EMD 455-1-6 MATERIALS MANUAL INDEX NO. 0602

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# MATERIAL SPECIFICATION

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION
LA GRANGE, ILLINOIS

SPECIFICATION NO.
EMS - 203

| REV. | DATE | BY |
|---|---|---|
| C | 11-4-68 | Martin |
| D | 2-3-69 | Martin |

NAME-- COPPER BARS, RODS & SHAPES - ELECTRICAL & OTHER PURPOSES

REQUIREMENTS:-

This material shall conform to the requirements of ASTM B187-66a,** as herein amended.

1. Mechanical and Electrical Properties

| Temper | Diameter or Size, Inches | Tensile Strength psi | Elong.[1], Min., % | Bend Test Angle Degrees | Elect. Cond., Min., % | Hardness Rockwell "F" |
|---|---|---|---|---|---|---|
| Soft | Rods, 3/8 & Less | 37,000 Max. | 25 | 180 | 100 | --- |
| | Rods, Over 3/8 | 37,000 Max. | 25 | 180 | 100 | 50 Max. |
| | Bars, All Sizes | 37,000 Max. | 25 | 180 | 100 | 50 Max. |
| "D" Rivet | Bars, 3/8 & Less Thick | 34,000 Min. | 12 | 120 | 97.40 | 60 Min. |
| Hard | Rods, 3/8 & Less | 40,000 Min. | 12 | 120 | 97.40 | --- |
| | Rods, Over 3/8 to 1, Incl. | 40,000 Min. | 12 | 120 | 97.40 | 80 Min. |
| | Rods, Over 1 to 2, Incl. | 35,000 Min. | 15 | 120 | 97.40 | 75 Min. |
| | Rods, Over 2 to 3, Incl. | 35,000 Min. | 15 | 120 | 98.40 | 65 Min. |
| | Bars, 3/8 & Less Thick. & 4 or Less Wide | 37,500 Min. | 10 | 120 | 97.40 | 80 Min. |
| | Bars, All Other Sizes | 33,000 Min. | 15 | 120 | 98.40 | 65 Min. |
| | Channels, Angles, & Shapes | 32,000 Min. | 15 | --- | 98.40 | --- |

Note[1]: A minimum gage length of 1 in. shall be used.

2. Tolerances - Dimensional - Plus & Minus - Cold Drawn Rods

| Dia. or Distance Between Parallel Surfaces | Rounds | Hex. or Octagons |
|---|---|---|
| Up to 0.150 Incl. | 0.0013 | 0.0025 |
| Over 0.150 to 0.500, Incl. | 0.0015 | .003 |
| Over 0.500 to 1.000, Incl. | 0.002 | .004 |
| Over 1.000 to 2.000, Incl. | 0.0025 | .005 |
| Over 2.000 | .15 Per Cent[a] | .30 Per Cent[a] |

Thickness Tolerances - Plus & Minus - For Rectangular & Square Bars

| Thickness - Inches | Width - Inches: 1/2 & Under | Over 1/2 to 1-1/4 | Over 1-1/4 to 2 | Over 2 to 4 | Over 4 to 8 | Over 8 to 12 |
|---|---|---|---|---|---|---|
| 0.013 & Under | .001 | .001 | - | - | - | - |
| Over 0.013 to 0.050, Incl. | .0013 | .0013 | .0015 | - | - | - |
| Over 0.050 to 0.090, Incl. | .0015 | .0015 | .002 | .0025 | - | - |
| Over 0.090 to 0.130, Incl. | .002 | .002 | .0025 | .003 | .0035 | - |
| Over 0.130 to 0.188, Incl. | .0025 | .0025 | .003 | .0035 | .004 | .005 |
| Over 0.188 to 0.500, Incl. | .003 | .003 | .0035 | .004 | .0045 | .0055 |
| Over 0.500 to 1.00, Incl. | - | .004 | .004 | .0045 | .005 | .006 |
| Over 1.00 to 2.00, Incl. | - | .0045 | .0045 | .005 | .006 | - |
| Over 2.00 to 4.00, Incl. | - | - | - | .30%[a] | | |

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# MATERIAL SPECIFICATION

ELECTRO-MOTIVE DIVISION

SPECIFICATION NO.
EMS - 203
Rev. "D" 2-3-69
(CONTINUED)

Width Tolerances - Plus & Minus
Rectangular Bars (Square Excl.)

| Width - Inches | Tolerances |
|---|---|
| 0.050 and Under | 0.0013 |
| Over 0.050 to 0.090, Incl. | 0.0015 |
| Over 0.090 to 0.130, Incl. | 0.002 |
| Over 0.130 to 0.188, Incl. | 0.003 |
| Over 0.188 to 0.500, Incl. | 0.0035 |
| Over 0.500 to 1.250, Incl. | 0.005 |
| Over 1.250 to 2.00, Incl. | 0.008 |
| Over 2.000 to 4.000, Incl. | 0.012 |
| Over 4.000 to 12.000, Incl. | .30%[a] |

[a] Wherever a percent tolerance is shown, it is to be expressed to the nearest .001".

3. Chemical Composition: Copper - 99.88% Minimum (Silver Included as Copper).

4. Identification: Packages to be marked with E.M.D. order number, name of supplier, size, EMS 203, gross and net weight.

**NOTE: Wherever the specification or test of any society is referred to herein with its date, number, or revision letter stated, no other dated or more recent revisions are acceptable except by revision of this Electro-Motive Specification.

GENERAL INFORMATION:-(Not Mandatory Vendor Requirements):

EMS 203 is used at E.M.D. in bus bars, compensating conductors, brush holder ring connectors and applications where the higher tensile and fatigue strength of hard round edge bar is required or where other edge types or shapes are desired in either hard or soft temper.

A companion specification, MS 4352, covers only ROUND EDGE SOFT, copper bars and flat wire. It is used for all applications where its properties and shape will serve the purpose. The round edge, as defined in that specification, is actually round corner on the larger sizes.

EMD 203 Edges: All polygonal sections have substantially exact angles and sharp corners. Squares and rectangles have commercially sharp corners, unless otherwise specified. Actual radii are 1/32" maximum for sizes 3/16" up to 1" in thickness. By specifying "Round Corner", stock will have a corner radius of 1/16" for bars 3/16" to 1" inclusive and 1/8" radius for bars over 1" in thickness. By specifying "Round Edge", the edge will have a continuous arc on a radius 1-1/4 times the bar thickness for bars over 3/16" thick. The corners will be sharp, but not rough.

EMD sizes are usually large enough that round corners, if to be taped, or square corners are the most practical.

DRAFTING INFORMATION:-

The following shall appear on the drawing:

"D" MATERIAL: EMS 203 COPPER followed by "HARD", "SOFT", or "RIVET" as required.

If other than square edges are desired the edge type must be specified. The specifying of round corners does not materially reduce the area of conductors and is usually good practice.

NOTE: These specifications were developed without considering whether patents may or may not be involved. In all cases, therefore, the supplier shall be required to assume patent liability.