

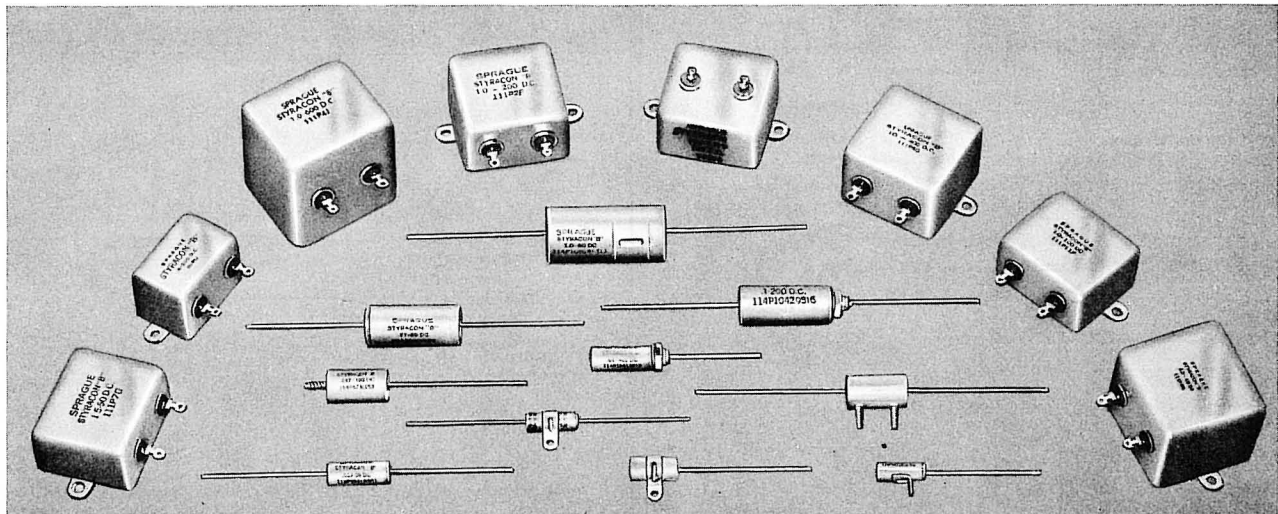
**SPRAGUE**  
THE MARK OF RELIABILITY

a GK Technologies subsidiary

# Engineering Bulletin

No.  
**2510D**Type 111P and 114P

## STYRACON<sup>®</sup> Film Capacitors Hermetically-Sealed in Metal Cases



2084

**D**ESIGNED for special applications with such requirements as extremely high insulation resistance, freedom from dielectric absorption, extremely low power factor (or high  $Q$ ), or for use where close capacitance tolerance or high capacitance stability is required, Sprague Styracon Film capacitors are finding use in many critical applications. Some typical applications are found in analog and digital computers, in precision timing circuits, in high  $Q$  tuned circuits, and integrating circuits in electronic equipment, and as laboratory standards of capacitance.

Styracon capacitors have as their dielectric a specially processed polystyrene plastic film.

The dielectric absorption, or the accumulation of charge after discharge, is extremely low. Styracon capacitors make excellent standards for the measurement of dielectric hysteresis or absorption in other capacitors.

The insulation resistance of Styracon capacitors at 25 C is well beyond the limit of accurate measurement of most  $\overline{IR}$  meters. When determined by the decay of a charge across the capacitor itself, the product of insulation resistance and capacitance will generally exceed 10,000,000 megohm-microfarads. Because of the difficulty of making measurements of this magnitude, Sprague Styracon capacitors are guaranteed only to have an insulation resistance  $\times$  capacitance product in excess of

250,000 megohm-microfarads at 25 C.

Styracon capacitors have a rated operating temperature range from  $-55$  C to  $+85$  C. The temperature co-efficient of capacitance is practically linear over this range with a value of approximately  $-120$  ppm/ $^{\circ}$ C. The measured capacitance is also practically independent of frequency. Retrace characteristics of Styracon capacitors are excellent.

Styracon Capacitors are furnished not only to the customary "standard" tolerances ranging from  $\pm 1\%$  through  $\pm 20\%$ , but are also available to meet special close tolerance requirements as tight as  $\pm .1\%$ . In addition, matched pairs of capacitors can be furnished for many of the standard tolerance spreads.

Sprague Styracon capacitors are available in various mechanical configurations to meet application needs. Cases most often used in industrial and military electronics and in computers include subminiature metal-clad tubulars and the drawn "bathtub" designs. All capacitors in this bulletin are hermetically sealed with glass-to-metal solder-seal terminals.

Capacitors will withstand the usual requirements for humidity resistance, temperature cycling, and immersion found in MIL capacitor specifications. Special constructions to withstand high acceleration, shock, and vibration requirements beyond MIL capacitor specifications are available.

**SPRAGUE ELECTRIC COMPANY****SPRAGUE**  
ENGINEERING  
BULLETIN  
**2510D**

# TYPE 114P CASE STYLES

Leads are bare solid tinned wire. Lead wire sizes are:

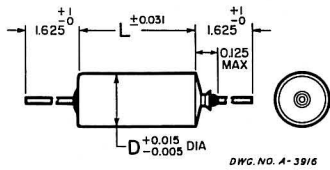
Can Dia.  
 .175 and .195  
 .235 to .312  
 .400 and over

Lead AWG  
 No. 24  
 No. 22  
 No. 20 except that style 15 and 16 capacitors  
 will be furnished with No. 22 leads.

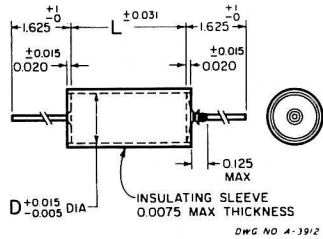
## Section Grounded to Case



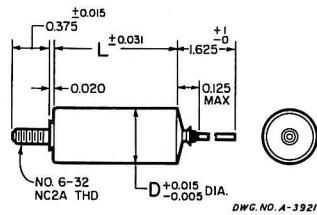
**Style 1**



**Style 3**

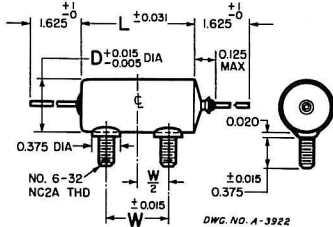


**Style 7**



Minimum D = .235"

**Style 8**  
 0.018 μF  
 and above

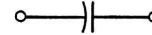


Minimum D = .400"

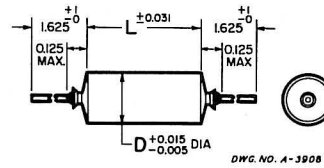
Minimum L = 1.062"

