RESISTORS IN THE R390 SERIES

Date: Tue, 19 May 1998 18:32:36 -0500
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] Flight of the Phoenix Msg 1

<snip> Carbon resistors aren't really great, but metal film resistors are definitely inductive and don't fail the same way. Sometimes carbon resistors were chosen more as fuses than voltage droppers and film types including IRCs that looked nearly like carbon composition don't fail the same way as real carbon composition resistors. IRCs loose value with age because the heat concentrated in the carbon film chars the molded case. Imported carbon or metal films probably don't do that, but low values will have considerable inductance that could mess up RF feedback circuits. <snip>

Date: Sun, 24 May 1998 09:38:43 -0500
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: [Fwd: Re: [R-390] Orange Drop Questions]

<snip> Mouser does carry carbon composition resistors. Their part number 30BJ500-. These ought to be closest to the original RF resistors. Metal film resistors though they may fail differently should be appropriated for bypass damaged screen and plate voltage (and cathode) resistors in all stages.

Date: Mon, 25 May 1998 18:06:41 -0500
From: Nolan Lee <nlee@communique.net>
Subject: [R-390] restoration parts 'n stuff...

<snip> Most of the resistors are ok, some have increased in value to about 10% over their marked values, these I intend to replace. Notice I said most? Every 2200 ohm 1/2watt resistor in the the Collins RF Deck has increased in value to a minimum of 4K. None show signs of over-heating and none of the 2200 ohm resistors in any of the other modules or the EAC deck have increased like this. I suspect a bad lot. Weird, huh? You bet, Twilight Zone dude... <snip>

Date: Thu, 07 Jan 1999 15:09:56 -0800
From: dma@islandnet.com
Subject: Re: [R-390] Brown and Black Beauties

In my experience so far, whether or not the 2.2k resistors need replacing depends very much on who made the deck and when. I have early Motorola and much newer Capehart units that have had no bad 2.2ks. With other decks I've had to replace almost all of this value, and several

other values as well.

Some mfrs seem to have more consistently used some makes/values that aged badly. What I've found is that if one 2.2k is bad in a deck, chances are lots of others will be as well. I've also found many of the small value (27ohm, 33ohm etc.) resistors are way out of spec - also the 82k resistor in the RF Amp screen grid circuit was very high on several of the radios I've worked on. This is not good! <snip>

Date: Mon, 08 Mar 1999 21:20:52 -0600
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] Resistors

Carbon composition resistors are labeled when made by measurement. And those with 5% are ALL marked with the gold band, then those with the 10% silver band are rarely better than 5% and generally not worse when new than their 10% markings. Those with 20% tolerance tend to be more than 10% off when new. So a 10% resistor with 10% error is like new.

But carbon composition resistors are prone to drifting with age, humidity, and heat. And the only thing predictable about that drift is that it will happen. If the resistors are true carbon composition the drift generally is upward. If they are IRC (which are really metal film molded in a carbon composition size case) they generally go down because heat converts the case to carbon.

Date: Mon, 8 Mar 1999 22:34:07 -0500 (EST)
From: Norman Ryan <nryan@duke.edu>
Subject: Re: [R-390] Resistors

> But carbon composition resistors are prone to drifting with age,.....

This is news, the IRC's (the fabled "Little Devils?") being metal film in a carbon composition size case. They're OK to use in the R-390*?

Date: Mon, 08 Mar 1999 23:46:33 -0600
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] Resistors

In 1963 through at least 1966 when I worked at Collins their composition resistor specification said QPL except IRC. So IRC was not Collins approved.

So long as I wasn't choosing a resistor for secondary application as a

fuse, I've used IRCs in radios. But I recognized that they would age differently. These days, if I want stability I'd use carbon or metal film resistors that weren't molded in the IRC fashion. But I'd not use them as fuses. Also carbon composition resistors and IRC had different RF characteristics.

Date: Wed, 31 Mar 1999 04:51:16 -0600
From: Nolan Lee <nlee@gs.verio.net>
Subject: Re: [R-390] Sangamo Caps in R-390A

<snip> While you're in there, don't forget to measure the values of all of the carbon composition resistors and change any that are either out of tolerance or, if you're as paranoid as I am, any that are close to being out of tolerance.

Date: Thu, 08 Jul 1999 18:59:29 -0500
From: Nolan Lee <nlee@gs.verio.net>
Subject: Re: [R-390] the ultimate R390A manual?

>I had heard that the Navships was "better", but have never seen it.

It's "better" in that it has a very detailed parts listing and some more modern block diagrams, but other than that, the original manual is a better manual. Actually, most all of the photos in the Navy manual are copies of the original ones in the 1956 manual. ;-)

>What's important is that whatever we start with provide the best base.

Agreed. I've never seen the 1985 Navy manual. It might be the a better choice for a basis.

>I'd like to see recommended replacement types --
>400 vs 600volt OD's or other depending on what fits.

More material for the FAQ. <grin>

>Most damage prone caps/resistors flagged.

This would be a tough one too. Other than the paper capacitors, all of which should be changed, there are a couple of locations where a few micas are suspect. Then there's the acid leaking tantalum. Other than that I can't really think of any pattern of parts failures of the capacitors. Ditto for the resistors. Other than one or two on the audio deck. One pattern that I have noticed is if you measure the value of one resistor, say a 2200 ohm one on the RF deck and it's "out", there's a damn good change that every other 2200 ohm resistor on the deck will also be "out". FAQ

material...

>Resistors recommended for upgrade in wattage flagged -- requiring continued use of carbon comp vs. film etc.

There are only a couple as far as the wattage change. Metal film for the AF deck resistors and carbon comp for everywhere else. <snip>

Date: Mon, 20 Sep 1999 15:01:08 -0500
From: "Larry Shorthill" <r41656@email.sps.mot.com>
Subject: [R-390] R390A audio - which side works hardest

I have noticed in recapping a few audio modules for the 390A, that in all of the examples I have (4), that the 560 ohm cathode resistors for the local amps have been replaced at least once, and that the 56 ohm resistors in each of these amps have been replaced as well. In addition, the end of the PC board with these resistors has been pretty well cooked (possibly due to the chassis mounted power resistors near by but maybe because the local side is dissipating more). I checked all of the cathode circuit resistors for both local and line and most to all of the local ones have shifted in value, while only some of the line side resistors have shifted. I have since replaced all of these resistors to more robust film ones that have higher dissipation ratings--should be OK for audio work.<snip>

Date: Mon, 11 Oct 1999 11:39:44 -0500
From: "A. B. Bonds" <ab@vuse.vanderbilt.edu>
Subject: Re: [R-390] Checking resistor values

>My question is this: how many of the resistors can be checked "in circuit"?
>I have all the transformers pulled out, and all the interconnecting cables >are removed thereby preventing a reading through an transformer, etc. >However, are there places to watch for when checking the resistor's values?

There are a few tricky spots, but not very many. Note that the general rule is that resistors drift high. If a resistor reads high (in circuit), then you KNOW it must be replaced, since the circuit can only reduce apparent resistance. In the even it reads low, you need to look at the diagram and see what might be affecting it. My experience has been that once you heat up an old resistor to remove one lead, it gets cooked and needs to be replaced in any event. Most of the time I just trust to luck for resistors that read low, especially if they are hard to get to.

>I know I've checked a couple of them across charging
>capacitors and that case is pretty obvious as the reading continues to
>rise/fall with the cap, however other misreadings aren't so easy to see.

That's a little odd, should only happen in the audio deck.

>I have one of those copies where each "page" is broken into several subpages
>making tracing a pain.

I ended up getting the biggest practical copies (11" x 17") of each segment and sticking them together with scotch tape. Ungainly but useful.

Date: Mon, 11 Oct 1999 11:48:43 -0500
From: "Scott, Barry (Clyde B)" <cbscott@ingr.com>
Subject: RE: [R-390] Checking resistor values

I didn't think about the case of reading low that you describe. A handy serendipity to remember. As for the charging capacitors, I seem to recall they were indeed in the audio deck.

Date: Fri, 14 Jan 2000 14:19:56 -0500
From: km1h@juno.com
Subject: Re: [R-390] Metal Film Resistors

And not all are created equal either Jerry. I remember a study going back to the heyday of the TS-930 (Horrors) when a rather bored government tech on Guam decided to investigate phase
noise. He had all the required test equipment at his disposal so he decided to play (engineers call it research, us techs call it as we see it). Anyway, by replacing the existing 1/8W generic resistors with Mil-Spec 1/4W metal film in the PLL circuits he was able to reduce phase noise by an average of 10dB/Hz at 10 to 100Khz offsets. He stressed Mil-Spec as compared to consumer grade but my notes from many, many 10M QSO's do not say why. Further improvement was had by replacing all 3 terminal regulators with discreet components.

While I was at Wang Labs in the Broadband RF Networks Group one of the engineers ran a study on metal film vs carbon film resistors. The conclusion was that at frequencies below roughly 300mHz the difference was inconsequential as lead inductance was the primary player. Above that frequency, carbon film was required in critical circuits. All tests were
run with premium grade parts, not RatShack floor sweepings.

How does this realate to a 390? Dunno for sure but someone with a lot of spare time and the test equipment might be encouraged to play.

Date: Fri, 14 Jan 2000 17:49:34 -0600
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] Metal Film Resistors

> And not all are created equal either Jerry.

I'm surprised that simpler regulator circuits were less noisy and gave adequate stability compared to IC regulators. Though I know that the input capacitor on the three terminal regulators needs to be as close to the input leads as it would be on a 1296 power transistor... Not inches away to keep the chip stable, in some cases. Mil Spec resistors have an excess noise limit. Generic western pacific rim resistors don't even seem to have any specification. For sure not EIA colors. Just something close to EIA colors. There's an article on the internet about reducing the excess phase noise of the IC-211. Part of it requires working on a better VCO but most of it is in reducing the noise from the resistors in the loop, mostly by reducing their value drastically by shunting them with an RF choke. Especially the series resistor isolating the DC driver from the RF on the varactors.

> While I was at Wang Labs in the Broadband RF Networks Group one of the
> engineers ran a study on metal film vs carbon film resistors. The
> conclusion was that at frequencies below roughly 300mHz the difference
> was inconsequential as lead inductance was the primary player. Above that
> frequency, carbon film was required in critical circuits. All tests were
> run with premium grade parts, not RatShack floor sweepings.

In the 60s a Collins, the composition resistor specification vendor list read, "QPL except IRC". That was because IRC resistors were carbon film on a quartz or glass tube molded inside an insulating block (and the mold parting lines were visible the length of the resistors). These IRC pseudo carbon composition resistors don't age the same as true carbon comp resistors. True carbon composition resistors tend to rise in value with age, heat, and humidity. IRCs tend to go down in value. That's because, I believe, that the molded case gets cooked to carbon because the heat producing part of the resistor is so small a fraction of the volume compared to a carbon composition resistor that's nearly all resistor. That makes resistors employed as fuses using IRC can fail shorted, instead of open. Not what one desires in a fuse!

Date: Fri, 14 Jan 2000 17:49:46 -0600
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] Metal Film Resistors

> Sometimes I order 2 watt ceramics to replace 1 watt carbons just because
> they look closer to the original, but that's my hangup. :^)

Nothing wrong with that. Warren Bruene at Collins looked into the solid state exciter of the 250 KW 821A-1 and was appalled to see NO 2 watt resistors. It was full of 1/8th watt 1% film resistors. Warren just felt any transmitter that size HAD to have 2 watt carbon comp resistors. Just didn't feel right! I suppose I should have shown him the 1.5 KW globars in the parasitic suppressors...

Date: Sat, 15 Jan 2000 09:30:04 -0500
From: "walvwl" <walvwl@grolen.com>
Subject: [R-390] metal film vs carbon.

Occasionally, I see a post relating how someone found a carbon composition resistor that was way out of tolerance. This is not surprising. Years ago, I learned a good lesson about resistors. We needed some 330 Ohm resistors but only had 300 Ohm in stock. In a vain attempt to prove how clever I was, I simply heat the resistors over a large soldering iron until they measured the proper value. I had a VTVM connected to the leads as I did this. All was fine until the equipment was sent to a temperature cycling chamber for 6 cycles of 0 to 70 degrees C. When the test was completed, all resistors had reverted back to about 2 or 3 Ohms above what they were when I started. Fortunately, my boss took it pretty well but I learned a good lesson. I cracked open the books. What I found out is briefly listed below. Much of it is gleaned form MIL specs.

The resistor manufacturers did not have good control of the carbon mixtures during the manufacturing process. Temperature coefficient varied from batch-to-batch and was non-linear. This was even worse for resistors of less than 1,000 Ohms.

The coating on the resistors was intended as an "adequate" moisture barrier. In other words, they're not hermetically sealed.

Resistors require an "adequate" heat sink. What you say? Yes, the leads of the resistors ARE the heat sinks. A good rule of thumb is to allow at least 1/2 inch lead length on each end of the resistor. Most of the heat is carried away by the leads. Ambient temperature lowers a resistor's power

rating as well as having it mounted in close proximity to another heat generator. In other words, resistor wattage must be derated when operating in a high ambient temperature environment.

Exposure to humidity under non-operating conditions such as storage may increase resistance as much as 15%. As some have discovered, this can go even higher after 30 some-odd-years of exposure in a humid environment or climate.

Applying voltage may change resistance another 2%. This is called voltage coefficient.

Recommended maximum voltage applied across a resistor to prevent breakdown varies with the power rating of the resistor. For those enquiring minds who want to know, here it is:

1/8 Watt = 200 Volts,
1/4 Watt = 400 Volts,
1/2 Watt = 700 Volts,
1 watt & 2 Watt = 1,000 Volts.

None of these are hard and fast but are pretty good guidelines.

I've read somewhere that you can restore old stock out of tolerance carbon composition resistors by baking them in a dry oven for about 24 hours at 100 degrees C but I've never tried that. Resistors are so inexpensive that it's much easier to replace them with metal film resistors and be done with it once and for all. The only draw back is they don't look authentic if you're attempting restoration. On the other hand, it's under the chassis and it won't show. For my part, I'll take functionality over good looks.

I'm not a resistor expert and I'm not a Physicist. I make my living as a Technician. So if I've made some errors, kindly correct me.

Date: Thu, 20 Jan 2000 13:49:27 -0600
From: "Dr. Gerald N. Johnson, P.E." <geraldj@ames.net>
Subject: Re: [R-390] The book, "Passive Components"

The ITT Reference Data for Radio Engineers covers a bit of resistor drift. The ARRL handbook or the Bill Orr radio handbook did too.

For capacitors, you need a grid dip meter and a piece of blank copper clad. Solder the capacitor to the copper clad with the leads you want to see and look for a dip with the dipper. It will be. Otherwise you could use a network analyzer, but you'd have poorer control of the leads. I think

some of that was covered in the ARRLs solid state circuit design book from the 60s or 70s that they have reprinted. Probably in some of the VHF/UHF handbooks too.

I don't know that I've seen "Passive Components" though I do have a book on capacitors and one or two on resistors, but mostly concerned with wire wound power components. One was handed out to students when I was an undergraduate.

Date: Sun, 24 May 1998 08:30:46 +0000
From: "Chuck Rippel" <crippel@exis.net>
Subject: Re: [R-390] Orange Drop Questions

<snip> Use the appropriate value METAL FILM (Not carbon film) resistors in the audio deck (no where else though).

Date: Tue, 18 Apr 2000 18:17:34 -0500
From: "Dr. Gerald N. Johnson" <geraldj@ames.net>
Subject: Re: [R-390] Re: Metal Film or Carbon comp Help...!

The metal film resistor being cut into a helix will be a bit inductive at RF. But with 33 ohms in series with that L, the Q is low. I've tried to quantify that inductance but its hard even at VHF the inductance of lead wires as short as I can make them makes the detectable inductance of the helix seem negligible. Last I tried that with 22 Ohm 1/4 watt resistors I concluded that the inductance wasn't significantly different from the inductance of a solid rod the length and diameter of the resistive element, which is what the inductance of a carbon composition resistor would be. And the metal film resistor likely won't change value nearly as wildly as the carbon composition resistor even when violently abused (such as ten times rated power dissipation).

Date: Tue, 6 Jun 2000 22:00:18 -0400
From: "Walter Wilson" <wewilson@knology.net>
Subject: Re: [R-390] 2 questions from a new user

<snip> > Resistors change in value, capacitors get leaky, contacts oxidize, etc.

There are just a few things I always like to do with an R-390A. RESISTORS Check them all, especially the larger ones. Carbon resistors seem to drift higher over time, depending on how much heat they've had to dissipate.<snip>

Date: Fri, 07 Jul 2000 11:11:12 -0500
From: "Dr. Gerald N. Johnson" <geraldj@ames.net>

Subject: Re: [R-390] Paper Cap Replacement (now resistors)

Carbon composition resistors for RF circuits and fuses. Modern metal film for everything else. Though its very hard to detect any effects from the spiral element of the film type resistors at HF. Film resistors won't necessarily fail open when treated as a fuse, sometimes they fail shorted because the concentrated heat in the film chars the molded or dipped case. IRCs were not on the Collins specification because of that phenomena and the fact that their RF characteristics were different from the carbon composition resistors. The modern metal film resistors are produced by techniques similar to those for precision film resistors and so have far better temperature, humidity, and time stability than the carbon lumps of old. I've abused some of the Mallory metal film power types to ten times rated dissipation with less than .01% permanent change in value. Since the wire leads were glowing (10 ohm resistor) in the dark, there was some change in value hot. I've seen such resistors survive the complete destruction of a TV by fire. Might have been the resistor caused the fire by igniting its surrounds, but metal film on quartz rods survives ordinary fires.

Date: Fri, 7 Jul 2000 21:09:47 -0400
From: km1h@juno.com
Subject: Re: [R-390] Paper Cap Replacement (now resistors)

I prefer metal oxide for non-RF power use myself. 1,3 and 5W axial lead versions are dirt cheap at Mouser and offer exceptional overload capability. My own experience is that they always fail open which may or maybe not be a benefit. Back around 1985, Bruce Carlisle, K1BC, ran extensive tests on carbon comp, carbon film and metal film resistors while we were at Wang Labs togther in the Broadband RF Development Group. Altho not really applicable to BA's suffice it to say that carbon comp way outperformed the others in RF applications to at least 500 MHz.

Date: Fri, 07 Jul 2000 21:20:41 -0500
From: "Dr. Gerald N. Johnson" <geraldj@ames.net>
Subject: Re: [R-390] Paper Cap Replacement (now resistors)

Resistors that fail open are better than resistors that fail shorted, like the molded IRC pseudo carbon composition that tended to fail shorted by charring the molded case. (The had a mold line visible the length of the resistors with lines across the rounded ends too). I've never had a metal oxide power resistor fail, despite a lot of abuse up to ten times rated power. I suppose they could fail. I'm more concerned that they will ignite their surroundings before they will fail.

Date: Sat, 08 Jul 2000 22:58:34 -0500
From: "Dr. Gerald N. Johnson" <geraldj@ames.net>
Subject: Re: [R-390] Paper Cap Replacement (now resistors)

The IRC resistors also have a nasty tendency to go down in value when gently overloaded because the small volume of resistance material, a thin film on a glass or quartz tube, tends to char the molded case and turn it into a carbon composition resistor in parallel with the film resistor. The going up in resistance, especially while stored is a problem of the connections between the wire leads and the film resistive element.

The Flame-Proof metal film power resistors are indeed not fuel contributors to a fire (starting with the original green ones from Mallory), but then can successfully operate at a dull red glow which may ignite neighboring less fire proof materials by the radiant heat. So their neighbors may supply the fuel for the resistors to ignite. Things like waxed capacitors and transformers and none flame retardant PC board material and plastic cases.

