Identifying tubes with the RoeTest

Preliminary:

This is about tubes where the labeling is no longer readable. How can you decide which tube that is? In principle the approach for identifying tubes is well explained by Mr Hans-Thomas Schmidt on his internet page (www.hts-homepage.de). Also thanks to Mr Schmidt for his support.

Fundamentals:

Here especially the many bulk tubes without labeling are addressed. This is not about some unknown exotic tube types. Also resistors, stabilizers, tuning eyes and cathode ray tubes are not addressed; this is about diodes, rectifier and amplifier tubes. Also special cases (like separate filaments for the systems) are not considered. Such exotic types can be identified by an expert without high measuring effort.

Approach:

There are thousands of tube data stored in the RoeTest's database (including comparable types). The goal is now to get as many tube parameters as possible and compare the data to the database to exclude all not possible tube types. It would be nice if there were only one tube remaining at the end. Unfortunately many tubes are similar so often several possible tube types will remain. This uncertainty can only be resolved by visual comparison and test operation using practical conditions.

Special cases:

It would be simple if each tube only contained one system. Then the electrodes could easily be found. This is sadly not the case. To use the software meaningfully the special cases must be known:

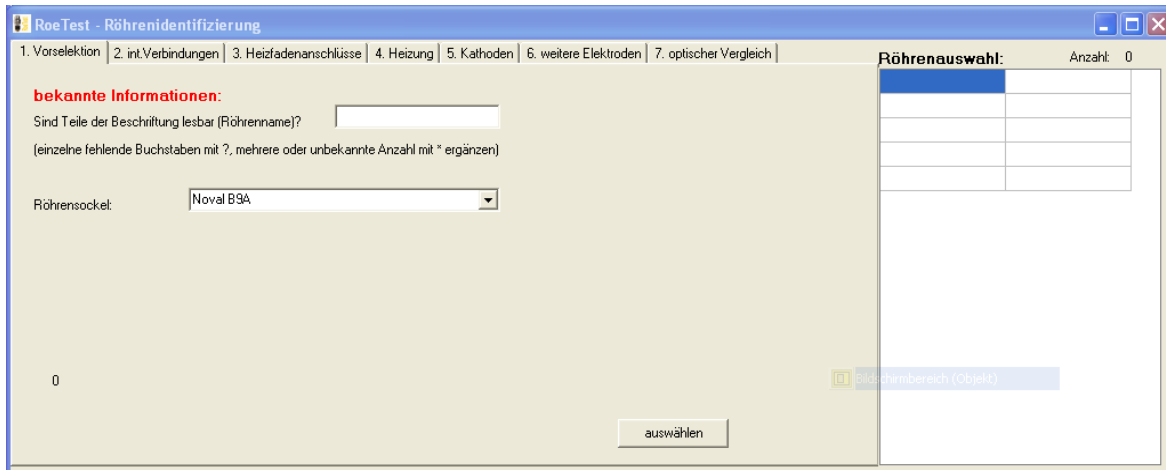| Problem:	Solution:
Pentodes: There are tubes where G3 is brought out and tubes where G3 is internally connected to the cathode. Such tubes would be recognized as tetrodes.	A full identification of all electrodes is not required at all. Already a partial identification (normally up to G2) suffices.
There are some tubes (e.g. EF80) where the screen (S) also influences measurement. An additional electrode would be recognized.	Same as above
The tube data base allows only 3 systems per tube. Tubes with more systems (e.g. EABC80) could not be identified.	For the most important tube types (xABC80) there is an exception built into the software so that those types already can be recognized after search of the cathode(s).
The state of most of the bulk tubes is unknown.	As long as the tubes are functionally okay the quality only plays a subordinate role. A certain minimal emission must be present to be able to recognize the electrodes. Faulty tubes cannot be identified.
There are compound tubes where electrodes of the systems are connected (e.g. ECH42, ECLL800)	The many different possibilities obviate a correct recognition of all electrodes. But those tube types are recognized normally already after finding the cathodes.