L	W
1.062	0.625
1.312	0.750
1.562	0.875
1.812	1.125
2.062	1.250
2.312	1.375
2.562	1.875

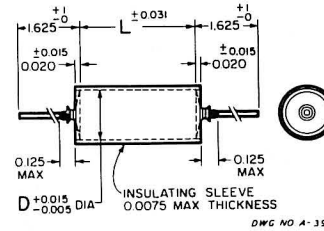
## Section Insulated from Case



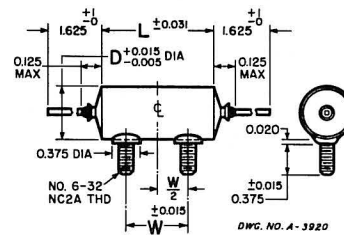
**Style 2**



**Style 4**



**Style 9**  
 0.018 μF  
 and above



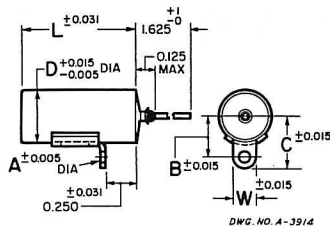
Minimum D = .400"

Minimum L = 1.125"

L	W
1.125	0.625
1.375	0.750
1.625	0.875
1.875	1.125
2.125	1.250
2.375	1.375
2.625	1.875

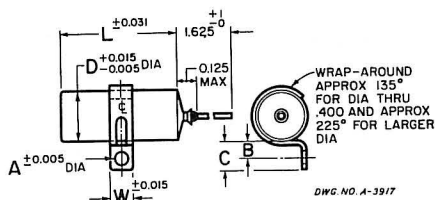
Grounded Case - continued

Style 10



D	W	A	B	C
.175	.250	.120	.250	.375
.195	.250	.120	.250	.375
.235	.250	.120	.281	.406
.312	.250	.120	.343	.468
.400	.250	.120	.359	.484
.500	.250	.120	.437	.562
.562	.250	.120	.437	.562
.670	.250	.156	.500	.625
.750	.281	.156	.562	.703
1.000	.281	.156	.687	.828

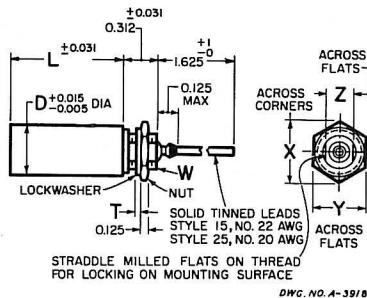
Style 12



Bracket located  $\pm 1/32$ " of center line

D	W	A	B	C
.175	1/4	.144	.187	.312
.195	1/4	.144	.187	.312
.235	1/4	.144	.187	.312
.312	1/4	.144	.187	.312
.400	1/4	.144	.187	.312
.562	1/2	.156	.250	.437
.670	1/2	.156	.250	.437
.750	1/2	.156	.250	.437
1.000	1/2	.156	.250	.437

Styles 15 and 25



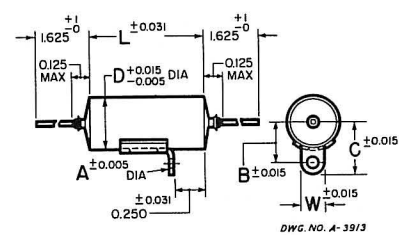
D	T	W	X	Y	Z	Lockwasher	Nut
<b>STYLE 15</b>							
.400 thru 1.000	.022	3/16"-24UNF-2A	.484	.437	.250 .255	Part 2-47	Part 6-113
<b>STYLE 25</b>							
.670	.035	7/16"-28UNEF-2A	.718	.675	.375 .380	Part 2-6A	Part 6-208
.750	.040	1/2"-28UNEF-2A	.796	.687	.437 .442	Part 2-54B	Part 6-120C
1.000	.040	1/2"-28UNEF-2A	.796	.687	.437 .442	Part 2-54B	Part 6-120C

Lockwasher and nut are furnished with each unit and are sold separately as replacement parts.

On .670" diameter units and above, use Style 25 units for new equipment designs as they are superior to Style 15 units on these larger case sizes under conditions of severe vibration. In addition, they will withstand higher flashover voltage.

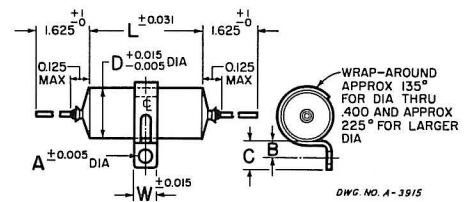
Insulated Case - continued

Style 11



D	W	A	B	C
.175	.250	.120	.250	.375
.195	.250	.120	.250	.375
.235	.250	.120	.281	.406
.312	.250	.120	.343	.468
.400	.250	.120	.359	.484
.500	.250	.120	.437	.562
.562	.250	.120	.437	.562
.670	.250	.156	.500	.625
.750	.281	.156	.562	.703
1.000	.281	.156	.687	.828

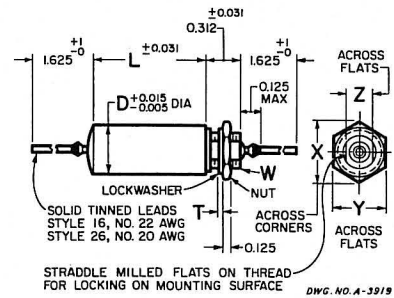
Style 13



Bracket located  $\pm 1/32$ " of center line

D	W	A	B	C
.175	1/4	.144	.187	.312
.195	1/4	.144	.187	.312
.235	1/4	.144	.187	.312
.312	1/4	.144	.187	.312
.400	1/4	.144	.187	.312
.562	1/2	.156	.250	.437
.670	1/2	.156	.250	.437
.750	1/2	.156	.250	.437
1.000	1/2	.156	.250	.437

