SECTION I: IRON POWDER CORES

Iron Powder Cores are made in numerous shapes and sizes: such as Toroidal Cores, E-cores, Shielded Coil Forms, Sleeves etc., each of which is available in many different materials. There are two basic groups of iron powder material: (1) The Carbonyl Iron and, (2) The Hydrogen Reduced Iron.

The Carbonyl Iron cores are especially noted for their stability over a wide range of temperatures and flux levels. Their permeability range is from less than 3 μ_i to 35 μ_i and can offer excellent 'Q' factors from 50 KHz to 200 MHz. They are ideally suited for a variety of RF applications where good stability and good 'Q' are essential. Also, they are very much in demand for broadband inductors, especially where high power is concerned.

The Hydrogen Reduced Iron cores have higher permeabilities ranging from 35 μ_i to 90 μ_i. Somewhat lower 'Q' can be expected from this group of cores. They are mainly used for EMI filters and low frequency chokes. They are also very much in demand for input and output filters for switched mode power supplies.

The next several pages are devoted to iron powder materials and the toroidal core configuration in particular. You will find physical dimensions of available items, their A_L values and other magnetic properties, as well as how to select the proper core for your application.

In general, toroidal cores are the most efficient of any core configuration. They are highly self-shielding since most of the flux lines are contained within the core. The flux lines are essentially uniform over the entire length of the magnetic path and consequently stray magnetic fields will have very little effect on a toroidal inductor. It is seldom necessary to shield a toroidal inductor.

The A_L value of each iron powder core can be found in the charts on the next several pages. Use this A_L value and the formula below to calculate the number of turns for a specific inductance.

$$N = 100 \sqrt{\frac{\text{desired 'L' } (\mu h)}{A_L \ (\mu h/100 \text{ turns})}} \qquad L(\mu h) = \frac{A_L \times N^2}{10,000} \qquad A_L(\mu h/100 \text{ turns}) = \frac{10,000 \times \text{'L' } (\mu h)}{N^2}$$

N = number of turns   L = inductance (μh) A_L = inductance index (μh)/100 turns)

Please see section IV on "Toroid Mounts & E-Core Bobbins" for information on mounting toroids to PC Boards. Amidon also provides complete wound and mounted cores.

- **For standard wound toroid, please see section V.**

- **For custom inductors based on your specifications, please call or fax today. You will be assured of prompt response with quotations in less than 72 hours.**

- **Amidon provides low cost manual and automated coil windings. Please call for more information.**

IRON POWDER MATERIAL

MATERIAL #0 (μ=1):
Most commonly used for frequencies above 100 MHz. Available in toroidal form only. Note: Due to the nature of this material the inductance resulting from the use of the given AL value may not be as accurate as we would like. Inductance vs. number of turns will vary greatly depending upon the winding technique.

MATERIAL #1 (μ=20):
A Carbonyl 'C' material, very similar to material #3 except that it has higher volume resistivity and better stability. Available in toroidal form and shielded coil form.

MATERIAL #2 (μ=10):
A Carbonyl 'E' iron powder material having high volume resistivity. Offers high 'Q' for the 2 MHz to 30 MHz. frequency range. Available in toroidal form and shielded coil form.

MATERIAL #3 (μ=35):
A carbonyl 'HP' material having excellent stability and good 'Q' for the lower frequencies from 50 KHz. to 500 KHz. Available in toroidal form and shielded coil form.

MATERIAL #6 (μ=8):
A carbonyl 'SF' material. Offers very good 'Q' and temperature stability for the 20 MHz to 50 MHz frequency range. Available in both toroidal form and shielded coil form.

MATERIAL #7 (μ=9):
A carbonyl 'TH' material. Very similar to the #2 and #6 materials but offers better temperature stability than either. Available in both toroidal form and shielded coil form. Frequency ranges from 5 MHz to 35 MHz.

MATERIAL #10 (μ=6):
A powdered iron 'W' material. Offers good 'Q' and high stability for frequencies from 40 MHz to 100 MHz. Available in toroidal form and shielded coil form.

MATERIAL #12 (μ=4):
A synthetic oxide material which provides good 'Q' and moderate stability for frequencies from 50 MHz to 200 MHz. If high 'Q' is of prime importance this material is a good choice. If stability is of a prime importance, consider the #17 material. The #12 material is available in all sizes up to T-94, in toroidal form. Not available in shielded coil form.

MATERIAL #15 (μ=25):
A carbonyl 'GS6' material. Has excellent stability and good 'Q'. A good choice for commercial broadcast frequencies where good 'Q' and stability are essential. Available in toroidal form only.

MATERIAL #17 (μ=4):
This is a new carbonyl material which is very similar to the #12 material except that it has better temperature stability. However, as compared to the #12 material, there is a slight 'Q' loss of about 10 % from 50 MHz to 100 MHz. Above 100 MHz, the 'Q' will gradually deteriorate to approximately 20% lower. It is available in both toroidal form and the shielded coil form.

MATERIAL #26 (μ=75):
A Hydrogen Reduced material. Has highest permeability of all of the iron powder materials. Used for EMI filters and DC chokes. The #26 is very similar to the older #41 material but can provide an extended frequency range.

IRON POWDER TOROIDAL CORES (For Resonant Circuits)

MATERIAL 0	Permeabilty 1		Freq. Range 100 MHz - 300 MHz			Color - Tan	
Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value μh/100 turns
T-12-0	.125	.062	.050	.74	.010	.007	3.0
T-16-0	.160	.078	.060	.95	.016	.015	3.0
T-20-0	.200	.088	.070	1.15	.025	.029	3.5
T-25-0	.255	.120	.096	1.50	.042	.063	4.5
T-30-0	.307	.151	.128	1.83	.065	.119	6.0
T-37-0	.375	.205	.128	2.32	.070	.162	4.9
T-44-0	.440	.229	.159	2.67	.107	.286	6.5
T-50-0	.500	.303	.190	3.03	.121	.367	6.4
T-68-0	.690	.370	.190	4.24	.196	.831	7.5
T-80-0	.795	.495	.250	5.15	.242	1.246	8.5
T-94-0	.942	.560	.312	6.00	.385	2.310	10.6
T-106-0	1.060	.570	.437	6.50	.690	4.485	19.0
T-130-0	1.300	.780	.437	8.29	.730	6.052	15.0

Note: Due to the nature of the '0' material, the inductance resulting from the use of the given A_L value may vary greatly depending upon the winding technique. This may cause discrepancy between calculated and measured inductance.

