this Specification and must be approved by the Employer.

The conductors shall comply in all respects with the requirements of IEC 61089 or other approved standard. The outer layer wires shall be pre-formed so that they remain inert when the conductor is cut. Each layer of conductor except the outer layer shall be covered with an approved grease of applied mass per unit length determined in accordance with IEC 61089. The extent of grease to be applied shall be Case 2 as described in IEC 61089. After application of grease and before the outer layer of wires is stranded the penultimate layer of wires shall be thoroughly wiped so that all remaining visible grease on the conductor is between the wires of the penultimate layer.

The stranding of each layer of the conductor shall be as close and even as possible. The lay of the outermost layer shall be right-hand.

The line conductors shall be supplied on drums which are constructed in accordance with an approved national standard so as to enable the conductors to be run out smoothly and in lengths as long as can be conveniently handled and erected. Drums shall be marked with type, size and length of conductor and also with an arrow to show the correct direction of rotation for rolling.

The inner end of the length of conductor must be passed through the flange and be secured external to the barrel. Wooden drums and battens shall be constructed from seasoned softwoods and be impregnated with a preservative against fungal and termite attack. The preservative shall not react with aluminium and the barrel and sides of drums shall be covered with a waterproof paper or equivalent so as to ensure no damage to the conductors. All nails to be countersunk and the drum construction must be proved adequate to transport the conductor weight.

The Supplier shall ensure close and continuous liaison between the manufacturers of conductors, clamps and fittings so that the equipment will be perfectly adapted. Particular care shall be taken during manufacture and during subsequent handling to ensure smooth surfaces free from abrasion.

Each principal type of bare conductor (i.e. AAAC or ACSR) is allowed to be supplied by only one sole reputable manufacturer; Split up of the supply will not be permitted.

## **5.2 Conductor material AAAC**

The aluminium alloy shall be of the highest conductivity commercially obtainable. The Contractor shall submit certificates of analysis giving the exact conductivity value and nature and percentage of aluminium alloy components.

The outermost aluminium alloy layer shall be stranded with a right hand lay and there shall be no joints in its individual wires. The inner layer of aluminium alloy wires shall be covered with grease of approved type and characteristics.

The conductor material and the grease are to be suitable for continuous operation at 85 °C without deterioration. The grease drop point shall not be less than 110 °C. Unless the Supplier can produce evidence in the form of service records, test certificates, etc. which demonstrate to the satisfaction of the Employer that this requirement is met, the Supplier shall carry out such tests as the Employer may require, at no additional cost to the Employer.

## **5.3 Conductor material ACSR**

The aluminium shall be of the highest purity commercially obtainable, and shall not be less than 99.5 %. The Contractor shall submit certificates of analysis giving the percentage and nature of aluminium impurities.

The outermost aluminium layer shall be stranded with a right hand lay and there shall be no joints in its individual wires. The steel core and the inner layer of aluminium wires shall be covered with grease of approved type and characteristics.

The conductor material and the grease are to be suitable for continuous operation at 80 °C without deterioration. The grease drop point shall not be less than 110 °C. Unless the Supplier can produce evidence in the form of service records, test certificates, etc. which demonstrate to the satisfaction of the Employer that this requirement is met, the Supplier shall carry out such tests as the Employer may require, at no additional cost to the Employer.

#### **5.4 Conductor material AAC**

The aluminium shall be of the highest purity commercially obtainable, and shall not be less than 99.5 %. The Contractor shall submit certificates of analysis giving the percentage and nature of aluminium impurities.

The outermost aluminium layer shall be stranded with a right hand lay and there shall be no joints in its individual wires. The inner layer of aluminium wires shall be covered with grease of approved type and characteristics.

The conductor material and the grease are to be suitable for continuous operation at 80 °C without deterioration. The grease drop point shall not be less than 110 °C. Unless the Supplier can produce evidence in the form of service records, test certificates, etc. which demonstrate to the satisfaction of the Employer that this requirement is met, the Supplier shall carry out such tests as the Employer may require, at no additional cost to the Employer.