Interactive system:

Over more than 100 years of tube history there is a wide variety of tube types.
There are so many technical implementations that it is impossible to recognize all types by the software. Technical qualification and experience are still needed. Tube identification with the RoeTest should be regarded as a helper tool that reduces the amount of work needed and speeds up identification. Also it is not possible to have all processing done automatically by the RoeTest's software. Instead a part of the tasks is transferred "interactively" to the operator (for example visual inspection of the tube – which base? Determining the brightness of the filament...) The user is lead step by step to arrive at the destination.

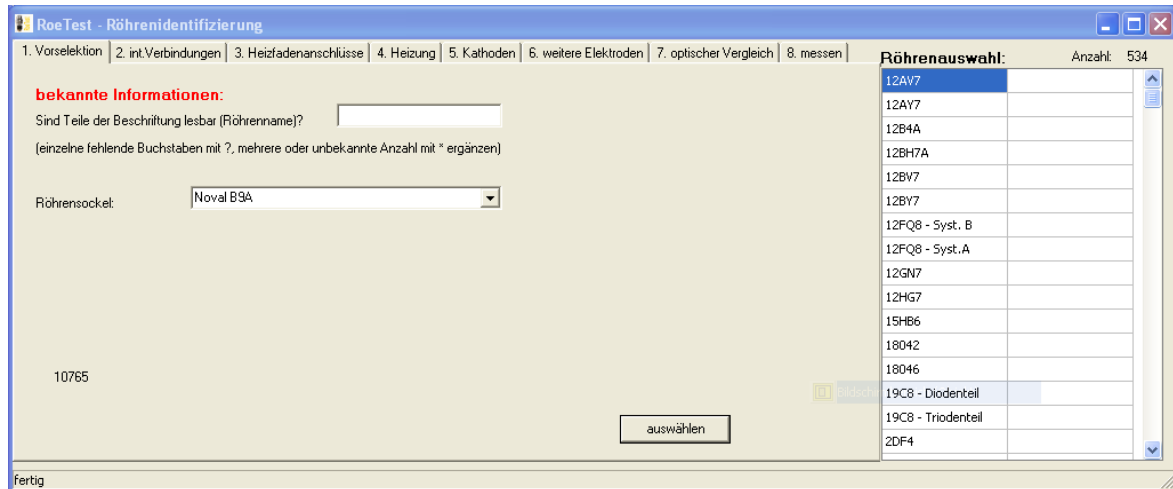Start of identification: RoeTest measuring software menu "B":

Operation:
The tabs must be processed from the left to the right (1 ... n):

1. Preselection:

The minimum specification needed is the type of the base. If parts of the labeling are still readable these parts should also be specified. The usual placeholders (* ?) may be used.

When selecting "auswählen" the database is searched and applicable tubes are entered into the selection window at the right side ("Röhrenauswahl"). Comparable tubes are not shown. If a comparable tube has the same parts of the name the referenced tube is entered instead. The number of tubes is also shown.

2. internal connections:

Insert the tube. When pressing the button <prüfen> the tube pins are checked for internal connections.

	1	2	3	4	5	6	7	8	9	10	Verbindung
Stift 1		X									1
Stift 2											
Stift 3	X										1
Stift 4					X						2
Stift 5				X							2
Stift 6											
Stift 7											
Stift 8											
Stift 9 (Seite)											
Stift 10 (oben)											

Ergebnisse: - = keine Verbindung, X=Verbindung

prüfen

3. Filament connections:

Now it has to be determined what internal connections are real connections and what are filament connections. There is no resistor measurement possible with the RoeTest. Instead a current measure is used. A small heater voltage is applied. A shortcoming of the RoeTest is used for this: There is a voltage drop across the current measuring resistors and the internal resistance of the FET so there is no 'true' short circuit with high current but only a moderate small short circuit current. Tested is with low heater voltage. The RoeTest first tries to find a suitable heater voltage (maximal 1.5 V to not endanger D-tubes). The voltage to be used is when about 30-100 mA flow in case of a short circuit.

