Instruction

for the

Tube Tester Type W 19.

Manufacturer:

MAX FUNKE

Zeichen Symbols	kennzeichnet	marguet
U_f . . .	Heizfadenspannung	Filament voltage Heater voltage
I_f . . .	Heizfadenstrom	Filament Current Heater Current
Ua . .	Anodenspannung	Plate Voltage
Ug1 . .	Spannung am 1. Gitter Steuergitterspannung	Grid No 1 Voltage Control Grid Voltage
Ug1w . .	Spannung am 1. Gitter bei Widerstandsverstärkung	Grid No 1 Voltage for resistance coupled circuits
Ug2 . .	Spannung am 2. Gitter Schirmgitterspannung	Grid No 2 Voltage Screen Voltage
Ug3 . .	Spannung am 3. Gitter Schutzgitterspannung	Grid No 3 Voltage Supressor
Ug4 . .	Spannung am 4. Gitter	Grid No 4 Voltage
U_L . . .	Leuchtschirmspannung	Target Voltage
Ia . . .	Anodenstrom	Plate Current
Iaw . .	Anodenstrom bei Widerstandsverstärkung	Plate Current for resistance coupled circuits
Ig1 .	Strom am 1. Gitter	Grid No 1 Current
Ig2 . . .	Strom am 2. Gitter	Screen Current
Ig2w . .	Strom am 2. Gitter bei Widerstandsverstärkung	Screen Current for resistance coupled circuits
I_L . . .	Leuchtschirmstrom	Target Current
S	Steilheit	Transconductance
D . . .	Durchgriff	
g	Verstärkungsfaktor	Amplification Factor
Ri . . .	Innerer Widerstand	Plate Resistance
Ra . . .	Außenwiderstand	Load Resistance
Raa . . .	Widerstand von Anode zu Anode bei Gegentaktverstärkung	Load Resistance Plate to Plate
Raw . .	Anodenwiderstand bei Widerstandsverstärkung	Plate Resistor for resistance coupled circuit
Rg2 . . .	Widerstand vor 2. Gitter	Screen Resistor
Rg2w . .	Widerstand vor 2. Gitter bei Widerstandsverstärkung	Screen Resistor for resistance coupled circuit
R_k .	Kathodenwiderstand	Self-Bias Resistor
R_{kw} . .	Kathodenwiderstand bei Widerstandsverstärkung	Self-Bias Resistor for resistance coupled circuit
I_k . . .	Gesamter Kathodenstrom	Total Cathode Current
R_{fk} . .	Widerstand zwischen Heizfaden und Kathode	Resistance Heater - Cathode
Rg1 . . .	Gitterableitwiderstand	Control Grid Resistor
Na . . .	Anodenbelastung	Plate Dissipation
Ng2 . .	Schirmgitterbelastung	Screen Dissipation
$\mathfrak{N}$ . . .	Sprechleistung	Power Output
d	Klirrfaktor	Total Harmonic Distortion
U_{fk} . .	Spannung zwischen Heizfaden und Kathode	Heater - Cathode Voltage
Ug~ . .	Steuerspannung an G_1	Peak Signal Voltage
C . . .	Ladekondensator	Filter Input Condenser
= . . .	Gleichstrom	DC Voltage / DC Current
~ . . .	Wechselstrom	AC Voltage / AC Current

Tube Tester W 19

This Tube Tester may be connected with any AC line outlet since it can be adjusted to 110, 125, 150, 220, 240 volts. The adjustment is made inside the equipment at the line transformer. After having removed the cover at the bottom, the soldering log is screwed under the corresponding terminal on top of the transformer. The equipment is delivered with the connection made for 220 volts.

The fuse in the fuse holder (see no. 1 of the picture) is for 1 amp. it is available everywhere. For 110, 125, 150 volts line voltage a 1.5 amp. fuse is also permissible. 10 fuse are in compensation to each valve tester.

A high-vacuum full-wave rectivier tube AZ 12 is provided inside as DC supply for plate and screen voltages. Since the equipment is delivered ready for use, this rectifier tube is already contained in the tester.

To assure constant plate and screen grid voltages, a voltage regulator tube GR 150 DA is also contained in the equipment when delivered (Don't tamper with it!) Since the tolerance of this tube must be very small, it is recommended that spare tubes be obtained only from us.

The plugs (no. 5 of the picture) are kept in special holes at the rear edge of the panel. It is not admissible to put them in the jacks at random because then they may cause a short if the tester is switched on without a test card bling applied.

The tube tester has an input connector which fits a normal appliance connector. The line cord is not supplied together with the equipment. The lid may be removed from the case.

The accessories mentioned in the following instructions are shown in the two pictures on the following pages.

1 = **fuse holder** with 1 amp. 20 mm long and 5 mm diameter.

2 = **Test Cards** contained in

3 = **Test Card Compartment**

4 = **Pins for keeping the Test Cards** in position.

