

## HOW BEAUTIFUL ARE THOSE BLACK BEAUTIES?

By Marv Beeferman

It started with a Reflector posting by Dave Sica for one of those ridiculous eBay auctions for overpriced Black Beauty "bumble bee" capacitors. Dave suggested that "if you buy these caps, I suppose you also have to use Western Electric solder to install them." Nick Senker followed up with a suggestion that someone comment on these capacitors. "I've seen them and have some but don't know anything about them."

John Ruccolo posted the following reply:

"These caps were known in the trade as Sprague "Black Beauties." Some have the color-coded bands (the "bumble bees"); others have normal markings. They were decent-quality (but not top-quality) in their day. Some may have been made by manufacturers other than Sprague (not sure).

Dave Sica is correct - they are original equipment in vintage guitars and amps and are very sought after today, depending on the value. Frankly, the prices have reached really ridiculous levels. There's even a market for used ones!

Today, they are notoriously leaky and frankly, really are not that good. But don't tell that to the audiophiles! I suppose NOS (New Old Stock) ones will work well...for a while. My advice: sell 'em. I strongly recommend modern Vishay/Sprague "Orange Drop" caps in any serious piece of vintage audio gear. I've always gotten excellent results with them."

After doing a little research on the topic, John's advice, for the most part, would be well-taken. One source (Rod Elliot, The Audio Pages - Capacitor Characteristics) noted the following with regard to Black Beauties: "...these are notoriously unreliable (especially NOS), sometimes unbelievably over-priced and should be avoided for anything more technologically advanced than land-fill."

If you examine audio electronics, test instruments or consumer electronics from

the late 1950s, chances are you'll encounter one or more "Black Beauty" capacitors. Introduced by Sprague Electric sometime in the 1950s, these capacitors originally featured a molded Bakelite case surrounding a foil/paper-wound capacitor. A filling of oil added through a brass tube, later soldered shut around an inserted wire lead (identified by a solder blob at the end of the capacitor), provided extra insulation. Over the years, these capacitors earned a reputation for poor reliability. Traces of acid in the dielectric paper provoked electrical leakage, and the brass filling tube leaked oil. When overloaded, this model's Black Beauty case would crack open like a peanut shell.



**Two early Black Beauties. Note the solder blob and fill tube at the left lead of each capacitor-prime paths for dielectric leakage.**

Later-model Black Beauties didn't include oil-filler tubes, which reduced oil leakage and thus improved reliability. However, they were still constructed of Mylar and paper with a mineral fill. Descriptive terms such as "Telecap" and "Difilm" (also applied to the Sprague "Orange Drop") were also added to the Black Beauty name.



**A later model Black Beauty, distinguished by red markings and lack of a filler tube.**

Still, those of us who restore vintage radios, audio equipment and test instruments routinely replace, or "shotgun," every Black Beauty capacitor we find. So, why do new and used Black Beauty capacitors sell at auction on Ebay for as much as \$4 each (or more)?

Let's start with one example that puts the issue in a historical perspective. The tone capacitors for all Gibson Les Paul "goldtop" model guitars prior to 1955 used a brown, waxy looking tubular Sprague capacitor called the "gray tiger." By 1956, this changed to Sprague's "bumble bee," which was black and covered with colored value stripes. These capacitors were used from 1956 until 1960 for all pre-SG Les Paul models (Juniors, Specials, Standards and Customs). In 1968, the same capacitor was again used on the single cutaway Les Paul standard reissues, but, by this time, Sprague had changed the marketing name of the capacitor to Black Beauty.

Today, some electric-guitar players and audiophiles swear that Black Beauties lend desirable sonic coloration to amplified sound. A great deal is made of the "sound" of capacitors. When pressed, they offer subjective comparisons with modern capacitors. One can agree that, when used for input or interstage coupling, certain capacitors can introduce audible distortion, but not when serving as AC-line bypasses! It is true that designers of low-performance consumer goods can easily get away with choosing barrel-of-nails capacitors and audiophile-grade equipment does demand better, but one can easily draw the line at idiosyncratic comparisons of Black Beauties to any other type of capacitor.

There are some sites on the Net showing that different caps have different properties, and this is often used as "proof" by many people that the differences are audible. Some sites make wild claims of irreparable damage to the signal by using the wrong type of cap. In some cases, you can read things like "listening tests have indicated..." But no mention is made of where the data is, who conducted the test, how it was conducted...or was the test really conducted at all. It appears that most claims of this nature indicate a hidden agenda.

Dielectric losses (dissipation factor, dielectric absorption) are featured heavily in most claims. Dissipation factor (DF) is the ratio of the effective series resistance

(ESR) of a capacitor compared to its reactance at a given frequency, generally given in percent. Dielectric absorption (DA) is a measure of the inability of a capacitor to completely discharge. The charge that remains after a determined discharge time is expressed in a percentage of the original charge; it's also called "capacitor memory" or "battery action."

