

# **Acquiring and Maintaining a Tube Tester in Today's Environment**

**Which types provide the best options for  
effectiveness and maintainability**

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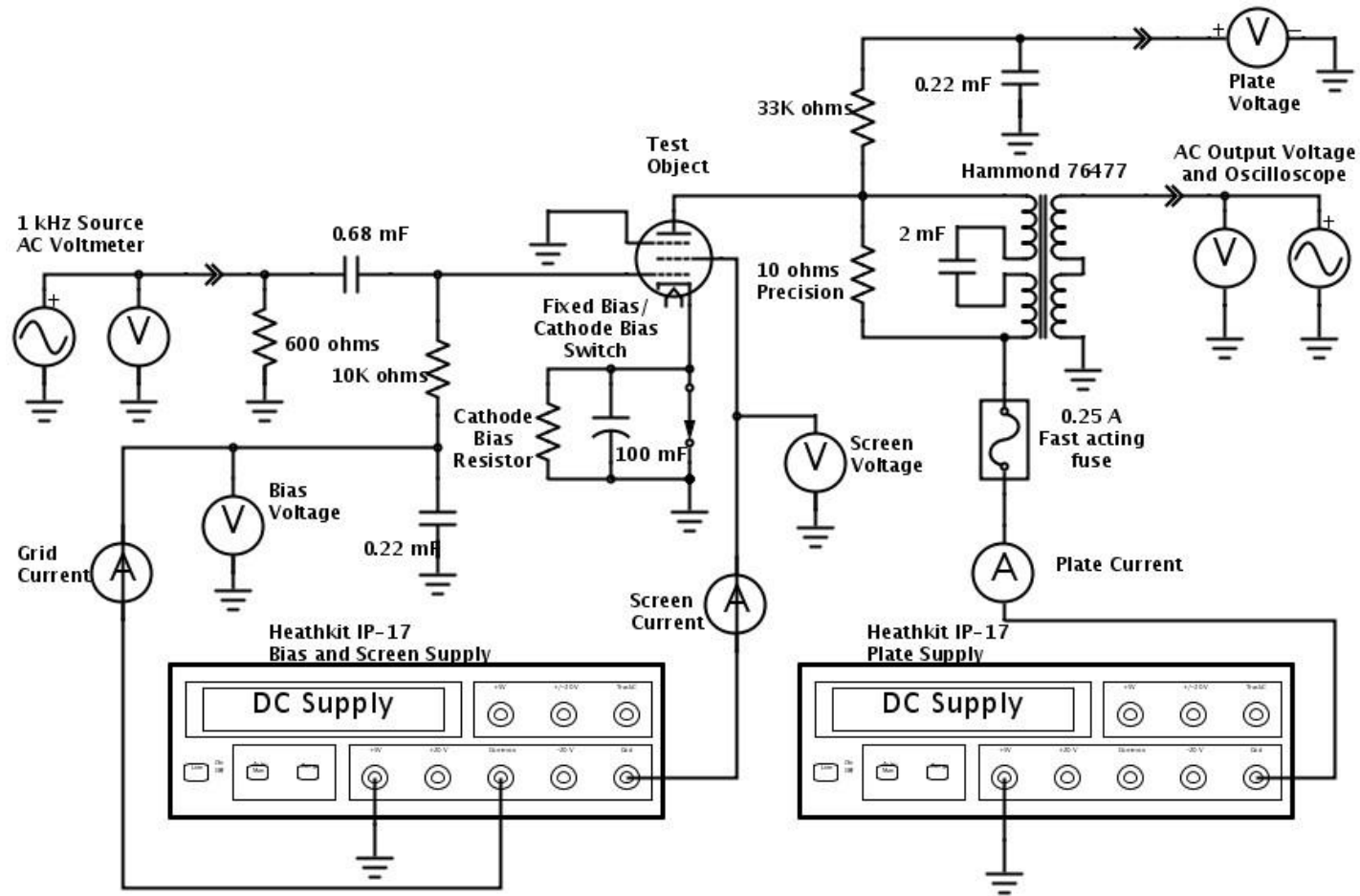
# Approach to the Subject

- **Review the basics of vacuum tube testing**
- **Identify the basic weaknesses of maintaining currently available testers**
- **Identify the four basic types of tube testers**
- **Review the basics of operation of the four types**
- **Make specific recommendations:**
  - **Hickok TV-7**
  - **Triplet 3444 (Westmore 501)**
- **Secondary recommendations**
  - **Hickok manufactured Western Electric KS 15750/15560, RD-1575**
  - **B&K 747**
  - **Triplet 3444A, 3423**
  - **Hickok 6000A (Shunt pot gm)**
  - **Heath TT-1 (Weston 981)**

# What has changed in the past few years?

- **Increasing age of historical testers – more service needed, becoming more difficult and more expensive**
- **Lack of parts and increasing cases of “leakage disease” in Hickok testers**
- **Passing of Roger Kennedy**
- **<https://www.hickokmeters.com/home>**
- **Increasing need on the part of many to test high value tubes – rebirth of Western Electric?**

# Schematic of the Jagundo



# The Jagundo Engineering Test Fixture

- Developed to measure tube characteristics in accordance with the definition of transconductance
- Provides for application of any practical values of bias and test voltages to vacuum tubes
- Built to obtain a baseline of knowledge about vacuum tube characteristics
- Like many others, I was confused about claims made for tube testers



# The Classic Tube Tester Document

Alan Douglas

- Now in the third? printing
- Comprehensive review of tube testers from many manufacturers
- Essential document for anyone reviewing various tube testers and their basic characteristics.



