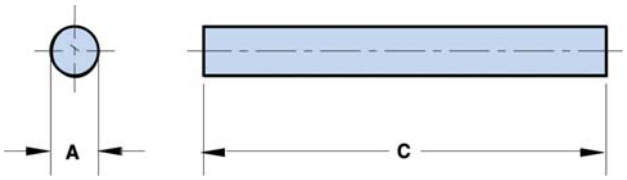
Antenna/RFID Rods

Quick Link: *www.fair-rite.com/rfid*

These rods are designed for use in antenna and RFID transponder applications. Rods are available in three materials to cover a frequency range from 50 kHz to 25 MHz. Suggested frequency ranges: 78 material < 200 kHz, 61 material 0.2 - 5.0 MHz and 67 material > 5.0 MHz.



- See graphs with temperature information of these rods in the rod information section.
- Rods can be supplied with a Parylene C coating. Parylene coated rods have a “4” as the last digit. Parylene C is RoHS compliant.
- For any rod requirement not listed here, feel free to contact our customer service group for availability and pricing.
- The "Antenna/RFID Kit" (part number 0199000024) contains a selection of these rods.
- Explanation of Part Numbers: Digits 1&2 = product class, 3&4 = material grade, the last digit 1 = uncoated rod and 4 = Parylene coated rod.

Legend

Dimensions (Top numbers are in millimeters, bottom numbers are in nominal inches.)

Low Permeability, 67 (μi=40) material

Part Number	A	C	μ_{ROD}	Wt. (g)	$A_e(cm^2)$
3067990821	0.75 ±0.025 0.030	7.50 ±0.25 0.295	22	0.02	0.00442
3067990831	1.00 ±0.025 0.039	10.00 ±0.30 0.394	22	0.04	0.00785
3067990841	1.50 ±0.025 0.059	15.00 ±0.45 0.591	22	0.13	0.0177
3067990851	2.00 ±0.025 0.079	15.00 ±0.45 0.591	18	0.23	0.0314
3067990861	2.50 ±0.025 0.098	20.00 ±0.60 0.787	19	0.47	0.0491
3067990871	3.00 ±0.04 0.118	25.00 ±0.70 0.984	20	0.85	0.0707
3067990881	4.00 ±0.04 0.157	30.00 ±0.75 1.181	18	1.80	0.126

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Low Permeability, 61 (μi=125) material

Part Number	A	C	μ_{ROD}	Wt. (g)	$A_e(cm^2)$
3061990821	0.75 ±0.025 0.030	7.50 ±0.25 0.295	35	0.02	0.00442
3061990831	1.00 ±0.025 0.039	10.00 ±0.30 0.394	35	0.04	0.00785
3061990841	1.50 ±0.025 0.059	15.00 ±0.45 0.591	35	0.13	0.0177
3061990851	2.00 ±0.025 0.079	15.00 ±0.45 0.591	25	0.23	0.0314
3061990861	2.50 ±0.025 0.098	20.00 ±0.60 0.787	27	0.47	0.0491
3061990871	3.00 ±0.04 0.118	25.00 ±0.70 0.984	29	0.85	0.0707
3061990881	4.00 ±0.04 0.157	30.00 ±0.75 1.181	25	1.80	0.126
3061990891	5.00 ±0.04 0.197	35.00 ±0.80 1.378	24	3.30	0.196
3061990901	6.00 ±0.05 0.236	40.00 ±0.80 1.575	22	5.40	0.283
3061990911	8.00 ±0.05 0.315	45.00 ±0.90 1.772	18	11.90	0.503