MATERIAL 1	Permeabilty 20		Freq. Range 0.5 MHz - 5 MHz			Color - Blue	
Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value μh/100 turns
T-12-1	.125	.062	.050	.74	.010	.007	48
T-16-1	.160	.078	.060	.95	.016	.015	44
T-20-1	.200	.088	.070	1.15	.025	.029	52
T-25-1	.255	.120	.096	1.50	.042	.063	70
T-30-1	.307	.151	.128	1.83	.065	.119	85
T-37-1	.375	.205	.128	2.32	.070	.162	80
T-44-1	.440	.229	.159	2.67	.107	.286	105
T-50-1	.500	.303	.190	3.03	.121	.367	100
T-68-1	.690	.370	.190	4.24	.196	.831	115
T-80-1	.795	.495	.250	5.15	.242	1.246	115
T-94-1	.942	.560	.312	6.00	.385	2.310	160
T-106-1	1.060	.570	.437	6.50	.690	4.485	325
T-130-1	1.300	.780	.437	8.29	.730	6.052	200
T-157-1	1.570	.950	.570	10.05	1.140	11.457	320
T-184-1	1.840	.950	.710	11.12	2.040	22.685	500
T-200-1	2.000	1.250	.550	12.97	1.330	17.250	250

Note: Most cores can be very useful well below the lower frequency limit shown above.

IRON POWDER TOROIDAL CORES (For Resonant Circuits)

MATERIAL 2	Permeabilty 10			Freq. Range 2 MHz - 30 MHz			Color - Red
Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value μh/100 turns
T-12-2	.125	.062	.050	.74	.010	.007	20
T-16-2	.160	.078	.060	.95	.016	.015	22
T-20-2	.200	.088	.070	1.15	.025	.029	25
T-25-2	.255	.120	.096	1.50	.042	.063	34
T-30-2	.307	.151	.128	1.83	.065	.119	43
T-37-2	.375	.205	.128	2.32	.070	.162	40
T-44-2	.440	.229	.159	2.67	.107	.286	52
T-50-2	.500	.303	.190	3.03	.121	.367	49
T-68-2	.690	.370	.190	4.24	.196	.831	57
T-80-2	.795	.495	.250	5.15	.242	1.246	55
T-94-2	.942	.560	.312	6.00	.385	2.310	84
T-106-2	1.060	.570	.437	6.50	.690	4.485	135
T-130-2	1.300	.780	.437	8.29	.730	6.052	110
T-157-2	1.570	.950	.570	10.05	1.140	11.457	140
T-184-2	1.840	.950	.710	11.12	2.040	22.685	240
T-200-2	2.000	1.250	.550	12.97	1.330	17.250	120
T-200A-2	2.000	1.250	1.000	12.97	2.240	29.050	218
T-225 -2	2.250	1.405	.550	14.56	1.508	21.956	120
T-225A-2	2.250	1.485	1.000	14.56	2.730	39.749	215
T-300 -2	3.058	1.925	.500	19.83	1.810	35.892	114
T-300A-2	3.048	1.925	1.000	19.83	3.580	70.991	228
T-400 -2	4.000	2.250	.650	24.93	3.660	91.244	180
T-400A-2	4.000	2.250	1.300	24.93	7.432	185.280	360
T-520 -2	5.200	3.080	.800	33.16	5.460	181.000	207

MATERIAL 3	Permeabilty 35			Freq. Range 0.05 MHz - 0.5 MHz			Color - Gray
Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value μh/100 turns
T-12-3	.125	.062	.050	.74	.010	.007	60
T-16-3	.160	.078	.060	.95	.016	.015	61
T-20-3	.200	.088	.070	1.15	.025	.029	76
T-25-3	.255	.120	.096	1.50	.042	.063	100
T-30-3	.307	.151	.128	1.83	.065	.119	140
T-37-3	.375	.205	.128	2.32	.070	.162	120
T-44-3	.440	.229	.159	2.67	.107	.286	180
T-50-3	.500	.303	.190	3.03	.121	.367	175
T-68-3	.690	.370	.190	4.24	.196	.831	195
T-80-3	.795	.495	.250	5.15	.242	1.246	180
T-94-3	.942	.560	.312	6.00	.385	2.310	248
T-106-3	1.060	.570	.437	6.50	.690	4.485	450
T-130-3	1.300	.780	.437	8.29	.730	6.052	350
T-157-3	1.570	.950	.570	10.05	1.140	11.457	420
T-184-3	1.840	.950	.710	11.12	2.040	22.685	720
T-200-3	2.000	1.250	.550	12.97	1.330	17.250	425
T-200A-3	2.000	1.250	1.000	12.97	2.240	29.050	460
T-225 -3	2.250	1.405	.550	14.56	1.508	21.956	425

Orders placed are shipped same day from stock.

IRON POWDER TOROIDAL CORES (For Resonant Circuits)

MATERIAL 6	Permeabilty 8		Freq. Range 10 MHz - 50 MHz			Color - Yellow	
Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value μh/100 turns
T-12-6	.125	.062	.050	.74	.010	.007	17
T-16-6	.160	.078	.060	.95	.016	.015	19
T-20-6	.200	.088	.070	1.15	.025	.029	22
T-25-6	.255	.120	.096	1.50	.042	.063	27
T-30-6	.307	.151	.128	1.83	.065	.119	36
T-37-6	.375	.205	.128	2.32	.070	.162	30
T-44-6	.440	.229	.159	2.67	.107	.286	42
T-50-6	.500	.303	.190	3.03	.121	.367	40
T-68-6	.690	.370	.190	4.24	.196	.831	47
T-80-6	.795	.495	.250	5.15	.242	1.246	45
T-94-6	.942	.560	.312	6.00	.385	2.310	70
T-106-6	1.060	.570	.437	6.50	.690	4.485	116
T-130-6	1.300	.780	.437	8.29	.730	6.052	96
T-157-6	1.570	.950	.570	10.05	1.140	11.457	115
T-184-6	1.840	.950	.710	11.12	2.040	22.685	195
T-200-6	2.000	1.250	.550	12.97	1.330	17.250	100
T-200A-6	2.000	1.250	1.000	12.97	2.240	29.050	180
T-225 -6	2.250	1.405	.550	14.56	1.508	21.956	100

MATERIAL 7	Permeabilty 9		Freq. Range 3 MHz - 35 MHz			Color - White	
Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value μh/100 turns
T-25-7	.255	.120	.096	1.50	.042	.063	29
T-37-7	.375	.205	.128	2.32	.070	.162	32
T-50-7	.500	.303	.190	3.03	.121	.367	43
T-68-7	.690	.370	.190	4.24	.196	.831	52

MATERIAL 10	Permeabilty 6		Freq. Range 30 MHz - 100 MHz			Color - Black	
Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value μh/100 turns
T-12-10	.125	.062	.050	.74	.010	.007	12
T-16-10	.160	.078	.060	.95	.016	.015	13
T-20-10	.200	.088	.070	1.15	.025	.029	16
T-25-10	.255	.120	.096	1.50	.042	.063	19
T-30-10	.307	.151	.128	1.83	.065	.119	25
T-37-10	.375	.205	.128	2.32	.070	.162	25
T-44-10	.440	.229	.159	2.67	.107	.286	33
T-50-10	.500	.303	.190	3.03	.121	.367	31
T-68-10	.690	.370	.190	4.24	.196	.831	32
T-80-10	.795	.495	.250	5.15	.242	1.246	32
T-94-10	.942	.560	.312	6.00	.385	2.310	58

All items listed in this CATALOG can usually be shipped immediately from stock.