Button <prüfen>:
The software checks the short circuit current. Currents less than

Short circuit current x Factor

are recognized as filament connections. A built in logic tries to recognize mid points of filaments or connected filaments.

| 1. Vorselektion | 2. int.Verbindungen | 3. Heizfadenanschlüsse | 4. Heizung | 5. Kathoden | 6. weitere Elektroden | 7. optischer Vergleich | 8. messen |

	1	2	3	4	5	6	7	8	9	10	F	Verb.
Stift 1		0										1
Stift 2												
Stift 3	0											1
Stift 4					X						F1	2
Stift 5				X							F2	2
Stift 6												
Stift 7												
Stift 8												
Stift 9 (Seite)												
Stift 10 (oben)												

Testparameter: Kurzschlußstrom bei bestimmter Heizspannung:

Heizspannung (V): 1,50

Kurzschlußstrom (mA): 0

Faktor Kurzschlußstrom: 0,85

Kurzschluß > (mA): 0

Ergebnisse: Gemessener Strom in mA

99999 = Schluss

Heizspannungsanschlüsse ggf. manuell korrigieren (F1, F2, FM) - Automatik ist nur bei einem Heizfaden möglich!

prüfen   auswählen

Subsequently pressing the button <auswählen> can be used to further restrict the tube selection.

4. Heating

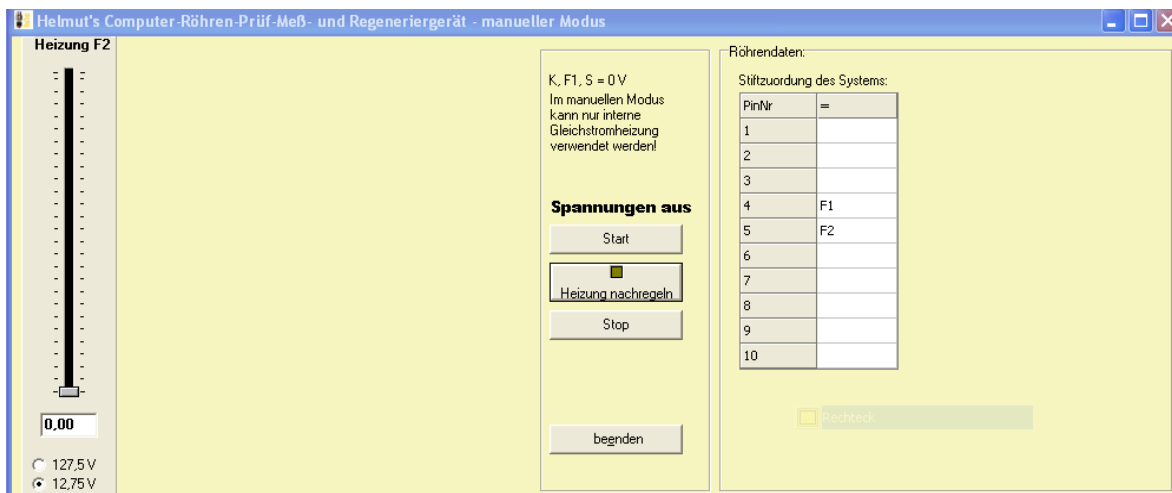To determine the heating values use the button <<Heizspannung im manuellen Modus ermitteln>:

Determining the heater voltage is a task of the user. The heater voltage shall be slowly increased and the brightness of the cathode respectively the filament must be observed. This needs some experience how bright these should be. A rule is that preamplifier tubes mostly glow only lightly, output stage tubes glow brighter. Also the ratio of voltage and current must be observed. Often it is easy to find out whether it is an E- P- of U-type tube. Please note: Tubes with filament mid points are defined in the database so that the heating voltage is always connected to the filament ends and not to the mid point. For example ECC83: This tube requires for that type of connection 12.6V at 0.15A heater current and not 6.3V at 0.3A! But there are also tubes where it is uncertain if it is a P- or E-type tube. In this case specify slightly higher tolerance limits for voltage <u>and</u> current.
At a later point of time the selection can be repeated anytime with tighter limits.