# Four Basic Types of Testers

## 1. Simple emissions testers

The simplest form of tube tester; simply tying all elements other than the cathode to the plate and testing as a diode. Eico 625, Heath TC series

## 2. Dynamic emissions testers

Enhanced emissions by introducing AC signals to the various elements which result in proportional changes in the plate current. Eico 666, 667, Jackson 648

## 2a. Proportional gm – Weston 981 (1957) → Heathkit TT-1, Triplet 3423

## 3. Dynamic transconductance “Indicated Transconductance” (Hickok ckt.)

Use of special split winding transformer and FW rectifier to divert signals from + and – swings of test signal through different paths and measuring the difference between them. Hickoks in general, TV-2, TV-3, TV-7, TV-10, 600, 6000, 539 series, KS-15560, 15750, R-1575, later B&K

## 4. Engineering definition of transconductance. Triplet 3444 (close), 3444A (more current capacity), Weston CA-1630, RCA WT-100A, Amplitrex AT1000, Hickok Cardmatic (close), also computer controlled

# **Focus on the areas of greatest interest and practicality**

**Literally hundreds, maybe thousands of tester types. Previously noted text by Alan Douglas is an excellent review of most testers of interest.**

**The focus of this discussion will be on the quality of test results, maintainability and cost of the testers recommended for consideration for use into the future.**

**Some will have different perspectives. This presentation is based on my experience and analysis of the operation of the testers to be addressed.**



# Special case among all testers, the Hickok circuit

## Standard Explanation

60 Hz AC signal applied to the tube grid. Alternate AC pulses provided by split transformer and 83 rectifier are applied to the tube being tested. Alternate pulses of current flow between legs of return circuit to transformer windings.

Grid test voltage derived from a separate winding on the same transformer.

Gm of tube is proportional to the difference between the two legs.

Reality is not as simple as the standard explanation.

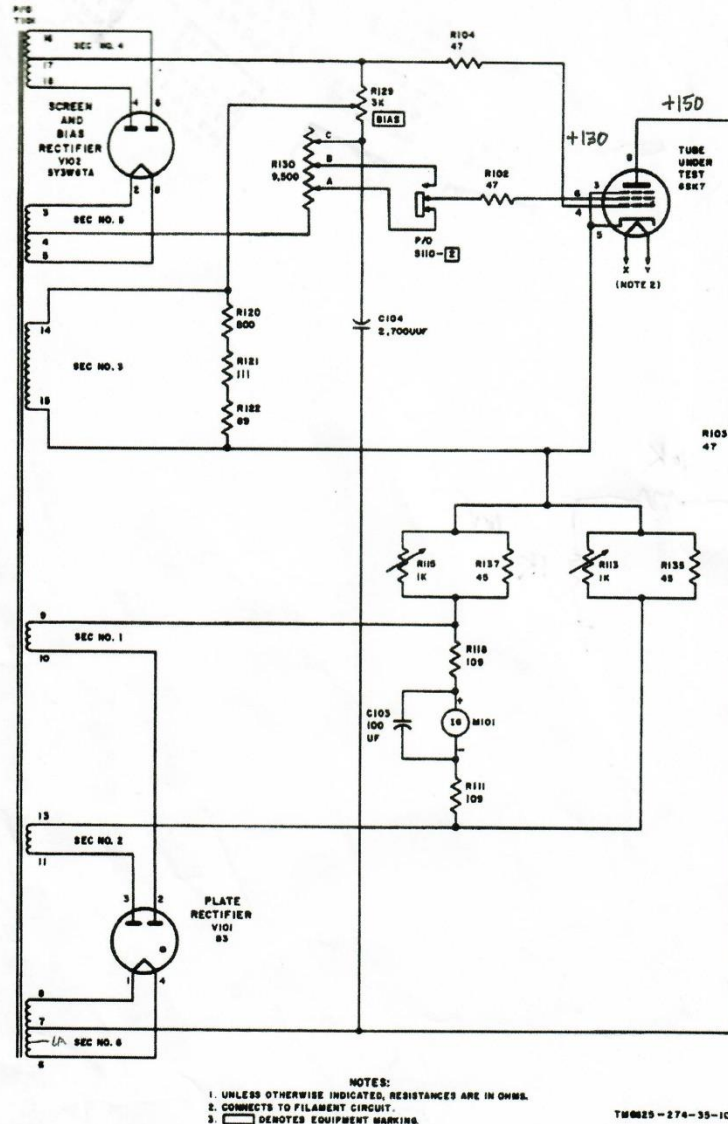


Figure 11. Simplified mutual conductance test circuit, TV-7D/U.