Styles 16 and 26

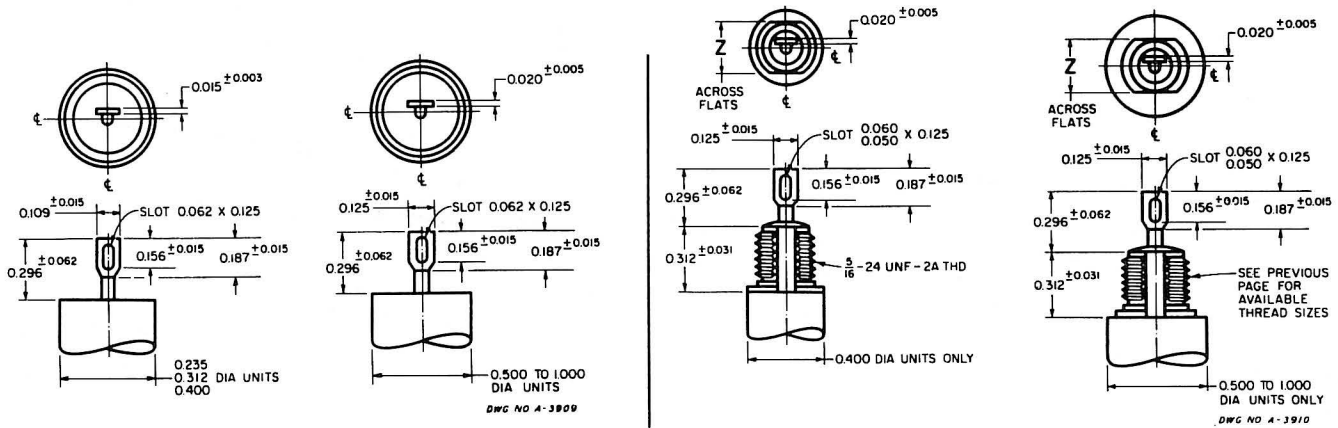


D	T	W	X	Y	Z	Lockwasher	Nut
<b>STYLE 16</b>							
.400 thru 1.000	.022	3/16"-24UNF-2A	.484	.437	.250 .255	Part 2-47	Part 6-113
<b>STYLE 26</b>							
.670	.035	7/16"-28UNEF-2A	.718	.625	.375 .380	Part 2-6A	Part 6-208
.750	.040	1/2"-28UNEF-2A	.796	.687	.437 .442	Part 2-54B	Part 6-120C
1.000	.040	1/2"-28UNEF-2A	.796	.687	.437 .442	Part 2-54B	Part 6-120C

Lockwasher and nut are furnished with each unit and are sold separately as replacement parts.

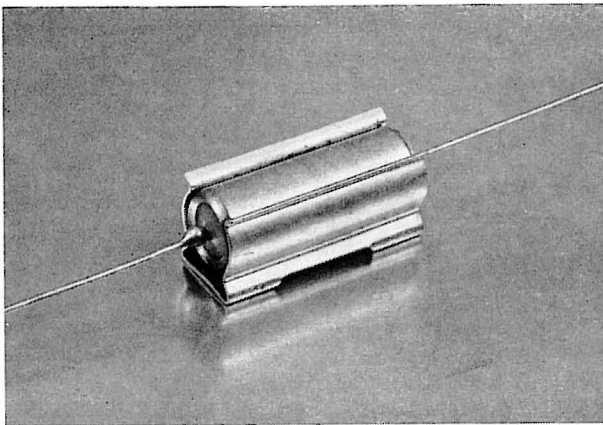
On .670" diameter units and above, use Style 26 units for new equipment designs as they are superior to Style 16 units on these larger case sizes under conditions of severe vibration. In addition, they will withstand higher flashover voltage.

## TYPICAL TAB TERMINAL DIMENSIONS



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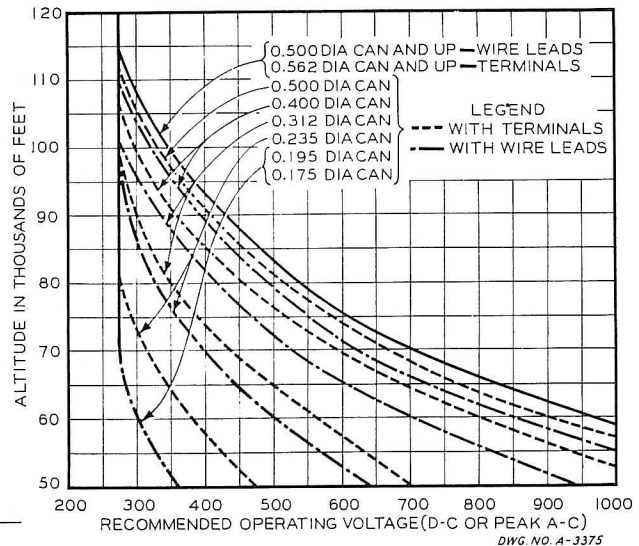
## Application Notes



**Mounting.** Tubular capacitors should be mounted such that the leads are not required to withstand forces arising from the mass of the capacitor body where shock or high frequency vibration is likely to be encountered. The necessity for exercising great care in the use of a strap or clamp is emphasized. A clamp which pinches the body too tightly may injure it, either because of the stress produced in tightening or because of the aggravation of these stresses by vibration.

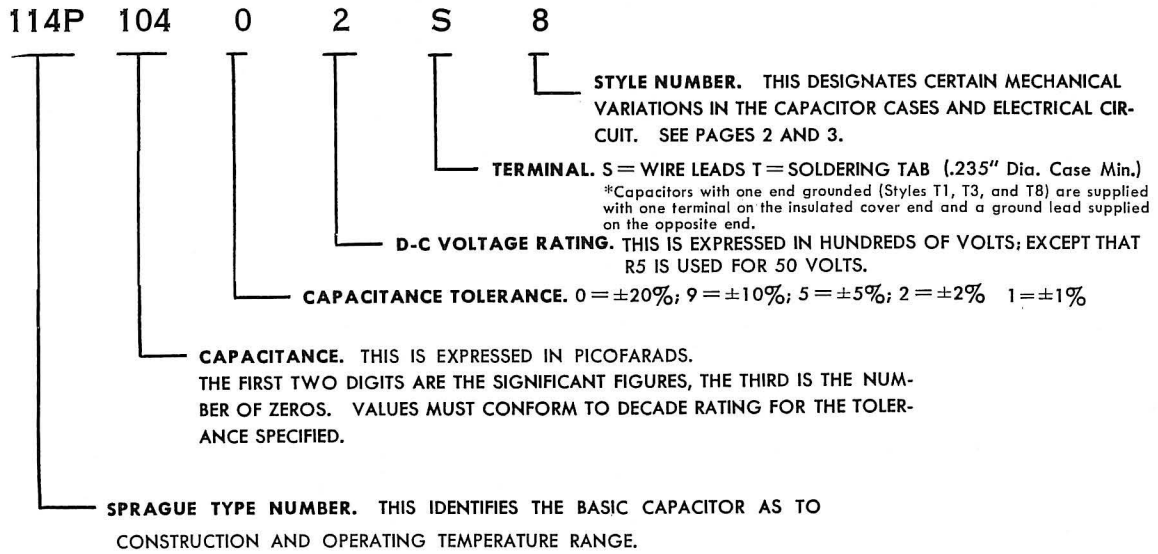
There are available, however, clamps designed to support capacitors subject to shock and vibration. Typical of these is the spring clip shown in the above photograph.