Medium Permeability, 78 (μi=2300) material

Part Number	A	C	μ_{ROD}	Wt. (g)	$A_e(cm^2)$
3078990821	0.75 ±0.025 0.030	7.50 ±0.25 0.295	48	0.02	0.00442
3078990831	1.00 ±0.025 0.039	10.00 ±0.30 0.394	48	0.04	0.00785
3078990841	1.50 ±0.025 0.059	15.00 ±0.45 0.591	48	0.13	0.0177
3078990851	2.00 ±0.025 0.079	15.00 ±0.45 0.591	31	0.23	0.0314
3078990861	2.50 ±0.025 0.098	20.00 ±0.60 0.787	34	0.47	0.0491
3078990871	3.00 ±0.04 0.118	25.00 ±0.70 0.984	36	0.85	0.0707
3078990881	4.00 ±0.04 0.157	30.00 ±0.75 1.181	31	1.80	0.126
3078990891	5.00 ±0.04 0.197	35.00 ±0.80 1.378	29	3.30	0.196
3078990901	6.00 ±0.05 0.236	40.00 ±0.80 1.575	26	5.40	0.283
3078990911	8.00 ±0.05 0.315	45.00 ±0.90 1.772	20	11.90	0.503

Rod Information

Figure 1 shows the rod permeability as a function of the length to diameter ratio for the six materials available in rods.

Figures 3, 4 and 5 illustrate typical temperature behavior of wound rods. Wound rods in 33 and 77 material yield the best temperature stable inductors, see Figure 4. Both show a typical inductance change of < 1% over the –40° to 120°C temperature range. The parts have a L/D ratio of 8.1. Lower ratios will change less. This is shown in detail in Figure 5 for the same 52 material but with the L/D ratio as the parameter. A lower ratio means a lower rod permeability but with improved temperature stability.

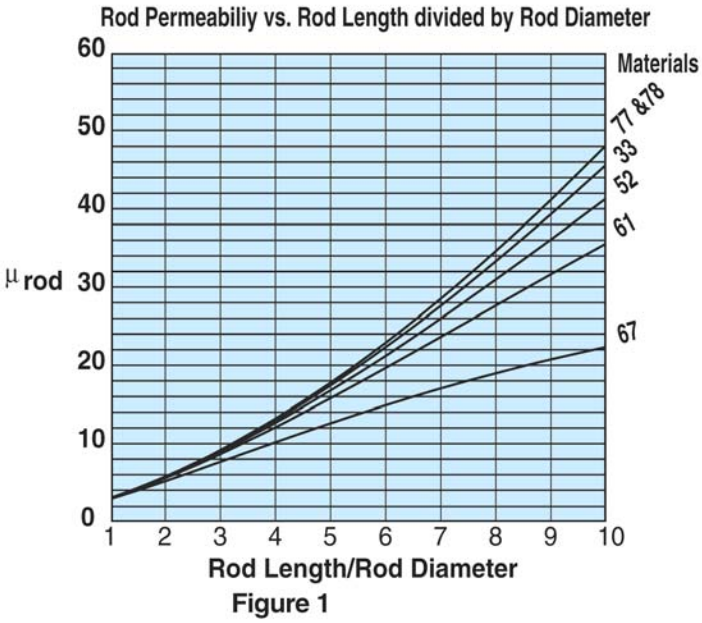

Figure 1

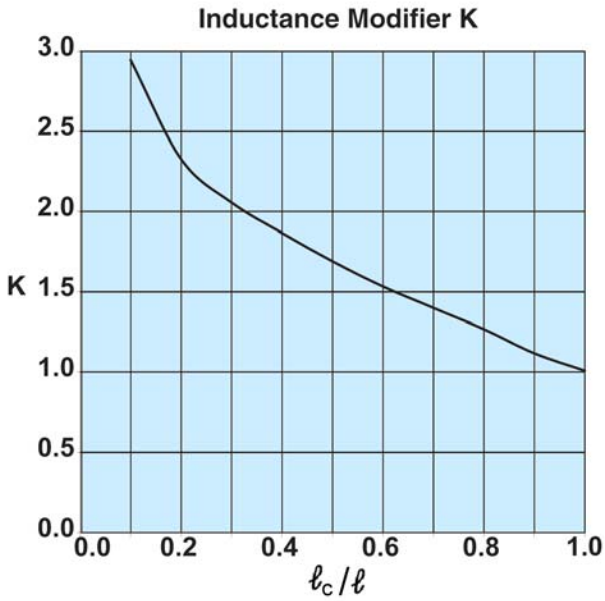

Figure 2

Wound Rod Inductance Calculations

To calcutate the inductance of a wound rod the following formula can be used,

$$L = K \mu_0 \mu_{rod} \frac{N^2 \, Ae}{\ell} 10^4 \, (\mu H)$$

Where: K = Inductance modifier
$\mu_o = 4\pi 10^{-7}$
μ_{rod} = rod permeability found in Figure 1.
N = Number of turns
Ae = Cross sectional area of the rod (cm^2)
ℓ = Length of the rod (cm)
ℓ_c = Length of the winding (cm)