Date: Sat, 08 Jul 2000 22:58:13 -0500
From: "Dr. Gerald N. Johnson" <geraldj@ames.net>
Subject: Re: [R-390] Orange Drops and yellow Tubulars

Mouser has a line of carbon comp resistors. So they are still available.

Date: Fri, 03 Nov 2000 09:14:48 -0600
From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@ames.net>
Subject: Re: [R-390] Resistor needed

Since IRC is a metal film, use a modern 1% metal film, you can get close that way.

Date: Wed, 08 Nov 2000 02:19:04 -0600
From: "Dr. Gerald N. Johnson, electrical engineer" <geraldj@ames.net>
Subject: Re: [R-390] resistors

If any thing the critical resistors for inductance from spiraling are the low values at VHF and up. Say 35 ohms and down, even then at 150 MHz I found it hard to separate the inductance of 1/8" of lead from the inductance of the helically cut resistor element on a 20 ohm resistor. Or to put it another way, I found it hard to get the lead inductance down far enough to be sure I was measuring resistor element inductance.

The potential problem with low value resistors at VHF is that their inductance may not result in parasitic suppression the same as a carbon

composition resistor (and there are a few such resistors in the R390(A), mostly 47 or 100 ohms in series with a grid or plate). I don't think the Q of a helically cut resistor with 100K resistance as a coil will be above .001 and so won't cause a problem of that inductance in parallel with any tuned circuits.

The beauty of metal film resistors starts with stability, toughness, and goes on to include low noise though you can't get below the Johnson noise level. (something like kTR). When the metal film is on a quartz core like the green Mallory tin oxide resistors, the resistors can withstand operating at ten times their nominal rating. They will tend to glow red and so tend to ignite their surroundings and I've found them (sans coating) in tolerance after the resulting fire. I don't know that the ordinary 1% or 5% metal film resistors will do so spectacularly. But I think they will do more than adequately in nearly all applications.

Date: Sat, 03 Feb 2001 14:51:56 -0500
From: Jim Miller <jmille77@bellsouth.net>
Subject: Re: [R-390] Bandwidth Problem?

Old resistors tend to increase in value beyond tolerances. I found several that needed replacing. Especially if they are in a screen circuit or carry B+ to a tube. Chokes can degrade with age as well due to heating.

Date: Thu, 10 Feb 2000 20:00:56 -0500 (EST)
From: Norman Ryan <nryan@duke.edu>
Subject: Re: [R-390] Audio Deck resistors

There are two sizes of resistors on the R-390A AF deck's circuit board: 1/2 and 1 watt. If you can fit 2 watt resistors where any 1 watt resistors have gone out of spec, do so. The two 560 ohm resistors come to mind. <snip>

Date: Wed, 05 Sep 2001 11:21:04 -0400
From: "Bruce Ussery" <bruceussery@hotmail.com>
Subject: [R-390] resistor question

I have found several bad resistors since starting work on my R390, and have been lucky enough to find replacements in my junk box parts. As a side project, I dug out my old Knight-Kit VTVM which I built while a teenager, since I will need it when I get around to alignment. It looks great, but would not calibrate properly. No bad tubes or caps, of course. Just bad resistors! Some 30-40% off. Tiring of digging through my junkbox resistors some of which probably got cut out of dead TVs when I was a kid), I was about to order an assortment from Digi-Key or

somewhere similar, which leads to my question. Do you guys replace bad carbon comp resistors with new carbon comp resistors, or use another type? Do we know if newer ones will eventually drift upward like so many of these from the '50s and '60s did? I have no qualms about using carbon film types in the Knight Kit, but I'm not so sure about the Collins. Maybe noise could be an issue in some circuits?

Date: Wed, 05 Sep 2001 11:57:39 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] resistor question

>.....replace bad carbon comp resistors with new carbon comp resistors, or use another type?

Use metal film or whatever else you can get. You cannot get newly made carbon comp resistors and it's a good thing that you can't. You don't want them.

>Do we know if newer ones will eventually drift upward like so many .....

Yes, we do know.. they will not drift.

> I have no qualms about using carbon film types in the Knight Kit, but.....

Baloney. Only the first RF stage in any receiver is likely to cause any trouble with noise from the resistors used, and only then if the resistor is in the signal path.

Date: Wed, 05 Sep 2001 15:49:06 -0400
From: Norman Ryan <nryan@intrex.net>
Subject: Re: [R-390] resistor question

I use carbon comps and check that they are in spec beforehand. It's a pain dealing with them because they do drift (normally upward) over time and are getting harder to come by. I get them wherever I can--hamfests, eBay, surplus stores, etc. However, if they're not overheated or kept in damp locations, they do better. I use itty bitty pure copper Mueller alligator clips as heat sinks when soldering in. Dr. Jerry explained a while back that some circuits don't like carbon comps, but I don't recall which. RF or inductive circuits, perhaps?

Date: Wed, 05 Sep 2001 20:26:25 -0700
From: antipode <antipode@ne.mediaone.net>
Subject: Re: [R-390] resistor question

"You cannot get newly made carbon comp resistors. . ."

Not true. You can still purchase them from a number of sources. Ohmite for instance still makes them. You're right though that they are probably not the best choice for use in our '390's with all the other types being produced these days. I do remember a fellow back in the '70's who rebuilt stereo amps (tube type) and used metal films throughout. I believe it was VanAlstyne Audio (he was one of my customers), and he claimed using the metal films made a big difference in the noise reduction.

Date: Wed, 5 Sep 2001 22:52:31 -0500
From: "M.L. McCauley" <mtech@airmail.net>
Subject: Re: [R-390] resistor question

I seem to remember this as well. Setting all the Audiophool BS one hears aside, it is not the case that use of modern metal and carbon film resistors yields a small, but measurable, noise reduction in small signal high gain circuits over carbon comp types? What say all?

Date: Thu, 6 Sep 2001 05:59:04 -0500
From: mikea <mikea@mikea.ath.cx>
Subject: Re: [R-390] resistor question

.....it is not the case that use of modern metal and carbon film resistors yields a small, but measurable, noise reduction in small signal high gain circuits over carbon comp types? What say all?.....

In my experience, the modern metal and carbon film resistors do induce less noise than the carbon composition resistors. I have noticed that they are pretty much the rule in professional (not audiophool) small-signal audio mixers and preamps, and that the carbon composite resistors are very much the exception there.

Date: Thu, 6 Sep 2001 08:14:26 -0400
From: Tom Leiper <twleiper@juno.com>
Subject: Re: [R-390] resistor question

Just take a look inside ANY piece of quality instrumentation, such as a Tektronics scope, and see if you can find any comp resistors in circuitry that handles signals or precision regulation. And I am talking about any over at least the last 25 years.

Date: Thu, 06 Sep 2001 09:47:25 -0400
From: "Bruce Ussery" <bruceussery@hotmail.com>
Subject: Re: [R-390] resistor question

Saw carbon comps still available in Mouser catalog, but looks like I'll be using something else. To keep it looking original, maybe we can come up with a way to "over-mold" metal film resistors with some sort of brown material that's impervious to moisture and heat, sort of like when we put modern electrolytics in old metal cans. Painting those stripes on is gonna be a bear... In the mean time, I'll order some "monster" coax and get all my RF connectors gold plated. I wont even need an antenna :-)

Date: Thu, 6 Sep 2001 11:08:10 -0400From: "Helmut Usbeck" <vze2gmp4@verizon.net>
Subject: Re: [R-390] resistor question

One area that hasn't been covered with this resistor question is a problem I had a couple of years ago with an audio amp I was building. Most modern film type resistors have a voltage rating of 250 volts DC. Deposited types can have a much lower rating than that. With the project I was doing I had a problem with film types opening up on me and also changing value. Yes, they will change value. I went back to IRC where I purchased them and they filled me in on this info. They also sent me some data sheets on resistors which proved interesting. The problem had nothing to do with the wattage rating but voltage flashover. Using these types the circuit I had using 350-400 vdc. did damage them. Went back to the composition type and all was well. I've replaced resistors in my 390a with newer type resistor and haven't had any problems, more than likely since B+ voltages in a typical 390a dont run more than 210 - 240 (normally). There's also film type resistors being made that that have tin plated steel leads that are just bad news. Used in many consumer products nowadays. The specs on these things are just all over the place. Radio Shack seems to specialize in these. Also when buying resistors from Radio Shack or other places such as Jameco check the values. Its not unusual to find things like 100K resistors measuring 10K. They're not off value but mismarked color code. Discount parts places get many if not all there parts as surplus from manufactors that sell these things in bulk as off spec items. Manufactorers sell them seconds but the info about this is not passed along to the retail buyer. This includes transistors, IC's caps, just about anything they have hanging on there boards in blister packs. Stick to buying parts from "real" part houses and using known name brands and you cant go wrong.

Date: Thu, 6 Sep 2001 09:51:32 -0700 (PDT)
From: Joe Foley <redmenaced@yahoo.com>
Subject: Re: [R-390] resistor question

>Yes, they will change value. I went back to IRC where I purchased
>them and they filled me in on this info. They also sent me some data

sheets
>on resistors which proved interesting. The problem had nothing to do with
>the wattage rating but voltage flashover.
++++++++++++++

Interesting that this should come up now! I'm trying to make a current meter for my R-390A power panel. What I need to know is, what is the voltage rating on the resistors that I want to use for metering resistors? I've got some Ohmite Dividohm wire wound resistors but the turns look too close for 125 volts. Are these rated as to applied voltage?

Date: Thu, 6 Sep 2001 14:01:42 -0400
From: Tom Leiper <twleiper@juno.com>
Subject: Re: [R-390] resistor answer

It would be too close if there was only one turn, but the actual voltage between turns is small. For instance, if the resistor in your application had 125 turns, the voltage between turns would be only 1 volt. Don't worry, be happy. For those of you who simply must get carbon comps, I have a rather large inventory from a military manufacturer that was closed down years ago (RadaLab) in nice little labeled bags. I've used them for most of my SP-600 restorations with good results. If somebody needs a few, and I mean a few, just let me know, and if I have them I'll mail'em to you. They are not for sale unless they plant me, in which case you can check with my heirs.

Date: Fri, 07 Sep 2001 00:19:11 -1000
From: Raymond Cote <rjcote@hawaii.rr.com>
Subject: Re: [R-390] resistor question

We here at the University of Hawai, since we are always trying to minimize noise sources in small signals found metal film to be les noisy than the carbon types, when available. Seems to me that there was a problem with the higher values over 4 meg? I think we still had to use the carbon resistors for the higher values. On another note, I have a large collection of Carbon comp resistors, 1/2, 1 and 2 watt sizes if anyone is hard up for some especially after this thread. :o)

From: "scott" <polaraligned@earthlink.net>
Date: Sun, 28 Jul 2002 20:32:13 -0400
Subject: [R-390] Resistor Tolerances

I got my "A" IF deck recapped today. Probably half the resistors are more than 10% high but less than 20%. I did not replace any of these. Does anyone know if there are any resistors that I should hold to 10% or less?

I would think that 15%, of which most were, would be OK. I tried tuning in to 14.283 and BARELY was able to hear mention of satellites. I then tuned down to 14.279 and was able to hear nothing. I tried this using a SX-71 and a DX-160. The DX-160 performed better BTW. So now I really want to get this "a" back together so I can eavesdrop on future Sunday afternoons. :-)

From: "Greg Werstiuk" <greg_werstiuk@msn.com>
Subject: RE: [R-390] Resistor Tolerances
Date: Sun, 28 Jul 2002 19:44:59 -0700

Scott - I assume the resistors used in R-390x's are carbon composition. Moisture absorption alone will shift their tolerance up to about +-20%. When they were more commonly used (20 years ago), I occasionally had to educate customer incoming inspection departments claiming to have received "out of tolerance" product with the proper method for measuring the resistance value of carbon composition resistors. Among other requirements, before measuring resistance, they must be baked for a specific period of time at a specific temperature to eliminate absorbed moisture.

Date: Mon, 29 Jul 2002 07:22:15 -0400
From: JAMES T BRANNIGAN <jbrannig@optonline.net>
Subject: Re: [R-390] Resistor Tolerances

There was an article in QST several months ago that was a real "eye-opener" about stored resistors.

From: "scott" <polaraligned@earthlink.net>
Subject: Re: [R-390] Resistor Tolerances
Date: Mon, 29 Jul 2002 07:45:03 -0400

Well I never buy NOS resistors and certainly not caps. Baking resistors before measuring tolerance is just not the real world, even though most boat anchors do just that. :-) The real question I have is: If the tolerance needs to be held to original specs on any specific areas of this set. I am trying to rely on someone's experience to save me a lot of needless work now or in the future. Most of the TV and radio restoration work I have done, +15% is OK, even on a 10% spec resistor, and I have not had performance problems as a result. Of course if a 5% is specifically called for, I will hold it to tighter tolerances. Most, if not all, of the resistors seem to be 10% in my modules and I am thinking that this was just a military requirement rather than an necessity.

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From: "John KA1XC" <tetrode@worldnet.att.net>

Subject: Re: [R-390] Resistor Tolerances
Date: Mon, 29 Jul 2002 08:20:40 -0400

Scott, no need to be precise on most of the resistor values, the ultimate answer will be found when you finish your work, align the radio and make some measurements. How sensitive the circuit is to the resistor value depends on where the resistor is in the circuit. The resistor values used in B+ decoupling (2.2k), grid input, grid parasitic suppression, or audio plate are not critical at all. *The values used in the voltage dividers for the screens are a little more important, and the cathode resistors probably make the most impact as they set the bias level for the tubes.* (Don't forget that tubes have fairly wide tolerances too and drift over operating age as well).

If you measured all the resistor values in your radio and you didn't find anything that was way out or broken then you already made great progress. In the past when I have done this I've found resistors that were 50% or more out, or even one that was 10 times out (somebody in depot repair didn't pay attention to the last color band). 390nonA power supplies are another matter, there's always crispy critters in there!

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Date: Mon, 29 Jul 2002 10:55:15 -0400
Subject: Re: [R-390] Resistor Tolerances
From: Thomas W Leiper <twleiper@juno.com>

> Most, if not all, of the resistors seem to be 10% in my modules .....

I am "resisting" the "requirement" to respond, but my "tolerances" have been exceeded by over 10%. Certainly any aspect of the original construction was a military requirement and not necessarily an operational requirement since many things can be changed that actually improve performance in some ways. But by trying to hold tolerances tight, they are trying to hold the performance to a predictable level so that when it is put into service they know what to expect, and not have one radio being "hot" and another a "dud". Imagine if you went to by another Questar and the specification was plus or minus a half wave...

Date: Mon, 29 Jul 2002 10:53:18 -0500 (CDT)
From: Dave Merrill <r390a@enteract.com>
Subject: Re: [R-390] Resistor Tolerances

While in college, I had a part time job as a tech in the TV engineering department of a now-defunct Chicago manufacturer. This was back in the days when all the BW sets were tube and the color sets were hybrid. Part of my job was to do 'r-box engineering' on existing designs - remove a

10% resistor, substitute a resistor box and run the value +/- 20% from the schematic value to determine if a 20% part could be used. Saving a fraction of a cent here and there adds up when you're making thousands of units. Much different design objective than military gear where cost isn't the most important criteria.

From: "scott" <polaraligned@earthlink.net>
Subject: Re: [R-390] Resistor Tolerances
Date: Mon, 29 Jul 2002 13:19:09 -0400

Thank You John. That is the answer I wanted. I'll watch out for the screen dividers and the cathode resistors especially, and keep them within the recomennded tolerence. The other resistors, I won't worry if they go a few percent over.

From: "Greg Werstiuk" <greg_werstiuk@msn.com>
Subject: RE: [R-390] Resistor Tolerances
Date: Mon, 29 Jul 2002 22:16:24 -0700

I wouldn't expect you to bake them. While it's not "real world" in a test bench environment, I promise you it is "real world" during equipment manufacturer's incoming inspections and during military audits of component vendors. I only wanted to be sure you knew the measured value could be significantly shifted by moisture absorption. This would have been understood and accounted for during the design. As a result, a 5% or 10% rated carbon composition resistor with a measured value in the +- 20% range shouldn't necessarily be considered a component requiring replacement.

From: "Drew Papanek" <drewmaster813@hotmail.com>
Date: Tue, 30 Jul 2002 13:26:41 -0400
Subject: [R-390] Re: R-390 Resistor Tolerances

An observation about the effect of resistor tolerances in the R-390 series: The value of many resistors in the IF deck could vary over a wide range with little practical effect. Screen and cathode resistor variation would have an effect on gain but remember that the potential IF gain is much higher than necessary or desireable. When all is said and done, we simply adjust the IF Gain control far below maximum thereby obtaining best noise figure.

Date: Tue, 30 Jul 2002 16:56:36 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Re: R-390 Resistor Tolerances

BUT.... If you increase the IF gain to compensate for one low-gain RF

stage, or one low-gain IF stage, you are disturbing the gain distribution of the radio as a whole and, under certain circumstances, the thing will perform less well than if you'd fixed that low-gain stage properly. I agree with you that this condition will bring little practical effect though.

From: "Kenneth Crips" <w7itc@hotmail.com>
Date: Sat, 31 Aug 2002 19:26:46 -0600
Subject: [R-390] Electronic question

A question, I smoked four resistors in My TS520-SE. My fault, I did an idiot job tuning it. The resistors are on a circuit board controlling the grids, plates and modulation of the 6146B finals. no real harm, just have to dig through the resistor stash and install another set. The resistors in question are all 4000 ohms 1/4 watt carbons. The four are installed in parallel sets, the rule as I understand it is resistors in parallel are always half the lowest resistance, in this case it should be about 2000 ohms. Why do it this way. Why not just use a single 2000 ohm resistor. The only reason I can think of is it is a size thing. The area where this circuit board is located is on the bottom below the finals and there isn't much room. What say you out there oh great Guru's of the Order of St Videcon.

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Date: Sat, 31 Aug 2002 21:47:46 -0400
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [R-390] Electronic question

Ken, I'm not clear on the function of the resistors. They may be in parallel for heat dissipation or inductance considerations. In any event, it is always better to follow the original design when replacing components, particularly in power RF circuits.

From: "Bob Camp" <ham@cq.nu>
Subject: Re: [R-390] Electronic question
Date: Sun, 1 Sep 2002 10:03:51 -0400

This gets into the "strange but true" section of electronic components. Carbon comp resistors behave in an odd way at RF. You would expect them to get inductive or capacitive as frequency goes up but they don't. Oddly enough they simply get lower in value as frequency rises up to a couple hundred MHz. The data I have seen was from the 1940's and applied to values above a couple of hundred ohms. It's been about 30 years since I read the paper but as I recall the drop off was at a different rate for different sized resistors. The net effect - replace carbon comps with carbon comps if there is RF on them. If it's a DC circuit then go for something that is less humidity sensitive.

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From: "Kenneth Crips" <w7itc@hotmail.com>
Subject: Re: [R-390] Electronic question
Date: Sun, 01 Sep 2002 11:53:07 -0600

Re: Carbon comp resistors and RF

This gets into why I find technological history so interesting. In this case it's the reason why something was designed in a particular way. A good example is the receivers of Hammerlund and Collins. Two engineering teams designing a device to do the same thing, and their solutions to get the job done; Fascinating!