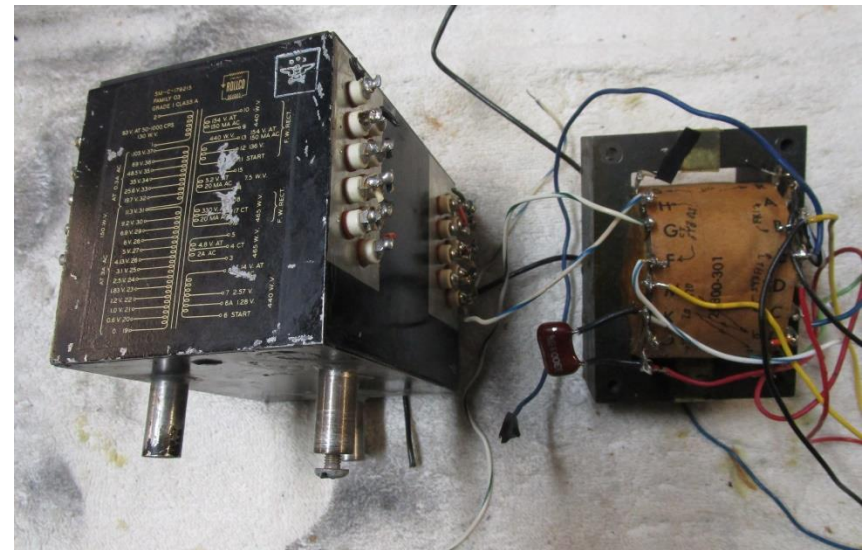
# Major Vulnerabilities

## Meters



Hickok 539B/C

## Special Transformers Leakage Disease



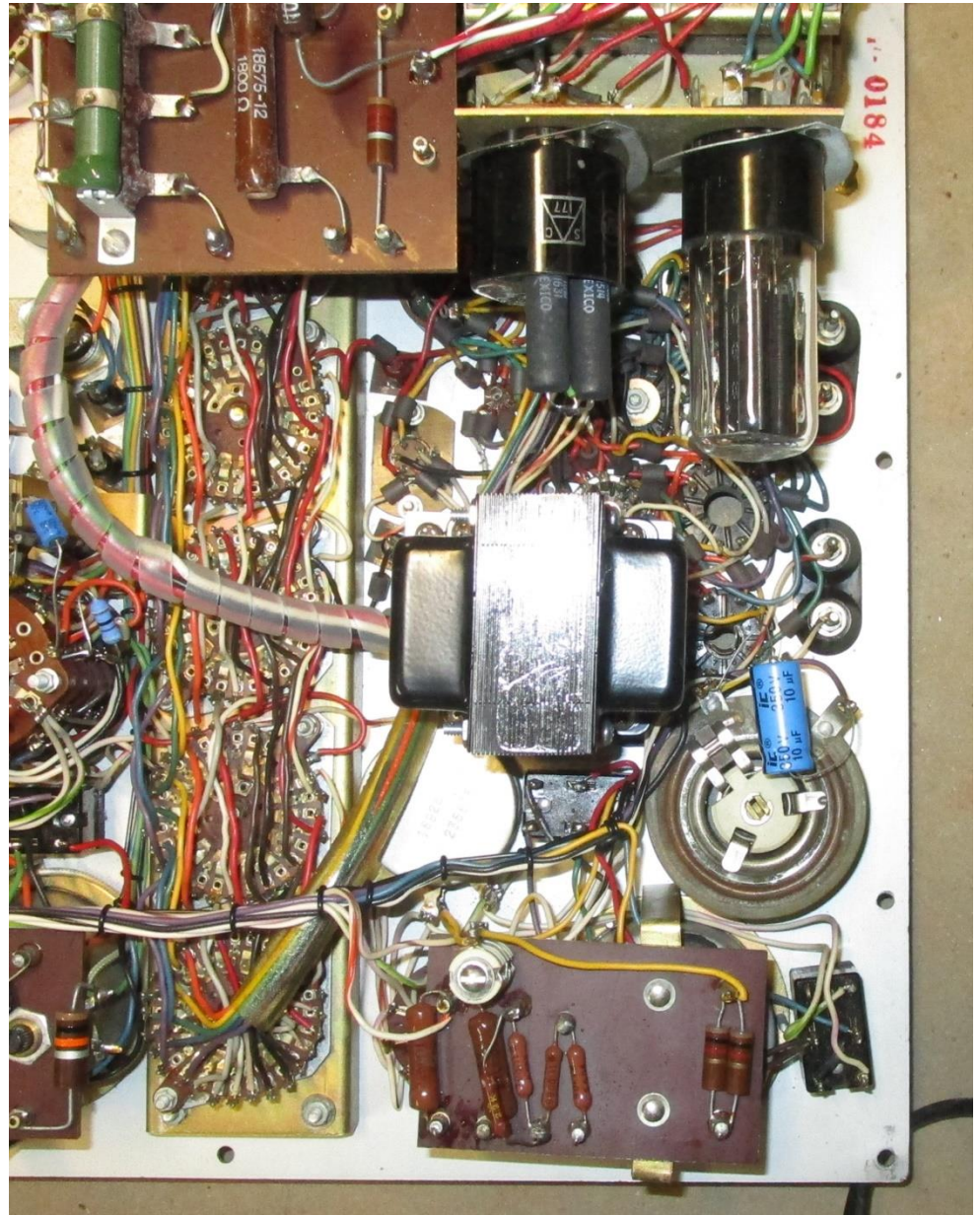
TV-7/U Production  
TV-7A/U

539B/C  
KS15560  
KS15750



# Cure for Leakage Disease

- Only applies to large format Hickok testers, 539A, B, C. Not relevant to KS versions or RD-1575
- Removes all functions of the 5Y3 rectifier from the existing plate supply transformer
- Reduces heat loading in the large transformer, which may extend its life
- Makes no change in operation of the tester
- Not a cure-all, only makes sense to recover a tester in otherwise excellent condition



# Individual Characteristics of Hickok TV-7s

- **TV-7/U Original military acceptance for US Navy – Hickok made RCA 154V transformer (leakage disease?), phenolic switches, anchor symbol in ID plate, skirted bias and shunt knobs. *Avoid***
- **TV-7/U First production run, phenolic switches, 154V transformer, Supreme Instruments manufacture, various meters, skirted bias and shunt knobs, SI following serial number. *Fair***
- **TV-7A/U Second production variant, 154V transformer, ceramic switches, from start to serial 1201 had adjustable pots in gm bridge. After 1201, later configuration installed. Card inside tester will tell if change had been made to earlier serial numbers. Unique ribbed knobs, shunt and bias scales engraved on panel. SLE following serial number, manufacturer unknown, Possible ID for Supreme Instruments. *Good if after 1201 or modified.***
- **TV-7B/U Third production variant, made in two groups each by Forway and Hickok, 2 groups in 1955 and 2 groups in 1957. 164V transformer, black grommets added surrounding fuse bulb and shorts tube. *Best variant.\****
- **TV-7D/U Final production variant, all previous improvements, add ferrite anti-oscillation beads on socket leads, added F scale to Function switch. Made by over 10 different manufacturers. *Excellent – Avoid Bruno***
