

Testing N.O.S Russian Tubes

by Fabio Bonucci, IKØIXI



OFTEN AMATEUR RADIO home projects employ N.O.S. (New Old Stock) or used components. It is important to have a method to test these parts before installation in our equipment. This is especially true for components used in high-voltage circuitry, where the potential for catastrophic component failure is highest. It typically is an irreversible effect permanently damaging the element. This article is based on my experience on the GS-35B RF power triode but can be applied to other similar tubes.



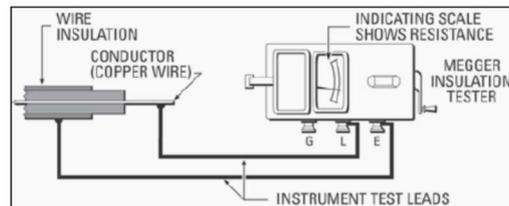
GS-35B RF Power triode

Many of us have noticed the attractive price on the surplus Soviet radar tubes and have wondered about using them as linear amps. Thousands of commercial amps have been converted to Soviet tubes because of expensive western-made replacement tubes. The cost makes this attractive, but you should remember you are getting what you paid for: they have been sitting on the shelf for decades, most are not useable without being conditioned first, some are not useable at all. Someone wrote that product quality in late USSR military

factories was somewhat lower than before; anyway, whatever the reason could be, if you apply HV and RF before burning in the heater (filament), you are almost guaranteed an internal tube flashover in every case.

So it became necessary to test N.O.S. Soviet military surplus RF power tubes before any use attempt. A simple Ohmmeter is not enough, you need a mega ohmmeter (a.k.a. megger). This idea comes from an email exchange with Alek, VK6APK, who wrote a short guideline on RF tube “meggering” on a forum.

The basic idea of a megger is to measure insulation resistance applying a current limited high voltage to an insulator or insulated component.



Meggering principle

In RF power tubes, we have to test the vacuum quality applying HV DC to the pins (or rings). Most popular and cheap meggers are built for electricians and operate on the 1000VDC range. They allow to test cables, electric motors and transformer windings, so they are able to test our beloved RF power tubes. This one here was a suggestion coming from Alek, VK6APK.

In my opinion, for amateur radio applications I suggest the use of higher



voltage megger capable to test at 2500 VDC and / or 5000 VDC. In fact, our RF tubes work at plate voltages well over the 1000VDC, so we need to test them in a different way to mains cables. In fact one of my spare GS-35Bs was okay when tested at 1000VDC but showed low insulation resistance between cathode (+) and grid (-) when tested at 2500VDC. I tried to fit it in my amplifier but the fuse on the plate blew immediately when the tube had been biased. So in this case the 2500VDC test has been crucial for tube selection.

HV megger prices start from few dozen Euros for cheap Chinese versions to thousands of Euros for professional instruments. I bought a FUSO Electric Co. F-631A analog HV megger for 100 Euros on eBay. It's old but like new, professional level and in perfect working order. On the FUSO F-631A the testing voltage is selectable 500/1000/2500/5000. It allows to read up to 50 GΩ.



FUSO F-631A H.V. Megger

When you buy a N.O.S. Soviet military vacuum tube, you have to measure the anode to grid insulation resistance first. Pay attention when using a megger! Although the megger HV output current is at very low level, it could be painful like a taser!. I do apply more than the tube working DC plate voltage (usually my testing voltage is set to 5kVDC) and observe the insulation resistance reading.

Comparing reading values from known good tubes is very helpful. Bill, K8CU, on his web site wrote that a GS-35B in perfect shape shows 6 μA of current leakage at 4 kVDC, significantly higher leakage current indicates a shorted tube. For the Ohm's law it means the insulation resistance should be about 850 MΩ (about 1 GΩ). My spare GS-35Bs shows at least 5 GΩ anode to grid when tested at 5 kVDC, well above the value indicated by Bill, K8CU. I got similar readings measuring the grid to cathode insulation resistance, both polarities and 10 GΩ cathode to anode. That tube works flawlessly, so I have taken 5 GΩ as my personal reference value. All the other spare GS-35Bs I own show 50 GΩ, more or less, measured between all elements.

As a preventive measure, all N.O.S. tubes have to be reconditioned, even if the insulation resistance test is okay because this procedure serves to reactivate the cathode emission as well. This procedure is named "gettering" treatment. A getter is a deposit of reactive material that is placed inside a vacuum tube to complete and maintain the vacuum. In the GS-35B the gettering material (typically a barium-based compound) is located on the cathode in the form of a coating. When the cathode become hot by heater, the gettering material is released and any impurity is absorbed, so tube vacuum insulation resistance (purity) increases. How to do gettering? Simply, slowly running the filament voltage up (3V – 6V – 9V in one