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From: "Jim Miller" <jamesmiller20@worldnet.att.net>
Subject: Re: [R-390] Resistors for the R-390A and beginner help
Date: Mon, 13 Jan 2003 20:34:28 -0500

My opinion: After restoring a 51S1, KWM-2A, two 75S3B's, a 32S3, a 75A4 and
two R-390a's, here is my advice: Don't replace the resistors unless you have to. As they age they do tend to drift out of tolerance. The best way I know of is to get a diital VOM and measure each one (in a hi impedance tube circuit you can usually measure most of them at the tube socket pins without unsoldering one end, power off of course). if they are within spec-ed tolerance (e.g. 10%), leave them alone. if they look blackened, swollen or burned, then they are good candidates for replacement. In my experience with the above radios, the the resitors that have tended to be out of tolerance have been screen resistors, resistors in the plate circuit, or cathode resistors, since they are usually carrying the most power. Do not use wirewound resistors to replace carbon resistors as they have an inductive characteristic. Also, beware of "black beauty" capacitors. Check some of the various restoration pages for a list of problem capacitors that should be replaced immediately, such as ithe cap. that couples to the mechanical filters in the IF module. And tighten all hardware, especially screws that mound tube sockets to the chassis. Repeated heating and cooling cycles will cause them to loosen resulting in poor grounding ove time. Do not spray bandswitches with contact cleaner or deoxit... in high impedance circuits the residue will conduct enough to screw up the circuit
performance, especially AGC. If you have to, use a very small swab to selectively clean switch contacts. As soon as the rotary switch phenolic material absorbs the spray, you're outta luck. Good luck. Jim N4BE

Date: Mon, 13 Jan 2003 20:55:52 -0500

From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Resistors for the R-390A and beginner help

One important point about the carbon composition resistors - they never were in tolerance !!!! It turns out that in order to properly check a carbon composition resistor you have to "stabilize it's moisture content". This used to involve baking them in an oven for a while to dry them out. This would tend to increase their resistance. If you left them in the oven to long they went out of tolerance on the high side. The radio was designed with this kind of behavior in mind. The guys at Collins didn't know everything but they certainly knew about carbon composition resistors. I just wish they had figured out PTO's about three years earlier .... another story.

Anyway, **except for the cathode bias resistors** just about every resistor in the radio will do just fine at 1.5X it's original value. A lot of the resistors will do fine at 2X the marked value. It's not worth changing them out unless there is a voltage off somewhere in the radio. Simply changing out every resistor that measures more than 10% off from marked value is a good way to ruin a radio. You will do more damage to the radio than the improvement you will get from fixing something that isn't broken.

Huff, puff. Hard to stomp and shout so much late in the evening .....

From: "Jim Shorney" <jshorney@inebraska.com>
Date: Mon, 13 Jan 2003 20:22:27 -0600 (CST)
Subject: Re: [R-390] Resistors for the R-390A and beginner help

Don't even buy the spray. I learned my lesson about sprays when I smoked an HW101 mode switch in about 1976. I got deoxit in the needle-tip applicator bottle. It's been through several radios, a couple of stereos, and has been loaned to a friend, and the bottle is still about 90% full. The 390a _might take it down to 85%. Probably not.

From: "Tom Warren" <wwarren1@nc.rr.com>
Subject: Re: [R-390] Resistors for the R-390A and beginner help
Date: Tue, 14 Jan 2003 07:04:56 -0500

So Bob (actually, I'm serious), how about telling us about PTOs and Collins' troubles in getting them designed. I've seen one or two things, but haven't found the articles where the Collins boys talk about the drifting permeability of the iron oxide (or is it ferrite?) cores and the shrinking coil forms. Where is this all discussed.

It'd be nice to hear a bit more discourse on why the radio can stand a

wider tolerance band than is specified. Except for about 7-10 places (excluding the very few resistors in parallel with an inductor) in the entire radio, you can measure all the resistors as if they were out of circuit. Seems to me that I actually lifted only one resistor in the IF deck to accurately measure its resistance. There are those 7-10 places where resistors are in parallel with the one you want to measure, and generally it's simple to do the parallel equivalent and measure that number. It's slightly more complex, but not much. The only resistor in the entire radio I really quake at replacing is a two-watter buried under the mech filter switch and up against one of the shields. Fortunately, that one wasn't bad in both my radios. Also in tight places, you can leave part of the old component lead then use a bit of 1/16" copper (copper, not brass, as copper is easier to solder) tubing (available from many hobby stores) as a sleeve to fit over the end of the new component and the old lead. Crimp on the end of the new component and solder in. Doesn't look too bad and serves the purpose. Others will suggest wicking the old solder from the original joint of the old component and resoldering that in addition. If more detail is needed, write me, and I'll find some old e-mail correspondence.

PS: I'm currently working on a Progressitron and a Cosmos. Among other reasons, that's why I want to know.

Date: Tue, 14 Jan 2003 20:43:15 -0500
From: Bob Camp <ham@cq.nu>
Subject: Re: [R-390] Resistors for the R-390A and beginner help

Well we'll save the PTO stuff for another time. Most of it has been discussed here or in the magazines. There the *theory* on the resistors: First you grab your handy copy of Mil-Hbk-217 and look up reliability of carbon comp resistors. The interesting little note there mentions that the entire failure rate listed is for value change. Hmmm so if I can tolerate a larger value change I don't have to count the failures of the resistors in my MTBF calculation you say. That's what it says. Official DOD handbook, the note's been there forever and ever. Next you dig back into the lore of carbon comp's and find that the values never did stay put very well. This all in mind we take a look at some circuits:

I started to do this in detail on the front end of the radio and it quickly got far more difficult to explain than it's probably worth. Here are a couple of examples:

The resistors off the AGC line going to the grids of the tubes form an attenuator with a ratio of say 80%. In other words one resistor is 1/5 the size of the other one and you get 8 volts on the grid for every 10 volts of

AGC voltage. Let's say that one resistor is 270K and the other is 1.5 meg ohm. The ratio in this case should be 1500/(270+1500) = 0.85. If both resistors go up by 50% the ratio stays the same and nothing much happens. If only one goes up by 50% you get 1500/((270*1.5)+1500) = 0.79. That's not much of a change in the attenuator. Now you get about 7% less AGC voltage on the tube. Given that you will see >20% variation between new tubes 7% isn't going to hurt anything.

Next you have decoupling resistors. They are the first thing off of the B+ line going to the screen or to the plate. Most of them only have a couple of volts drop under normal conditions. The B+ will vary by 20% or so as the line voltage swings. In order for any of the decoupling resistors to start messing up things they would have to increase their drop by say 30 or 40 volts. That's a lot of change for a resistor that starts out with a <10 volt drop on it.

Next up are the grid bias resistors. Most of them seem to be a meg or so. Since grid current should be darn near zero ua they should have < 1 volt on them. A doubling in the resistor *might* get them up to a volt on a good day. Go down to the tube store and ask for a set of tubes matched to < 1 volt on the grid. Have your American Express card ready :)

Now for the cathode bias resistors. These do set the stage current, especially on the triode stages. Cut down the current by a factor of two and the stage gain will drop a bit. Age the tube for a couple of years and the stage gain will do the same thing. Cutting the current here isn't a good thing but it happens anyway. The function of gain to resistor value is a little complex but at least you can say that the resistor has to more than double to cut the current in half. A perfectly normal set of tubes out of the same batch will spread 1.5:1 on idle current. Trying to get things any closer than this can be a pain. The audio guys go to a lot of trouble on that sort of thing.

I realize that does not cover every resistor in every circuit in the radio. It should give you a pretty good idea what is going on though.

Let me know if any of it makes any sense.

From: "Tom Warren" <wwarren1@nc.rr.com>
Subject: Re: [R-390] Resistors for the R-390A and beginner help
Date: Tue, 14 Jan 2003 21:02:53 -0500

Makes perfect sense. Now that I see where you're going, I'll take a serious look at a bunch of the circuits there and see if I can find any holes in your analysis. I suspect there are no holes. I've been following the other

compulsive types on this net (Nolan, where are you??) who replace the resistors if they're out of their reputed tolerance band. My Motorola IF deck had about 15 resistors out of spec (along with two dead mech filters, two IF cans with stuck slugs, and the usual capacitor replacements). My pristine EAC'67 is in much better shape, having replaced fewer than a half dozen resistors plus all the usual caps. I'm glad you brought up this point about the design brilliance of the Collins boys in that drifting resistors don't bother the performance as much as I would have thought. I'll look up MIL-HDBK-217 also. I think it's still around somewhere.

From: "Drew Papanek" <drewmaster813@hotmail.com>
Date: Wed, 15 Jan 2003 17:23:43 -0500
Subject: [R-390] Resistors, SSB

<snip> On replacing leaded caps/resistors in those crowded spaces: Trying to undo the connection from a tube socket pin or other terminal often does damage. Cutting out old component leaving a stub at the terminal and splicing in new component using small copper tubing sleeves was a good suggestion. Alternatively, the new component's leads can be coiled using a piece of the old component's lead as a form, and these coils slipped over the aforementioned stubs and soldered. This works especially well if new component has smaller diameter leads than old. Such would be the case when using 1/4 watt carbon film or metal film resistors to replace old 1/2 watt units (calculate dissipation to determine suitability of replacement).

Unless they're cooked, leave those 2.2K decoupling resistors alone. As Bob pointed out, the variation in voltage drop across these (due to drifting out of tolerance) is miniscule compared to changes brought about by line voltage variation and normal gm tolerance range of tubes. Of more importance would be screen and cathode resistor values. For IF stages after "mechanism a philharmonic" (that funky fractured translation of "mechanical filter"), resistor values become less critical. This is because that section of the IF chain has much more gain than needed and we reduce it anyway by tweaking IF gain pot for best S+N/N ratio. Drew

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From: "Phil Atchley" <k06bb@elite.net>
Date: Mon, 7 Jul 2003 01:58:54 -0000
Subject: [R-390] Them sneaky resistors

Hi. Since I've been waiting for the PTO and the capacitors to arrive so I can finish the overhaul of this R-390A receiver I've had time to spend a little extra time checking and re-checking components in such places as the IF module, audio module etc. So far everything has checked in spec resistance wise. Except that is for one resistor in the screen circuit of

V508. It should be 47K and was 104K. Now, I went through that amplifier very methodically from one end to the other THREE times before finding it on the third trip through the module. Now, either a gremlin crawled into that resistor between the second and the third check OR I somehow overlooked it on the first two passes, and I went through it with a fine toothed comb! Since V508 is the AGC amplifier this could cause weak AGC action when I finally get the set finished.Moral of the story? You can't check those old resistors enough times!

From: "Bill Smith" <billsmith@ispwest.com>
Subject: Re: [R-390] Them sneaky resistors
Date: Sun, 6 Jul 2003 19:34:01 -0700

I doubt you missed your failed resistor. I recall recapping and checking resistors in a HRO-7R. The set played fine, but died about two weeks later. I was rather surprised, but opened it to find several of the 470K resistors had opened up. I replaced them and thought my troubles were over. They were, for another two weeks or so. To make a long story short, I replaced all the 470K resistors in that set. National seemed to use a supplier who provided particularly poor resistors (at least from a longevity standpoint). I have found more poor resistors in those receivers than any of the other popular manufactuers. Interestingly, there was no obvious current or temperature change that could have affected the faulty resistors. Most were in grid circuits, used to decouple the AVC line, for example. Perhaps the shock of the temperature change when unsoldering associated bad capacitors started some sort of process. At any rate, it doesn't seem that unexpected that running your set will affect some of the components and some of them can take a while before they obviously fail.

From: krkaplan@cox.net
Date: Mon, 07 Jul 2003 15:08:03 -0700
Subject: [R-390] Re: Them sneaky resistors

Wow - same problem here. Just yesterday I had to replace a couple of resistors in the RF Amp of a National NC-98. One was a 470k control grid resistor and the other a 47k screen grid resistor. They were as open as a blown fuse. I examined them under a 10x magnifying lens and could see no signs of over-heating or any other kind of stress. Down with carbon comps <g>...

From: "RJ Mattson" <rjmattson@hvi.net>
Date: Tue, 29 Jul 2003 00:48:27 -0400
Subject: [R-390] I.F. SubChassis carbon resistors.

After checking all the carbon resistors in the IF deck, I found seven that are way high. The rest are hitting the high limit of the 10% tolerance. My collection of NOS 5% carbons are now 10% tolerance or worse. This doesn't give me a good feeling. Would any of the new technology 1/4 resistors be acceptable for RF applications and have long term stability? Bob

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From: "Phil Atchley" <k06bb@elite.net>
Subject: Re: [R-390] I.F. SubChassis carbon resistors.
Date: Tue, 29 Jul 2003 05:08:20 -0000

I use the modern "film" resistors in RF circuits of various receivers all the time and have never had a problem. However, for "most of the resistors in the R-390a you will want to use the 1/2 Watt resistors. In high impedance circuits the film resistors should actually be "quieter" though there are various opinions on that.

From: "Larry Shaw" <larryshaw@alltel.net>
Date: Sat, 1 Nov 2003 18:45:09 -0600
Subject: [R-390] recap

I agree about the resistors I worked on R-390's and the old Facsimile machines in St. Louis in 1961 at Jefferson Barracks. The resistors in both machines had almost become open. 1 meg to 18 meg. We went to a local electronics shop and fixed the problem so we could go home. It must have been a bad batch but we Got it fixed. Seemed to be the high value 1 meg and above that caused the problem.

Date: Tue, 27 Jan 2004 16:13:47 -0600
From: mikea <mikea@mikea.ath.cx>
Subject: Re: [R-390] That's more like it!!!

> I ordered the "Experimenters" kit of 1% metal film resistors from Mouser.
> To my dismay, they use a completely different color code scheme and the
> colors are not as vibrant as on the old resistors, they to be inspected
> carefully so the right value is selected.

I tend to do my inspection of resistors with an ohmmeter. Small labels with the value written on get wrapped around one lead. Very much more difficult to do with SMDs, but I avoid them anyway, in favor of stuff where I can read values without a magnifier.

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Date: Tue, 27 Jan 2004 17:26:07 -0500
From: Jim Brannigan <jbrannig@optonline.net>
Subject: Re: [R-390] That's more like it!!!

I finally learned to check all components before using them. As I get older the round lighted magnifier lamp has become my best friend. BTW, I have been dumping my old "junke Boxe" parts and replacing them with new stock from Mouser, Allied, etc. I don't know how long these places stay be in the retail, small quantity business and if I am going to put all the effort into replacing components, it seems reasonable to use new parts instead of the 30 year old dregs from the junke boxe.

Date: Sun, 25 Jul 2004 14:27:19 -0400
From: Bob Camp <ham@cq.nu>
Subject: [R-390] Carbon Comp Resistors in RA.17's, RA.117's and R-390's

This also relates to the resistors in the R-390 carbon composition resistors in the R-390 so it is worth repeating here.

Carbon comps came in three flavors 20%, 10% and 5%. A lot of people have commented that the 5% tolerance was more a wish than a specification. A 10% 1K resistor that reads 912 ohms is still in specification.

In order to check a carbon composition resistor for value there is a bake out procedure you have to go through. I don' t remember it exactly but 48 hours at 125 C sounds about right. The value of the resistor was measured something like 24 hours after it returned to room temperature. On the R-390 most of the carbon composition resistors are 20% tolerance parts. They tend to drift up in value with age. As far as anybody can tell the radios work every bit as well with resistors that are 30% high as they did with resistors that are on value. Every time we swap out a part on these radios there is a risk of damaging something else on the radio. I would only swap out parts that I am sure are a problem. I'm not suggesting that you keep the BBOD's in the radio, or that you do a ten hour test of every part you swap out. I'm only suggesting that you be reasonably sure the reward from replacing the part is worth the risk of damage.

Date: Wed, 5 Jan 2005 22:30:19 -0500
From: "richard may" <rtmay@htn.net>
Subject: [R-390] re: wiring harness

Thanks to all who helped me find a wiring harness for my receiver. After

tracing the wiring, I found that R124 located on the circuit board above the readout was burned beyond recognization. Darned if I can find it in my TM. Can somebody help? Thanks, Richard May, W8FCW,

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Date: Wed, 5 Jan 2005 21:40:42 -0600
From: "WD5JWY" <wd5jwy@tekwav.com>
Subject: RE: [R-390] re: wiring harness.

R124 RESISTOR FIXED, COMPOSITION: 2.7 OHM 1 WATT (per the Y2K manual)

Date: Wed, 5 Jan 2005 21:51:16 -0600
From: "WD5JWY" <wd5jwy@tekwav.com>
Subject: RE: [R-390] re: wiring harness.

FYI - from looking at the schematic, R124 is used as a current limiting resistor and supplies current to both I101 and I102 (dial lamps) from the 6.3 volt winding on T801 (power supply chassis). If R124 is open, both I101 and I102 should not be working. Possibly one of the lights developed an internal short which forced R124 to act like a fuse and burn open. I would check and/or replace the dial lamps prior to replacing R124. The dial lamps are both type #328 bulbs, by the way. Just some thoughts.

Date: Mon, 10 Jan 2005 21:45:10 EST
From: DCrespy@aol.com
Subject: Re: [R-390] Servicing Advice on Signal Generator URM-25D

Dallas' note below.. He makes a great point, if it isn't broken, don't ..... About resistors, just check the resistances from the tube pins to ground (most manuals have a chart). I usually find at least one with a problem to correct. Otherwise, no wholesale replacements. (I confine recapping to electrolytics and black beauties.)

Date: Mon, 10 Jan 2005 20:47:28 -0600
From: "Dallas Lankford" <dallas@bayou.com>
Subject: Re: [R-390] Servicing Advice on Signal Generator URM-25D

The tube pin resistances seldom correspond to the values of resistors in an R-390A (or other receiver). And some of numbers in the tube resistance charts are not even correct. I have yet to see a resistor in an R-390A, other than one that was burned brown or black (due to a short or whatever), that needed replacing. Like I said, if you want to know the value of a resistor in an R-390A, you will usually have to "lift" one end, and then you might as well go ahead and replace it. But then we are back to the "resistor replacing" game, aren't we? (though perhaps not what

the original rersistor replacers intended) <snip>

Date: Tue, 03 Jan 2006 09:37:36 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Resistors

>....but WHAT is a LOW NOISE RESISTOR?.....

A perfectly good question! It turns out that anything that is not very very very cold makes electrical noise. (That means near absolute zero - minus 273 degrees Centigrade or some such.) The phenomenon is based on the fact that molecules move about if they are at any temperature above absolute zero. This does not matter much to R-390A/URR users, though it does to folks doing radio astronomy and folks building detectors to sense submerged submarines from bumps in the earth's magnetic they produce. But I digress. If you put some current through a resistor, the material makes additional electrical noise. Some resistor materials make more than others, current and voltages being equal. It appears that folks who build phonograph cartridge amplifiers and low noise VHF receivers can tell the difference between such resistors. Almost all the noise from a properly aligned R-390A/URR receiver is generated in the first RF amplifier tube. It's quite possible that if the resistors around that tube are particularly noisy, they will contribute a noticeable amount to the receiver noise. If the IF gain is set very much too high, the IF amplifier will make noticeable noise. This is bad. Any IF amplfier makes measurable noise, and Roger has been telling us how to measure that, and to select tubes to reduce that noise. Additional noise is generated in the mixer tubes. Some tube substitutions suggested in modification articles make less noise than the ones normally used in the R-390A. I have not tried these changes, but I hope to one day. I have a spare RF deck for the purpose. It's the opinion of experienced radio users that very very few of us live in places where the received noise level is low enough so that the noise generated in a receiver is of much matter at all. On HF, that is. Above 30 mc it's a different matter. Faulty (that is leaky) RF and IF bypass caps definitely make noise. After you have found this going on, and fixed it a number of times, the noise from this source is quite distinguishable from other noise. It's sort of like telling the difference between an oboe and a clarinet. As I understand it, carbon composition resistors are favored by the high fi builders for low noise and for other differences they hear in the sound. And they also report that some other resistors are better for noise. I would be glad to hear about any perceived or measured differences in noise in the R-390 receivers due to resistor changes..

