General Radio 1419-K Decade Capacitor

You're going to think I'm a nut case, but this General Radio Decade Capacitor is, by far, my favorite piece of boatanchor equipment. There are a number of reasons, but the main ones are:

1. General Radio Company (now defunct) made very high quality and ingenious instruments that were designed to work well and last a long time. My decade capacitor certainly demonstrates these qualities!

2. General Radio played an important and historical role both in the development of the electronics industry and in employee relations. Its management was highly principled and unconventional. For example, GenRad was providing paid vacation and other benefits such as medical benefits for their employees many decades before other companies even considered doing such things (they started Blue Cross Blue Shield benefits in 1938!). The history of the company and its technology is fascinating. If you are interested, you might wish to read more about it on the teradyne website at http://www.teradyne.com/corp/grhs/ .

The 1419-K

General Radio started manufacturing their high accuracy standard capacitors in 1915. I don't know how old my 1419-K model is, but I suspect it dates back to at least the 1950's. For all I know, my particular unit may have been used during WWII. It is certainly old, probably at least 50 years old. The serial number on it is 657. By comparison, I see that there is now a unit for sale on eBay with a serial number in the 1800s. Anybody have any info on the dates of manufacture based on serial number? If so, please send me a note.

The 1419-K uses General Radio "model 980" standard capacitors inside. General Radio announced new, improved standard silvered mica capacitors in 1957 (the 1409 models). In that announcement, they said that "It has been about twenty-five years since the General Radio line of standard mica capacitors was developed under the direction of the late G. W. Pickard" (see http://www.ietlabs.com/pdf/GR_Experimenters/1957/GenRad_Experimenter_July_1957.pdf) . They didn't identify the preceding capacitor designs, but I suspect it was the 980 series mica capacitors used in my 1419-K. So they may have originated as early as 1932.

These are silvered mica standard capacitors. They can have some problems with "dielectric absorption", as described in ancient GenRad publications, but they're generally very stable over time.

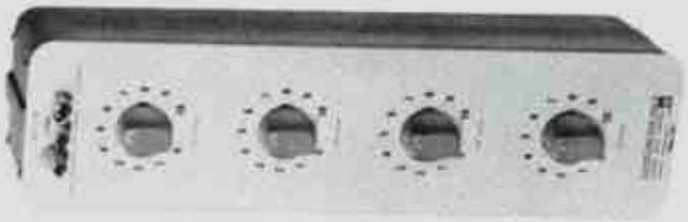
Below are front views of this decade capacitor. The circle on the right of the case appears to be the result of some kind of sticker, possibly a calibration sticker. The gum on it ate through the black crinkle finish on the box and left a smooth (but gummy) surface.


ZERO CAP
0.1 μF / STEP
0.01 μF / STEP
0.001 μF / STEP

Here's a rear view with the case removed. The value selection switches are in the middle and the "980" standard capacitors are arranged on the left and right. They have values of 1, 2, 2, and 5 units for each decade. By adding these in parallel (using the switches) values from 0-10 are obtained for each of the three decades.

And here is a closeup of some of the standard capacitors, "type 980". The smaller one on the right is the only cap in the box that doesn't have a printed (or stamped?) label... it appears to be labeled by hand. I wonder why?

When I say that GenRad made quality equipment I wasn't just kidding. Following is a page from their 1973 catalog showing this unit's specs (I've got an older data sheet but this one is more readable and it has the same specs). I've highlighted a few of the numbers for use below (you have to look closely for a lightened background within the Specifications area). Also note that this 1973 version used a lighter finish front at this time, so my unit at least predates 1973.



1419 Decade Capacitors

- **100 pF to 1.1 μF**
- **choice of models**
- **two- or three-terminal connection**

Type 1419 Decade Capacitors are offered in three models using two different dielectric materials to satisfy a variety of needs.

Types 1419-A and -B (Polystyrene) Capacitance and dissipation factor constant with frequency, essentially noninductive, very low dielectric absorption. The dielectric is specially prepared of purified high-molecular-weight polystyrene, having very high resistance and freedom from interfacial polarization. Moisture sealing with Teflon* feed-through insulators assures high performance under adverse humidity conditions.

Type 1419-K (Silvered Mica) Higher accuracy, low dissipation factor, and +35 ±10 ppm/°C temperature coefficient (10-50°C) for use in higher ambient temperatures.

* Registered trademark of E. I. duPont de Nemours and Company

SPECIFICATIONS

Type Number	1419-A *	1419-B *	1419-K *
Dielectric	Polystyrene	Polystyrene	Silvered Mica
Maximum Capacitance of Box (μF)	1.110	1.1110	1.110
In Steps of (μF)	0.001	0.0001	0.001
Dials	3	4	3
Zero Capacitance, typical			
2-terminal connection	37 pF	50 pF	41 pF
3-terminal connection	15 pF	20 pF	13 pF
Accuracy†			
2-terminal connection‡	±1%	±(1% + 2 pF)	±0.5%
3-terminal connection	±1% except ±1.5% on smallest decade	±1% or −(2% + 4 pF)	±0.5% except ±1% on smallest decade
Dissipation Factor at 1 kHz	<0.0002		<0.0003
Insulation Resistance at 100 V, 25°C 50% RH, typical	>10^{12} Ω		>5×10^{9} Ω
Max Voltage§ (dc or peak)	500 V up to 25 kHz		500 V up to 10 kHz
Max Operating Temperature (C)	65°		75°
Voltage Recovery§	<0.1%		<3%
Resonant Frequencies (typical)	1 μF—400 kHz; 0.1 μF—1MHz; 0.01 μF—2.7 MHz; 0.001 μF—7.8 MHz; 0.0001 μF—23 MHz		
DI Cap/1-kHz Cap	<1.001		Typically 1.03
Cabinet: Lab-bench			
Overall Dimensions — in. (mm)	13 x 4.31 x 5 (330 x 110 x 127)	16.3 x 4.31 x 5 (415 x 110 x 127)	14.13 x 5.5 x 6 (359 x 140 x 153)
Net Weight — lb (kg)	8.38 (3.8)	10.5 (4.8)	11.25 (5.1)
Shipping Weight — lb (kg)	10 (4.6)	11 (5)	18 (8.5)
Catalog Number	1419-9701	1419-9702	1419-9711

† Capacitance increments from zero position are within this percentage of the indicated value for any setting at 1 kHz.
‡ Limits are checked with switch mechanism high, electrically, and the common lead and case grounded.
§ At frequencies above the indicated max, the allowable voltage decreases and is (approx) inversely proportional to frequency. These limits correspond to a rem... ...rise of 40° C at max setting of each decade in box.
¶ Final % of so... ing voltage V measured after leaving terminal voltage at V for 1 h, then discharging for 10 s through a resistance of V ohms.

* Federal stock numbers are listed before the index.

Now take a look at my recent measurements on my 1419-K (using an HP 4276A LCZ meter). The first picture

shows the measured value when all the switches are set to zero. The spec says a "typical" value would be 41 pF. Note that the measured value on this ancient standard is only 1 pF away from this. Imagine that, with a box that size!

And how about it's non-zero value accuracy? Below all the switches are set to "10" so the total capacitance should be 1.110 uF.

Note that the measured value, 1.1076 uF, only differs from the spec sheet by 0.2% (OK, the error is really in combination with the HP 4276A's accuracy, which is about 0.1%). This result is well within the 1419-K's original spec of 0.5% !

The excellent accuracy of this very old instrument may give you an idea of just one of the reasons I'm so fond of General Radio.

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