Dielectric losses are blamed for "smeared" high frequencies. This implies that as frequency increases, the problem gets worse. However, as the frequency increases, the amount of signal across the cap falls and at the highest frequencies, the capacitor is effectively almost a short circuit. Thus, to the contrary, the influence of any coupling capacitor diminishes as frequency increases, and is most significant at the lowest frequency of interest.

With regard to dielectric absorption problems, it would have to be assumed that caps will be charged and then discharged in an audio system. However, this does not happen in normal audio circuits; to do so would cause signals to be generated that, after amplification, would mean instantaneous speaker disintegration. Once the cap is loaded with normal circuit impedances, the effect goes away almost completely. The result, even in filter circuits, is an immeasurably small loss of signal and nothing more. Contrary to audiophile claims, dielectric absorption does not magically create reverberation, sub-harmonics, background "glare," "whiteness" during silent passages or "image smearing."

There are many other persistent myths that exist in the audiophile world regarding capacitors that, when exposed to the technical light of day, are similarly exploded. They include:

- \* All ceramic capacitors introduce distortion;
- \* Dielectric absorption compresses dynamic range;
- \* Polypropylene dielectrics are lossy and inefficient;
- \* Capacitors look inductive at audio frequencies;

It appears that similar to the Western Electric solder fiasco, once unfounded rumors start, they take on a life of their own and it becomes almost impossible to get the discussion back into the land of reality.

While searching through my junk box,

I discovered a bunch of early 60s NOS "Difilm" Black Beauties in their original plastic display boxes and wondered what condition they were in. All capacitors were rated +/- 10% at 600 volts, except for the 1 and .047 mfd values (1000 volts) and the .15 mfd value (400 volts). Using a Sencore LC102 AUTO-Z dynamic capacitor tester that I use at work, I randomly selected one capacitor from each value and tested it at its working voltage. The results are found in Table 1.

<u>Value (mfd)</u>	<u>Tested Value (mfd)</u>	<u>D/A(%)</u>	<u>Leakage (uamps)</u>
.5	.495	5	.30
.1	.101	8	.26
.01	.015	20	.01
.002	.0033	32	.08
.03	.0392	37	.00
.003	.0042	25	.05
.01	.0138	27	.02
.15	.1563	9	.10
.047	.0482	11	.10
.005	.0065	26	.01
.001	.0022	29	.12

D/A = dielectric absorption

As you can see from the data, the Black Beauties performed quite nicely with regard to value and extremely well with regard to leakage. The results for dielectric absorption were expected. Aluminum and tantalum electrolytics are considered failures at values above 15% and ceramics at 10% which are associated with high leakage. However, for this type of capacitor, its low leakage characteristics makes the D/A test effectively meaningless.

But, as I have discovered through many years of test experience, the only way to verify the reliability of a NOS capacitor (especially one that has been sitting around for some 45 years) is to test it after applying its working voltage for a number of hours. The results for three .01 mfd, 600 volt black beauties are found in Table 2.

<u>Value (mfd)</u>	<u>D/A(%)</u>	<u>Leakage (uamps)</u>	<u>Time of applied voltage (600V)</u>
.01378	29	0.00	Initial
.01343	33	0.00	16 hours
.01385	27	0.00	Initial
.01380	28	0.00	9 hours
.01393	31	0.00	Initial
.01378	32	0.00	6 hours

Notice that these NOS black beauties performed quite respectably. So what kind of conclusions can be drawn? Well, based on the information offered on the web and a very unscientific test:

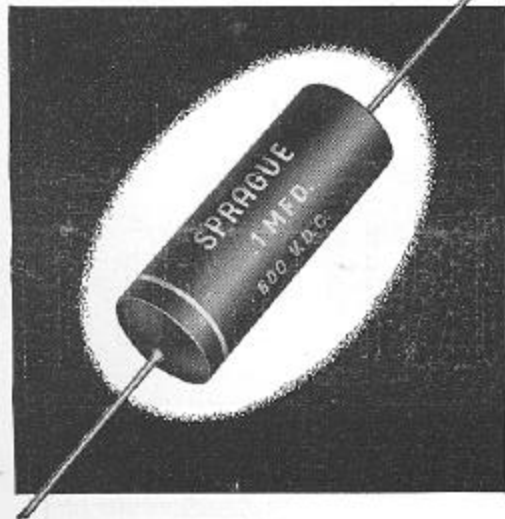
1. In general, standard capacitors are perfectly acceptable for audio, and will rarely (if ever) compromise sound quality unless used beyond their ratings or a completely inappropriate type is selected for the application.
2. Always replace Black Beauties with filler tubes.
3. If it's going to involve quite a lot of work, think twice about replacing Black Beauties produced in the late 50s (no filler tube) or using NOS for replacement applications. But if someone wants to offer you \$4 each for your used or NOS Black Beauties, I'd jump on it.

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