**Altitude Limitations** Capacitor bushing flashover voltage limitations should be taken into consideration when designing circuits for use in guided missiles and similar high altitude applications. The curves below give typical maximum voltages which should be taken into consideration when using Subminiature Paper Capacitors in electronic equipment. From the practical standpoint these curves indicate that it may sometimes be necessary to specify a higher working voltage capacitor in a larger diameter case in order to insure satisfactory operation of the finished equipment.



# TYPE 114P – Tubular Cases with Extended Foil Sections

ALWAYS SPECIFY BY COMPLETE CATALOG NUMBER, SUCH AS:



## Table of Dimensions

For a complete catalog number, the capacitance code numbers listed in the following table must be pre-fixed with the designation 114P to indicate the construction type desired, and must be followed by a style number selected from the available styles shown on pages 2, 3 and 4. For example, 114P10402S3.

The tolerances allowed on the dimensions tabulated below are shown in the line drawings on pages 2, 3 and 4 which illustrate the available case styles.

It should be noted that for styles 8, 9, 15 and 16, the minimum can diameter available is .400 inch and for style 7 the minimum is .235 inch. Any combination of capacitance and voltage rating, for which the diameter shown in the table is smaller, will be furnished in Styles 8, 9, 15, and 16 in a can .400 inch in diameter or in Style 7 capacitors in a can .235 inch in diameter. The minimum lengths of Style 8 and 9 capacitors are tabulated on page 2. The minimum lengths of Style 15 and 16 capacitors are 0.687 and 0.750 inch, respectively.

*Note: For units larger than .562 by 1.812, mounting by means of the lead wires is not recommended.*

μF	Size		Capacitance Code		
	D	L*	±20% Tol.	±10% Tol.	±5% Tol.
<b>50 VOLTS D-C WORKING</b>					
.001	0.235	0.687	1020R5	1029R5	1025R5
.0011	0.235	0.687			1125R5
.0012	0.235	0.687		1229R5	1225R5
.0013	0.235	0.687			1325R5
.0015	0.235	0.687	1520R5	1529R5	1525R5
.0016	0.235	0.687			1625R5
.0018	0.235	0.687		1829R5	1825R5
.002	0.235	0.687			2025R5
.0022	0.235	0.687	2220R5	2229R5	2225R5
.0024	0.235	0.687			2425R5
.0027	0.235	0.812		2729R5	2725R5
.003	0.235	0.812			3025R5
.0033	0.235	0.812	3320R5	3329R5	3325R5
.0036	0.235	0.812			3625R5
.0039	0.235	0.812		3929R5	3925R5
.0043	0.235	0.812			4325R5
.0047	0.235	0.812	4720R5	4729R5	4725R5
.0051	0.235	0.812			5125R5
.0056	0.312	0.812		5629R5	5625R5
.0062	0.312	0.812			6225R5
.0068	0.312	0.812	6820R5	6829R5	6825R5
.0075	0.312	0.812			7525R5
.0082	0.312	0.812		8229R5	8225R5
.0091	0.312	0.812			9125R5
<b>50 VOLTS D-C WORKING (Cont.)</b>					
.01	0.312	0.812	1030R5	1039R5	1035R5
.011	0.312	0.812			1135R5
.012	0.312	0.812		1239R5	1235R5
.013	0.312	0.812			1335R5
.015	0.312	0.812	1530R5	1539R5	1535R5
.016	0.312	0.812			1635R5
.018	0.400	0.812		1839R5	1835R5
.02	0.400	0.812			2035R5
.022	0.400	0.812	2230R5	2239R5	2235R5
.024	0.400	0.812			2435R5
.027	0.400	1.062		2739R5	2735R5
.03	0.400	1.062			3035R5
.033	0.400	1.062	3330R5	3339R5	3335R5
.036	0.400	1.062			3635R5
.039	0.400	1.062		3939R5	3935R5
.043	0.400	1.062			4335R5
.047	0.400	1.062	4730R5	4739R5	4735R5
.051	0.400	1.062			5135R5
.056	0.400	1.312		5639R5	5635R5
.062	0.400	1.312			6235R5
.068	0.400	1.312	6830R5	6839R5	6835R5
.075	0.400	1.312			7535R5
.082	0.562	1.062		8239R5	8235R5
.091	0.562	1.062			9135R5

\*Add 0.062" to length for styles with section insulated from case.

**SPRAGUE ENGINEERING BULLETIN No. 2510D**

μF	Size		Capacitance Code		
	D	L*	±20% Tol.	±10% Tol.	±5% Tol.
<b>50 VOLTS D-C WORKING (Cont.)</b>					
.1	0.562	1.062	1040R5	1049R5	1045R5
.11	0.562	1.062			1145R5
.12	0.562	1.312		1249R5	1245R5
.13	0.562	1.312			1345R5
.15	0.562	1.312	1540R5	1549R5	1545R5
.16	0.562	1.312			1645R5
.18	0.562	1.562		1849R5	1845R5
.2	0.562	1.562			2045R5
.22	0.562	1.562	2240R5	2249R5	2245R5
.24	0.562	1.562			2445R5
.27	0.670	1.562		2749R5	2745R5
.3	0.670	1.562			3045R5
.33	0.670	1.562	3340R5	3349R5	3345R5
.36	0.670	1.562			3645R5
.39	0.750	2.062		3949R5	3945R5
.43	0.750	2.062			4345R5
.47	0.750	2.062	4740R5	4749R5	4745R5
.51	0.750	2.062			5145R5
.56	0.750	2.062		5649R5	5645R5
.62	0.750	2.062			6245R5
.68	0.750	2.062	6840R5	6849R5	6845R5
.75	0.750	2.062			7545R5
.82	1.000	2.062		8249R5	8245R5
1.0	1.000	2.062	1050R5	1059R5	1055R5