- **TV-7E/U Not a tester variation, ID on military stock replacement meter.**
- **TV-7C/U Stark, Canada, TV-7G/U Lorenz, Germany**



# Unique TV-7 Attributes

- For the B and D, each manufacturer made them the same. Many parts interchange, even between variants
- Name plates are secured only by two small screws and can often be switched or absent
- Many testers were serviced in military facilities, some rather poorly
- Various case and meter markings may not conform to the actual tester model, as these parts were commonly interchanged
- Misrepresentations and scams are common – be vigilant – know the unique differences

Separate plate  
only on TV-7/U



Ribbed knob  
only on the A  
and some D  
Brunos

# TV-7/U Panel Characteristics

## Top Photo

- Clean Panel
- Very nice Function Switch markings
- Skirted Bias and Shunt Controls
- Caution plate under transformer mounting screw
- No insulators around fuse and shorts bulbs
- All serial numbers followed by SI

## Bottom Photo

- Supreme, 3564-7 on knob skirts
- Hickok Navy version has anchor symbol in nameplate, 4160-94 on knob skirts
- Name plate with SI
- Supreme Meter (Roller-Smith?), Hickok, others





# TV-7A/U Panel



**This has to be an A, no grommets in the fuse and shorts holes and the match red dots lettering engraved at the upper left. Note the plugged hole at the lower left, correct location for line cord is the upper left. Correct A identified meter.**

# TV-7B/U Panel Characteristics

## Top Photo

- Insulating grommets added to fuse bulb and shorts bulb holes
- Chrome plug installed to cover extraneous line cord entry



## Bottom Photo

- Function Switch shows some wear, no paint separation
- Vertical bars show deposits from hand operation





# TV-7D/U Panel Characteristics

## Top Photo

- Clean Panel except for paint flaws
- Paint chipping in Function Switch and Bias control scales likely due to paint issues
- Grommets around fuse and shorts bulbs
- Manufactured by at least 10 different companies frequent
- Phaostron meter correctly marked