IRON POWDER TOROIDAL CORES (For Resonant Circuits)

MATERIAL 12	Permeabilty 4		Freq. Range 50 MHz - 200 MHz			Color - Green & White	
Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value μh/100 turns
T-12-12	.125	.062	.050	.74	.010	.007	7.5
T-16-12	.160	.078	.060	.95	.016	.015	8.0
T-20-12	.200	.088	.070	1.15	.025	.029	10.0
T-25-12	.255	.120	.096	1.50	.042	.063	12.0
T-30-12	.307	.151	.128	1.83	.065	.119	16.0
T-37-12	.375	.205	.128	2.32	.070	.162	15.0
T-44-12	.440	.229	.159	2.67	.107	.286	18.5
T-50-12	.500	.303	.190	3.03	.121	.367	18.0
T-68-12	.690	.370	.190	4.24	.196	.831	21.0
T-80-12	.795	.495	.250	5.15	.242	1.246	22.0
T-94-12	.942	.560	.312	6.00	.385	2.310	32.0

Note: The #17 material offers greater temperature stability than #12 materials, but #12 material can provide higher 'Q'.
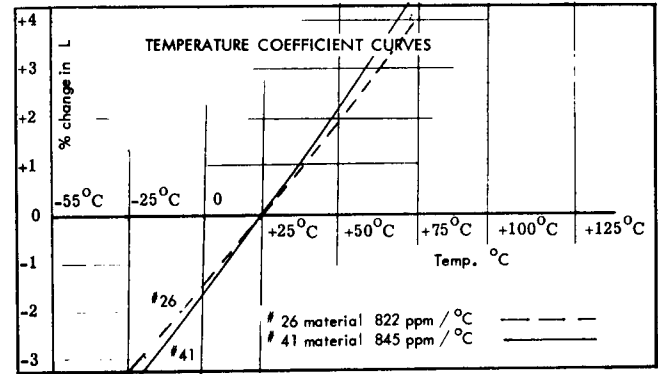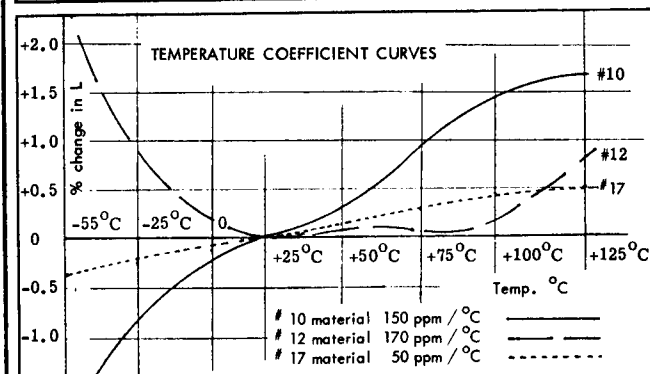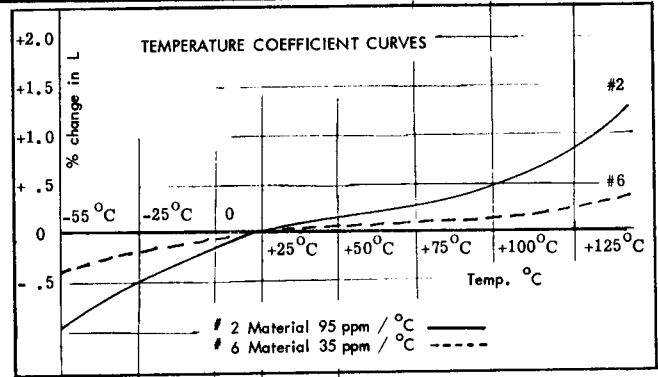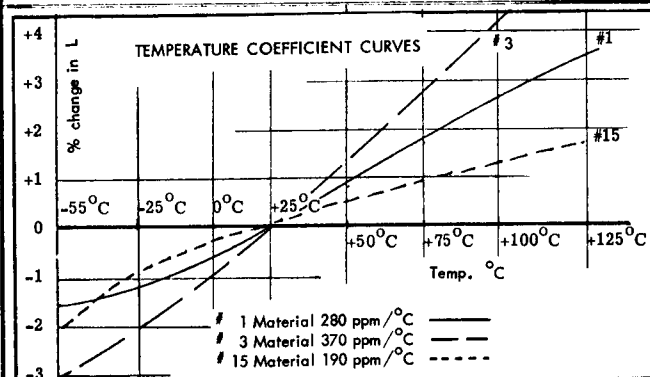
MATERIAL 15	Permeabilty 25		Freq. Range 0.1 MHz - 2. MHz			Color - Red & White	
Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value μh/100 turns
T-12-15	.125	.062	.050	.74	.010	.007	50
T-16-15	.160	.078	.060	.95	.016	.015	55
T-20-15	.200	.088	.070	1.15	.025	.029	65
T-25-15	.255	.120	.096	1.50	.042	.063	85
T-30-15	.307	.151	.128	1.83	.065	.119	93
T-37-15	.375	.205	.128	2.32	.070	.162	90
T-44-15	.440	.229	.159	2.67	.107	.286	160
T-50-15	.500	.303	.190	3.03	.121	.367	135
T-68-15	.690	.370	.190	4.24	.196	.831	180
T-80-15	.795	.495	.250	5.15	.242	1.246	170
T-94-15	.942	.560	.312	6.00	.385	2.310	200
T-106-15	1.060	.570	.437	6.50	.690	4.485	345
T-130-15	1.300	.780	.437	8.29	.730	6.052	250
T-157-15	1.570	.950	.570	10.05	1.140	11.457	360

MATERIAL 17	Permeabilty 4		Freq. Range 20 MHz - 200 MHz			Color - Blue & Yellow	
Core number	O.D. (inches)	I.D. (inches)	Hgt. (inches)	ℓ_e (cm)	A_e (cm)^2	V_e (cm)^3	A_L Value μh/100 turns
T-12-17	.125	.062	.050	.75	.010	.008	7.5
T-16-17	.160	.078	.060	.93	.015	.0141	8.0
T-20-17	.200	.088	.070	1.15	.025	.026	10.0
T-25-17	.255	.120	.096	1.50	.042	.055	12.0
T-30-17	.307	.151	.128	1.83	.065	.110	16.0
T-37-17	.375	.205	.128	2.30	.070	.147	15.0
T-44-17	.440	.229	.159	2.67	.107	.266	18.5
T-50-17	.500	.303	.190	3.03	.121	.358	18.0
T-68-17	.690	.370	.190	4.24	.196	.759	21.0
T-80-17	.795	.495	.250	5.14	.231	1.190	22.0
T-90-17	.942	.560	.312	6.00	.385	2.310	32.0

MATERIAL 26   See AC Line Filter and DC Choke section.