Heater voltage and heater current are entered to these fields:

Tubes have variations, therefore the following applies:

E-Tubes (designed for fixed heater voltage):
Tolerance for voltage = 0%
Tolerance for heater current should be specified e.g. 20%

P- and U-Tubes (designed for constant heater current):
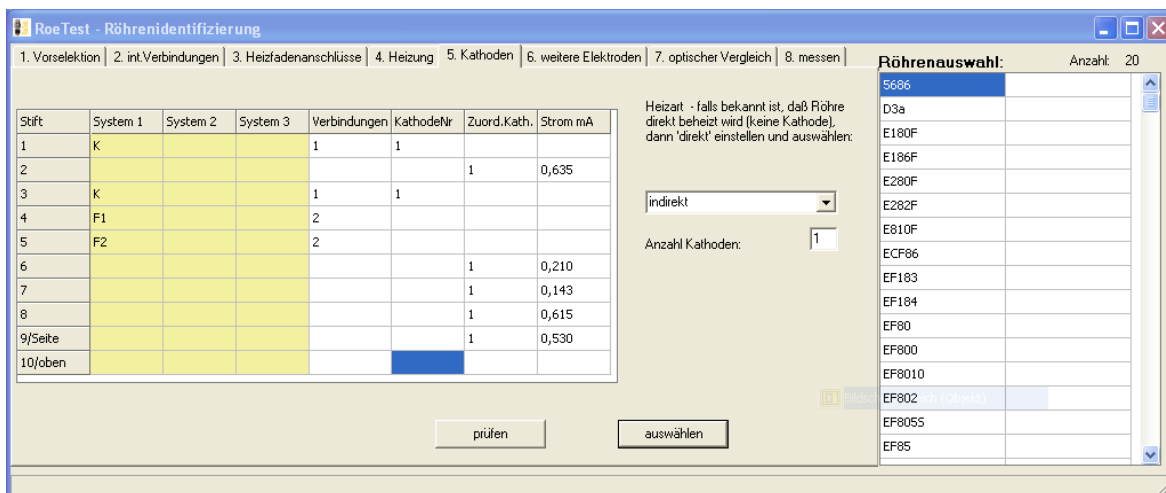Tolerance for voltage should be specified, e.g. 20%
Tolerance for heater current= 0%

Note: If the tolerance limit for the heater current is "0" the heater current will be automatically controlled in later tests else the heater voltage will be automatically controlled.
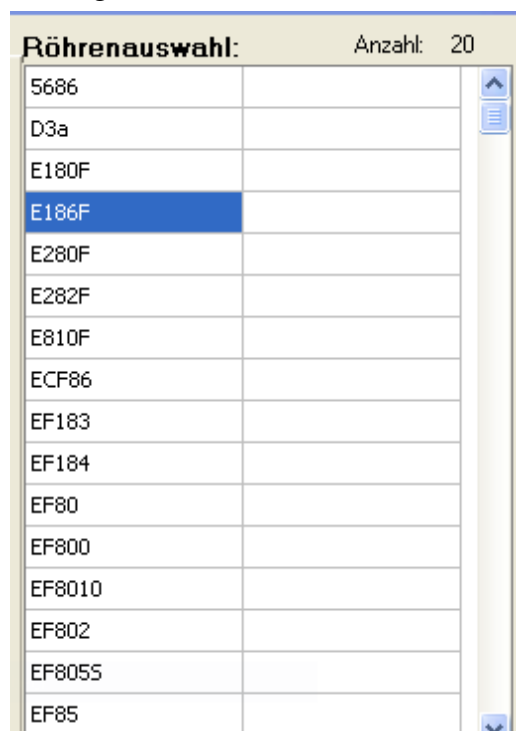
When the heater voltage has been determined and entered the tube selection can further be restricted by pressing the button <auswählen>..

5. Cathodes:

Pressing the button <prüfen> starts detection of the cathodes. For this purpose all electrodes are connected to a positive supply and one electrode after the other is switched to 0V.
If this electrode is a cathode a small current will flow. Internally connected pins must be treated as one pin. For this test the RoeTest operates as power tester 2 in high resistance mode. Overloading of the unknown tube is therefore impossible. It is important that the RoeTest has been calibrated exactly. This especially applies to the current measure range of G2. Hard- and software must be calibrated so that an idle current of "0" is displayed. In the following mask a small value must be entered as limit for recognizing an electrode (this somewhat depends on the hardware, my value is 0.011 mA).