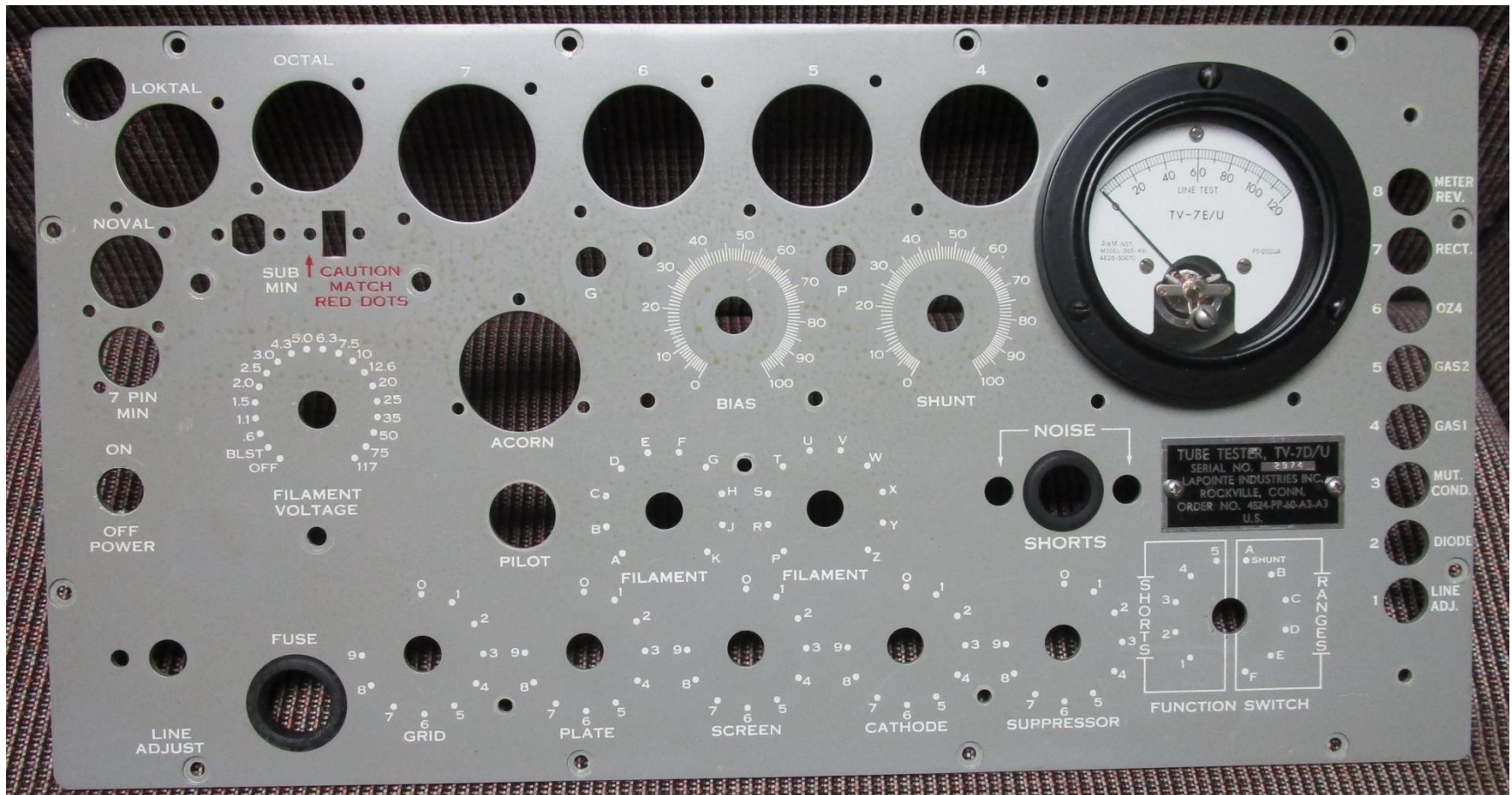


## Bottom Photo

- Little evidence of wear and deposits due to use but obvious paint separation
- Painted hardware – service clues
- Note F position of Function Switch, unique to the D variant
- Also creates vulnerability unique to the D variant