IRON POWDER TOROIDAL CORES

TEMPERATURE COEFFICIENT CHARTS

TEMPERATURE COEFFICIENT CURVES

% change in L

#3 #1 #15

-55°C -25°C 0°C +25°C +50°C +75°C +100°C +125°C

Temp. °C

1 Material 280 ppm/°C ———
3 Material 370 ppm/°C — —
15 Material 190 ppm/°C - - - -

TEMPERATURE COEFFICIENT CURVES

% change in L

#2 #6

-55°C -25°C 0 +25°C +50°C +75°C +100°C +125°C

Temp. °C

2 Material 95 ppm / °C ———
6 Material 35 ppm / °C - - - -

TEMPERATURE COEFFICIENT CURVES

% change in L

#10 #12 #17

-55°C -25°C 0 +25°C +50°C +75°C +100°C +125°C

Temp. °C

10 material 150 ppm / °C ———
12 material 170 ppm / °C — —
17 material 50 ppm / °C - - - -

TEMPERATURE COEFFICIENT CURVES

% change in L

-55°C -25°C 0 +25°C +50°C +75°C +100°C +125°C

Temp. °C

#26 #41

26 material 822 ppm / °C — — —
41 material 845 ppm / °C ———

IRON ᴼ POWDER MATERIAL vs. FREQUENCY RANGE

Higher Q will be obtained in the upper portion of a materials frequency range when smaller cores are used. Likewise, in the lower portion of a materials frequency range, higher Q can be achieved when using the larger cores.

Material												
# 3 (Gray)												
# 15 (Rd & Wh)												
# 1 (Blue)												
# 2 (Red)												
# 6 (Yellow)												
# 10 (Black)												
# 12 (Gn & Wh) also #17, Blue & Yel												
# 0 (Tan)												
Freq. (MHz)	.05	.1	.5	1.	3.	5.	10	30	50	100	200	300
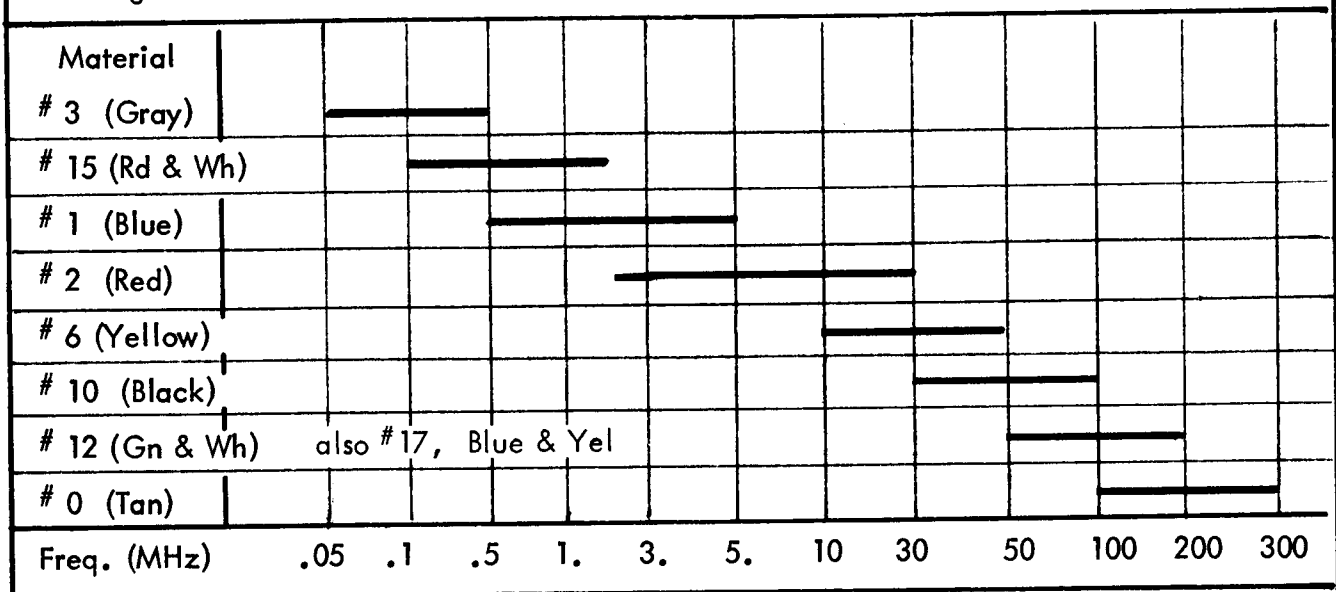
IRON POWDER TOROIDAL CORES

Physical Dimension

Core	OD (in)	ID (in)	HGT (in)	Mean lgth. (cm)	Cross sect. (cm²)	Core	OD (in)	ID (in)	HGT (in)	Mean lgth. (cm)	Cross sect. (cm²)
T- 12	.125	.062	.050	.75	.010	T-130	1.30	.78	.437	8.29	.73
T- 16	.160	.078	.060	.95	.016	T-157	1.57	.95	.570	10.05	1.14
T- 20	.200	.088	.070	1.15	.025	T-184	1.84	.95	.710	11.12	2.04
T- 25	.250	.120	.096	1.50	.042	T-200	2.00	1.25	.550	12.97	1.33
T- 30	.307	.151	.128	1.83	.065	T-200A	2.00	1.25	1.000	12.97	2.42
T- 37	.375	.205	.128	2.32	.070	T-225	2.25	1.40	.550	14.56	1.50
T- 44	.440	.229	.159	2.67	.107	T-225A	2.25	1.40	1.000	14.56	2.73
T- 50	.500	.300	.190	3.20	.121	T-300	3.00	1.92	.500	19.83	1.81
T- 68	.690	.370	.190	4.24	.196	T-300A	3.00	1.92	1.000	19.83	3.58
T- 80	.795	.495	.250	5.15	.242	T-400	4.00	2.25	.650	24.93	3.66
T- 94	.942	.560	.312	6.00	.385	T-400A	4.00	2.25	1.000	24.93	7.43
T-106	1.060	.570	.437	6.50	.690	T-500	5.20	3.08	.800	33.16	5.46

A_L Values (µh/100 turns)

For complete part number, add Mix number to Core Size number.

Core Size	26 Mix Yel-Wh $\mu=75$ Mhz Pwr Frq	3 Mix Gray $\mu=35$ .05 -0.5	15 Mix Rd-Wh $\mu=25$ 0.1 - 2.	1 Mix Blue $\mu=20$ 0.5 - 5.	2 Mix Red $\mu=10$ 2 - 30	7 Mix White $\mu=9$ 1 - 25	6 Mix Yellow $\mu=8$ 10 - 50	10 Mix Black $\mu=6$ 30-100	12 Mix Grn-Wh $\mu=4$ 50-200	17 Mix Bl/Ylw $\mu=4$ 40-180	0 Mix Tan $\mu=1$ 100-300
T- 12-	na	60	50	48	20	18	17	12	7.5	7.5	3.0
T- 16-	145	61	55	44	22	na	19	13	8.0	8.0	3.0
T- 20-	180	76	65	52	27	24	22	16	10.0	10.0	3.5
T- 25-	235	100	85	70	34	29	27	19	12.0	12.0	4.5
T- 30-	325	140	93	85	43	37	36	25	16.0	16.0	6.0
T- 37-	275	120	90	80	40	32	30	25	15.0	15.0	4.9
T- 44-	360	180	160	105	52	46	42	33	18.5	18.5	6.5
T- 50-	320	175	135	100	49	43	40	31	18.0	18.0	6.4
T- 68-	420	195	180	115	57	52	47	32	21.0	21.0	7.5
T- 80-	450	180	170	115	55	50	45	32	22.0	22.0	8.5
T- 94-	590	248	200	160	84	na	70	58	32.0	na	10.6
T-106-	900	450	345	325	135	133	116	na	na	na	19.0
T-130-	785	350	250	200	110	103	96	na	na	na	15.0
T-157-	970	420	360	320	140	na	115	na	na	na	na
T-184-	1640	720	na	500	240	na	195	na	na	na	na
T-200-	895	425	na	250	120	105	100	na	na	na	na
T-200A-	1550	760	na	na	218	na	180	na	na	na	na
T-225-	950	424	na	na	120	na	100	na	na	na	na
T-225A-	1600	na	na	na	215	na	na	na	na	na	na
T-300-	800	na	na	na	114	na	na	na	na	na	na
T-300A-	1600	na	na	na	228	na	na	na	na	na	na
T-400-	1300	na	na	na	185	na	na	na	na	na	na
T-400A-	2600	na	na	na	360	na	na	na	na	na	na
T-520-	1460	na	na	na	207	na	na	na	na	na	na