#### **5.5 Bare Stranded Soft-Drawn Copper Conductors**

The copper shall be of the highest purity commercially obtainable, and shall not be less than 99.8 %. The Contractor shall submit certificates of analysis giving the percentage and nature of copper impurities.

The outermost copper layer shall be stranded with a right hand lay and there shall be no joints in its individual wires. The conductor material is to be suitable for continuous operation at 80 °C without deterioration.

### **6. Shop inspection and testing**

#### **6.1 Services prior to and during inspections and tests**

In accordance with IEC (60888, 60889, 60468, 61089, 61395), the Supplier shall submit procedures for material testing, manufacture, quality control and performance testing as they apply from the procurement phase of raw material to the finished product.

No inspection will be made or deemed valid unless the Employer's head office, the Supplier and Manufacturer are in possession of all relevant approved drawings and procedures for the item to be tested. The Supplier on request shall supply the Employer's Representative with a copy of drawings and procedures at the time of the test.

#### **6.2 Inspections and tests during manufacture**

Equipment shall wherever practical be subject to tests on completion in the Manufacturer's Supply to prove that the reliability, operation and performance conform to the requirements of this Specification and the provisions of IEC standard.

The Supplier shall on request submit, for approval, procedures describing the proposed test methods to be used. Type and layout of test facility, location of instrumentation, formula for calculation of results and correction to Site conditions, etc. shall be included where appropriate.

All instruments and apparatus required for the inspection or used for the performance of tests shall be calibrated to an agreed standard at a laboratory of National repute. The cost of making such calibrations shall be borne by the Supplier in all cases. Records shall be available for examinations by the Employer or his Representative.

## **7. Packaging**

The Supplier shall prepare, pack, and load all materials and equipment for shipment in such a manner that they are protected from damage during shipment and shall be responsible for and make good any and all damage resulting from improper packing until final acceptance of the Supply.

## **8. Shipping marks**

Marking shall consist of the following information in sequence and in a frame, commensurate with the size of the container.

- Consignee:
- Name
  - Contract number
  - Port of discharge
  - Item & Package number in sequence and quantity per package
  - Commodity description
  - Net and gross weight and cubic measurement
  - Shipper's and/or trademarks
  - Caution marks, if applicable



## 9. Conductor types

### 9.1 All aluminium alloy conductors (AAAC)

| Description                     | Unit              | Type - Denomination            |                                |
|---------------------------------|-------------------|--------------------------------|--------------------------------|
|                                 |                   | AAAC<br>95 mm <sup>2</sup>     | AAAC<br>120 mm <sup>2</sup>    |
| Overall diameter                | mm                | 12.5                           | 14.0                           |
| Nominal cross section           | mm <sup>2</sup>   | 93.3                           | 117                            |
| Stranding                       |                   | 19                             | 19                             |
| Weight                          | daN/km            | 255.5                          | 322                            |
| Ultimate Tensile Strength (UTS) | kN                | 26.05                          | 32.68                          |
| Modulus of elasticity (final)   | N/mm <sup>2</sup> | 55900                          | 55900                          |
| Coefficient of linear expansion | 1/°C              | 23x10 <sup>-6</sup>            | 23x10 <sup>-6</sup>            |
| Rated DC resistance at 20 °C    | /km               | 0,358                          | 0.285                          |
| Current carrying capacity 80 °C | A                 | 342                            | 395                            |
| Typical length on reel          | m                 | 2000                           | 2000                           |
| <b>Standard</b>                 |                   | <b>DIN 48201<br/>IEC 61089</b> | <b>DIN 48201<br/>IEC 61089</b> |