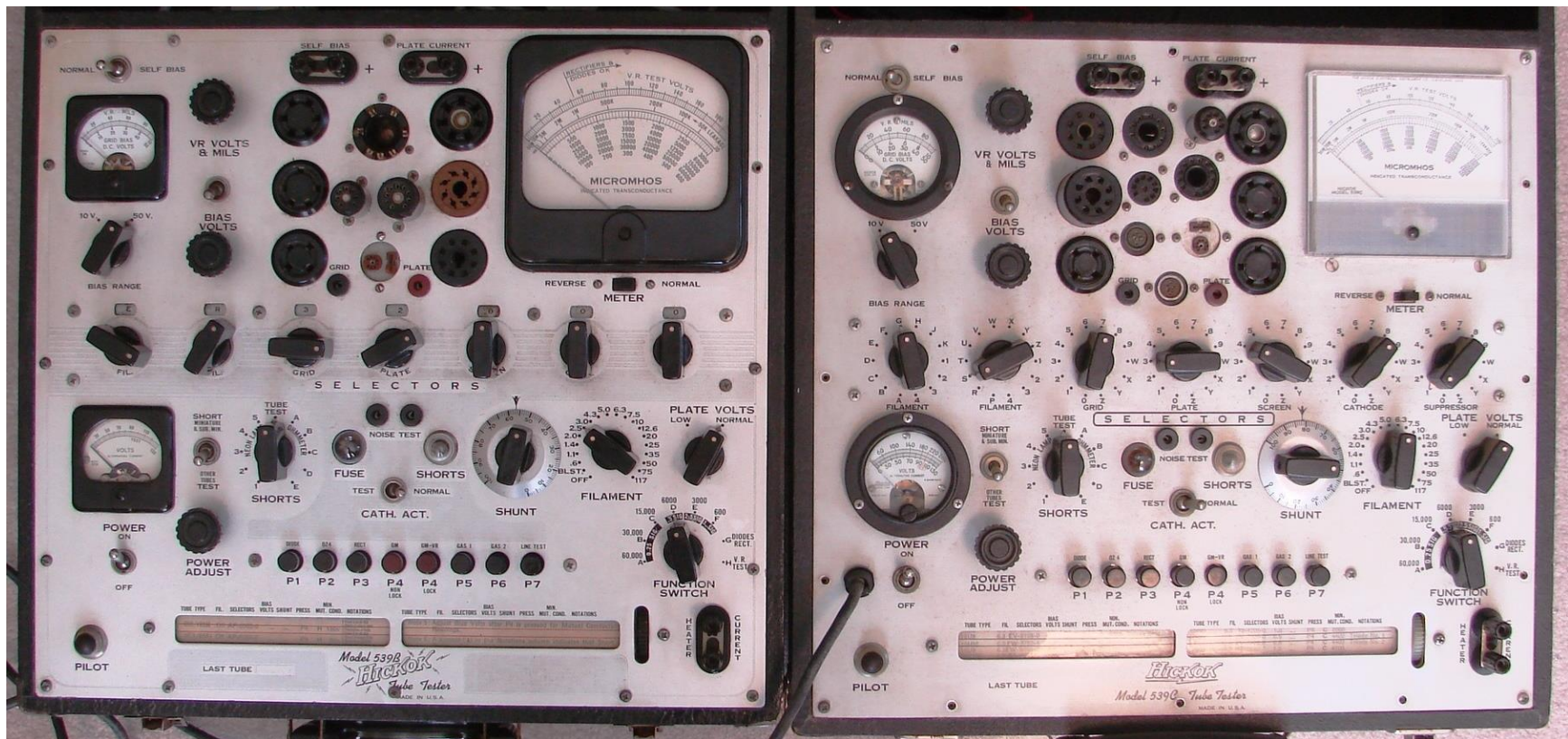
# Excellent D panel with E meter



**F position on Function Switch, grommets in Fuse and Shorts holes. E marked meter was for replacement use, not another variant of the TV-7.**



# Two Highly Regarded Testers Hickok 539B, C Replete with Issues



Early 539B on left, late 539C on the right. Most early versions have “leakage disease”, many late 539Cs do not. All meters are special, hard to find and expensive. Both use a special bias pot that can only be obtained from donors.

# Rarer, Better Choices

## The WECo KS15560, KS 15750, RD-1575



**KS-15560 left, most in wooden cabinet, KS-15750 right, metal cabinet. Both use the regular Hickok power transformer, similar gm meter. DC bias eliminates vulnerability to leakage disease. Unit on right demonstrates Simpson “Wide Vue” bias and line meters. Common bias pot. 15560 does not test thyratrons or VR tubes. Same roll chart for both.**

# Other Hickoks/circuits

**Gm readings from a Hickok circuit tester cannot be expected to agree with tests performed under the manufacturer's specifications**

- 1. TV-3**
  - TV-3 is older and has VOM functions – rare and unusual meter
  - TV-3C made by Jetronics, other designations made by Hickok
- 2. TV-10**
  - Updated TV-3 without VOM functions
  - B, C, D versions made by others
- 3. TV-2 CBS-Columbia designed?**
  - Hickok bridge, higher voltage, other elements have DC voltage
  - Big, heavy, inconvenient, fussy to use
  - All versions have transformer/meter issues
- 4. 533 to 538, 600, 800, 6000, 6000A**
  - Transition from “English” control to Shunt – major meter vulnerabilities
- 5. B&K 747**
  - Hickok circuit after Hickok patent expiration, solid state, lightly built. Meter is not marked in gm, but neither are TV-7, TV-2.