Date: Tue, 03 Jan 2006 10:39:43 -0500
From: Barry Hauser <barry@hausernet.com>

Subject: Re: [R-390] Resistors

Thanks for the explanation. Of course, now I'll be listening for oboes and clarinets ;-). It's difficult to say what the audio builders think as a lot of that stuff is now mixed with lore, urban legend, and maybe a large dose of hype (as in monster cables, oxygen, etc.) I think part of the reason for favoring carbon comps is avoidance of inductance or capacitance introduced by metal or carbon film resistors -- whether real or imagined. Some audiophile restorers seem to be looking to preserve whatever component characteristics inherent in the old tube designs -- good, bad or indifferent -- to maintain that warm, fuzzy 50's feeling or whatever. This ranges into the fringe area where used Black Beauties fetch high prices. This is not to poke fun -- I really don't know -- but merely suggest that the reasons for favoring this or that type of component do not necessarily fall along familiar parametric lines, known elements of the laws of physics and chemistry, electricity, etc. I suppose if your objective is to retain authentic performance, including distortion and noise, it would make sense to stay with components of identical or similar construction -- providing functional components of the type can be found today. As I recall, there was a thread some years ago about whether or not a modern carbon film resistor might cause a problem somewhere in the R-390A if used as a replacement for a carbon comp. I think the conclusion -- at least the one I drew from the thread -- was that it might affect one or two areas, but generally no problem and not worth worrying about..

Date: Tue, 03 Jan 2006 08:04:35 -0800
From: "Kenneth G. Gordon" <kgordon@moscow.com>
Subject: Re: [R-390] Resistors, noise, etc.

Actually, there are TIMES, even on 160 meters, when the external noise level IS low enough to hear receiver noise. However, external noise levels ARE getting worse. Back in the late 1960s, I found that receiver noise was definitely an important factor at 14 Mhz and above.

>.....carbon composition resistors are favored.....

A recent article in ER magazine by Ray Osterwald on the restoration and enhancement of the SX-101A covered resistor noise in quite good detail. HE says that carbon comp resistors are the noisiest, and has data to prove it. He also discussed capacitors in the same article. This is one of 4 or 5 articles on the SX-101, and is well worth the read for the information it contains which apply to our R-390s.

Tuesday, 03 Jan 2006 12:49:40 -0500

From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Resistors

>I.....favoring carbon comps is avoidance of inductance or capacitance ....

I don't remember the details from the tests one fellow did on metal film resistors, but my conclusion from the data was: Just Don't Worry About It. The fact is, very very few resistors in the R-390 are actually used with RF or IF on them. The rest are bypassed thoroughly. Does the R-390A/URR use IF coil snubber resitors? I think the R-390/URR does, and it was a mistake to snip them out to get narrower passband and higher gain.)

>Some audiophile restorers seem to be looking to preserve.....

Yes, that makes sense. I have not yet had the chance to compare sounds of capacitors, or resistors. Maybe one day.

>... I suppose if your objective is to retain authentic performance.....

I have a few period resistors around. I often find they have drifted up in value, even if unused.

>modern carbon film resistor might cause a problem somewhere.....

I don't remember that, but then there are a lot of things I don't remember. heheh I think what I'll do is use modern parts and see if they cause any trouble. I expect they won't.

Date: Tue, 03 Jan 2006 12:56:32 -0500
From: Roy Morgan <roy.morgan@nist.gov>
Subject: Re: [R-390] Resistors, noise, etc.

I appreciate Ken's observation. I live in a very built-up area, and though the power lines in my neighborhood are underground, it is a very short distance to some medium and high power lines. Maybe it's the cell phones, computers and TV's that make such a racket around me. Of course, the lights on dimmers that our older daughter cannot ever turn OFF are the worst offender. There is a hope in our family that we can move out to a much more rural area. The horses that will be around us won't make any electrical interference that I know of. <snip>>
>HE says that carbon comp resistors are the noisiest, and has data to prove it.

Wonderful. His having tried some experiments or gathered data will help us all decide what to use.

Date: Tue, 03 Jan 2006 11:21:10 -0800
From: Buzz <muttman@charter.net>
Subject: Re: [R-390] Resistors

Back in the early 60's I worked for a company that tried to build R390's. Every radio was taken into a screen room then tested for noise. I don't remember what the spec. was, but most all the radios passed on the first time.

Date: Tue, 3 Jan 2006 17:45:55 EST
From: Flowertime01@wmconnect.com
Subject: Re: [R-390] Resistors

Just like the name says. However it is said with a lot less cheek than when talking about some low noise oxygen free audio stuff. Guys WHAT is a LOW NOISE RESISTOR? If you are draging .000001 micro amps across 2 ohms a low noise resistor is not going to have a lot of value. If you are draging 0.1 amps across 1K ohm dropping a 100 volts and spilling 10 watts of heat into the air, then a low noise resistor may be in order. Two extreme examples. Good low noise resistors have uses. Just because you can do it should you do it? All resistors no not have the same noise. Noise is how much variation you get in current across a resistor when a constant voltage is applied. We like to think all resistors are rock solid constant state devices that never vary one atom in conduction. Problem is this just is not how it works in the real world. Over ten minutes you get a fair average. Over a second you get a fair average. At any instance you can get a good variation that amounts to noise. So better resistors than the old carbon resistors have been developed and put into production. If you put one into a circuit some where will it make a difference you can hear? YMMV. depends on where you are putting it.

>From the extreme examples, it looks like high current circuits would benefit most from a low noise resistor.

RF front ends, Oscillator and mixer circuits being the noise determine circuits in a receiver would be candidates for low noise resistors. Some new caps are also lower in noise than some older model caps. The new smaller size and lower leakage get more selling points than cap noise. Leakage in a cap is not constant. The variation is not large. but variation in leakage amounts to change in the circuit. This change is defined as noise. So many caps get changed not because they do not hold a charge

and perform the filter function we expect from them. They get changed because they leak at a not constant and varying rate which can be measured as varying noise at the receivers output. Roger AI4NI

Date: Tue, 3 Jan 2006 19:24:46 -0500
From: "Jim M." <jmiller1706@cfl.rr.com>
Subject: Re: [R-390] Resistors

(Quoted From: http://www.dataforth.com/catalog/doc_1065.html)

Resistor Thermal Noise

Quote: "There are ... subtle sources of noise that often go unrecognized. Electrons within a conducting media or a semiconductor device that are available to move are responsible for current flow (charge per second) when excited by external voltages. With no externally applied voltages, electrons are still in motion randomly interacting with other electrons and with the material's lattice sites and/or impurities; however, their average velocity in any direction remains zero (i.e. no current flows). This statistically random electron motion creates noise voltages whether there is an applied external voltage or not. Consequently, conducting media generates internal noise without current flow.

Additional types of noise occur when current flows. The random statistical nature of trillions of electrons traveling with an average velocity in the same direction traversing random paths and interacting with material lattice sites will create several types of noise. In many instances, these noise voltages will seriously affect instrumentation. The laws of material physics and quantum mechanics which govern electron motion are random and, therefore, behavior models must be treated with statistical methods. This means that noise voltages are typically expressed as a "mean square" value. One common noise category is resistor thermal noise, which is the noise developed in a resistor in the absence of current flow. Thermal noise was modeled by Nyquest in 1928 and experimentally measured by Johnson. This noise, often referred to as "Johnson" noise, is generated in a resistor independent of any current flow and has a mean-square voltage value of 4*k*T*R*(BW). In this expression "k" is Boltzman's constant, "T" is temperature in degrees Kelvin, "R" is resistance in ohms, and "BW" is bandwidth, in Hz.. For example, at 100 degrees C, the noise voltage measured with an ideal true RMS 1 Meg Hz bandwidth voltmeter within a 500k ohm resistor is approximately 100 micro-volts. Clearly, this can cause serious errors when measuring low level voltages with high gain signal conditioning modules. ..." See also
http://www.tutorialsweb.com/rf-measurements/noise-figure/noise-in-electronic-components.htm

Also from
http://www.physics.ucdavis.edu/Classes/Physics122/Phys122_Johnson_Noise.pdf

you will need some math

Date: Sun, 29 Jan 2006 17:35:59 -0500
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] VFO endpoint adjustment - stumped!

<snip>....Hmm, that 2.2k resistor looks a little suspiciously brown, better check it out.... actually 8K!!! This makes the score on this radio for a total of seven 2.2K resistors that were too high in value by hundreds of percent! (Almost all of them in the plate lines). So I fixed that. <snip> <snip> And a word to everyone: never ever trust a 2.2K 1/2W carbon resistor you see in a R-390A. I started investigating in my other radio (which had seen much better treatment over the years) and all of its 2.2K's were too high by a couple hundred percent too!

Date: Sun, 29 Jan 2006 16:17:32 -0700
From: DW Holtman <future212@comcast.net>
Subject: Re: [R-390] VFO endpoint adjustment - stumped!

<snip>...I think most RF decks havea lot of bad 2.2K resistors. Most of the tubes in the RF Deck have 2.2K resistors as plate loads such as V202 and V204 with the plate current going through them.

Date: Thu, 2 Mar 2006 23:16:09 -0600
From: "Barry" <n4buq@knology.net>
Subject: [R-390] When good resistors go bad

All the talk a few weeks ago about certain resistors going high over the years prompted me to start looking at some of the resistors in one of my IF decks. I think the discussion revolved around some 22k plate resistors going high (but I might not be remembering that correctly).

My plate resistors have weathered well (at the high end of the tolerance or maybe a percent or two above, but not enough to warrant replacement IMHO), but I discovered that a couple of the 27k screen grid resistors (2nd and 3rd IF amp) have gone to 39k (definitely too high). I'm wondering what affect this is currently having on the system. I assume the lower screen grid voltage results in lowered gain at that tube, right? I haven't done a voltage measurement on the screens to see how far off they are, but I assume they are low. While looking around at the innards of the deck, I did notice one particular resistor (I don't remember exactly

which one) that is literally buried at the first IF amp. It is a 2.2k (I think) but they installed about a 3-watter down there. Good thing because it is spot on specification. It appears this was the first resistor installed in that area, it would require major surgery to replace it, and they must have known it would need to be hefty to avoid needing replacing.

Anyway, still having fun with the radios, but am wondering about the affect(s) of the high-value screen resistors.

Date: Fri, 03 Mar 2006 06:38:47 -0500
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] When good resistors go bad

<snip>..... I think the discussion revolved around some 22k plate resistors

My complaint was 1/2W 2.2K plate resistors, especially in the RF deck and VFO (almost every one was high by over 100%, some 200-300%, many showed evidence of past heat damage/charring). That's not ridiculously high but it can affect gain distribution and make it non-optimal. It does affect DC bias and maybe a stage will clip a little more easily (but nothing in the IF deck should be clipping if AGC is working...). Overall there's more than enough gain in the IF stages, alltogether, so I don't think you'll see a lot of affect from the screens being off a couple of volts. The "GAIN ADJ" pot can be set off a little bit to bring the RF/IF gain balance back into alignment.

<snip>.. It is a 2.2k (I think) but they installed about a 3-watter.....

You're talking about the one underneath the bandwidth shaft on the front wall of the IF deck? Doesn't look bad at all on my decks, the shaft itself is removable.

Date: 3 Mar 2006 13:59:39 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] When good resistors go bad

The resistor I'm talking about is R506 (22k, 2w). It is underneath the bandwidth shaft, but there are a lot of other wires in the way. I'd really hate to have to replace that one. Yes, the shaft is removable, but there's still a lot of other "junk" in the way. Thanks for the comments. I plan to replace the 27k resistors, but like you say, I may not notice a lot of difference in the overall gain as it is adjustable anyway. I still need to check the RF deck's resistors, but I'm dreading pulling that thing...
Barry

Date: Sat, 4 Mar 2006 17:30:13 -0600
From: "Barry" <n4buq@knology.net>
Subject: [R-390] More "bad" resistor comments and questions

I'm in the process of replacing those 27k screen resistors. I clipped one end of each one from the "Switched RF/IF B+ Line" side and measured the resistor completely out of circuit. I'm seeing about 49k now whereas I was seeing about 39k before. I was measuring from Pin 2 of the main IF chassis plug to the #6 pin of V502 and V503 so I should have had nothing but those 27k resistors in the line I was measuring so I can't account for the difference between the "then" and "now" readings.

Something else that's kind of strange. There are 82k resistors from pin 6 to ground. With the other resistors now clipped (isolating the #6 pins from the rest of the IF module), I'm seeing about 76k for the values of these resistors. The only other component in this equation are the 5000pf disc ceramic bypass caps also from pin 6 to ground. Is it possible these bypass caps are showing some DC resistance (i.e. very leaky) and that's causing me to see some parallel resistance across those 82k resistors? If so, then this may account for why the 27k resistors have nearly doubled in value over the years. If those 5000pf bypass caps are that leaky, then they would cause excessive current to be drawn through those 27k resistors constantly.Does this sound reasonable? The 5000pf caps in question are "Erie" brand and are rather dark brown in color. Does anyone else have any experience with these going bad on a consistent basis? I don't want to cut a leg on these caps just to test them, but when I unsolder the old 27k resistors, I'll be able to unsolder one leg of the 5000pf caps and test them completely out of the circuit. Thanks!
Barry - N4BUQ

Date: Sat, 04 Mar 2006 19:16:25 -0500
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] More "bad" resistor comments and questions

<snip>...so I can't account for the difference between.....-snip-

These resistors when they "go bad" are often no longer purely ohmic. (Giving you different resistances when measured with different meters, or even in the other polarity.) They may be incredibly sensitive to humidity and phase of moon too, and just the heat of being unsoldered or the change in lead strain from being clipped might change their values like you saw.

<snip>...Is it possible these bypass caps are showing some DC resistance.....

82K to 76K is under 10%. Don't sweat it. I agree that this is opposite the direction that carbon comps usually age. Seems unlikely that a whole bunch of disk caps would go leaky in that way. In my experience disk caps are more likely to fail open. (Or in transmitter power stages simply burn up - most of my transmitters have suffered some failure in the final compartment that consisted of sparks flames and smoke!) If you really have these pins open-circuit now, you might want to take a megger and check out socket resistance, especially if it looks like the socket insulation may be decaying.

Date: Sun, 5 Mar 2006 09:32:05 +0100
From: "paolo gramigna" <paolo.gramigna@controllo.it>
Subject: Re: [R-390] More "bad" resistor comments and questions

<snip> .....When I suspect a resistor, first I check the resistance and voltage as stated in the voltage/resistance table in the manual; if there is more than a 10% difference, then I'll clip one end and measure it with a "bad" ohmmeter (something with 1000 ohm/volt) in order to put some current in it. At that point, being the resistor already clipped, it's usually faster and safer to replace it with a new one; I'm told that metal oxide resistors are more stable than carbon, and smaller too.

Date: 6 Mar 2006 15:32:07 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: [R-390] Bad resistors - the saga continues

While replacing the 27K resistors last night (and breaking one of those little two-pronged standoffs which fortunately I had a replacement for but that's another story), I found R544 (2.7M in the AGC circuitry) to be completely open (or higher than the 30M my meter can detect). I wonder what the effect this had on the operation of the radio? I'm going to replace it, but was just wondering what function this resistor provides.

V506A's plate resistor, R549, was on the high side of it's tolerance (82K gone to 90K), but it was easy to get to and since one end had to be lifted to replace one of the 27K's, it's getting replaced too. I also wonder what effect (if any) this would make on the operation of the radio. Slight difference in AGC voltages? Thanks, Barry - N4BUQ

Date: Wed, 03 May 2006 10:07:52 -0400
From: JMILLER1706@cfl.rr.com
Subject: Re: [R-390] More C709 info

<snip> And while I'm at it, ANY and ALL plate or screen resistors are suspect - they will drift way off with age (again, the constant exposure to HV and current may be a factor). Most are 2200 ohm half watt. If I find

a suspect, I replace it with a 2200 ohm ONE watt unit (the modern ones are actually the same size).

Nothing is sacred in a radio. Replacement is a good thing. It's all good. Hope this helps.

Date: Fri, 19 May 2006 19:25:14 -0700 (PDT)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Need Resistor info

I have in the neighborhood of 16 + BA's to rehab. Since I have to do all this re-capping it seems sensible to replace the old carbon comps while I'm in there. (Especially all the 2K2 1/2 W units in the R390's with 1 watt 2K2's. Question: has anyone had any experience with the KOA-Speer or Xicon metal film and carbon film resistors sold by Mouser. The price is right in the 100's. I'd prefer to buy Vishay's but at the quantity I'm looking at there is a huge price jump. I could use Vishay's in the front end and the el-cheapo's for the rest. Any thought appreciated. Regards, Perrier

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Date: Fri, 19 May 2006 22:34:22 -0500
From: "Bill Hawkins" <bill@iaxs.net>
Subject: RE: [R-390] Need Resistor info

Hello, got your shotgun loaded, do you? Vishay? Wasn't their specialty high resistance precision resistors? I suppose each of us has got to do what the voices tell us to do, but this seems extreme. It's a communications receiver, not a precision measurement device. Do not expect precision resistors (or capacitors) to improve the performance of a radio that depends on its mixers, crystals and the Q of its tuned circuits. Or perhaps you are one of those audiophiles who looks for perfection in all the wrong places? Apologies if I've missed the mark . .

Date: Fri, 19 May 2006 23:36:54 -0400
From: "James A. (Andy) Moorer" <jamminpower@earthlink.net>
Subject: Re: [R-390] Need Resistor info

Dunno about the KOA, but I've used tons of the Xicon metal film ones and they are great! Not heat or humidity sensitive like carbons can be. Very stable.

Date: Sat, 20 May 2006 10:01:42 -0400
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] Need Resistor info

My experience is that for 50's/60's vintage gear, many of the carbon comp resistors (often 10% or 20% parts originally) are now off by HUNDREDS of percent.

This is enough that the behavior/performance is probably different than the original design. But often the radio still mostly works (although not necessarily as good as new.) I don't think Perry's intention was to drop 0.1% resistors in, but at the same time modern cheapo metal and carbon films are so much better than the carbon composition ones of old that I think the Xicon/Vishay distinction is probably meaningless.

As a practical matter with modern metal or carbon film resistors there is no tolerance band that is wider than 5%. I have been mostly using Mouser/Xicon 1W and 2W metal films with great success in tube gear (old and new). Note that the Xicon 2W units are about the same size as the original 1/2W carbon comps.

One of my opinions: The Xicon 1/2W carbon films look like cheap crap (but are probably still way better than the original carbon compositions.) The metal films look way classier (but still of course look very little like the original carbon comps.) I am not ENTIRELY sure that I believe the Xicon 2W rating. It's possible that this optimistic number comes from mounting to a thick PCB with very short leads, and this is not how they're typically mounted in tube gear. At the same time metal films can get so hot that they are glowing dull red and still be within their original spec after you clear the fault and let them cool down :-).

Others may worry about putting a metal film in place of a carbon comp and what inductance may do to RF performance, but in my primitive measurements of replacing 300%-out-of-tolerance carbon comps with metal films the performance always increases (probably having everything to do with getting the DC bias point back to where it was originally designed to be and nothing to do with a little bit extra inductance.) I do not have ambitions as large as Perry's to think about doing hundreds of resistors at a time.

Generally I restrict myself to resistors that ohm out way out of spec or have obviously suffered great abuse (charring, swelling). Certainly in my 390A's nearly all the 2.2K's usually into this category, and there were a couple of original resistors on my audio decks that were consistently off too. What I am jealous of is that OBVIOUSLY Perry has much more time than me to play with old radios!!!