<b>100 VOLTS D-C WORKING</b>					
.001	0.235	0.687	10201	10291	10251
.0011	0.235	0.687			11251
.0012	0.235	0.812		12291	12251
.0013	0.235	0.812			13251
.0015	0.235	0.812	15201	15291	15251
.0016	0.235	0.812			16251
.0018	0.235	0.812		18291	18251
.002	0.235	0.812			20251
.0022	0.235	0.812	22201	22291	22251
.0024	0.235	0.812			24251
.0027	0.312	0.812		27291	27251
.003	0.312	0.812			30251
.0033	0.312	0.812	33201	33291	33251
.0036	0.312	0.812			36251
.0039	0.312	0.812		39291	39251
.0043	0.312	0.812			43251
.0047	0.312	0.812	47201	47291	47251
.0051	0.312	0.812			51251
.0056	0.312	0.812		56291	56251
.0062	0.312	0.812			62251
.0068	0.312	0.812	68201	68291	68251
.0075	0.312	0.812			75251
.0082	0.400	0.812		82291	82251
.0091	0.400	0.812			91251
.01	0.400	0.812	10301	10391	10351
.011	0.400	0.812			11351
.012	0.400	1.062		12391	12351
.013	0.400	1.062			13351
.015	0.400	1.062	15301	15391	15351
.016	0.400	1.062			16351
.018	0.400	1.062		18391	18351
.02	0.400	1.062			20351
.022	0.400	1.062	22301	22391	22351
.024	0.400	1.062			24351
.027	0.400	1.312		27391	27351
.03	0.400	1.312			30351
.033	0.400	1.312	33301	33391	33351
.036	0.400	1.312			36351
.039	0.562	1.062		39391	39351
.043	0.562	1.062			43351

μF	Size		Capacitance Code		
	D	L*	±20% Tol.	±10% Tol.	±5% Tol.
<b>100 VOLTS D-C WORKING (Continued)</b>					
.047	0.562	1.062	47301	47391	47351
.051	0.562	1.062			51351
.056	0.562	1.312		56391	56351
.062	0.562	1.312			62351
.068	0.562	1.312	68301	68391	68351
.075	0.562	1.312			75351
.082	0.562	1.312		82391	82351
.091	0.562	1.312			91351
.1	0.562	1.312	10401	10491	10451
.11	0.562	1.312			11451
.12	0.670	1.562		12491	12451
.13	0.670	1.562			13451
.15	0.670	1.562	15401	15491	15451
.16	0.670	1.562			16451
.18	0.750	2.062		18491	18451
.2	0.750	2.062			20451
.22	0.750	2.062	22401	22491	22451
.24	0.750	2.062			24451
.27	0.750	2.062		27491	27451
.3	0.750	2.062			30451
.33	0.750	2.062	33401	33491	33451
.36	0.750	2.062			36451
.39	1.000	2.062		39491	39451
.43	1.000	2.062			43451
.47	1.000	2.062	47401	47491	47451
.51	1.000	2.062			51451
.56	1.000	2.062		56491	56451
.62	1.000	2.062			62451
.68	1.000	2.062	68401	68491	68451

<b>200 VOLTS D-C WORKING</b>					
.001	0.235	0.812	10202	10292	10252
.0011	0.235	0.812			11252
.0012	0.235	0.812		12292	12252
.0013	0.235	0.812			13252
.0015	0.235	0.812	15202	15292	15252
.0016	0.235	0.812			16252
.0018	0.235	0.812		18292	18252
.002	0.235	0.812			20252
.0022	0.235	0.812	22202	22292	22252
.0024	0.235	0.812			24252
.0027	0.312	0.812		27292	27252
.003	0.312	0.812			30252
.0033	0.312	0.812	33202	33292	33252
.0036	0.312	0.812			36252
.0039	0.312	0.812		39292	39252
.0043	0.312	0.812			43252
.0047	0.312	0.812	47202	47292	47252
.0051	0.312	0.812			51252
.0056	0.400	0.812		56292	56252
.0062	0.400	0.812			62252
.0068	0.400	0.812	68202	68292	68252
.0075	0.400	0.812			75252
.0082	0.400	1.062		82292	82252
.0091	0.400	1.062			91252
.01	0.400	1.062	10302	10392	10352
.011	0.400	1.062			11352
.012	0.400	1.062		12392	12352
.013	0.400	1.062			13352
.015	0.400	1.062	15302	15392	15352
.016	0.400	1.062			16352
.018	0.400	1.312		18392	18352
.02	0.400	1.312			20352

\*Add 0.062" to length for styles with section insulated from case.