# Stock Triplet 3444

## 1962?

### Triplet 3444 Evolution

Above serial 2000:  
Center pin of loktal socket  
connected To pin 9 on 9  
pin socket

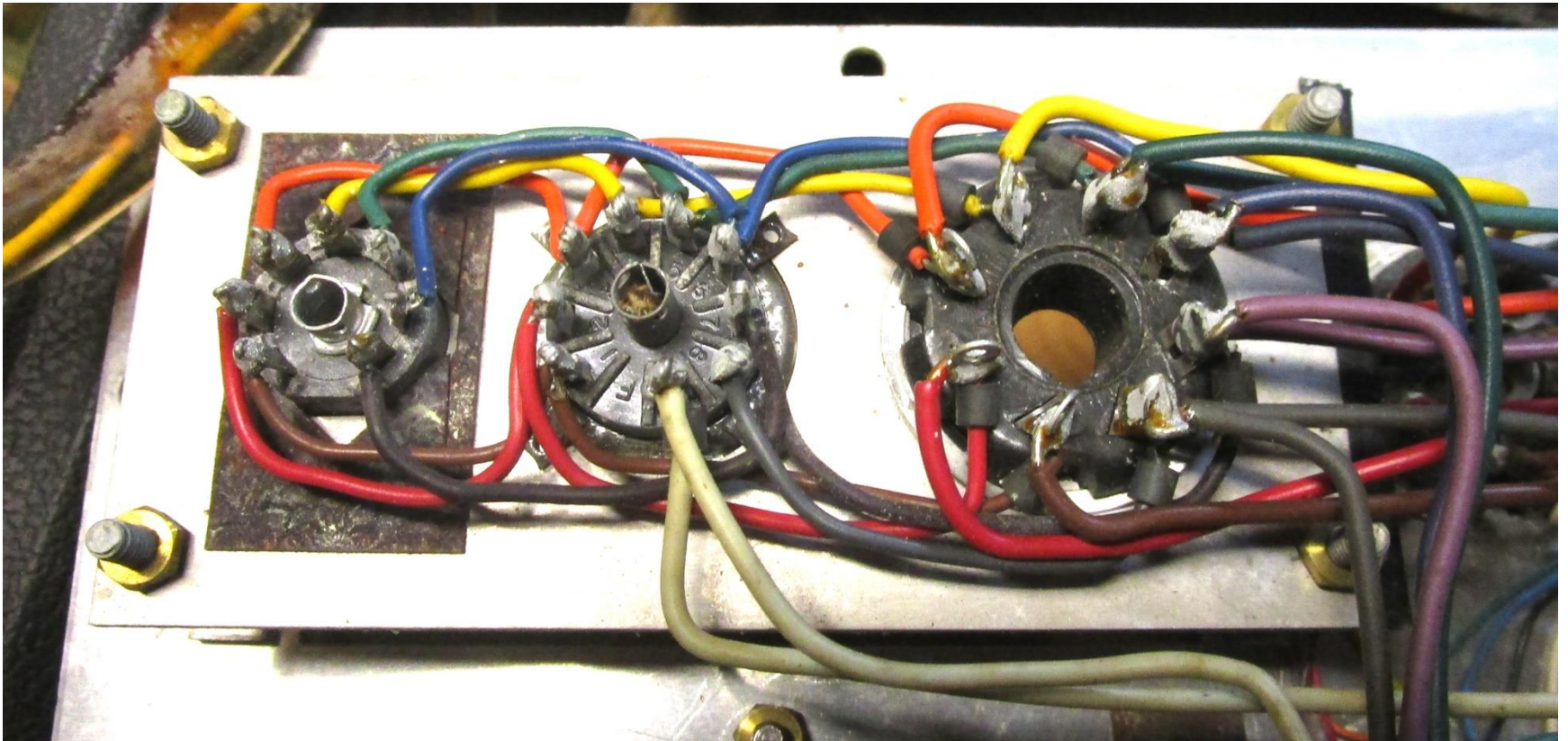
Above serial 3000:  
Add Nuvisor socket and  
cathode cap jack on front  
panel

Above serial 5000:  
Bias voltage applied to  
both control grids of all  
dual section tubes



*“Arguably, Triplet is the best of all USA-made and designed vintage testers”.*  
Igor S. Popovich B.Sc. (El. Eng.) Audio Tests & Measurements Revised 2022