Date: Tue, 23 May 2006 13:13:21 -0400
From: Roy Morgan <roy.morgan@nist.gov>
Subject: RE: [R-390] Need Resistor info

Yes. My employer (Teradyne) in the 70's used Vishay resistors as instrument standards - 0.1 and 0.05 percent tolerance units costing up to 8 or 10 bucks each then. They were chosen for precision and stability, had black rectangular bodies and "axial" leads suitable for PC board mounting. A current DigiKey catalog shows them offering wirewound power and small resistors, surface mount devices and aluminum cased wire wound resistors of normal tolerances. It's quite possible that they make the high precision, high stability ones still but they simply aren't in this catalog. The Vishay web site, http://www.vishay.com/ indicates that they make all sorts of items, including 314 hits for discrete resistors. Some are rated at 0.005 percent tolerance, some are high stability, metal films, flameproofs.. and on and on.

>I suppose each of us has got to do what the voices tell us to do, but this seems extreme.

There are many opinions about what resistors contribute what to the sound of high fi amps and other devices. I can't even repeat in general what those opinions are. I do wonder if a very few low noise resistors in the front end of an R-390A or other receiver might reduce it's self noise just a bit.

Date: Tue, 23 May 2006 13:29:27 -0400
From: "James A. (Andy) Moorer" <jamminpower@earthlink.net>
Subject: Re: [R-390] Need Resistor info

None of the resistors in the circuit would any effect on the noise of the RF stage (except in the extreme, of course - that is, extremely broken). The only resistor that would have a chance of having any effect is the grid-leak resistor. This is in parallel with the antenna (through a tank circuit transformer). The antenna impedance is going to be so low that it will swamp (short out) any noise voltage from the grid-leak resistor.

I'm not sure the input noise in an R-390A could possibly be any lower. People routinely get sensitivities in the fractions of microvolts. See my "noise and sensitivity page"
http://www.jamminpower.com/main/noise.jsp. With an antenna impedance of, say, 100 ohms, there is a thermal noise of .04 microvolts on the grid regardless of what resistors are used. Not much you can do to reduce that except maybe sink the front end in liquid nitrogen.

Date: Tue, 23 May 2006 21:13:25 -0500
From: Robert Nickels <w9ran@oneradio.net>

Subject: Re: [R-390] Need Resistor info

Wirewound, metal film, trimpots - resistors and components of all kinds, actually. My first job was working for a fellow named George Risk who was a contemporary of Art Collins growing up in Cedar Rapids Iowa who founded Dale Electronics in 1950, naming it after his son Dale. He merged with the Lionel Train company during the merger-mania of the late 50s, got fired, and went on to start other companies. He told the story many times of how he got in the precision resistor business. He had an investor who was willing to put up $10,000 to start a company after WWII. George really wanted to make carbon comp resistors because the demand was so great, but AT&T wanted $50,000 for a manufacturing license. However a license to make precision wirewound resistors with their proprietary viteous enamel coating was only $1,000 so Dale Electronics was born. He wound the first 25 resistors by hand on a lathe in a rented room above the dimestore in Columbus, Nebraska and took the train to Chicago to show them to Galvin (Motorola). He came home with an order for 50,000 pieces. Dale invented the heat-sink mounted power resistor, and many associate the name with those gold anodized packages.

Dr. Felix Zandman, Chairman of the Board and founder of Vishay was also a pioneering resistor manufacturer in Israel, and acquired Dale as a cornerstone of his passive component empire in the early 80's.

Date: Thu, 07 Sep 2006 08:17:37 -0400
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: RE: [R-390] Recapping question

>which drifted worst were the 3.9K's?.....

I don't have a lot of statistics to back this up (having only a couple of 390A's and a bunch of other mil-spec and consumer stuff from the era) but to overgeneralize:

1: Triode stages seem to be a lot more likely to char and burn plate and cathode resistors than pentode stages. In R-390A terms this means the ones around 6C4's and 12AU7's.

2. The carbon comps that drift up the most tend to be in the low K-ohm to 10's of K-ohm range. The others are not immune but the problem is not as endemic there. <snip>

Date: Fri, 22 Sep 2006 00:49:11 -0400
From: Scott Bauer <odyslim@comcast.net>

Subject: [R-390] nos pots

I need pots for a couple of 390-A's. Mouser does not have them. Neither does AES. I am looking for the good 2 watt pots that cam with the radios. Any ideas?

Date: Fri, 22 Sep 2006 18:13:01 +1000
From: "Bernard nicholson " <vk2abn@bigpond.net.au>
Subject: [R-390] Re: R-390 Digest, Vol 29, Issue 38

Pots come in many shapes & sizes they may have a common resistance marked, but some have a logarithmic taper some are linear and some are Anti log taper so BE AWARE,

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Date: Fri, 22 Sep 2006 08:03:39 -0400
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] nos pots

Which pot? 500K limiter, 5K RF gain, 2.5K line gain and local gain audio?
I have had good luck taking 5K audio taper pots, putting 5K resistors in parallel to maintain the correct cathode load on the V601B cathode follower, and using them in the line and local gain positions. I don't think there's anything magical about the 2W rating there. The input impedance to the next stage is 470K so there's nothing magical about the exact resistance rating either. Last time I checked the 2.5K audio taper pots were still current parts in the Allen-Bradley catalog, just not standard stocked things at Mouser Digikey et al.

Date: Fri, 22 Sep 2006 07:22:22 -0500
From: "Craig Anderson Ext 1365" <Craig.Anderson@saintpaul.edu>
Subject: NOS pots

New pots are available through Allied under the Honeywell line. Honeywell bought Clarostat a few years back. I bought some (2.5 watt) to replace all of my pots in both of my R-390A's. They are not cheap in the $18-20 range each.

Date: 22 Sep 2006 13:14:23 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: [R-390] Limiter Pot Switch Question

Do they have the kind with the piggy-back double-pole switches for the limiter control? Is it possible to retrofit a new pot with the old switch?

-

Date: Fri, 22 Sep 2006 10:04:01 -0400
From: "David C. Hallam" <dhallam@rapidsys.com>
Subject: RE: [R-390] nos pots

Pots of all kinds are available for these people:
http://www.potentiometer.com/

They can make up about any thing you might want. They are NOT LOW PRICED, at least on specials I enquired about a quantity of 1 dual concentric shaft (not ganged) 100k/100k pot for the RF/Zero level control of my Viking Invader. Price was $48.

Date: Fri, 22 Sep 2006 11:37:35 EDT
From: ToddRoberts2001@aol.com
Subject: Re: [R-390] nos pots

I have brand new R-390A Audio Pots R-104, R-105. These are the correct 2Watt 2.5K Audio Taper pots for the Local Gain and Line Gain front panel controls and come with the mounting nuts and washers. Price $15.00 each plus $3 should cover shipping for several to the lower 48. Contact me off list if interested. 73 Todd WD4NGG

Date: Thu, 19 Oct 2006 21:30:25 -0700 (PDT)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Shared Resistor offer

I have 4 A's and 4 SP 600's to do a total re-build on this winter. I want to use the Vishay CCF60 series of resistors for both sets. These have a 1 watt rating. The problem is that Mouser only sells them in quantities of 100 for 10 cents each. Between the two sets there are 52 different values of 1/2 watt resistors. The total outlay then comes over $500. I cant outlay that much cash for just one of a specific value. If any one wants to split on these resistors with me, contact me off list and I will send a word doc so you can tell me what you'd like. If there is enough of a response the cost will be .10 each plus postage with a order of 5 per value and a minimum total of 100 pieces CUF.

Date: Fri, 20 Oct 2006 10:13:20 -0400
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] Shared Resistor offer

Are you sure about that? My look at Vishay part numbers in the Mouser catalog shows these to be 13 cents each in quantity of 1 (as well as the massive quantity you quote). They seem to be 1% parts, so (to my eye) all those extra bands will look "funny" so I'm definitely not interested so you

may want to just ignore me! Mouser does sell generic (Xicon) 1W, 2W, and 3W metal film resistors that work fine too, and they're 5% so they don't look so funny.

Date: 20 Oct 2006 15:13:24 -0000
From: "n4buq@knology.net" <n4buq@knology.net>
Subject: Re: [R-390] Shared Resistor offer

I think what he means is that in order to get them for $0.10 each, you have to buy 100.

Date: Fri, 20 Oct 2006 10:31:10 -0700 (PDT)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] More on shared resistors

According to my count there are 108 1/2 watt resistors in the R390 and the
SP-600 takes 127. 90 percent are less than 5 of a value. I'm doing a 5 unit block on the weird ones because of the time to do this. So you will have a few extra and if you find yourself short on a value I'll send them to you for free.

Caveat: not all SP 600 models used all the same parts. We might have to fiddle and trade. So you're looking at probably 200 resistors per unit. A staggering $20 per set. I am making NO money on this. If you pass it will be the best deal you lost.

-

Date: Fri, 20 Oct 2006 14:08:40 -0400
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] More on shared resistors

The Vishay CCF60's are nice 1% resistors (and surprisingly cheap!) but if you actually had some in your hands you might decide they are not what you want to put in your radios. In my humble opinion, the Vishay PR01/PR02 or maybe the Mouser-sold Xicon's (261- or 282-'s) would be more appropriate if you wanted to do replacement of typical 10 or 20 percent 1/2W, 1W, 2W carbon comps. The above is just my personal opinion but I am not a big fan of 1% resistors except where the extra precision is actually needed. (There are some 1% resistors in a 390A, I know, and I wouldn't be opposed to the CCF60 or CCF55 as a replacement there.) In many tube-based projects (repair, refurb, and from-scratch) I've done in the past few years I've been very happy with the PR01's/PR02's/Xicon metal-film varieties.

Date: Fri, 20 Oct 2006 18:23:22 -0500 (EST)

From: <w9ya@arrl.net>
Subject: Re: [R-390] More on shared resistors

I may misunderstand your needs but I looked at the resistor kits that Digikey offers. Digikey sells 5% carbon film 1/2 watt resistor kits. There are three such kits, two of which should cover 90% of your needs as per what you indicate below. (As I read it.) Each of these two kits is under 17 bucks, or 34 bucks total. A few extra resistors should bring the total up to 50 bucks or so per unit. Not so bad. Oh yeah the Digikey part nos. are RS150-ND and RS250-ND .

Date: Sat, 21 Oct 2006 16:04:57 -0700 (PDT)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Resistor Replacement Set Update

I've finalized my resistor kit buy. Most are Vishay 3/4 W 1% metal film. Some values had to be made by paralleling 2 Xcion 1/2 W 1% metal film resistors. A few values over 510K are Xcion 1 W Carbon Film 5% resistors. NO PARTIAL SETS.

Here is the deal:

SP 600 Kit	Specified: 102	You get: 180	$23 Post paid ($2 more for Canada)
R390A Kit	Specified: 108	You get: 225	$28 Post paid ($2 more for Canada)

The R390a kit is slightly more as it has a few more separate values. Email me off list and I will send a .doc file with the exact values and amounts if you wish. If you want to buy with the current information I've given. E-mail me off list and I will give you all the info. Please send me your full REAL NAME and address. If you've used your call sign so long your not quite sure, please check your drivers license. When I get checks for at least a total of 10 kits I'll make the order. If not checks will be returned. No substitutions, parties of over 8 subject to a fixed 15% gratuity. Complaints handled by Les Locklear. Barry - n4buq@knology.net has agreed to finance kits for list members for $1 down and $1 a week for 52 weeks per kit. [Not really, but he is a troublemaker and deserves this shot.]<G>

Date: Wed, 24 Jan 2007 20:17:42 -0800 (PST)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Re: Parts Selection

Wrote: There's nothing fundamentally wrong with over-speccing replacements. Some here get really carried away with it (e.g. putting in 1% resistors everywhere...) There is a certain justification for doing it once in such a way that it won't have to be done again for another 50 years but garden-variety mylars would suffice almost all the time. Whoa!! Time Out. I do resemble them there remarks.

I champion 1% metal film resistor replacement over carbon comps for the following reasons. First they are decades more stable, have a far lower noise factor, are smaller than, and are one third the price of carbon comps. Also some "A"'s 2.2K resistors are underrated so with metal films you can double up in the same space or opt for the 3/4 watt rated Vishay series. The only other viable choice are 5% Carbon Films. I haven't used them and they are almost the same price as metal films. Baring tube or cap shorts 50 years of operation for metal films is just warm up time. <snip>

Date: Thu, 25 Jan 2007 09:38:27 -0500
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: [R-390] Re: Parts Selection

> I champion 1% metal film resistor replacement over carbon <snip>

At the same time you seem to completely ignore the widely available 5% metal films :-). I have nothing against metal films. There's nothing fundamentally wrong with putting a more precise component in place of a burnt up component. I've put in my share of 2.2K 5% metal films. I would be even happier if there were 10% and 20% metal films but these things do not practically exist. The funny extra stripe on 1% resistors has something to do with my reaction. It's an eye-attractor, saying "hey I'm doing something that requires very specialized parts here with tight tolerances". Now there are a couple of high-precision resistors in a 390A and I'm not opposed to replacing those with 1% parts if they need it. (They don't burn up like the 2.2K's, and some of them have something to do with VU metering by my understanding.) <snip>

Date: Thu, 25 Jan 2007 19:14:15 -0500
From: "Drew Papanek" <drewmaster813@hotmail.com>
Subject: [R-390] Re: Parts Selection

>I champion 1% metal film resistor replacement ..... <snip>

I like the "smaller than" part. It makes repairs and restorations much easier. Noise is a consideration only where the resistor is in the signal path. In the R-390A RF amplifier stage, for example, the cathode resistor is bypassed with a capacitor (two, actually) and hence is not in the signal

path. Carbon or metal film would make no difference. There are very few R-390A signal path locations where carbon composition resistors are found. One that comes to mind is in the crystal filter circuit. Another is the plate load resistor for the 12AU7 audio amp stage. Signal level at those points is high enough that metal film would make no difference in noise performance.

One caveat in any resistor replacement is to consider the voltage flashover rating. It is not of much concern in today's solid state low voltage circuits, but it is of great importance in tube equipment. Mouser carries Vishay/Dale metal films; the CCF55 series is rated at 300V maximum and the larger CCF60 series is good to 500V.

Low level audio amp stage plate load resistors would benefit from appropriately voltage-rated metal film resistor replacement. In that application there is 100V or more across a resistor of a couple hundred K or so and carbon comps fail frequently, drifting way up to sometimes over a meg or even becoming intermittent, causing "crackles" in the audio.

>Also some "A"'s 2.2K resistors are underrated so with metal films you can
>double up in the same >space or opt for the 3/4 watt rated Vishay series.

There is no harm in uprating in many circuits but isolation resistors in plate circuit is not the place to do it. The 2.2K resistors in the B+ feeds to various R-390A stages also serve as fuses. There always is the possibility of a shorted tube which will burn out the isolation resistor and limit current to a little less than 100 mA while doing so. The radio's B+ fuse(s) might not blow fast enough to prevent damage to other components. Metal film resisors will withstand much greater overload than carbon comps. In most circuit locations that would be good, but not where the resistor serves as a fuse. The aforementioned 2.2K resistors should be replaced with carbon composition types. I do not know how well carbon FILM types would work in a fuse role. Since carbon films are more reliable, cheaper, and more readily available than carbon comps, I think some experimentation would be in order. <Evil Grin> Time to get out the suicide cord! Mine is the UL-rated version with 3 alligator clips for grounding :-). Time to let the smoke out of a few resistors, 110VAC style! As far as underrated 2.2K resistors goes, a fuse protects best when operated close to its limit. Maybe some of the 1/2 watt 2.2K's should actually be 1/4 watt? (I haven't taken time to calculate.) The resistance value of those 2.2K plate circuit isolation resistors is not too critical. If used in a circuit where the current were, say, 5mA the voltage drop would be about 10V. If the resistor drifted to 3K, the drop would be 15V. That 5 volt difference is small compared to changes due to tube characteristic variations and line voltage changes. I say leave them alone unless

they're WAY off... There is always risk of damage (breaking a terminal off an irreplaceable coil, for example) when reworking and I don't think the small gain justifies the risk.

>Barring tube or cap shorts 50 years of operation for metal films is just warm up time.

I agree. Metal films everywhere except where burnout (fuse) characteristics are a concern.

Date: Thu, 25 Jan 2007 20:02:05 -0500
From: Mark Huss <mhuss1@bellatlantic.net>
Subject: Re: [R-390] Re: Parts Selection

I had a similar discussion with an Army Instructor. He claimed that a carbon resistor acts as a fuse, and always fails open. That it will open under overcurrent(ie. heat) faster. Finally he told me to put my money where my mouth is. We took a handful of carbon comp. resistors, a power supply, and an ammeter. Then put 1 Watt through the 1/2 watt resistors. Every time, current went up for about thirty seconds, climbing higher and higher, until the carbon resistor was nearly a short, then it opened. Don't remember the figures, but I got Beer money for a night in Leominster for the whole class out of it. Heat causes Carbon Comp. resistors to drop in value (crystalization?) until the current is so high the heat causes it to crisp open. Somehow, that does not strike me as a good fuse.

Date: Sun, 28 Jan 2007 22:23:50 -0500
From: "Drew Papanek" <drewmaster813@hotmail.com>
Subject: [R-390] RE: Parts Selection

Thanks for your observations on carbon composition resistor burnout. Like you guys, in my younger days I used to intentionally burn up resistors (and other components) usually by applying 110 VAC just to see what would happen. Seldom was the CUIDT (Component Under Intentional Destructive Test) metered to read current/voltage. I burned up a few back in the high school lab and watched the meters on the power supply, but I don't recall any
behavior indicating reduction of resistance just before smoke release. Then again, I don't recall much of anything from that time; maybe too much "smoke release"... :-) Another complication is the cabon comp lookalikes made a while back by IRC. Those were actually metal films in plastic cases. Overload supposedly carbonizes the case material, reducing resistance.

The red-hot overload mode of metal film resistors brings to mind an idea: cut a MF resistor's leads to stub length, overlap and solder on each a wire extension and (no mechanical connection other than solder). When the resistor overheats, solder melts and the resistor body (hopefully) falls away, opening the circuit. Add a spring for more positive action and you have basically borrowed from the arrangement used in slo-blo 3AG style fuses.

Date: Wed, 07 Mar 2007 20:59:20 -0500
From: Carole White-Connor <carolew@bellatlantic.net>
Subject: [R-390] New Project Follow-up

Thanks to your help and patience, my yellow-striper is up and running, and giving very impressive performance. It now sounds like an R-390A should. Does anyone have a list of frequently troublesome resistors (like Chuck's list of troublesome caps)? I ask for a reason. I came across an article where Chuck notes that R-614, a 560-ohm resistor in the AF section, frequently drifts, sometimes to 700-800 ohms. Mine tested 1,000 ohms! I changed it out and it made a tremendous difference in the audio. I'm wondering if there are other known drifters.

Date: Thu, 8 Mar 2007 08:42:46 -0600
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] New Project Follow-up

I agree with Bill that you should reduce the probability of failure by changing parts as indicated with parts with much lower probability of failure. Carole has already proven that degraded performance is a result of degraded components in his radio. Not really defined as a failure in the normal sense but certainly degrading. Especially since his project is a survivor from St. Julians Creek, more work will be required. Many of the carbon comp resistors will be out of spec. due to humidity exposure....a result of the outdoor storage of those radio's. Those radio's are great projects and well worth the effort to bring back. Many will say it's not possible but that has been proven wrong more than a few times by many here. More work? Yes. Anybody can fix up one that has lived a charmed life.