**SPRAGUE ENGINEERING BULLETIN No. 2510D**

μF	Size		Capacitance Code		
	D	L*	±20% Tol.	±10% Tol.	±5% Tol.
<b>200 VOLTS D-C WORKING (Continued)</b>					
.022	0.400	1.312	22302	22392	22352
.024	0.400	1.312			24352
.027	0.562	1.062		27392	27352
.03	0.562	1.062			30352
.033	0.562	1.062	33302	33392	33352
.036	0.562	1.062			36352
.039	0.562	1.312		39392	39352
.043	0.562	1.312			43352
.047	0.562	1.312	47302	47392	47352
.051	0.562	1.312			51352
.056	0.562	1.562		56392	56352
.062	0.562	1.562			62352
.068	0.562	1.562	68302	68392	68352
.075	0.562	1.562			75352
.082	0.670	1.562		82392	82352
.091	0.670	1.562			91352
.1	0.670	1.562	10402	10492	10452
.11	0.670	1.562			11452
.12	0.750	2.062		12492	12452
.13	0.750	2.062			13452
.15	0.750	2.062	15402	15492	15452
.16	0.750	2.062			16452
.18	0.750	2.062		18492	18452
.2	0.750	2.062			20452
.22	0.750	2.062	22402	22492	22452
.24	0.750	2.062			24452
.27	1.000	2.062		27492	27452
.3	1.000	2.062			30452
.33	1.000	2.062	33402	33492	33452
.36	1.000	2.062			36452
.39	1.000	2.062		39492	39452
.43	1.000	2.062			43452
.47	1.000	2.062	47402	47492	47452
<b>400 VOLTS D-C WORKING</b>					
.001	0.235	0.812	10204	10294	10254
.0011	0.235	0.812			11254
.0012	0.312	0.812		12294	12254
.0013	0.312	0.812			13254
.0047	0.400	0.812	47204	47294	47254
.0051	0.400	0.812			51254
.0056	0.400	1.062		56294	56254
.0062	0.400	1.062			62254
.0068	0.400	1.062	68204	68294	68254
.0075	0.400	1.062			75254
.0082	0.400	1.062		82294	82254
.0091	0.400	1.062			91254
.01	0.400	1.062	10304	10394	10354
.011	0.400	1.062			11354
.012	0.400	1.312		12394	12354
.013	0.400	1.312			13354
.015	0.400	1.312	15304	15394	15354
.016	0.400	1.312			16354
.018	0.562	1.062		18394	18354
.02	0.562	1.062			20354
.022	0.562	1.062	22304	22394	22354
.024	0.562	1.062			24354
.027	0.562	1.312		27394	27354
.03	0.562	1.312			30354
.033	0.562	1.312	33304	33394	33354
.036	0.562	1.312			36354
.039	0.562	1.562		39394	39354
.043	0.562	1.562			43354
<b>400 VOLTS D-C WORKING (Continued)</b>					
.047	0.562	1.562	47304	47394	47354
.051	0.562	1.562			51354
.056	0.670	1.562		56394	56354
.062	0.670	1.562			62354
.068	0.670	1.562	68304	68394	68354
.075	0.670	1.562			75354
.082	0.750	2.062		82394	82354
.091	0.750	2.062			91354
.1	0.750	2.062	10404	10494	10454
.11	0.750	2.062			11454
.12	0.750	2.062		12494	12454
.13	0.750	2.062			13454
.15	0.750	2.062	15404	15494	15454
.16	0.750	2.062			16454
.18	1.000	2.062		18494	18454
.2	1.000	2.062			20454
.22	1.000	2.062	22404	22494	22454
.24	1.000	2.062			24454
.27	1.000	2.062		27494	27454
.3	1.000	2.062			30454
.33	1.000	2.062	33404	33494	33454
.36	1.000	2.062			36454
.39	1.000	2.562		39494	39454
.43	1.000	2.562			43454
.47	1.000	2.562	47404	47494	47454
<b>600 VOLTS D-C WORKING</b>					
.001	0.400	0.812	10206	10296	10256
.0011	0.400	0.812			11256
.0012	0.400	1.062		12296	12256
.0013	0.400	1.062			13256
.0015	0.400	1.062	15206	15296	15256
.0016	0.400	1.062			16256
.0018	0.400	1.062		18296	18256
.002	0.400	1.062			20256
.0022	0.400	1.062	22206	22296	22256
.0024	0.400	1.062			24256
.0027	0.400	1.062		27296	27256
.003	0.400	1.062			30256
.0033	0.400	1.062	33206	33296	33256
.0036	0.400	1.062			36256
.0039	0.400	1.062		39296	39256
.0043	0.400	1.062			43256
.0047	0.400	1.062	47206	47296	47256
.0051	0.400	1.062			51256
.0056	0.400	1.062		56296	56256
.0062	0.400	1.062			62256
.0068	0.400	1.062	68206	68296	68256
.0075	0.400	1.062			75256
.0082	0.400	1.312		82296	82256
.0091	0.400	1.312			91256
.01	0.400	1.312	10306	10396	10356
.011	0.400	1.312			11356
.012	0.400	1.312		12396	12356
.013	0.400	1.312			13356
.015	0.400	1.312	15306	15396	15356
.016	0.400	1.312			16356
.018	0.562	1.312		18396	18356
.02	0.562	1.312			20356
.022	0.562	1.312	22306	22396	22356
.024	0.562	1.312			24356
.027	0.562	1.562		27396	27356
.03	0.562	1.562			30356

\*Add 0.062" to length for styles with section insulated from case.

**SPRAGUE ENGINEERING BULLETIN No. 2510D**

μF	Size		Capacitance Code		
	D	L*	±20% Tol.	±10% Tol.	±5% Tol.
<b>600 VOLTS D-C WORKING</b>					
.033	0.562	1.562	33306	33396	33356
.036	0.562	1.562			36356
.039	0.670	1.562		39396	39356
.043	0.670	1.562			43356
.047	0.670	1.562	47306	47396	47356
.051	0.670	1.562			51356
.056	0.750	2.062		56396	56356
.062	0.750	2.062			62356
.068	0.750	2.062	68306	68396	68356
.075	0.750	2.062			75356
.082	0.750	2.062		82396	82356
.091	0.750	2.062			91356

μF	Size		Capacitance Code		
	D	L*	±20% Tol.	±10% Tol.	±5% Tol.
<b>600 VOLTS D-C WORKING (Cont.)</b>					
.1	0.750	2.062	10406	10496	10456
.11	0.750	2.062			11456
.12	1.000	2.062		12496	12456
.13	1.000	2.062			13456
.15	1.000	2.062	15406	15496	15456
.16	1.000	2.062			16456
.18	1.000	2.562		18496	18456
.2	1.000	2.562			20456
.22	1.000	2.562	22406	22496	22456

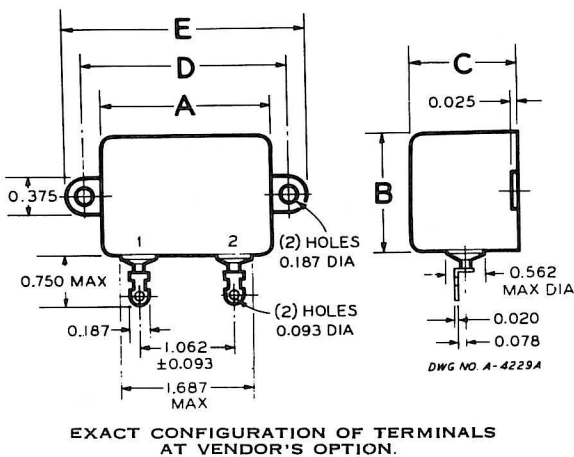
\*Add 0.062" to length for styles with section insulated from case.