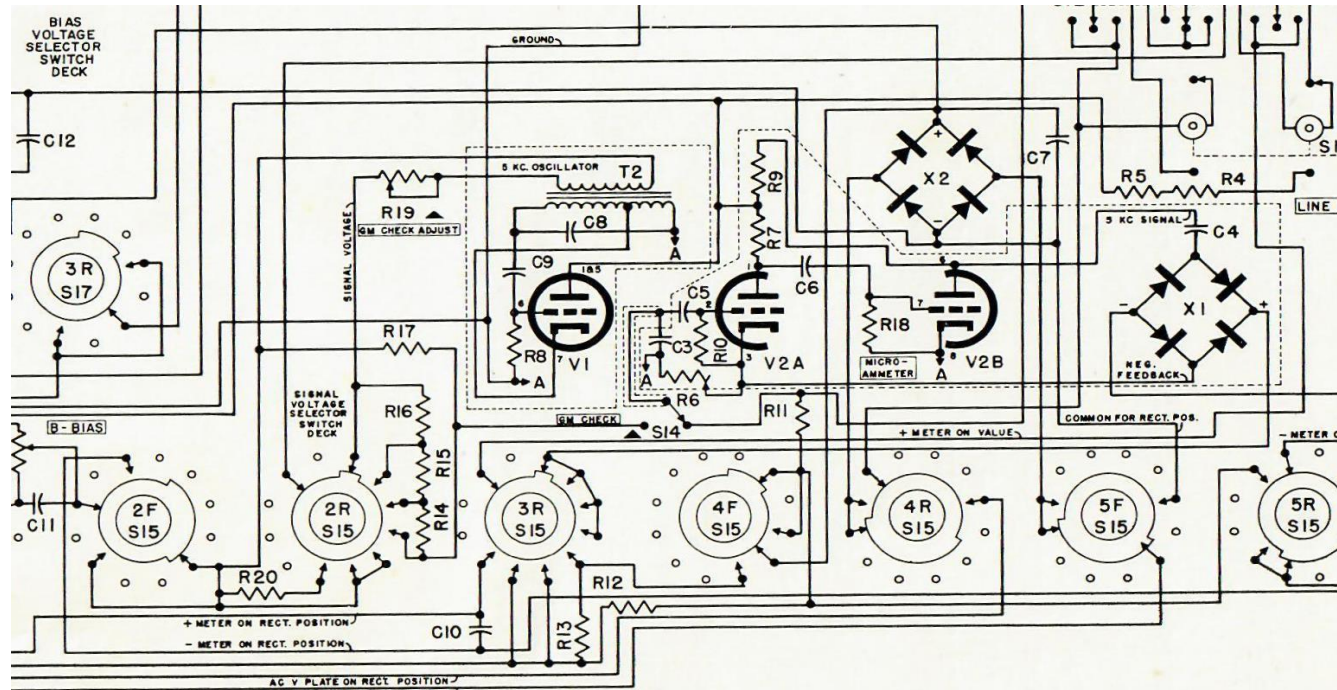
# Original 3444 Socket Wiring



**Early ferrites on octal leads and parallel wiring below the deck. Sockets replaced to deck level with new ferrites on all leads with crossing wiring when possible.**



# Section of the 3444 Circuit



**Schematic shows oscillator circuit to develop test signal (6C4), resistive divider (R17-R14) for changing scales, calibration switch, adjustment control and meter amplifier (12AU7) for driving the diode bridge (X1) to operate the test meter. These are necessary to conduct an engineering test for gm. DC test voltages required are provided by diode bridge X2 and a bias rectifier.**



# Triplet 3444 (Upgraded)

## Changes from Stock

- Power supply filtering
- Decoupling and filtering in oscillator and meter circuits
- Added test signal filtering
- Separate switch in calibration circuit
- New common sockets brought up to deck level, ferrites on all miniature socket leads
- No changes from stock operation except for gm calibration switch
- Additional operational procedures provided.



# Full Conversion 3444

## Testing a 6L6 at 400V





# Triplet 3444A

## 1969

- Tests compactron, magnoval, septar, acorn, 10 pin and lighthouse tubes
- Up to 150 mA plate current (unreg.)
- Solid state electronics
- Pushbuttons replace lever handles on the 3444
- 60,000 gm position
- Rare 50 uA meter
- Rare and expensive
- 10 pin switches.



# Hickok 6000A

- The last of Hickok's small form service testers
- Shunt pot for gm setting - hold down the test button and burn the pot
- Excessively sensitive shorts test
- Has compactron, magnoval, 5 and 7 pin Nuvistor sockets
- Socket island can theoretically be changed to test old large pin tubes; not so simple to do
- Some users want the loktal socket removed, replaced with a 4 pin to test older tubes
- 7 pin Nuvistor socket can also be changed for an additional 9 pin
- Meter is major liability.





# B&K 747

- Solid state Hickok circuit made after Hickok patent expired
- Lightly built, plastic case, prone to damage
- Uses multiple sockets and unusual controls
- Can be a useful tester if you can find a nice one



# And the Winners are:

**For maintainability regardless of serious testing compromises:**

**TV-7 variants, B and D tied for first, A for second, SI first production for third**

**Reasonable option: 539C late production and 752, A, confirmed not to have leakage disease, KS-15560, KS-15750**

**AVOID: First run Navy acceptance Hickok made TV-7/U, 539A, B, TV-2 (all), TV-3 (all), TV-10, Bruno TV-7D/U**

**For balance of cost, maintainability, excellence of testing conditions and accuracy: Triplett 3444 upgraded, 3444 stock. Adequate panel space for digital plate current meter.**

**Reasonable option: 3444A - rare, expensive, excellent performance, difficult (expensive) to service, some critical items very hard to find. AT1000 - expensive. Hickok Cardmatic if you can find service and cards. An excellent computer controlled version available at [TubesontheWeb.Com](http://TubesontheWeb.Com).**

# Thanks for your attention

- This presentation has been structured to serve as a reference if desired
- A limited number of printed copies with 4 slides/page are available.
- If you would like to obtain a full size pdf of the slides, send a request to [pkharthave@gmail.com](mailto:pkharthave@gmail.com)
- Also available on request is a paper on the Hickok 539 series and how evaluate them and test for leakage disease
- Cards available with full contact information