Pressing the button <auswählen> will then further restrict the tube selection.

In the example there remain only 20 possible tubes.

6. other electrodes

Detected are the first two electrodes of each system, G1 and G2 or G1 and A or A
(the remaining electrodes of a system are just marked with 'X') and the number of systems.
A maximum of 3 systems per tube is possible.

After "prüfen" has been performed the selection is done (for this example) by

- Number of systems (press button)
- G1 (press button)
- G2 (press button)
- for tubes that have electrodes of different systems connected the detection of the electrodes is uncertain. But such tubes are already recognized before pressing the G2 button, for example the ECH41
- A (do not press button) not used here since A has not been detected
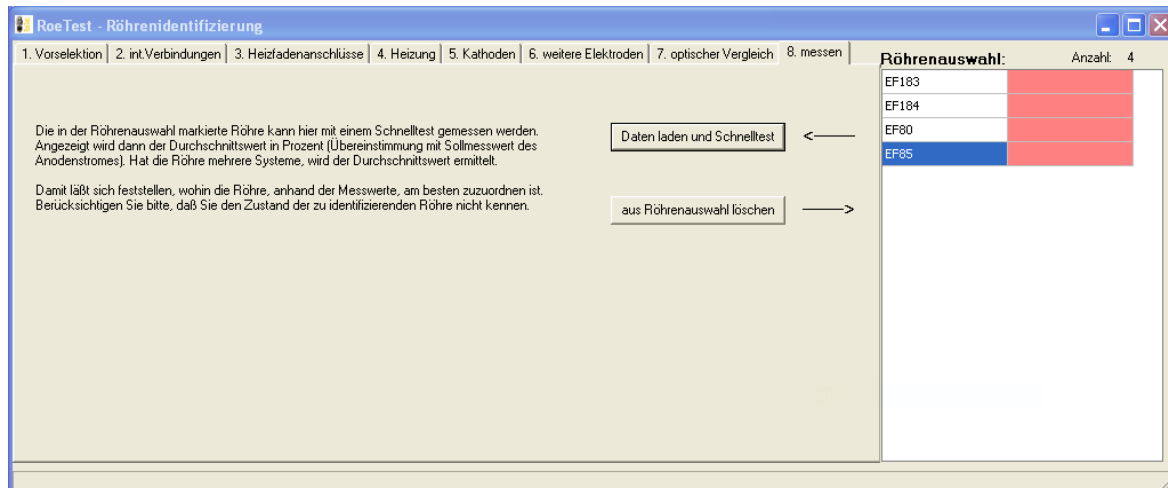- There remain 18 possible tubes.

7. visual comparison

After that the tube has to be compared visually. Best is comparison with available tubes. Alternatively comparison can be done using pictures. For this purpose the internet page <www.radiomuseum.org> can be used (if an internet connection is available and the tube has exactly the same description there). Those of you that have stored tube pictures will have the pictures automatically displayed when selecting the tube (for how to store tube pictures see the instruction manual). All tubes that are out of question can be removed using the button <aus Röhrenauswahl löschen>. Please note: there are different formats of the tubes and tubes of different manufacturers may look different. In most cases several tubes can be excluded so that only a view of possible tubes will remain.

8. measuring

There should only few tube types remain. Now you can measure the tubes one after each other by marking the tube in the tube selection list and pressing the button
 <Daten laden und Schnelltest>. A percentage value will be shown – the compliance with the underlying measure data for the respective tube.

More possibilities:

A distinction between control type pentodes (odd ending number, e.g. EF85) and non control type pentodes (even ending number, e.g. EF80) can easily be done by recording a characteristic curve.

Presumably in the end only a few tubes remain. But a distinction with 100% reliability is not always possible.

final remarks

The preceding system is a valuable tool. The hit rate is relative high. But you need - as already mentioned – expert knowledge. Further one has to get acquainted with the system and gather experience. This experience first should be made using some known tube types before trying to identify a unknown tube for the first time.