Rod Information

The inductance modifier is found in Figure 2. The ratio winding length divided by the rod length will give the inductance modifier. If the rod is totally wound the K = 1. Shorter but centered windings will yield higher K values.

Using the rod 3061990871 as an example.
For this rod the length over diameter ratio is 8.33 and for 61 material Figure 1 gives a μ_{rod} of 29. The rod has an Ae = 0.0707 cm^2 and ℓ = 2.5 cm.
A winding of 80 turns of 30 AWG wire will yield a fully wound rod, therefore K = 1.
Using the formula the calculated inductance is 65.96 μH.

The same rod but wound with 50 turns of the 30 AWG wire has a winding length of 1.5 cm. The inductance modifier is 1.5/2.5 = 0.60, which results from Figure 2 in a K value of 1.51.
Again with the formula we calculated an inductance of 38.9 μH.

The measured values for both windings were 66.95 and 39.50 μH respectively.

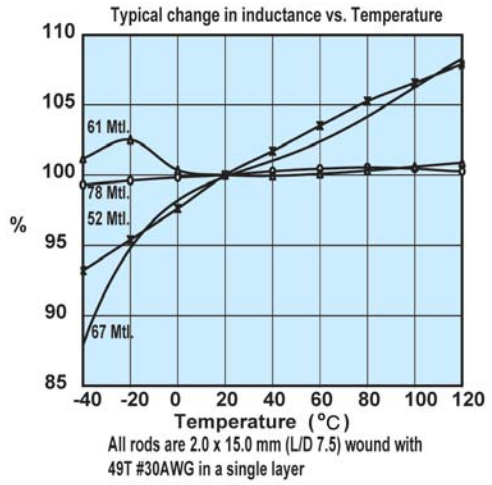

Figure 3

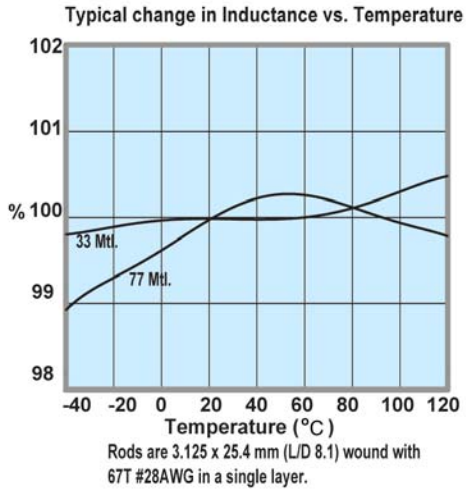

Figure 4

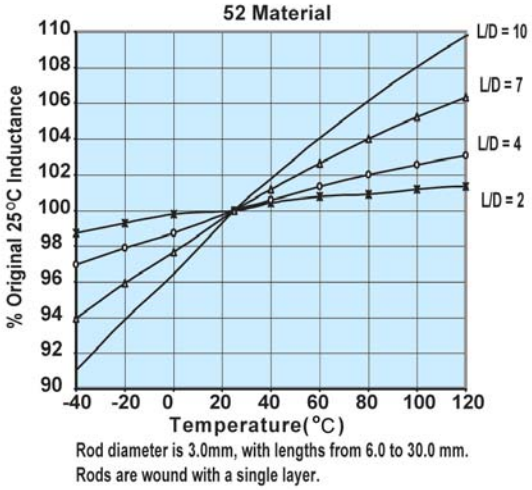

Figure 5