## 9.2 Aluminium conductors steel reinforced (ACSR)

| Description                     | Unit              | Type - Denomination            |                                |
|---------------------------------|-------------------|--------------------------------|--------------------------------|
|                                 |                   | ACSR<br>120/20 mm <sup>2</sup> | ACSR<br>210/35 mm <sup>2</sup> |
| Overall diameter                | mm                | 15.5                           | 20.27                          |
| Nominal cross section           | mm <sup>2</sup>   | 141                            | 243                            |
| Stranding                       |                   | 26/7                           | 26/7                           |
| Weight                          | daN/km            | 494                            | 851                            |
| Ultimate Tensile Strength (UTS) | kN                | 44.94                          | 74.94                          |
| Modulus of elasticity (final)   | N/mm <sup>2</sup> | 75510                          | 75510                          |
| Coefficient of linear expansion | 1/°C              | 18.9 x10-6                     | 18.9 x10-6                     |
| Rated DC resistance at 20 °C    | /km               | 0.2374                         | 0.1380                         |
| Current carrying capacity 80 °C | A                 | 440                            | 630                            |
| Typical length on reel          | m                 | 2000                           | 2000                           |
| <b>Standard</b>                 |                   | <b>DIN 48204<br/>IEC 61089</b> | <b>DIN 48204<br/>IEC 61089</b> |

### 9.3 All aluminium conductors (AAC)

| Description                     | Unit              | Type - Denomination       |                           |                           |                           |                            |
|---------------------------------|-------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|
|                                 |                   | AAC<br>35 mm <sup>2</sup> | AAC<br>50 mm <sup>2</sup> | AAC<br>70 mm <sup>2</sup> | AAC<br>95 mm <sup>2</sup> | AAC<br>120 mm <sup>2</sup> |
| Overall diameter                | mm                | 7.5                       | 9                         | 10.5                      | 12.5                      | 14.0                       |
| Nominal cross section           | mm <sup>2</sup>   | 35                        | 50                        | 70                        | 95                        | 120                        |
| Stranding                       |                   | 7                         | 19                        | 19                        | 19                        | 19                         |
| Weight                          | daN/km            | 94                        | 133                       | 181                       | 256                       | 322                        |
| Ultimate Tensile Strength (UTS) | kN                | 5.74                      | 8.44                      | 11.29                     | 15.65                     | 18.74                      |
| Modulus of elasticity (final)   | N/mm <sup>2</sup> | 58850                     | 55900                     | 55900                     | 55900                     | 55900                      |
| Coefficient of linear expansion | 1/°C              | 23x10 <sup>-6</sup>       | 23x10 <sup>-6</sup>       | 23x10 <sup>-6</sup>       | 23x10 <sup>-6</sup>       | 23x10 <sup>-6</sup>        |
| Rated DC resistance at 20 °C    | /km               | 0.833                     | 0.595                     | 0.437                     | 0.308                     | 0.246                      |
| Current carrying capacity 80 °C | A                 | 180                       | 225                       | 270                       | 340                       | 390                        |
| Typical length on reel          | m                 | 2000                      | 2000                      | 2000                      | 2000                      | 2000                       |
| Standard                        |                   | DIN 48201<br>IEC 61089    |                           |                           |                           |                            |

#### 9-4 Bare Stranded Soft-Drawn Copper Conductors

| Description                  | Unit         | Type - Denomination          |                              |                              |                              |
|------------------------------|--------------|------------------------------|------------------------------|------------------------------|------------------------------|
|                              |              | Copper<br>35 mm <sup>2</sup> | Copper<br>50 mm <sup>2</sup> | Copper<br>70 mm <sup>2</sup> | Copper<br>95 mm <sup>2</sup> |
| Conductor construction       | No. x Q (mm) | 7x2.52                       | 19x1.78                      | 19x2.14                      | 19x2.50                      |
| Overall diameter             | mm           | 7.56                         | 8.90                         | 10.70                        | 12.50                        |
| Approximately overall weight | Kg/km        | 317.0                        | 429.0                        | 619.0                        | 845.0                        |
| Max. DC resistance at 20 °C  | /km          | 0.52400                      | 0.38700                      | 0.2680                       | 0.19300                      |
| <b>Standard</b>              |              | <b>IEC 60228</b>             |                              |                              |                              |