na - not available.

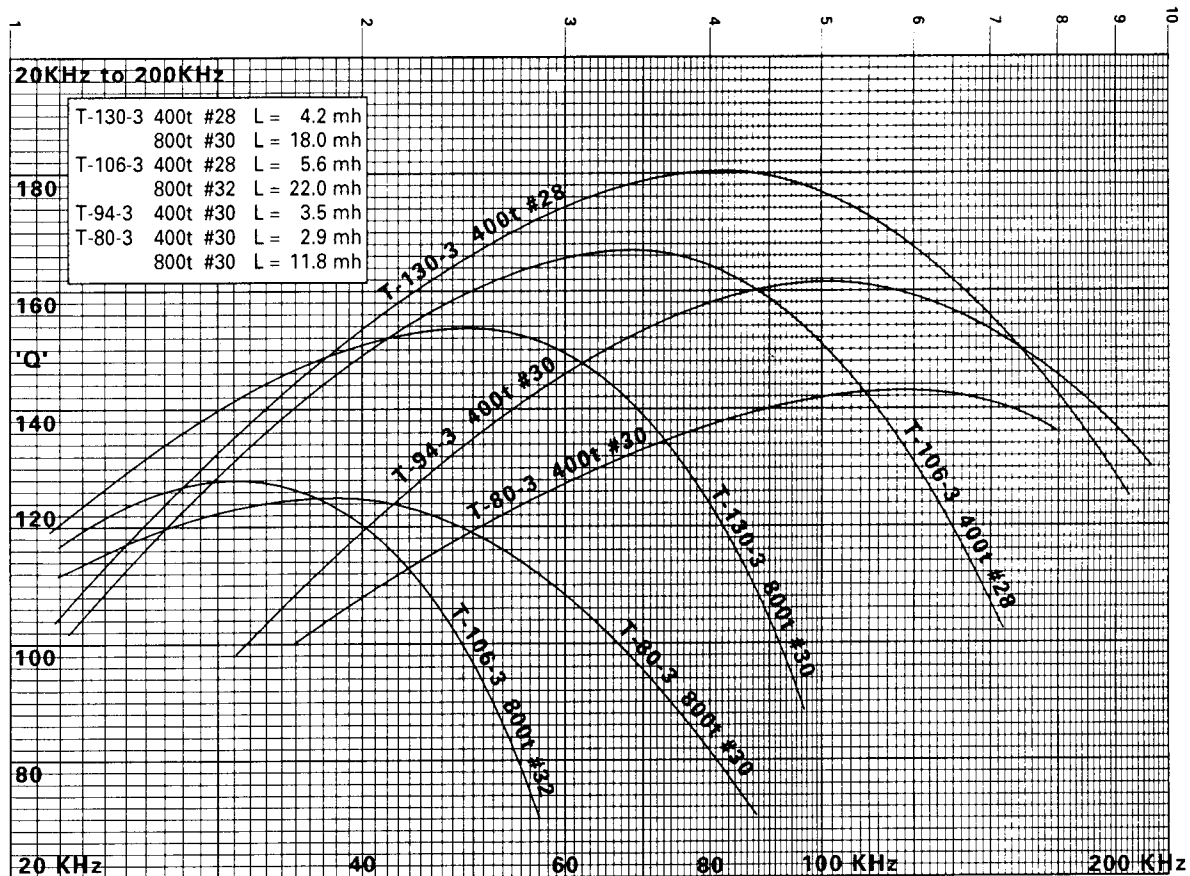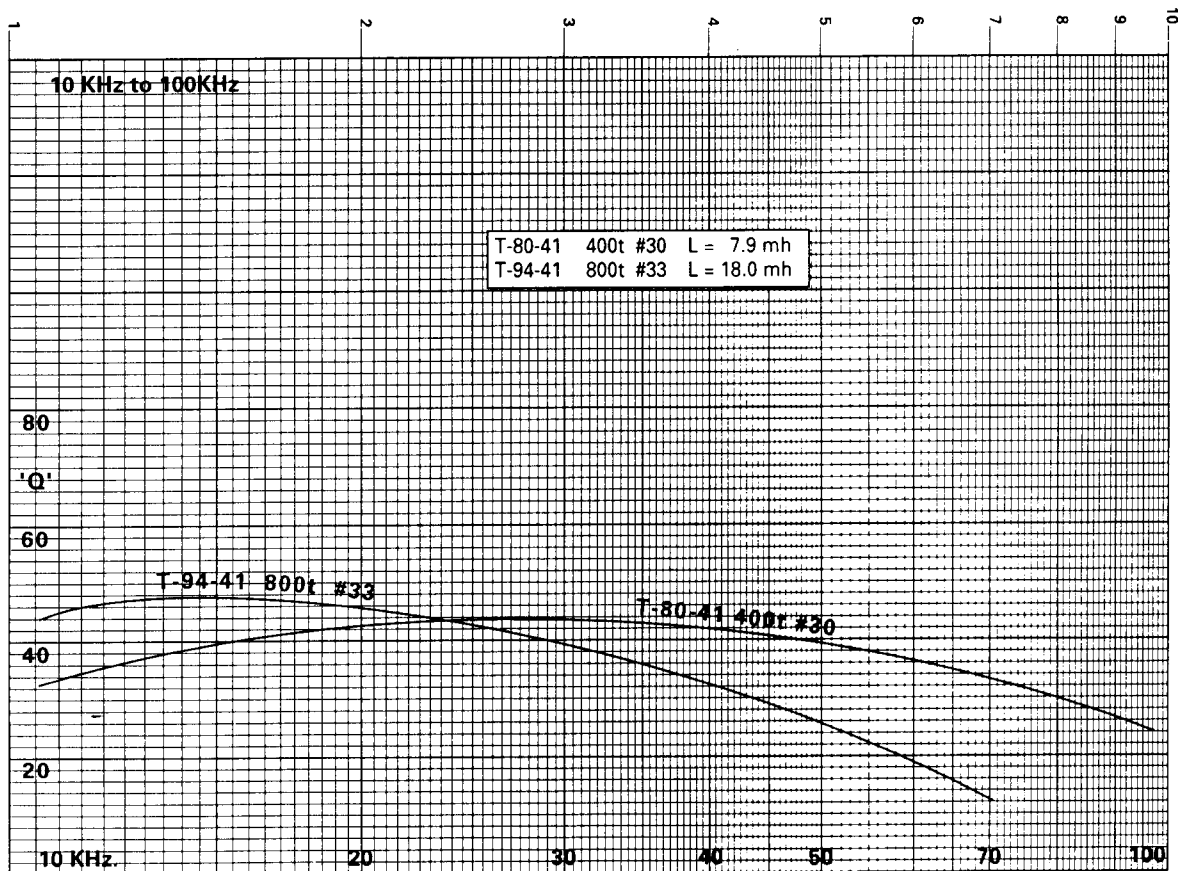