4.1 The all-aluminum conductor identified by the code word Bluebell is composed of 37 strands each having a diameter of 0.1672 in. Tables characteristics of all aluminum conductor list an area of 1033500 cmil for these conductor. Are this values consistent with each other? Find the overall area of the strands in square millimeters.

Solution:

Diameter=0.1672*1000=167.2 mils/strand

Conductor area=$(167.2)^2$*37=1034366 cmils

Strand diameter=.672*2.54*10=4.24 mm

Conductor area = $\pi/4(4.24)^2$*37= 5224mm^2

Answer.

4.2 Determine the dc resistance in ohms per km of bluebell at 20∘ C by Eq. (4.2) and the information in Prob. 4.1 and cheek result against the value listed in tables of 0.01678 ohm per 1000ft. Compute the dc resistance in ohms per km at 50∘C and compare the result with the ac 60-Hz resistance of .1024 Ω/mi listed in tables for this conductor at 50∘C. Explain any difference in values. Assume that the increase in resistance due to spiraling is 2%.

Solution:

R_{dc} =(17.0*1000)/1033500 =.01645

Corrected for Standing,

R_{dc} =1.02*.01645 = .01678 **Ω/1000` at 20**^{0}C

At 50^{0}c,

R_{dc} =((228*50)/(228+20))*.01678*5028

=0.09932 **Ω/mile**

This value does not account for skin effect and so is less than the 60-HZ value.

Answer

4.3An all-aluminum conductor is composed of 37 strands each having a diameter of 0.333 cm.compute the dc resistance in ohm per kilometer at 75^{0}C . Assume that the increase resistance due to spiralingis 2%.

Solution:

Area = π((.333*10^{-2})^2 / 4)37=3.222*10^{-4}m^2

R_{dc} =(2.81*10^{-8})/(3.222*10^{-4}) *1000 =.0878 **Ω/km at 20**^{0}C

At 75^0 c, and corrected for stranding,

R_{dc} =1.02*((228+75)/(228+20))*0.0878 = 0.1094 **Ω/km,75**^{0}c

Answer.

4.4 The energy density at a point in a magnetic field can be shown to be B^2/2 μ where B is the flux density and μ is the permeability. using this result and eq(4.10) show that the total magnetic field energy stored within a unit length of solid circular conductor carrying current I is given by μ i^2/16 π Neglect skin effect and thus verify equation.

Solution:

B_x = $μ_x$I/2 πr^2 wb/m^2

Energy stored in the tublar element of thickness d_x ,unit length and radius:

De = Bx^2/2 μ dv = Bx^2/2 μ(2 πx.I.d_x) j

=(μr^{2}I^2)/(4 π^2 r^4)*1/2 μ.2 πxdx j

$=(\mu x^2 I^2)/(4 \pi^2 r^4)*dx\ j$

Total energy per unit length is,

$B_{int} = \int_{x=0}^{x=r} de = \mu i^2/4 \pi r^4 \int_0^r x^3 dx$

$= \mu i^2/16\pi$

Since,

$E_{int} = 1/2\ L_{int}\ I^2$

$L_{int} = 2*(E_{int}/i^2) = 2/i^2\ (\mu i^2/16\pi) = \mu/8\pi$ H/M

$=1/2\ (10^{-7})$H/M **Answer.**