Carole I would suggest you spend the time and check all the resistors you can while in circuit. I would focus especially on the high value resistors as they seem to drift the most. Others have mentioned a specific value that tends to be off quite a bit...my memory fails me on those notes...seems it was for some 1K ohm resistors but I don't remember for sure. (somebody chime in here) <snip>

Date: Thu, 08 Mar 2007 10:43:43 -0500

From: JMILLER1706@cfl.rr.com
Subject: Re: [R-390] New Project Follow-up

I have noted that the resistors tend to drift high with age. If they are within 10% (the silver band indicates 10% tolerance) then you are probably OK. If significantly higher, or if they have a scorched look, they should be replaced. Nice thing about tube circuits is that you can check most resistors in circuit with a good digital ohmmeter without having to unsolder them. In my experience, look out for any resistor carrying power such as those screen or plate circuits. You tend to see a lot of 2200 ohm half watt resistors in plate circuits in the IF and elsewhere - check them for drift or charred look. Look at cathode resistors too (most are typically less than 600 ohms). I would replace with 1-watters if they need to be replaced. If screen resistors increase in value, the stage gain will tend to decrease (if I recall my tube theory correctly). Being 10% high is probably not too bad, but beyond that is pushing it in my opinion. Otherwise, you can let the failures " find themselves". Don't be surprised to see fixed mica caps and trimmer caps go bad - so far I have had to replace several of them in RF cans and oscillators. And just by wholesale replacing questionable .005 uF screen and B+ and AGC bypass caps throughout the radio, or tightening up tube sockets or chassis screws that hold down ground lugs, I have increased performance considerably. The constant heat-cold on/off cycles over the lifetime of the radio will actually cause screws to loosen! And any cap. in the radio is a candidate for age-induced failure - any. Good luck Jim N4BE

Date: Thu, 8 Mar 2007 14:58:09 -0500
From: "Jay Rusgrove" <JRusgrove@comcast.net>
Subject: [R-390] Carbon comp resistors

2 cents...Several years ago, while working on a military antenna development project that used carbon composition resistors (yes, an antenna with resistors!), I ordered in a number of different value carbon comps. These were new old stock resistors from Allen Bradley. The majority of resistors, of all values, were out of spec - all on the high side. A call to the supplier yielded a single page paper, MIL-R-39008C and paragraph 6.9 reads:

>6.9 Out-of -tolerance resistors. Resistance shifts due to absorption of moisture are inherent in carbon >composition resistors. Before being considered failures, out-of-tolerance resistors should be conditioned in a >dry oven at temperatures of 100 deg. C +/- 5 deg. C for the duration shown below prior to conducting >resistance measurements.

>Style RCR05: 25 +/- 4 hours Style RCR42: 130 +/- 4 hours All other styles: 96 +/- 4 hours

>Resistors which continue to be out of tolerance after the above conditioning process shall be considered >failures.

So before changing out resistors that are only mildly out of tolerance it might be a good idea run the radio for a period of time and let the resistors experience a good 'heat soak'. While you won't achieve 100 deg. C (hopefully!) inside the radio a several day power on stint may prove worthwhile. I wouldn't expect resistors that are wildly out of tolerance to work their way back in but those that are out 5 to 10% may. Conditioning resistors for the antenna project caused most to come back into tolerance. Values changes were noted at as much as 15% but most changes were in the 2 - 7.5 % range.

Date: Wed, 12 Mar 2008 00:53:27 +0000
From: John Burke <wa0ene@hotmail.com>
Subject: [R-390] R-390] I got my R-390 working!!?

When I restored my 1954 Motorola R-390/URR I found a majority of the 2.2k ohm 1/2 watt resistors in both the RF and IF deck to be well out of tolerance. I also had to replace several other resistors for the same reason. The performance improved dramatically and several of the original problems were cured at the same time. Since I have been unable to locate a copy of the parts manual for the 390, I have been unable to ID the resistor manufacture but they are smaller then IRC or AB 1/2 watters and have a rough texture to their surface. Also, the resistors in the power supply regulator are most generally out of tolerance due to the heat problem in this design, so take a look at them too. It's well worth the effort.

Date: Tue, 11 Mar 2008 21:28:54 -0400
From: Gene Beckwith <W8KXR@neo.rr.com>
Subject: Re: [R-390] R-390] I got my R-390 working!!?

It may be redundant...but in general...the old carbon composition resistors in the R390Xs and other heavy metal vintage rigs have a directional tendency to increase in value over time...with or without being in service...I don't know the chemistry and what happens to the resistive material...but even unused - nos - carbon comp resistors can and may change value over time...directionally to increase in value... When rehabing a heavy metal rig...advise checking NOS stock before using for replacement....Really enjoying the notes here on the reflector...

Date: Mon, 13 Sep 2010 22:09:21 -0500
From: "Cecil Acuff" <chacuff@cableone.net>

Subject: Re: [R-390] Arising from the dead: Again

Well I have no proof of it at this point but it's been mentioned in the past that some metal film resistors are deposited in a spiral and it stands to reason that inductance would be created in that design. Only at RF frequencies I would guess. That being said I can see how metal film resistors would be highly recommended for audio circuits. They are superior for sure.

Guess I'll have to throw a few on the sencore cap/inductor tester and see how they test against the same value carbon comp. I've also heard that baking the moisture out of NOS carbon comps will bring them back to their original values too but I've not tried that either... Oh well...that' one of the good things about the list...you can learn something new each day if you go looking for it...:-)

Date: Mon, 13 Sep 2010 21:15:50 -0700 (PDT)
From: "Drew P." <drewrailleur807@yahoo.com>
Subject: Re: [R-390] Rising from the dead, again

Perry done wrote: [snipped into bite-sized chunks]

"Both Chuck Ripple and Dallas Lankford have published audio circuit improvements for the R390A. In his audio improvement circuit for the SP 600 chuck specifically advises to use metal film resistors for improved performance."

Metal film resistors are preferred over carbon compostition type in very low level circuits because of the lesser noise of the metal film types. I don't think that the audio circuits of the R-390 series have low enough signal levels for carbon composition resistor noise to be a problem. However, metal film types have a very high reliability, reason enough to recommend them.

"I tend to agree about doing a shotgun approach on some of the R390A modules as it is a real chore. But if you have to go into a module to do caps I believe one should do resistors at the same time."

Defective or discolored resistors, yes. But the failure rate of most of the carbon composition resistors in the R-390A is sufficiently low to, in most cases, leave them alone. The exception would be, as Perry mentioned, in cases where access is poor and the module is already apart for some other invasive procedure.

"As for the SP 600, since the underside is relatively open, one should replace all the carbon film resistors as well as moving the power

dropping resistors to the top side of the chassis. Especially if one is replacing any BBODs."

Methinks you meant to say "carbon composition". Carbon films can be a good replacement for carbon comps provided the carbon films have a sufficiently high voltage rating. Carbon films are "quieter" than carbon comps but are still noisier than metal films.

Again, is the failure rate of carbon comps in the SP-600 high enough to warrant wholesale replacement, especially in easy access areas?

I have found carbon composition resistors to be failure prone in ciruits where the resistor has a high impressed voltage. Screen dropping resistors can be failure prone, as can plate load resistors in resistance coupled stages.

"If you ever have to take out and repair the RF deck of a SP 600, by the time you get it removed you will want to put in the best, most reliable. resistors, capacitors, and new wires money can buy. For further proof Read The Fine Manual or ask someone who has none it; it will make you a believer."

I wholeheartedly agree. Recapping the SP-600 RF section is severely invasive, risking damaging difficult to obtain parts. 'Tis best to insure that going in there is done only once. Same for the Hallicrafters SX-28.

Date: Fri, 18 Feb 2011 14:43:53 -0600
From: Ben Loper <brloper@gmail.com>
Subject: [R-390] AB Ohmite resistors

While working on my 75A-2 I cam across a source of NOS Allen Bradley and Ohmite carbon composition resistors. 1/4 1/2 1 and 2 watts sizes. I was putting my list together for what I might need and I wondered if anyone needed some. The ones I saw are all unused in packages. Ii haven't had a chance to go through all of them, but if there are some frequently used or
sizes someone needs send me your list. These are the older style and again completely unused.

Date: Fri, 18 Feb 2011 16:02:51 -0500
From: rbethman <rbethman@comcast.net>
Subject: Re: [R-390] AB Ohmite resistors

The first suggestion would be to take a "random" sampling to see how the values have held up. I had a bunch like that, even in their original metal

box and drawer. I found that time was NOT their friend! I've since procured a fair collection of the "newer" metal film type. I do random checks, and have yet to find one out of spec. Since rolling around an R-390A or SP-600 isn't the easiest thing for a 60 plus year old, I've taken to the use of the more modern components!

Date: Fri, 18 Feb 2011 21:45:07 -0500
From: "Bill Riches" <bill.riches@verizon.net>
Subject: Re: [R-390] AB Ohmite resistors

Be careful of NOS carbon resistors - 10 or 20 year old ones can be out of tolerance!

Date: Sat, 19 Jan 2002 20:59:03 -0600
From: Terry O'Laughlin <terryo@wort-fm.terracom.net>
Subject: [R-390] Worn pot heresy

>Cailube is the thing to use for pots. .....

If the track is worn through, a friend who repairs guitar amps taught me a last ditch trick. Use the graphite lube spray for car door locks. His theory is the graphite fills in the little chuck holes in the resistance element. I have tried it and it works on audio gear. I've never tried it on a radio.

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Date: Sun, 10 Jul 2005 07:55:01 -0400
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] Cleaning Potentiometers

A new pot. Off the top of my head, there are only 5 pots in my R-390A (localaudio, line audio, limiter, carrier meter, if gain) and they're all vanilla. (OK, the limiter has a little-bit-funky switch on the back, but if that's in fine condition, it can be transplanted to a new pot maybe with a little drilling/milling). When I do put new ones in, it's mil-spec cermet or plastic. I'm not going to claim that they'll never get noisy, but they've been damn good so far.

Date: Sun, 10 Jul 2005 13:10:01 +0100
From: "Peter Worrall, G4GJL" <g4gjl@btopenworld.com>
Subject: Re: [R-390] Cleaning Potentiometers

Just a two cents worth comment..... I have rebuilt 5 R390As. from the St Juliens Creek Massacre. With one exception all had dirty audio pots, which I cleaned with lubricating switch cleaner. However one further problem is that the ohmic value of these pots increases with age (

and this would apply to any set, St Juliens or not), so I got nice clean noise free pots, but still with rather raspy and poor audio. I ended up replacing most of them with new pots of the correct ohmic value, this brought the audio back to life. The above action was taken after replacement of the plug in electrolytics with modern fresh in-fills,which in itself brought about a marked increase in audio performance

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Date: Sun, 10 Jul 2005 10:57:43 -0400
From: "Bruce Hagen" <bhagen@msn.com>
Subject: RE: [R-390] Cleaning Potentiometers

I'm with Tim on the pot problem. We use to have a product available called Quietrole that you used with an eye dropped that worked well but it seems to be long gone.

Date: Sun, 10 Jul 2005 08:05:06 -0700
From: "Leigh Sedgwick" <bipi@comcast.net>
Subject: Re: [R-390] Cleaning Potentiometers

Just a single comment on a single potentiometer on the R390A (and other old BA receivers). Chuck Rippel recommends replacing the S-meter zero pot on the IF deck with a new, ten turn, precision potentiometer of the same value. So I gave it a try, then quickly ordered 2 more, one for my 51J4 (which is installed), and one for my 51S1 which I am holding in spare for the day it starts to give me trouble. Bottom line, set your carrier meter (easily) and forget it....it does not change every time you turn on the radio. Ya, its not original, but, I kept the old ones and the improvement is well worth the trouble.

Date: Sun, 10 Jul 2005 11:29:02 -0400
From: Barry Hauser <barry@hausernet.com>
Subject: Re: [R-390] Cleaning Potentiometers

Some say they use DeOxit in the pots, but that might be risky. I read of one or two cases where it dissolved the carbon material. Caig makes another product called CaiLube which is intended for pots. I've used it with good results.

Of course, if the pot has drifted way off value, or if the wiper has worn a grove through the carbon, then it needs replacement. However, I have had some success disassembling badly worn pots and adjusting/bending things to get the wiper to contact an unworn part of the carbon comp. Sometimes it's not a matter of warn-through, but insufficient tension on the wiper.

You can test them out of the receiver on an analog ohmmeter, slowly

rotating the shaft and watching the meter pointer for jumps, or use a signal tracer or audio siggen and speaker, etc. Probably not worth the bother for an easily replaced pot, but for those more difficult to find, it's worth a try. Anybody else ever do this, or am I the only one. It ain't the money ;-)

Date: Sun, 10 Jul 2005 12:12:26 -0400
From: "Joel Richey" <richey2@mindspring.com>
Subject: [R-390] Cleaning pots

I usually disassemble em and clean the carbon with, hate to say this but what ever I have on hand, have used alcohol, ordinary contact cleaner etc. Clean the wiper, small drop of very lite oil on the shaft, put it back together and its as good as new. Squarting a shot of cleaner into the pot is usually a temp fix.

I don't for a minute think any contact cleaner will "eat carbon" if you read the ingredients you will find most of em have the same stuff. most pots in the 390 are high quality and worth the effort to repair. Thats my story and Iam sticking to it.

Date: Sun, 10 Jul 2005 12:33:37 -0400
From: Barry Hauser <barry@hausernet.com>
Subject: Re: [R-390] Cleaning pots

While we're on the subject -- >I usually disassemble em and clean the carbon with, hate to say this but what ever I have on hand, have used alcohol, ordinary contact cleaner etc.

If you have them opened and can see what you're doing, you can test whatever cleaner on a non-critical part of the carbon to be on the safe side. I personally have never dissolved the carbon. Might not require any cleaner, but just a wipe-down.

> Clean the wiper, small drop of very lite oil on the shaft, put it back
> together and its as good as new.

That is if the wiper track is not badly worn. Sometimes it isn't worn through, but rough enough to continue to cause intermittents. While you have it apart, you can check for this as I previously noted. Often you can "re-track" the wiper with the pot still mostly assembled -- shaft still in place. Or you can remove the retainer and back out the shaft and wiper assembly. If the track looks good enough, don't attempt to re-track it. Make sure the tension on the wiper is adequate.

>Squarting a shot of cleaner into the pot is usually a temp fix.

Agreed. Often all you're doing is redistributing the debris and it has a way of migrating back -- if you didn't make it worse in the first place. If attempting the squirt job, my experience is that it generally takes quite a bit of cleaner and two or three treatments, allowing the stuff to drain out each time and possibly a final blast from an air can. Even then it's still unreliable because you're basically flying blind. The tendency is to prematurely conclude that the pot is not repairable.

> I don't for a minute think any contact cleaner will "eat carbon" if you
> read the ingredients you will find most of em have the same stuff.

I'm going by second/third-hand reporting. It isn't the carbon, but the binder used that varies. The solvents in contact cleaners also varies. Alchohol acts differently than naptha (in DeOxit), etc. Chances are a wide variety of solvents are OK with the pots you'll find in an R-390/R-390A. The assumption might be dicier with later vintage equipment, particularly consumer stuff.

> most pots in the 390 are high quality and worth the effort to repair.
> Thats my story and Iam sticking to it.

I agree. With the kind of intense maintenance, preservation and repair that many list members do, disassembling and restoring a pot is a snap. One tip -- when replacing the cover, carefully bend back the tabs. If it's still a bit loose, rather than risk staking the tabs or resorting to extreme force, you can apply a little epoxy or other cement on the tabs to secure the cover if you like. (Generally not necessary.) Again, it isn't the money. Replacement grade pots are often not of the same quality and involve some adjustment and messing around anyway. Often the shaft is of the wrong type -- half-shaft, split-splined, etc. or missing the locking tab (or wrong spot) which keeps the pot oriented on the panel, or shaft too long and has to be cut down, and so on. Barry

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Date: Sun, 10 Jul 2005 14:28:50 -0400
From: shoppa_r390a@trailing-edge.com (Tim Shoppa)
Subject: Re: [R-390] Cleaning pots

> Replacement grade pots are often not of the same quality

Very true. But I've had excellent luck with "plastic" conductive element pots. New they're often $7-$10. But they are mil-spec items and are very robust... certainly beating the $0.79 pots from the surplus places!

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Date: Mon, 11 Jul 2005 00:34:59 -0400
From: "Drew Papanek" <drewmaster813@hotmail.com>
Subject: [R-390] Thoughts on Pots

Here is some of my input on the topic being bandied about...

>What are you guys using to clean..... <snip>

I squirt in 100% isopropyl alcohol with an eyedropper. If one treatment does not clean it, two almost always does. A readily available source of the alky is isopropyl gasoline dryer. Get the kind that says "isopropyl" and does not call out any additives. Alternatively, one might try using 100% pure ethanol, available at local liquor stores as "Grave's Grain Alcohol". It is not as good a solvent as the isopropanol and probably won't work, but one can then soothe the resultant frustration by drinking the ethanol :o)

>However, I have had some success disassembling .... <snip>

I did that once with the airflow sensor on a friend's car (Mazda). The airflow sensor is a pot mechanically coupled to a spring-loaded vane in the engine's air intake. Moving the wiper to an unworn portion of the resistance element and then cleaning with isopropyl alky cured an intermittent lean mixture problem (engine sputtered) at certain RPM / load conditions.

>Anybody else ever do this, or am I the only one.....

I'm as much or more a cheapskate than anyone else, but it was worth tinkering to escape paying about $400 for a new airflow sensor!

>.....replacing the S-meter zero pot on the IF deck with a new, ten turn,
>precision potentiometer of the same value.

David Wise some time ago came up with a simple mod involving adding a couple of resistors and moving a wire or two around on the pot connections. I added that to my unit and it works great; lets you keep the original pot. Search the "Pearls of Wisdom" at r-390a.net for his posting. Drew

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Date: Mon, 14 Jul 2008 09:06:59 -0400
From: Barry <n4buq@knology.net>
Subject: [R-390] Potentiometer Nuts/Washers

Anyone know a source for stainless steel potentiometer nuts (assumably 3/8-24) and the internal tooth lockwashers? I can find the nuts and washers but not sure if they're stainless.

Date: Mon, 14 Jul 2008 09:26:10 -0400
From: "Tim Shoppa" <tshoppa@wmata.com>
Subject: Re: [R-390] Potentiometer Nuts/Washers

Usually pot nuts are 3/8-32 UNEF. If you really want Stainless, McMaster-Carr 91862A318 for $3.08 is the nut, and 98449A031 ($6.27 for 100) is an internal tooth lockwasher. More typically a nickel-plated brass nut would be what came with the pot. McMaster-Carr 91862A521 ($0.14). I think Mouser has them too but it's just a little footnote on one of their pot pages and I can't see it anymore :-).

Date: Mon, 14 Jul 2008 09:36:31 -0400
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Potentiometer Nuts/Washers

Yes, on second thought, they are 3/8-32 and I did find them just now on McMaster. Searching for "Panel Nuts" is more helpful than potentiometer nuts. I don't think I'll be springing $3.08 for them, though. I thought the originals were probably s/s and wanted them if reasonable, but will probably go with plated ones otherwise. The ones on the controls of this harness are in pretty bad shape.

Date: Wed, 23 Sep 2009 14:22:44 -0400
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Allen Bradley Potentiometer Numbering Schemes

The stampings read: A B (obvious what this means) B-4056 8133 Type J
Anyone know what it is?

Date: Wed, 23 Sep 2009 15:17:41 -0400
Date: Wed, 23 Sep 2009 15:30:59 -0500
From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Allen Bradley Potentiometer Numbering Schemes

I was hoping I could find the specs without having to unsolder anything and test it but I suppose that might not be the case. It's odd, though, that Krohn Hite still lists this generator (1200a) as an active unit yet it's constructed of discrete components (transistors, etc.) which looks to be 1980s techniques and components.