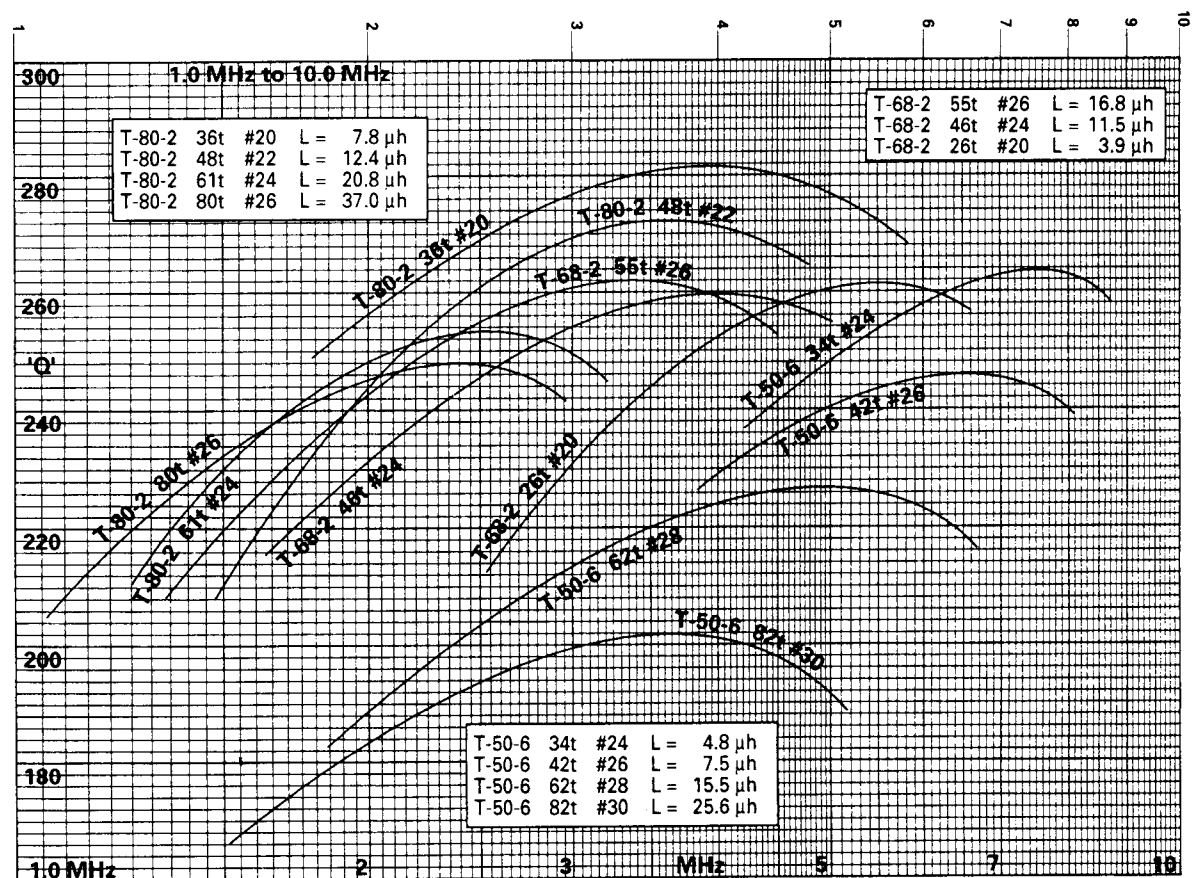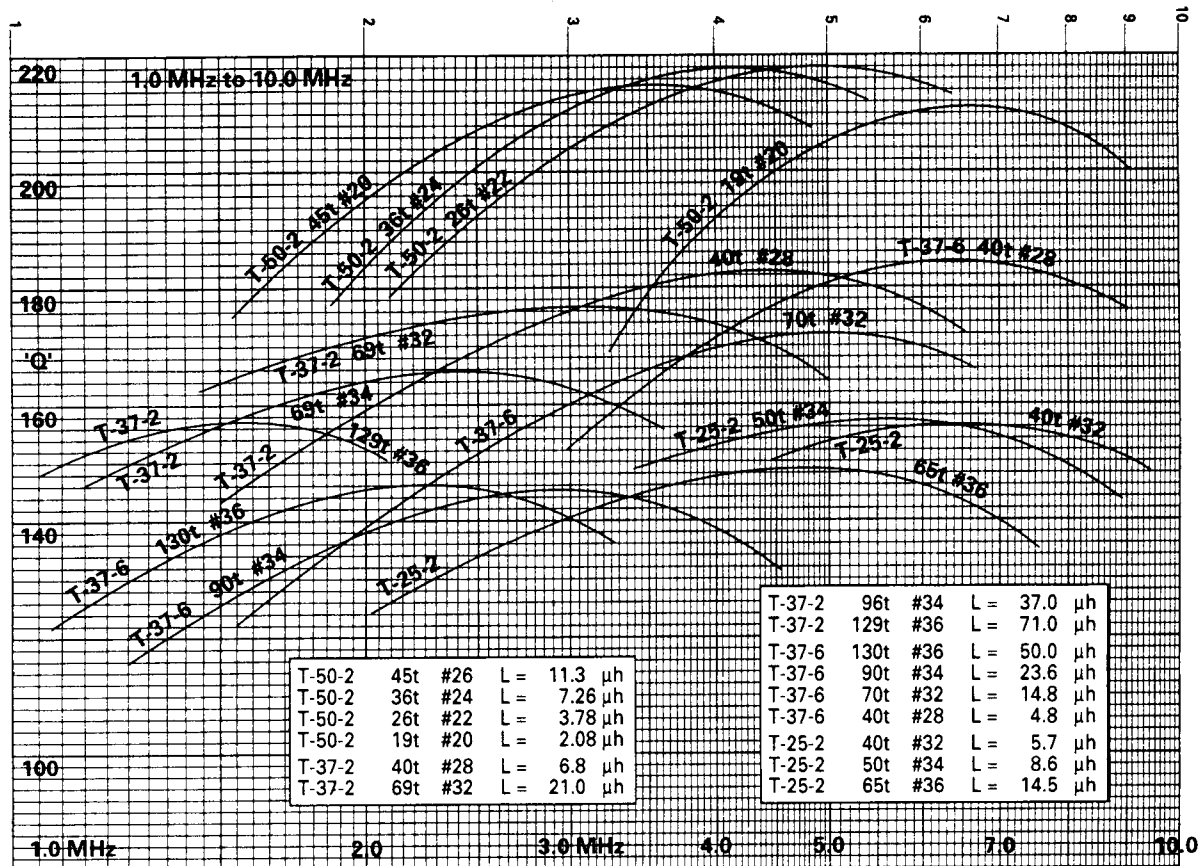## COPPER WIRE TABLE