## TYPE 111P - - Drawn Metal Cases

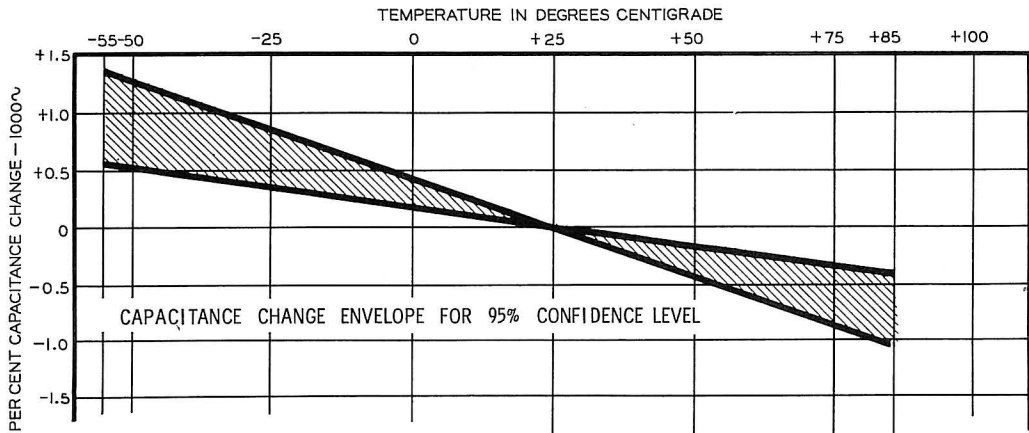
Dimensions in Inches						
μF	Cat. No.*	A	B	C	D	E
	±5% Tol.	±0.062	±0.062	+0.062 -0.125	±0.031	±0.062
<b>30 VOLTS D-C</b>						
.68	111P23J	1.812	1.000	0.750	2.125	2.500
1.0	111P24J	1.812	1.000	0.875	2.125	2.500
1.5	111P35J	2.000	1.750	0.875	2.375	2.750
2.0	111P26J	2.000	1.750	0.875	2.375	2.750
3.0	111P27J	2.000	2.000	1.000	2.375	2.750
4.0	111P36J	2.000	2.000	1.500	2.375	2.750
5.0	111P37J	2.312	2.062	1.500	†	†
8.0	111P30J	2.312	2.062	2.125	†	†
<b>50 VOLTS D-C</b>						
1.5	111P38J	2.000	2.000	1.250	2.375	2.750
2.0	111P39J	2.312	2.062	1.125	†	†
3.0	111P40J	2.312	2.062	1.875	†	†
5.0	111P41J	2.312	2.062	2.875	†	†
<b>100 VOLTS D-C</b>						
1.0	111P11J	2.000	1.750	0.875	2.375	2.750
2.0	111P42J	2.312	2.062	1.875	†	†
3.0	111P43J	2.312	2.062	2.875	†	†
<b>200 VOLTS D-C</b>						
.68	111P14J	2.000	1.750	1.000	2.375	2.750
1.0	111P15J	2.000	2.000	1.250	2.375	2.750
2.0	111P16J	2.312	2.062	2.125	†	†
<b>400 VOLTS D-C</b>						
.68	111P17J	2.000	2.000	1.250	2.375	2.750
1.0	111P18J	2.000	2.000	1.500	2.375	2.750
1.5	111P44J	2.312	2.062	2.875	†	†
<b>600 VOLTS D-C</b>						
.33	111P20J	2.000	1.750	1.000	2.375	2.750
.47	111P21J	2.000	2.000	1.125	2.375	2.750
.68	111P22J	2.000	2.000	1.500	2.375	2.750
1.0	111P4J	2.312	2.062	2.125	†	†

\*For ±20% tolerance, substitute M for J; for ±10% tolerance, substitute K for J; for ±2%, G for J; and for ±1%, substitute F for J.

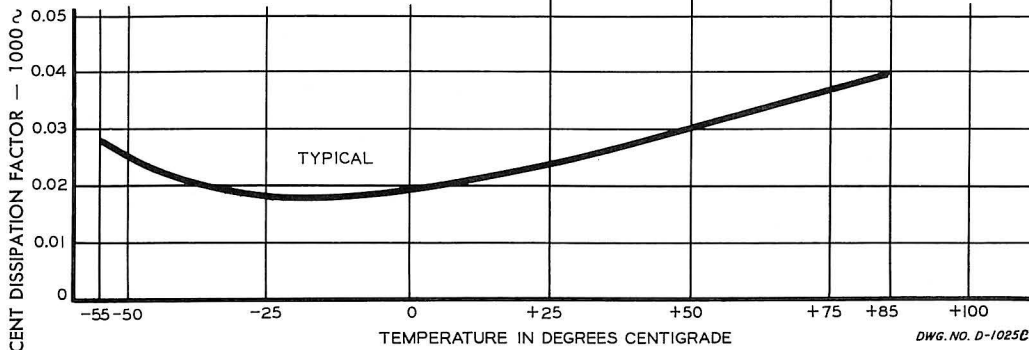
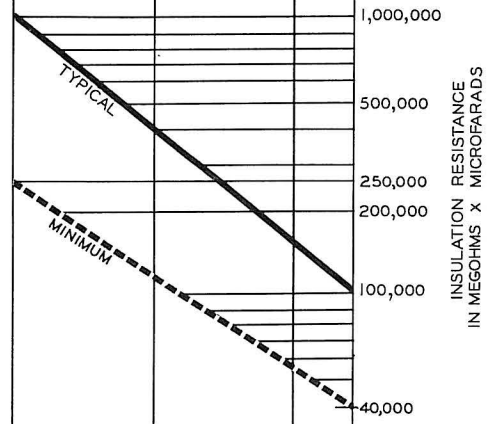
†No mounting ears are provided on this case. It is recommended that these capacitors be mounted using a wraparound bracket, fabricated by the user to best meet the chassis conditions in his particular equipment.







**ELECTRICAL  
CHARACTERISTICS  
vs  
TEMPERATURE  
for  
STYRACON®  
CAPACITORS—  
TYPES 114P and 111P**



**NOTE:** Capacitance and dissipation factor measurements made at 60 cycles and 1000 cycles are the same for all practical purposes.

DWG. NO. D-1025E

# PERFORMANCE CHARACTERISTICS

## 1. Temperature Range.

**1.1 Operating.** These capacitors are designed to operate over a temperature range of  $-65\text{ C}$  to  $+85\text{ C}$ .

**1.2 Non-Operating.** These capacitors must not exceed  $+85\text{ C}$  under any conditions for any period of time. The capacitors are permanently damaged by temperatures in excess of  $+85\text{ C}$ .

**1.3** For optimum capacitance stability, a maximum temperature of  $65\text{ C}$  is recommended for both operating and non-operating conditions.

## 2. Insulation Resistance.

**2.1 At 25 C.** The minimum product of insulation resistance, expressed in megohms, and capacitance, expressed in microfarads, shall be 250,000 megohm-microfarads.

**2.1.1** However, in no case need the insulation resistance exceed 250,000 megohms.

**2.1.2** Where the case is not a terminal, the insulation resistance between the case and either terminal shall be at least 50,000 megohms.

**2.2 At 85 C.** The minimum product of insulation resistance, expressed in megohms, and capacitance, expressed in microfarads, shall be 40,000 megohm-microfarads.

**2.2.1** However, in no case need the insulation resistance exceed 100,000 megohms.

**2.3** Measurements shall be made after a two minute charge at the rated voltage or 500 volts d-c, whichever is less.

**3. Capacitance and Tolerance.** The capacitance of all capacitors shall be within the specified tolerance limits of the nominal rating.

**3.1** Capacitors of  $1\ \mu\text{F}$  or less in capacitance shall be measured at a frequency of 1000 cycles per second at  $25\text{ C}$ , or else referred to measurements made at that frequency and temperature.