Date: Wed, 23 Sep 2009 21:00:19 -0500

From: "Barry" <n4buq@knology.net>
Subject: Re: [R-390] Allen Bradley Potentiometer Numbering Schemes

I don't know for sure, but I have a feeling this one came from a surplus EE lab auction at some point. I basically needed an audio generator and had really wanted a nice HP 3310B, etc., but this one came along and since it does have basic sweep functionality, I got it. It does seem to be a fairly well made unit (although not quite as well-made as similar HP equipment). The potentiometer in question isn't too bad; it just gets a bit "touchy" at some points along the way. I may opt to bend the tabs up, remove the back cover, and try some DeOxit and/or FaderLube in it.

Date: Sat, 19 Mar 2011 11:10:14 -0500
From: Ben Loper <brloper@gmail.com>
Subject: [R-390] Cleaning volume control

I'm working on a scratchy volume control and I've heard Caig MCL is what
works best. Should I use Deoxit on it first then MCL or is MCL all that needed. I can't open the pot so I need to use the spray to flush it out.

Date: Sat, 19 Mar 2011 12:52:36 -0400
From: k2cby <k2cby@optonline.net>
Subject: [R-390] Cleaning volume control

De-Ox-It is great for switches, relays, plugs, jacks, tube sockets and other metal-to-metal contacts, but I have never had good luck using on carbon volume controls - it sometimes dissolves the carbon or whatever binder is used to adhere the carbon dust.

My favorite treatment for carbon pots is ordinary "TV tuner" cleaner/lube spray from Radio Shack.

If you are cleaning a mil-spec quality sealed pot (Type "AB" or "Type J"), you can drill a 1/16 (or smaller) hole in the back, shoot in the solvent, shake it out and either solder the drill hole shut or cover it with tape.

Lesser-quality pots (even if "sealed") can be opened by judiciously prying up the tabs on either side of the bushing (usually 2 tabs on each side) that hold the rear cover to the front plate. Use slip-jointed pliers to close the tabs when you are finished.

Miles B. Anderson, K2CBY
16 Round Pond Lane
Sag Harbor, NY 11963

Date: Sat, 19 Mar 2011 13:07:21 -0400
From: Al Parker <anchor@ec.rr.com>
Subject: Re: [R-390] Cleaning volume control

I think MCL is "moving contact lube", is it blue? Caig's blue stuff is for carbon controls, don't use the red stuff in there, and if you use it (red) on wafer switches, spray at your own peril. Much safer to just put a small drop on the switch contacts, to avoid swelling the phenolic wafers. Opinions are often worth what you pay for them.

Date: Sat, 19 Mar 2011 13:10:33 -0400
From: Curt Nixon <cptcurt@flash.net>
Subject: Re: [R-390] Cleaning volume control

I have been using Deoxit fader lube as a cleaner, lube and it has worked very well on wirewound as well as comp pots in my classic Drake, Yaesu and now the R-390A. FWIW

Date: Sat, 19 Mar 2011 13:45:16 -0400 (EDT)
From: ToddRoberts2001@aol.com
Subject: Re: [R-390] Cleaning volume control

I have always had good luck over the years using the CAIG CaiLube MCL Moving Contact Lubricant that comes in the blue labeled can to clean and lubricate carbon pots with. Give the pot a good shot through the open slot and flush it out well while working the control back and forth. Treated pots have been silent from then on. One 5 oz. can has lasted me well over 5 years and still going strong.

Date: Sun, 20 Mar 2011 11:16:45 -0500
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: [R-390] Plastic Potentiometers and Magic Dust

Those cheap plastic volume controls and the magic dust that makes up the
variable resistance are indeed a big problem. The little wiper arm inside of
the pot eventually picks up a speck of dirt and begins to wear a track. I have not had much luck in really restoring their operation. You can make things better for a while but the only real solution is to replace the pot, preferably with something that is not magic dust glued on a piece of plastic. The fader lube does work. I have a old clock-radio that has some personal significance to me that I at least got back to the point where the audio would not drop out completely when changing the volume.-- Ms. Tisha Hayes/ AA4HA

Date: Sun, 20 Mar 2011 12:42:22 -0500
From: "Cecil Acuff" <chacuff@cableone.net>
Subject: Re: [R-390] Plastic Potentiometers and Magic Dust

Be aware of companies formulation changes. Example: I have used Blue Shower for years for cleaning switch contacts, pots etc...in the stereo business...all the way back into the early 70's. Sometime around 5 years ago Blue Shower was reformulated. The can looked identical and had no indications on it that anything had changed. A friend asked me to clean up the scratchy pots in a Pioneer stereo for him. Which I gladly took on... Shot the first one with Blue Shower and for the first few rotations all appeared to be fine then the pot self destructed. A post mortem showed the plastic parts had basically melted down.

Reading the label on the can it did indicate that it was not safe on some plastics...that was new. I had been using Blue Shower for years...decades with no problems on the same vintage gear with no problems. A talk with the electronics store where I bought the product indicated that they had in fact reformulated the product to make it more environmentally friendly and now it
was not safe to use on some plastics.

Last time I will purchase that.... So to make a long story short be careful what you use and where...and just because you might have used it for years doesn't mean it is still the same product you though it was.... Did find a suitable replacement pot and got the stereo back functional but was sweating it for a while...

Date: Wed, 22 Oct 2014 20:41:05 -0500
From: kc9ieq via R-390 <r-390@mailman.qth.net>
Subject: Re: [R-390] OD Demise Redux

NOS carbon comps are getting to be pretty bad too when it comes to drifting up in value, at least from what I'm seeing here in my stash. Unless the item I am restoring is rather rare or a near mint condition example qualifying as museum quality, I find myself almost exclusively using the Vishay PR02 line of 2 watt metal film resistors. They have a 5%, tolerance, are rated for 500 volts, (look closely at carbon film and metal film resistor datasheets, many are rated to only a couple hundred volts), are almost exactly the same size as a 1/4W CC, and are even a reddish/brown color thst blends in halfway decently. I'm at the (young, relatively speaking) age where I could very well have to go back and re-replace resistors in a rebuilt radio down the road, (20? 40? 50 years later?) if I used even brand new CC resistors as replacements. They just are not sealed well enough to remain stable. Plain and simple.

I'm doing a 1958 Seeburg Stereo jukebox amp right now. So far I've replaced 37 out of tolerance 1/4W CC resistors, and i'm only about 70% done with it. I really wouldn't want to go back and have to do the WHOLE thing over again, down the road. Lots of hours to do one of these things the right way.

Date: Sat, 25 Oct 2014 16:39:47 -0700
From: Perry Sandeen via R-390 <r-390@mailman.qth.net>
Subject: [R-390] Megger and Capacitor Measuring

<snip> ..... I believe the same for all the carbon resistors. Many are known to drift. It is now even more cost effective to replace them as Mouser sells the many Vishay .5W 1% odd value metal film resistors that can be used for 24 cents for single unit with no minimum quantity. Xcion 1% metal film .5W are 50ppm and 15 cents each but one has to buy them in units of 10. However they are 100 for $6.50 which is ideal if you have several radios to rehab.

Several less obvious benefits comes with the MF resistors. Circuits using them will maintain a more stable condition. I?m a great believer of removing

all variables possible. Also as a general rule they are smaller which makes for
easier

I readily concede that the process I do takes far more time upfront. However in the long run-years and years I'm way ahead.

Date: Sat, 25 Oct 2014 19:57:10 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] Megger and Capacitor Measuring

There is a subtle, but well known by the 1940?s difference between carbon comps and most other resistors:

With carbon comps, they stay resistive as you go up in frequency. The resistance drops, but there is no stray C.

With a metal film, you have a stray C that parallels the resistance. The end caps make up the C, the body has the R.

The impact in a circuit is more pronounced with both types as the resistance goes up at a given frequency. If you are designing something like an RF circuit the difference could matter. On a DC or audio circuit - forget about it. The only place in a radio it might matter would be loading resistors across a tuned tank. They are rare enough that I would not loose a lot of sleep over the issue.

Date: Sun, 24 Sep 2017 19:03:53 -0500
From: Stan Gammons <s_gammons@charter.net>
Subject: [R-390] Resistors

I have a Teledyne mfg R-390A I recently bought from Russ, WB3FAU. Thanks Russ! It needs a little TLC to get it going and I was wondering what the group recommends for replacements for the carbon resistors? I've found a few in the AF deck that are out of tolerance and wondered if I should go with the Ohmite OY series, metal film or ? <snip>

Date: Sun, 24 Sep 2017 20:38:37 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] Resistors

Metal films are fine in the audio, IF, and bias sections of the radio. If you get into a resistor that is in the RF path, use a carbon comp if that what was there originally. They are a bit weird in their RF performance and it's hard to duplicate their characteristics.

Date: Sun, 24 Sep 2017 20:07:29 -0500
From: Stan Gammons <s_gammons@charter.net>
Subject: Re: [R-390] Resistors

Ok. Sounds like the Ohmite carbon comp are what I should use in RF if any need replacing.

Date: Sun, 24 Sep 2017 23:18:48 -0400
From: Glenn Little WB4UIV <glennmaillist@bellsouth.net>
Subject: Re: [R-390] Resistors

Check any "new" carbon composition resistors for value before using them. Carbon composition resistors are made of carbon powder and a composite binding agent. This binding agent might be hydroscopic (all that I have seen was). If there are cracks or porous flaws in the encapsulation, the binding agent will absorb moisture and expand.
The value of the resistor was determined by the amount of carbon in the binding agent and the compression created by the encapsulation.
If the binding agent swells, the carbon powder will be less compressed and the resistor value goes up. You might be able to restore the resistor to its original value (for a finite period of time) by heating it to drive off the moisture. This is the failure mode as I understand it.

I am open to corrections. All carbon composition resistors that I measure are high in value. Some brands higher than others. Fortunately, the resistor value is not extremely critical in our older receivers. There are ceramic composition resistors that may work. We used these in surge suppressors where we originally used carbon composition resistors for their surge handling capabilities. If we used carbon or metal film resistors in this application we had issues with inductance and the inability of the thin film being able to absorb and dissipate surges without opening.

Date: Mon, 25 Sep 2017 01:19:46 -0400
From: Charles Steinmetz <csteinmetz@yandex.com>
Subject: Re: [R-390] Resistors

No doubt you will receive a flurry of replies saying that metal film resistors cannot be used at RF because of their high inductance. That is by and large a false myth. I have measured thousands of metal film resistors, both through-hole and surface-mount, with values from fractional ohms to a few hundred megohms, and found that most can be used well into the GHz range with no problem (the exceptions are some very high-value resistors, in the tens to hundreds of megohms range).

Zack Lau (now W1VT), ARRL's Senior Lab Engineer for many years now,

wrote on the subject long ago in "Lab Notes" (QST):

"Q: How does the inductance of metal-film resistors compare with that of carbon composition resistors?

A: The metal-film resistors made today seem to be quite low in inductance, and are comparable to carbon types. I've used them well into the VHF range with little difficulty. However, these should not be confused with wirewound resistors, which are probably too inductive even in the
MF/HF spectrum."

<http://www.arrl.org/files/file/Technology/tis/info/pdf/9208066.pdf>

That does not necessarily mean you should replace all carbon comp resistors in a 390/390A with metal film resistors. Carbon comps are among the most rugged resistors available, and metal films are more fragile with respect to damage from overload (i.e., overcurrent and over-dissipation, particularly surge currents). This is not a huge issue in most 390/390A circuits, and even where there is a potential risk (power supply decoupling resistors and other high-current, high-dissipation locations), it can be mitigated by using MFs with twice the dissipation rating of the CCs being replaced.

Date: Mon, 25 Sep 2017 09:51:04 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] Resistors

The problem with carbon comps at RF is that they don't really go inductive or capacitive. The physics of the resistor is such that they stay resistive, but drop in value. The effect has been known at least since the 1940's. It certainly was well known by the time the R-390 was designed. The effect is similar to stray capacitance (since internal capacitance is what causes it). Large values are impacted at lower frequencies compared to small values.

Since carbon comps for "fancy stuff" pretty much died out by the 1970?s, digging into them also died out. This sort of stuff has been 'nerd trivia' for a *long* time. I just happened to have a prof in school (back in the 70's) who was a resistor nerd. You would have to dig into the IRE proceedings (1947 maybe?) to find the papers.

Date: Mon, 25 Sep 2017 11:16:08 -0400
From: <wb3fau55@neo.rr.com>
Subject: [R-390] Stan- resistors

Stan, if you do not have carbon repalacements, go with new film type. --
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Date: Mon, 25 Sep 2017 12:16:56 -0400
From: Charles Steinmetz <csteinmetz@yandex.com>
Subject: Re: [R-390] Resistors

> The problem with carbon comps at RF is that they don't really go inductive or capacitive. The physics of the resistor is such that they stay resistive, but drop in value. * * *

> The effect is similar to stray capacitance (since internal capacitance is what causes it). Large values are impacted at lower frequencies compared to small values.* * *

The two statements above are inconsistent with each other. The effect *is* due to reactance, but the phase angle of the AC signal through the resistor doesn't change as much as it would with a pure RC circuit. This is because the reactance does not change at 10x per decade (as it would with a pure RC circuit) -- which is how distributed capacitance works. This is essentially the same as saying that the net capacitance in CC resistors is due to a bunch of really bad (lossy) capacitors.

If someone were to raise this feature of CC resistors as a reason not to replace them with MF resistors -- i.e., the MFs do not exhibit the faults of the CCs, those faults were "designed into" our HF boatanchors, therefore the radios won't work properly with MFs -- that is simply a bridge too far. The reactive effect on CCs at VHF and below is negligible, just as the inductance of MFs is (in both cases, we're talking about sane resistor values for RF work). [*NOTE* -- I am *not* suggesting that Bob was making this argument. I'm merely anticipating another old wives' tale I've seen repeated far, far too often in the BA community.]

Date: Mon, 25 Sep 2017 12:41:28 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] Resistors

The gotcha is that the 270K resistor in the circuit at 30 MHz is actually presenting 150K. The circuit was designed for 150K rather than the 270K. It shows 270K since that's what is marked on the carbon comp resistor. If you are going to replace them, you need to take that into account.

Date: Mon, 25 Sep 2017 13:53:31 -0400
From: Charles Steinmetz <csteinmetz@yandex.com>
Subject: Re: [R-390] Resistors

That differential is more than 10x greater than any reactance effect I've ever observed in an actual, new-condition CC resistor. There may be CCs that measure like that, but not quality resistors in new condition.

In the actual CC resistors I've tested, a 270k CC will operate within 5% of nominal through HF into VHF. Note that most CCs in boatanchors were
originally rated +/- 10%, with a few rated +/-5%. Also, note that a 390/390A will work just fine (and meet spec) with resistors in most positions at +/- 50% (which is even further from nominal than the 270/150 example given, so even if someone did happen to get a 270k CC that exhibited 150k at 30MHz, the radio would almost certainly still meet spec. But, as noted above, things are not *nearly* that bad in real life.)

Date: Mon, 25 Sep 2017 13:30:00 -0500
From: kc9ieq <kc9ieq@yahoo.com>
Subject: Re: [R-390] Resistors

Is it possible there is also high DC potential across this resistor, additionally lowering the effective value being carbon comp? I'm not familiar enough to know where this resistor is without pulling up schematics and hunting.

Date: Mon, 25 Sep 2017 14:30:35 -0500
From: Stan Gammons <s_gammons@charter.net>
Subject: Re: [R-390] Resistors

Thanks for the comments on the resistors. Sounds like it's Ok to use metal film anywhere but the RF deck. Perhaps it would be "best" to replace any that need replacing with the Ohmite carbon composition resistors? The OD/OF/OY series depending on what wattage the resistor is.

Date: Mon, 25 Sep 2017 16:39:07 -0400
From: Charles Steinmetz <csteinmetz@yandex.com>
Subject: Re: [R-390] Resistors

Use metal films everywhere, except where there is a risk of a large surge current (for example, the resistors between sections of the electrolytic filter capacitors on the B+ supplies, where there could be a significant turn-on surge). Even there, if you use MFs with twice the rated power of the original CCs, you will be fine.

Date: Mon, 25 Sep 2017 17:41:28 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] Resistors

Here's a table that shows the effect:
http://g3ynh.info/zdocs/comps/refs/EPD_Botos.pdf
He does not go into the details, but the megahertz megohm stuff looks about right. Keep in mind that I'm doing this all from memory of a paper I last read in 1973..

Date: Mon, 25 Sep 2017 17:48:59 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] Resistors

Here's a summary article showing the basic megohm X megahertz issue with carbon comps. It does not go into the why.
<http://g3ynh.info/zdocs/comps/refs/EPD_Botos.pdf>
Very simply put, in a carbon comp, the stray C bridges across small segments of the resistor. Rather than showing up as "pure C" that a tank circuit would resonate out, it stays resistive, but at a lower value. It's not the same effect as end cap capacitance in a metal film resistor. Since tube tanks may have quite high values of load resistance, anything at those impedances could be an issue. If you get down to tens or hundreds of ohms, you will not see a problem at R-390 sort of frequencies. I'll keep digging for the paper. I last read it in 1973 .

Date: Wed, 27 Sep 2017 10:27:40 -0500
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: Re: [R-390] Resistors (in areas other than the RF/IF deck

For power supply type applications I often use 5 watt cermet (ceramic) resistors. I not even like to leave 50 year old carbon comps across caps in the power supply.

I can see that there are some people who are quite passionate over the metal film vs. the rest of the world for resistor choices. By default I will do a swap for a metal film because I have thousands of them in a variety of wattages and %'s. If I run across one that ends up skewing a tuned circuit I go "hmm, interesting, try to find a different resistor, swap it again and move along".

Generally I am against shotgunning components with the exception of paper caps, BBOD or leaky oil caps (the only good paper cap or BBOD is one that you have sold on ebay to an audiophool. They can mix it with their quad eutectic solder, cryo-treated tubes and oxygen free copper wires).

Date: Wed, 27 Sep 2017 12:19:28 -0400
From: Moe Fretz <tubetester@gmail.com>

Subject: Re: [R-390] Resistors (in areas other than the RF/IF deck

I might add also:
""
the only good paper cap or BBOD is one that you have sold on ebay to an audiophool.
"""""""""
You can always tell if the caps are bad by the amount of rattle they make when they hit the garbage can.

Date: Wed, 27 Sep 2017 11:26:57 -0500
From: Stan Gammons <s_gammons@charter.net>
Subject: Re: [R-390] Resistors (in areas other than the RF/IF deck

I agree with you on shotgunning. The AF and IF deck in the R-390A I have has a bunch of paper caps. I plan to replace those. In troubleshooting the audio problem it had, I found some resistors that are out of tolerance thus I wondered what the gurus here recommended to use as replacements. I plan to use metal film resistors. Thanks everyone for your help on this.

Date: Wed, 27 Sep 2017 15:21:58 -0500
From: Tisha Hayes <tisha.hayes@gmail.com>
Subject: Re: [R-390] Resistors and capacitors in audio

You should not have any problems with metal-film resistors in the audio section of the radio. At the most you are going to see 3 KHz through those
components and whatever inductive differences there may be between a carbon comp and a metal film will be insignificant.

In non-inductive applications a metal film resistor very well may be the superior choice. They are usually more temperature stable and have less inherent noise than a carbon composition.

Even on the issue of induction I think there are some variations on metal-films; In dissecting components there seem to be two or three different manufacturing styles for metal film resistors. You can see these differences too; take a metal film and use an razor blade to scrape off the enamel coating. You will find that many resistors are made of a grooved glass rod and only the groove around the glass contains the metal film layer. By varying the number, depth and fill of the grooves the manufacturer can control the value of the resistor. I have seen others where there is not a groove but the entire body of the glass rod is coated uniformly from end to end. I think the latter design of not using the groove makes the resistor non-inductive by its very design. It is probably

more of a manufacturing challenge for consistency to maintain a specific thickness of metal film but so much of that technology has evolved with the making of semiconductors and vapor deposition.