Wire size AWG	Diameter in inches (enamel)	Circular mil area	Turns per linear inch	Turns per sq.cm	Continuous duty current (amp) single wire, open air	Continuous duty, (amp) conduit or in wire bundles
8	.1285	16510	7.6		73	46.0
10	.1019	10380	10.7	13.8	55	33.0
12	.0808	6530	12.0	21.7	41	23.0
14	.0640	4107	15.0	34.1	32	17.0
16	.0508	2583	18.9	61.2	22	13.0
18	.0403	1624	23.6	79.1	16	10.0
20	.0319	1022	29.4	124.0	11	7.5
22	.0253	642	37.0	186.0	—	5.0
24	.0201	404	46.3	294.0	—	—
26	.0159	254	58.0	465.0	—	—
28	.0126	160	72.7	728.0	—	—
30	.0100	101	90.5	1085.0	—	—
32	.0079	63	113.0	1628.0	—	—
34	.0063	40	141.0	2480.0	—	—
36	.0050	25	175.0	3876.0	—	—
38	.0039	16	224.0	5736.0	—	—
40	.0031	10	382.0	10077.0	—	—

IRON POWDER CORE SIZE vs. TURNS and WIRE SIZE
Approximate number of turns for full single layer winding

Awg wire	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Core Size																
T-12	0	0	0	1	1	1	2	4	5	8	11	15	21	29	37	47
T-16	0	0	1	1	1	3	3	5	8	11	16	21	29	38	49	63
T-20	0	1	1	1	3	4	5	6	9	14	18	25	33	43	56	72
T-25	1	1	1	3	4	5	7	11	15	21	28	37	48	62	79	101
T-30	1	1	3	4	5	7	11	15	21	28	37	48	62	78	101	129
T-37	1	3	5	7	9	12	17	23	31	41	53	67	87	110	140	177
T-44	3	5	6	7	10	15	20	27	35	46	60	76	97	124	157	199
T-50	5	6	8	11	16	21	28	37	49	63	81	103	131	166	210	265
T-68	7	9	12	15	21	28	36	47	61	79	101	127	162	205	257	325
T-80	8	12	17	23	30	39	51	66	84	108	137	172	219	276	347	438
T-94	10	14	20	27	35	45	58	75	96	123	156	195	248	313	393	496
T-106	10	14	20	27	35	45	58	75	96	123	156	195	248	313	393	496
T-130	17	23	30	40	51	66	83	107	137	173	220	275	348	439	550	693
T-157	22	29	38	50	64	82	104	132	168	213	270	336	426	536	672	846
T-184	22	29	38	50	64	82	104	132	168	213	270	336	426	536	672	846
T-200	31	41	53	68	86	109	139	176	223	282	357	445	562	707	886	1115
T-225	36	46	60	77	98	123	156	198	250	317	400	499	631	793	993	1250
T-300	52	66	85	108	137	172	217	274	347	438	553	688	870	1093	1368	1721
T-400	61	79	100	127	161	202	255	322	407	513	648	806	1018	1278	1543	2013
T-520	86	110	149	160	223	279	349	443	559	706	889	1105	1396	1753	2192	2758

10 KHz to 100KHz

T-80-41	400t	#30	L = 7.9 mh
T-94-41	800t	#33	L = 18.0 mh

80

'Q'

60

T-94-41 800t #33

40

T-80-41 400t #30

20

10 KHz.   20   30   40   50   70   100

20KHz to 200KHz

T-130-3	400t	#28	L = 4.2 mh
	800t	#30	L = 18.0 mh
T-106-3	400t	#28	L = 5.6 mh
	800t	#32	L = 22.0 mh
T-94-3	400t	#30	L = 3.5 mh
T-80-3	400t	#30	L = 2.9 mh
	800t	#30	L = 11.8 mh

180

160

'Q'

140

T-130-3 400t #28

120

T-94-3 400t #30

T-80-3 400t #30

T-130-3 800t #30

T-106-3 400t #28

100

T-106-3 800t #32

T-80-3 800t #30

80

20 KHz   40   60   80   100 KHz   200 KHz

1.0 MHz to 10.0 MHz

T-50-2	45t	#26	L =	11.3 µh
T-50-2	36t	#24	L =	7.26 µh
T-50-2	26t	#22	L =	3.78 µh
T-50-2	19t	#20	L =	2.08 µh
T-37-2	40t	#28	L =	6.8 µh
T-37-2	69t	#32	L =	21.0 µh

T-37-2	96t	#34	L =	37.0 µh
T-37-2	129t	#36	L =	71.0 µh
T-37-6	130t	#36	L =	50.0 µh
T-37-6	90t	#34	L =	23.6 µh
T-37-6	70t	#32	L =	14.8 µh
T-37-6	40t	#28	L =	4.8 µh
T-25-2	40t	#32	L =	5.7 µh
T-25-2	50t	#34	L =	8.6 µh
T-25-2	65t	#36	L =	14.5 µh

1.0 MHz to 10.0 MHz

T-80-2	36t	#20	L =	7.8 µh
T-80-2	48t	#22	L =	12.4 µh
T-80-2	61t	#24	L =	20.8 µh
T-80-2	80t	#26	L =	37.0 µh

T-68-2	55t	#26	L =	16.8 µh
T-68-2	46t	#24	L =	11.5 µh
T-68-2	26t	#20	L =	3.9 µh

T-50-6	34t	#24	L =	4.8 µh
T-50-6	42t	#26	L =	7.5 µh
T-50-6	62t	#28	L =	15.5 µh
T-50-6	82t	#30	L =	25.6 µh

IRON POWDER SHIELDED COIL FORMS

Adjustable / Slug Tuned

L-43 Coil Forms (Specify material)

L-43
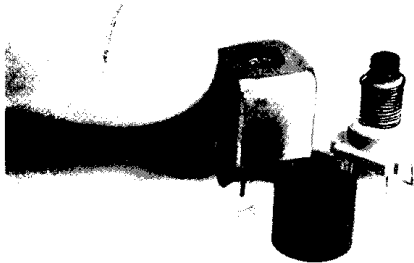
Miniature in size
Slug tuning
Copper shield can, tin plated
Easy to wind
Good Q
Frequency range .2 to 200 MHz.
Inductance range .02 to 700 uh.