**3.2** Capacitors of more than  $1\ \mu\text{F}$  in capacitance shall be measured at a frequency of 60 cycles per second at  $25\text{ C}$  or else referred to measurements made at that frequency and temperature.

**4. Dissipation Factor.** The maximum dissipation factor of all capacitors shall be  $0.1\%$  at  $25\text{ C}$ .

**4.1** Capacitors of  $1\ \mu\text{F}$  or less in capacitance shall be measured at a frequency of 1000 cycles per second, or else referred to measurements made at that frequency.

**4.2** Capacitors of more than  $1\ \mu\text{F}$  in capacitance shall be measured at a frequency of 60 cycles per second, or else referred to measurements made at that frequency.

## 5. Voltage Test.

**5.1** Capacitors shall withstand a d-c potential of twice the rated voltage applied between the terminals for two minutes.

**5.2** When the case is not a terminal, the capacitors shall withstand for one minute a d-c potential of twice the rated voltage applied between the case and the terminals connected together.

**5.3** The test voltage must be applied and discharged through a resistor of at least one ohm per volt.

**6. Life Test.** Capacitors shall withstand a test potential of  $150\%$  of rated voltage between terminals, or between terminals and case, if the case is a terminal, for a period of 250 hours at  $85\text{ C}$ .

**6.1** Not more than 1 failure shall be permitted in 12 units tested. Failure shall be considered to be any one of the following:

- (a) A permanent short or open circuit.
- (b) A change in capacitance of more than  $\pm 2\%$ .
- (c) A change in insulation resistance to less than  $60\%$  of the original limit when measured in accordance with section 2.
- (d) An increase in dissipation factor to more than the original limit when measured in accordance with section 4.

**6.2** An alternate life test may be run at  $65\text{ C}$  with not more than one failure permitted in 25 units tested. The requirements of 6.1 shall apply except that the capacitance change limit is  $0.5\%$ .

**7. Temperature and Immersion Cycling.** These capacitors will meet the temperature and immersion cycling tests of Military Specification MIL-C-19978.

**8. Moisture Resistance.** These capacitors will meet the moisture resistance tests of Military Specification MIL-C-19978.

## 9. Vibration.

**9.1** All capacitors shown in this bulletin will withstand the 55 cycle vibration test in accordance with MIL-STD-202, method 201.

**9.2** Type 114P Capacitors, Styles 1, 2, 3, 4, 12, 13, 15, 16, 25, and 26, shall withstand the 2000 cycle vibration test at  $15g$  in accordance with MIL-STD-202, method 204, test condition B provided supplementary mounting is used for Styles 1, 2, 3, and 4.

**9.3** As the result of these tests, there shall be no mechanical damage, and the measurement shall show no evidence of intermittent contacts or open or short circuiting.

**PERFORMANCE CHARACTERISTICS (cont.)**

**10. Lead Pull Test.** Capacitors with wire leads shall withstand a steady pull of 5 pounds applied axially to the leads for one minute.

**11. Lead Bending Test.** Leads shall withstand, without breakage, bending about the point of egress from the capacitor first 90° in one direction, then back to the original position, and then 90° in the opposite direction.

**12. Dielectric Absorption.** The dielectric absorption shall be less than 0.05%.

**12.1** Dielectric absorption is determined by charging the capacitor to rated voltage for 5 minutes, discharging through a 5 ohm resistor for 10 seconds and then measuring the voltage which reappears across the terminals of the capacitor after

60 seconds have elapsed. A vacuum tube electrometer or similar instrument with an input of 10<sup>11</sup> ohms should be used to measure recovery voltage. The percentage is calculated as noted below:

$$\% \text{ Dielectric Absorption} = \frac{\text{Recovery Voltage} \times 100}{\text{Charging Voltage}}$$

**12.1.1 Alternate Test Procedure.** The test procedure for measuring dielectric absorption given in Military Specification MIL-C-19978 may be substituted for the test method of section 12.1. When measured by the military specification test method, dielectric absorption shall be less than 0.1%.

**12.1.2** Because of limitations of test equipment currently available, it is not feasible to accurately determine dielectric absorption for capacitors rated less than 0.05 μF.



**GUIDE TO APPLICATION AND OPERATION**

**1. Capacitance Drift and Temperature Coefficient:**

**1.1** The temperature coefficient of capacitance is the change in capacitance expressed in parts per million per degree Centigrade. It is normally computed from measurements made at a frequency of 1 kilocycle per second at 25 C and at the maximum specified temperature in the same temperature cycle.

**1.2** The normal range of temperature coefficient of Styracon capacitors is -120 ppm/°C, ±50 ppm/°C.

**1.3** The capacitance drift is defined as the percent deviation of the capacitance of the unit measured immediately before and after a temperature cycle.

**1.4** The capacitance drift of typical units is less than ±0.2%.

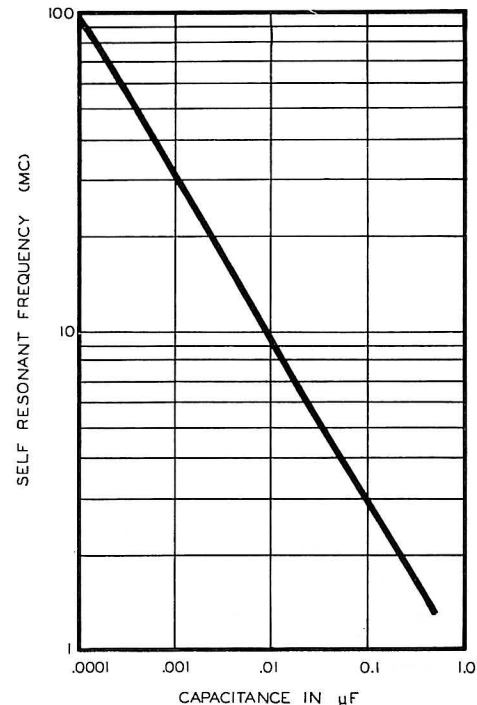
**2. Tolerances:**

**2.1** In both tubular and bathtub constructions, the following tolerances are available other than the standard ±20%, ±10%, and ±5%:  
±2%, ±1%, ±.5%, ±.25% ±.1%

**2.2** Matched pairs or groups can be furnished from any of the above tolerance spreads.

**2.3** Special tolerances are available upon request.

**3. Long Term Stability:** On the basis of shelf and life tests of a typical capacitor, it is known that the capacitance change will be substantially less than 0.1% after one year at temperatures between 20 C and 50 C.



TYPICAL SELF-RESONANT FREQUENCY AS A FUNCTION OF CAPACITANCE FOR TYPE 114P CAPACITORS WITH 1/4" LEADS