This unusual tendency by me to take things apart down to their fundamental level goes back to the questions I asked as a child.. "What makes a resistor resistive?" My daddy would break open a resistor and hand me an ohmmeter to let me figure it out. Sometimes that resulted in dining room table calamities like making an arc-lamp out of graphite pencils with two six volt lantern batteries (stunk the house up) or exploding chemical concoctions when I discovered electrolysis and the oxygen and hydrogen that makes up water (btw, do not try the same experiment with salt water, that was a completely different disaster, you do not end up with sodium metal but one of the gases will clear out the house).

Date: Wed, 27 Sep 2017 16:42:04 -0500
From: Don Reaves <donreaves@gmail.com>
Subject: Re: [R-390] Resistors and capacitors in audio

This is an interesting reference site for resistors, published by a group of University Technology of Eindhoven engineers in the Netherlands.

http://www.resistorguide.com/types/

I learned that carbon comp resistors can change 10% in value just sitting on a shelf in a years time. This explains the huge value shift in my NOS carbon comp resistor hoard that I kept from my Dad's Radio-TV shop back in the 70s. The color codes now mean nothing. I started a new hoard of freshly minted carbon film resistors, because they are rated at 500 volts, are dirt cheap and they look better in a radio than a metal film type.

Date: Wed, 27 Sep 2017 17:59:06 -0500
From: kc9ieq <kc9ieq@yahoo.com>
Subject: Re: [R-390] Resistors and capacitors in audio

Hey Don,I don't disagree with anything you said here, but check out the Vishay PR02 series of metal film resistors. They are rated for 500V, have a better temperature coefficient than pretty much all carbon films, (But not as great as some more expensive metal films), and are a brownish color which blends in pretty well in older equipment. They have a 2W rating but are about the size of a 1/2W carbon comp. A little pricey compared to carbon films, but can often be found on sale at Newark!

Date: Wed, 27 Sep 2017 19:15:41 -0400

From: Roger Ruszkowski <flowertime01@wmconnect.com>
Subject: Re: [R-390] Resistors and capacitors in audio

A nice reading thread, all kinds of new things I did not know that I did not know until this thread.

Date: Wed, 27 Sep 2017 19:08:17 -0700
From: Pete Lancashire <pete@petelancashire.com>
Subject: Re: [R-390] Resistors and capacitors in audio

For those who want the real thing I have > 1,000 real Allen Bradley CC Resistors 1/8, 1/4 and 1/2 W. ALL are new never used, etc etc. ALL are 5%. All are now over 10% from their marked value, most > 20% and the real good ones, the one marked 100K Ohms or higher are up to 50% off. $2 each. I also have some Back Beauty cap for $20 each, the special one with cracked cases are $10 each.

Date: Sun, 5 May 2019 23:24:16 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Resistors going bad

Well my good 10-4 buddies, I've been trying to persuade you for years to do awholesale resistor replacement using 1% metal films.? Now you have living proof of why. Years ago I even did a resistor buy of 4,000 resistors and offered kits at s discount from a DIY buy. Unfortunately they're all gone years ago. If buying 1% MF's are just too much of a strain on your budget, you could get butwith 5% Xion carbon films. Remembering the saying that THERE IS NO SUCH TING AS A FREE LUNCH, it might be wiser to start doing a module at a time. It's far easier than in-and-out every month or so or sooner. FFT YMMV

Date: Thu, 25 Jul 2019 19:36:04 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] R-390A Conversion Oscillator Low output

<clip> I also advocate replacing all the carbon comps with 1% metal films which aren't all that expensive if one shops around as there are many used of the same value. <clip>

Date: Thu, 25 Jul 2019 16:00:17 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] R-390A Conversion Oscillator Low output

IF you go the route of replacing the carbon comps, understand that their RF characteristics are unique. No other resistor out there does quite the same thing at HF that a carbon comp does. There may be some fiddling

involved....

Date: Mon, 29 Jul 2019 22:26:23 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] Replacing carbon comps with metal film resistors

>IF you go the route of replacing the carbon comps, understand that their
>RF characteristics are unique. No other resistor out there does quite the
>same thing at HF that a carbon comp does. There may be some fiddling
>involved..

That's very interesting. I never new that. Fortunately all resistors in both the A and SP 600 are only used as voltage dividers or in audio for gain increase. Before Dr. Jerry got hounded off this list by moron trouble makers, he did experiments to see if the spiral trimming would cause any inductance problems at the RF frequencies us B/A aficionados use.? He found no problems whatsoever. About 12 years or so I make a bulk purchase of 4,000 0.5W MF resistors and made resistor kits for both the A and SP 600. I sold over 25 kits of each and no one ever said that they had a problem.

So I guess from Bob's comment is that all the *chip* resistors we see now are made out of something besides carbon.

Date: Mon, 29 Jul 2019 19:39:06 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] Replacing carbon comps with metal film resistors

Indeed you will find resistors across coils in various radios to set the
Q of the circuit. That’s where the trouble comes in. A conventional carbon comp does not have the same RF characteristics (cap in parallel with the resistance) that other resistors have. Instead its resistance stays “pure R”
and just drops as frequency goes up.

Date: Tue, 30 Jul 2019 00:01:54 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: Re: [R-390] Replacing carbon comps with metal film resistors

Bob showed that I was mistaken when I said there were no carbon comps in RF circuits in the R390A as some are used for Q swamping. That said, IMNSHO at the frequencies we're dealing with, I don't think it will make any difference to use the MF resistors. But, I could be wrong (again).
If someone could show that MF's made a difference when used for Q swamping in the I and the list would like to hear what the results were.

Date: Mon, 29 Jul 2019 21:08:37 -0400
From: Bob kb8tq <kb8tq@n1k.org>
Subject: Re: [R-390] Replacing carbon comps with metal film resistors

You need to measure the actual Q of the circuits to see the difference. That's not as easy as it might sound. In some cases the added C from a metal film is going to make a difference. There are formulas for all this. I'm not quite able to dig them up at the moment. For a given frequency, It's more pronounced at higher values.

Date: Mon, 29 Jul 2019 23:50:22 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Replacing carbon comps with metal film resistors

This is an experiment I performed a lot of times before, but just to check again.... The Q swamping resistors inside several R-390A IF transformers are 39K, 10%, 1/2W, carbon composition... I opened my parts drawer for resistors of that value, and woke up my old trusty Hewlett-Packard 4192A LF Impedance Analyser. And there are the values I measured for various resistors types at 455kHz (all those being rated at 1/2W) with the minimum connecting lead lengths by using the HP 16047C Test Fixture.

But just before you look at those results.... I hope that everyone remembers that in the equivalent serial representation, an impedance is a value of pure resistance, plus or minus a reactance. Meaning, Z = R ± X. If the measured reactance is positive, you have an inductance in series with the resistive part, and if it is negative, you have capacitance in series with the resistive part. In theory, a perfect resistor will exhibit a measured reactance of ZERO, or, expressed otherwise, smaller is the measured reactance, more the part is close to the perfect model.

Ohmite carbon composition:
40100 ± 1370

Philips carbon film:
38710 ± 950

Sanyo carbon film:
38850 ± 780

Corning Glass Works (CGW) metal oxide Film:
39470 ± 870

Philips metal film:
38980 ± 400

In this test, at 455kHz, the metal film resistor wins. But the surprise is that the carbon composition turned out to be the more "imperfect" of the lot !

Date: Tue, 30 Jul 2019 04:25:41 -0500
From: Cecil <chacuff@cableone.net>
Subject: Re: [R-390] Replacing carbon comps with metal film resistors

Depends....if the circuit was designed around the ± 1370 capacitive reactance then the metal film will have the most impact on change. Carbon comps (NOS) have a bad habit of absorbing moisture...I'm curious how the reactance would change after a good baking to drive out any moisture. Just thoughts at 4AM...

Date: Tue, 30 Jul 2019 08:14:17 -0400
From: "James A. (Andy) Moorer" <jamminpower@earthlink.net>
Subject: Re: [R-390] Replacing carbon comps with metal film resistors

Every time I have done this test (in the context of pro audio), the metal films won hands down. My problem with using them for boatanchors is that they are hard to find in high wattages (above 1/2 W) and high resistances (above maybe 470K). They are out there, but just hard to get. And waaaay more expensive than comps.

Date: Tue, 30 Jul 2019 10:03:36 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Replacing carbon comps with metal film resistors

One of the "features" of the CC resistors is the variation of their value with the instantaneous applied voltage, which leads to a form of distortion for the audio signals. Some like it: they call it "vintage sound".... the metal film/metal oxide film parts do not exhibit that behavior, and they do not absorb moisture with time as the CC does. It is true that the hi-value, high wattage MF parts are hard to find, but the MOF are more commonly available (from Vishay and other mfg.) Regarding the price, if you look at Mouser or Digi-Key, the CC (especially the Stackpole ones) are not really less expensive than their MF counterparts. I used to buy my leaded MF resistors from "surplus shops" around Montreal, but due to the proliferation of the surface-mount components, they are now also hard to find !

Date: Tue, 30 Jul 2019 15:28:47 +0000 (UTC)
From: Gary Geissinger <geissingergary@yahoo.com>
Subject: Re: [R-390] Replacing carbon comps with metal film resistors

Your experience agrees with mine. I have always used metal film resistors in professional audio gear. They give excellent in low noise circuits. Then I got into spacecraft design and metal film resistors were all that I could use. For high resistance values used in high voltage circuits metal film resistors have an unfortunate property. Due to the internal stress the metal in the film can migrate and raise the resistance. Might not be an issue in a tuned circuit, but I might choose a different resistor type exposed to over a KV or two. On the other hand they may be more stable than some other resistors in that case.

Date: Tue, 30 Jul 2019 16:03:04 +0000
From: "FISCH, MICHAEL" <mfisch@kent.edu>
Subject: Re: [R-390] Replacing carbon comps with metal film resistors

There is an online discussion at https://passive-components.eu/resistors-voltage-and-frequency-dependence/

Date: Tue, 30 Jul 2019 16:42:01 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Replacing carbon comps with metal film resistors

Thank you for the link, Michael.
A VERY GOOD, ALL IN ONE PLACE description of all variants of resistors characteristics.
https://passive-components.eu/resistors-voltage-and-frequency-dependence/

Date: Tue, 30 Jul 2019 22:08:37 +0000 (UTC)
From: Perry Sandeen <sandeenpa@yahoo.com>
Subject: [R-390] R390A and SP 600 combined resistor list

I've has several requests for the combined R390A and SP 600 list so I've asked Al to please post it on the R390A FAQ site with the other tutorials. If you want a copy please give Al a few days to get it posted. For those who want capacitor list, both are posted in the respective Y2KR3 and SP 600 Anthology.

Date: Tue, 9 Jul 2024 01:30:24 +0000 (UTC)
From: jkharvie <jkharvie@verizon.net>
Subject: [R-390] The role (if any) of modern resistors within a R390A receiver

I have a confession to make. My collection of 200 or so composition carbon resistors that I put together in 1989 for servicing rebuild of receivers is now showing the majority of the resistors have drifted out of 10% tolerance and are not usable. 27 ohm is now 38 ohms. 22K is now

32K etc ... fter some review I purchased a new collection of ~75 values, 5 resistors each. These are lovely 1 Watt carbon film resistors, good copper leads well tinned, non magnetic per the advertisement. Look great!

Dimensions: Body is 0.440" long, diameter of 0.157"
Leads are 0.026", 0.990" longEnd cups on resistor body are 0.165" diameter, ~0.090" wide

I thought I was out of the woods.... Issue/ question:The manufacturing of these resistors involves use of two "end" caps on the ceramic tube for the transition to the copper wire leads. I have discovered that these two end caps are made of an alloy that is able to be easily picked up by a magnet. I am thinking unintentional addition of magnetic reactance to areas of the receiver.

How big an issue is this going to be on the receiver?
1) Not an issue, go ahead and use without concern
2) Return these for a refund
3) OK to use in all areas except for the following areas.

Better options? thank you John (N3JKE)

Date: Mon, 8 Jul 2024 23:33:18 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] The role (if any) of modern resistors within a R390A receiver

John, for me this is not an issue, whatever the location they are used in a R-390A.

Date: Tue, 9 Jul 2024 05:40:28 +0000 (UTC)
From: Jim Whartenby <old_radio@aol.com>
Subject: Re: [R-390] The role (if any) of modern resistors within a R390A receiver

John Most modern leaded components appear to be tined copper over steel wire.? Perhaps your resistors are tinned copper over stainless?? Scrape a lead to see if the underlying metal is still copper.? I personally would not loose any sleep over it. I am sure that the receiver doesn't care either!? <grin> On the bright side, no more resistor value drift with carbon film!

Date: Mon, 2 Sep 2024 10:31:15 -0400 (EDT)
From: Barry <n4buq@knology.net>
Subject: [R-390] Measuring Resistance Values

Did Collins specify what input impedance a meter should be to properly read the resistance values in the manuals? I did see where a TS-352 was mentioned but that's selectable between 20,000 ohms/volt and 1,000 ohms/volt. I started checking the RF Deck in my R-390 and, starting with V201, I noted a few values that are significantly high. I was using a modern DMM with 10M input impedance so not sure if that could be the problem but I doubt it would account for that much difference but who knows. The voltages were off a bit as well but not nearly as much as the resistance values. I suspect the radio will still work with wacky voltages but the R values really have me thinking I have work to do.

Date: Mon, 2 Sep 2024 11:11:41 -0400
From: Glenn Little WB4UIV <glennmaillist@bellsouth.net>
Subject: Re: [R-390] Measuring Resistance Values

Carbon composition resistors drift up in value as they age. You can leave as is if the radio performs well. You can replace with modern carbon film, metal film or others to get the voltages back where they were designed to be. The performance may improve and tube life may be extended.

Date: Mon, 2 Sep 2024 10:30:44 -0500
From: "Les Locklear" <leslocklear@hotmail.com>
Subject: Re: [R-390] Measuring Resistance Values

I "kinda" remember 20,000ohms/volt as being the "standard" for those days. But at my age, my kinda and facts might be off...

Date: Mon, 2 Sep 2024 15:39:23 +0000 (UTC)
From: Jim Whartenby <old_radio@aol.com>
Subject: Re: [R-390] Measuring Resistance Values

BarryFrom: https://www.electronicdesign.com/technologies/test-measurement/article/21146730/multimeter-measurements-explained

Measuring resistance with a multimeter can be done a couple of different ways, depending on the level of accuracy needed in the measurement. Multimeters measure resistance by injecting a small current into the circuit, and then measuring the voltage drop across those points in the circuit. The known current, and the resulting voltage drop are then used to calculate the resistance using Ohm's Law, V = I2 R. Since even wires have resistance, the wires of the probes can actually add to the observed resistance measurement. For this reason, there are two different modes for measuring resistance: "2-wire mode and 4-wire mode."

In most analog meters, the current injected into the circuit is not tightly controlled. This leads to the compression of the meter reading at the high

resistance end of the scale. A constant current source eliminates this compression of the resistance scale but greatly increases the cost of the analog meter. This problem is not seen in a DVM. So to answer your question, input impedance of the meter is not a concern in measuring resistance.

Measuring voltages is a different story since the meter may load the circuit you are trying to measure. The higher the meter's impedance, the less the loading on the circuit being measured. So the original meter reading used to specify voltages in the circuit may read lower then when you verify the voltages using a DVM.

Not always specified or easily found in most equipment manuals but up to +/- 20% of the specified voltage reading would be an acceptable reading in most circuits. In other words, the voltages given are average readings or bogey numbers ?
>From Wikipedia:"A bogey is a published value for a parameter of an electronic component, such as a vacuum tube, that is average or typical of devices that will be sold, and which the device's manufacturer is attempting to achieve."
Hope this helps,

Date: Mon, 2 Sep 2024 11:52:49 -0400
From: "Jacques Fortin" <jacques.f@videotron.ca>
Subject: Re: [R-390] Measuring Resistance Values

A modern DMM with a 10M input can make differences only with the read voltages, but not for the resistances values. The Allen-Bradley resistors used during your set construction are about 70 years old now. Not surprising that they have raised in value and need to be changed. The only good news is that most of the Sprague "Vitamin Q" used within should still be good if they show no signs of internal oil leaks.

BTW, what is the serial and contract number of your set
Mine is a 14214-PH-51-93 sn 2074.

Date: Mon, 2 Sep 2024 12:33:31 -0400
From: Bob Camp <kb8tq@n1k.org>
Subject: Re: [R-390] Measuring Resistance Values

Ok, I'm guessing we have a typo. We are measuring voltage at the test points rather than resistances. Let's see, I've probably only made about 10 typo's in this message so far ? :) :) Some of the old VTVM?s had pretty crazy input impedances. It would a bit unusual to find one that was above 10 Meg *and* something you would use in a radio with hundreds of volts running around in it. Something like a Simpson 260 would be a much

lower input impedance device when set up for looking at test point voltages. Simple answer in this case, grab that Simpson and see what it reads.

Date: Mon, 2 Sep 2024 11:53:40 -0500
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Measuring Resistance Values

I didn't think it make a difference for resistance readings but was grabbing at straws - especially for the differences I'm seeing. Yes, I expect some drift in those carbon comps but the readings were rather extreme (i. e. 350k vs. 12k). I could believe 40k or 50k but that was crazy. Maybe I read 35k as 350k but I can't be sure now. With the RF deck out, the values are different so I can't reproduce that at the moment. Serial number on the tag is 3044 under contract 14214-PH-51-93. Attaching a pic of mine. Yes, the knobs aren't in their rightful locations but I was just getting some of them where I could test a few things.

Date: Mon, 2 Sep 2024 11:57:49 -0500
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Measuring Resistance Values

Actually I was checking both. It was the resistance values which were extremely high and I was trying to make sure it wasn't because of the meter I was using and I suppose it wasn't. When I get it reassembled, I can check voltages with something more appropriate.

Date: Mon, 2 Sep 2024 17:12:20 +0000
From: David Wise <d44617665@hotmail.com>
Subject: Re: [R-390] Measuring Resistance Values

When measuring resistance, VOMs usually make a circuit of battery-meter(with shunt)-Rcal-Rx, so the current through the DUT depends on meter range and Rx itself. Some models can pack quite a bit of current on the R-times-1 range, enough to destroy some semiconductors and panel meters. DMMs usually push a fixed current (which rarely exceeds 1mA) through Rx, and measure the voltage resulting. The only semiconductors in the R-390(*) design are the Diversity AGC diode and the bridge rectifier powering the antenna relay. There are no thermistors or other intentionally nonlinear resistances. In most cases, your choice of resistance measuring equipment is moot.

Date: Mon, 2 Sep 2024 12:36:51 -0600
From: "Jordan Arndt" <Outposter30@shaw.ca>
Subject: Re: [R-390] Measuring Resistance Values

Are you referring to resistance measurements at the component level, or at the resistance check points described in the manual...? At the compnent level, I check the resistors module by module and replace where necessary and then check at the resistance check points if that's found to be necessary because something isn't working properly. Given the heat produced within an R-390, I'd be surprised if there aren't at least a handful of resistors that have drifted a long way out of tolerance...

Date: Mon, 2 Sep 2024 18:48:45 -0400 (EDT)
From: Barry <n4buq@knology.net>
Subject: Re: [R-390] Measuring Resistance Values

In retrospect, my concern over the internal resistance of the meter is a non-issue for measuring resistance. I was definitely not thinking clearly when I wrote that.