Shield Can

.44"

.50"

.44"

.50"

.27"   .40"

.27"

Cup Core

.32"

Base   .25"
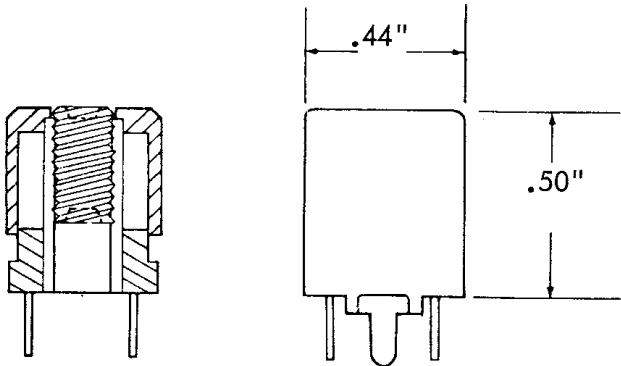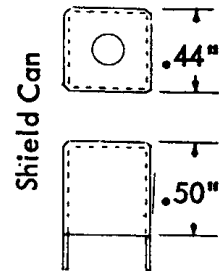
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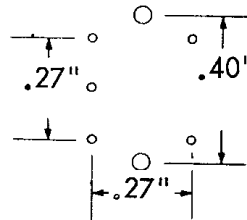
pin spacing
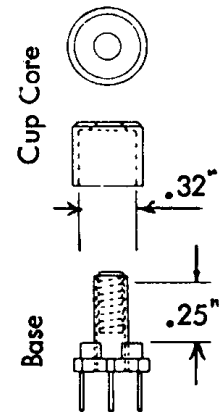
Part number	Frequency range (MHz)	A_L (μh/100 t) at max L	L ratio max to min	Typical Winding (mid-freq.)			
				Wire	Turns	L (μh)	Q max
L-43-1	0.30 - 1.0	115	1.6 - 1	3/44	75	42.50	80
L-43-2	1.00 - 10.0	98	1.6 - 1	9/44	21	4.00	120
L-43-3	0.01 - 0.5	133	1.8 - 1	3/44	223	600.00	90
L-43-6	10.00 - 50.0	85	1.4 - 1	26	6	0.30	30
L-43-10	25.00 - 100.0	72	1.3 - 1	24	5	0.14	150
L-43-17	50.00 - 200.0	56	1.2 - 1	22	3	0.05	200

Solid magnet wire may be substituted for the Litz wire, but somewhat lower Q may result.

Most efficient when tuning slug is set at maximum L.
For Tuning flexibility calculate so that slug will be
about 90% maximum L when at operating frequency.

$$\text{Turns} = 100 \sqrt{\frac{\text{desired 'L' } (\mu h)}{90\% \, A_L \, (\mu h/100 \text{ turns})}}$$

IRON POWDER TOROIDAL CORES

FOR
DC CHOKES and AC LINE FILTERS

For many years Iron Powder has been used as the core material for RF inductors and transformers when stability and high 'Q' are of primary concern. Because of the growing need for energy storage inductors for noise filtering, new materials have been developed for these applications

High 'Q' inductors are no longer required, in fact low 'Q' actually helps in damping high frequency oscillations. The #26 Iron Powder material is ideally suited for these applications since it combines low 'Q', good frequency response, and high energy capabilities.

Energy storage , expressed in microjoules, is calculated by multiplying one-half the inductance in µh times the current in amperes squared. The amount of energy that can be stored in a given inductor is limited either by saturation of the core material or temperature rise of the wound unit, resulting in copper loss and/or core loss.

In typical DC chokes, the AC ripple flux is normally small in comparison to the DC component. Since the DC flux does not generate core loss, our primary concern becomes saturation and copper loss. The DC saturation characteristics of the #26 material are shown in Fig. A on the following page.

Using this information, DC energy storage curves have been developed and presented in the chart on the 2nd following page. A table of energy storage limits vs. temperature rise is included in the chart. The table at the bottom of the page is for single layer winding.

In 60 Hz. line filter applications, the high frequency to be filtered falls into two categories: (1) Common-mode noise and (2) Differential-mode noise. The common-mode noise is in relation to earth ground and is common to both lines. Differential mode noise is the noise between the two lines.

The Common-mode noise filter is usually constructed on a high permeability ferrite type core with a bifilar type winding. This type of winding allows the 60 Hz. flux generated by each line to cancel within the core, thus avoiding saturation. If the #26 Iron Powder material were to be used, the large core size necessary to accommodate the required number of wire turns for the required inductance makes this option unattractive.

The Differential-mode filters must be able to support a significant amount of 60 Hz. flux without saturating. The AC saturation characteristics of the #26 material (Fig. B) and core loss information (Fig. C) can be seen on the following page. Notice how the permeability initially increases with AC excitation. This effect allows greater energy storage in 60 Hz. applications.

Energy storage curves have been developed for line filter applications as shown on the 3rd following page. The energy storage limit table is now taking into account both the core and the copper loss. In order to guarantee a minimum inductance over a wide current range, the design engineer may wish to calculate the required turns based on the listed A_L value of the core.

How large a core is needed to handle a certain amount of power? This is a question often asked. Unfortunately, there is no simple answer.

There are several factors involved such as: cross sectional area of the core, core material, turns count, and of course the variables of applied voltage and operating frequency.

Overheating of the coil will usually take place long before saturation in most applications above 100 KHz. Now the question becomes 'How large a core must I have to prevent overheating at a given frequency and power level'?

Overheating can be caused by both wire and core material losses. Wire heating is affected by both DC and AC currents, while core heating is affected only by the AC content of the signal. With a normal sinewave signal above 100 KHz, both the Iron Powder and Ferrite type cores will first be affected by overheating caused by core losses, rather than saturation.

The extrapolated AC flux density limits (see table below) can be used for BOTH Iron Powder and Ferrite type cores as a guideline to avoid excessive heating. These figures may vary slightly according to the type of the material being used.

Operating frequency is one of the most important factors concerning power capability above 100 KHz. A core that works well at 2 MHz. may very well burn up at 30 MHz. with the same amount of drive.

Core saturation, a secondary cause of coil failure, is affected by both AC and DC signals. Saturation will decrease the permeability of the core causing it to have impaired performance or to become inoperative. The safe operating total flux density level for most Ferrite materials is typically 2000 gauss, while Iron Powder materials can tolerate up to 5000 gauss without significant saturation effects.

Iron Powder cores (low permeability) are superior to the Ferrite material cores for high power inductors for this reason: fewer turns will be required by the Ferrite type core for a given inductance. When the same voltage drop is applied across a decreased number of turns, the flux density will increase accordingly. In order to prevent the flux density from increasing when fewer turns are used, the flux drive will have to be decreased.

Either core material can be used for transformer applications but both will have 'trade-offs'. Ferrite type cores will require fewer turns, will give more impedance per turn and will couple better, whereas the Iron Powder cores will require more turns, will give less impedance per turn, will not couple as well but will tolerate more power and are more stable.

Frequency:	100 KHz	1 MHz	7 MHz	14 MHz	21 MHz	28 MHz
AC Flux Den.	500 gauss	150 gauss	57 gauss	42 gauss	36 gauss	30 gauss