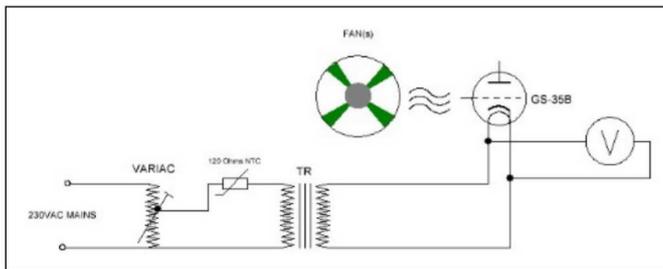
hour step each) and leave it at 12.6 VAC for minimum 24 / 48 hours. In this way the cathode is smoothly led to emission and contaminants trapped inside the vacuum will burn off by barium compound molecules released from the cathode. The tube must be air cooled all the time. To do this procedure comfortably, I built a wooden gettinger jig "breadboard style" with onboard 230 / 12.5VAC 60VA transformer and cooling axial fans. The four fans are fed by an external 12VDC source. With a Variac, I'm able to adjust the transformer primary winding voltage in order to set the proper heater voltage (secondary winding) starting from 0 to 15VAC. The transformer also ensure insulation between the tube heater and Variac (mains). A 120Ω NTC in series with the transformer primary winding helps to limit the heater inrush current. The heater voltage is monitored by a Fluke 37 bench multimeter and manually adjusted by the Variac knob.



Gettinger Jig

the heater supply source and back to room temperature. It's a "before and after" test,

Not always does the treatment give a perfect result (50 GΩ at 5kVDC). Final lower insulation resistance readings are possible but, in these cases, you should repeat gettinger treatment until the insulation resistance increasing trend stops. If after long gettinger treatment, say 4 - 5 days, the insulation resistance doesn't reach the reference value but gives you over 1 GΩ it's worth the risk to fit the tube in service using a fast 1A fuse and a "glitch" resistor on the amplifier HV line. As mentioned before, K8CU reports 1 GΩ of insulation resistance for a GS-35B, so it's the worth a try.



Gettinger Jig schematic

Gettinger treatment must continue till the insulation resistance reading reaches reference tube value (5 GΩ) or better. The increasing insulation resistance must be tested by megger every 24 hours, but not before the tube has been disconnected from

Once the tube passed the megger test, it has to be fitted in the amplifier and left in stand-by for a while. Sometimes tube flashovers occur when the tube is warm, so I suggest to wait at least one hour before any attempt to transmit. If after one or more hours of stand-by the tube didn't show any flashover, you can attempt to set the proper idle current first, then you can drive the tube with low input RF power, say 10W. If the amplifier works properly at 10W, I suggest to run it at this low power input for an hour before



attempting to raise the driving power. The plate current, coming from the cathode, seems to help to release the gettering material from the cathode itself, so the vacuum purity should improve more with RF power running. Step-by-Step, 10W each for an hour, you can try to increase the input power up to maximum. I know, it's a long procedure but it's the worth it. A spare GS-35Bs became SK when I drove it with

50W...it happens.

If after this long procedure your amplifier works properly at full output power, it's your lucky day, you've reconditioned the tube 100%. Enjoy!

All above is an empirical method, easy to do and based on my personal experience. A "learning-by-doing" adventure which worked for all my eight spare tubes. Have fun. ■

Interesting QSL Cards

by Dave Birch G0GKH

I WAS RECENTLY LOOKING through some old QSL cards that were from our local radio club president, the late Reg Holland, G3BPE.

Reg was a very good friend of mine and a very keen CW man. Although he was never in FOC I know he knew a lot of members.

When I used to go with him to events like the RSGB HF Convention he was well known to Al G3FXB and John G3BEX.

Among the cards are some real gems with long-lost prefixes from the 50's and 60's, a few of these were from FOC members of the time.

MEMBER OF THE FIRST CLASS OPERATORS CLUB

To Radio G3BPE Phone/CW Input 60 Wts
 Date 20.8.61 Ur sigs R... S... T...
 Time 1615 GMT Ant di pole
 Band 21 Mc/s Rx CR100

VU2XG

PSE/TNX QSL via R.S.G.B. 73 A. P. W. WINDLE
 G8HV, ex G8XG
Tnx Reg. oo. Pete

MEMBER OF THE FIRST CLASS OPERATORS CLUB

To Radio G3BPE Date 1-4-57
 Time 1210 A.M.T
 From: GEO. A. WAFER Band 28 Mc/s
 P.O. BOX 74 Phone/CW Input 80 Wts
 LUANSHYA Ur sigs R... S... T...
 NORTHERN RHODESIA Ant 66 ft
 Rx BC3482 Cont.

VQ2GW

PSE/TNX QSL via R.S.G.B. or direct 73
 DXCC, AAA, EMP, DX CERT: THANK YOU FOR THE QSO OM/26
 Printed in England

F.O.C.

John Munro
 Royal Air Force
 Bahrain Island, Persian Gulf

MP4BCO

To G3BPE Confirming our 21 Mc. QSO on Sept. 24 GMT
 Your CW/Fam/SB Signals R 5 S 7 T 9 on my Eddystone 358x Rx
 Tx SONAR 120 Input 120 watts Ant 1 beam
 PSE/TNX QSL Mni tnx for QSO es hpe cuagn 73 *John*
 Minerva Brentwood Essex

I have attached some images of some of the cards in case they are of interest for a future FOCUS.

There are cards from members MP4BCO and VQ2GW (not sure what their G callsigns were) plus one from Pete (now G8VG) from when he was operating as VU2XG in 1961. ■