5 = **Plug's** which are put in the Holes of the Test Card and in this way make the necessary connections.

6 = **Jacks** for connecting a Speaker for the Noise Test.

7 = **Test Switch** for making all Tests and Measurements in the right sequence.

8 = **Moving Coil Meter** with an impedance of 1000 ohms per volt with

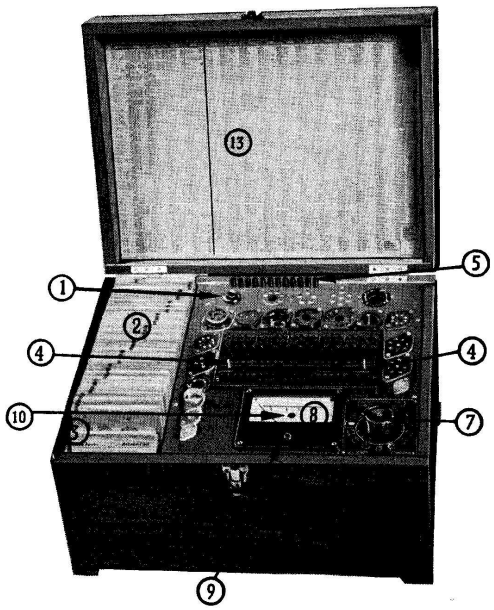
9 = **Zero Adjustment**.

10 = **Control Window** which starting with position 2 of the Test Switch is illuminated by the voltage Regulator Tube.

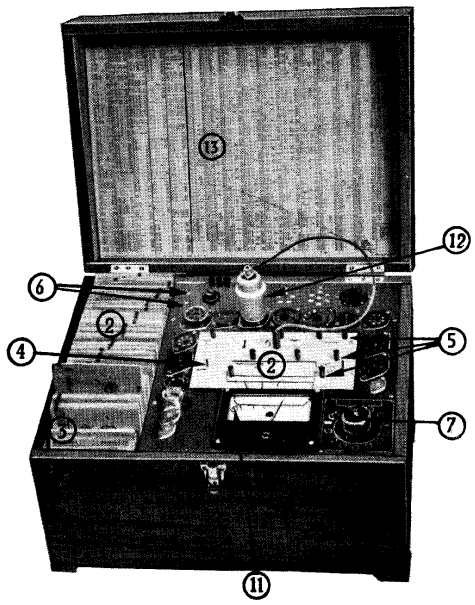
11 = **Fault Range „F"** at the left side of the Zero Point.

12 = **Tube** to be tested.

13 = **Tube and Test Card Index** contains the Standard (ABC) and the American-Tubes More lists are contained in the test card compartment.



Tube Tester W 19 without test card.



Tube Tester W 19 with a test card being applied.

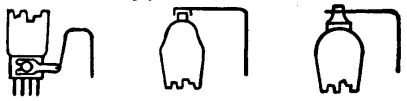
Instruction.

After the tester is adjusted to the right line voltage, it is ready for use and may be connected with a line outlet. It may stay connected permanently since in the start position of the test switsch (position „Aus" = „off") the power is switched off. If one wants to make a noise test of amplifier tubes (not necessary) a speaker has to be plugged into the jacks (6).

1. Put the Test Cards in position, Insert the Plugs and the Tube.

From the tube and test card index one chooses the correspondent test card and puts it on the panel in such a way that its holes fit the positioning pins. Wherever the card shows a hole plug is inserted. In this way all necessary connections are made automatically, that is: filament voltage (2 plugs) as well as plate voltage (1 plug), screen grid voltage (1 plug), right meter range (1 plug), right socket connections (several plugs at the top edge of the test card). The tube is inserted into the tube holder marked by an arrow.

If one of the following pictures appears on the card:



this means that the tube has additional electrodes which have to be connected with the correspondent jack by a special cable.

Errors are almost impossible since in most cases there is only one tube holder into which the tube will fit. Only the octal and the miniature socket are exceptions, there are two of each which have different filament connections. But it is also impossible to make an error with the plugs, since they will not fit into the wrong holes. There are some tubes (for instance on test card no. 19) which are available with lateral terminal screws and 4prong socket or without lateral screw and 5 prong socket. Thus if on a test card the symbol of a lateral terminal is shown but the tube does not have it (lateral terminal or plate cap) then, of course, no connection can be made, but the test will give the correct result nevertheless.

It may happen that on a test card two different sockets are marked, That means that the tube is available in both ways, as for instance on test card no. 1, for tube KL 1, which is available with European and prongless socket. Even then no error is possible since the tube will fit into only one of the two tube holders.

2. Turn Test Switch through all Positions, Look for Shorts and in position 12 make the Measurement.

In the starting position „Aus" the tester is switched off. Beginning with position 2 it is switched on, this can be seen by the light of the voltage regulator tube beneath the control window. Then, the test switch ist turned s l o w l y from position to position. In position 2 the filament is tested while in positions 3 to 10 shorts are shown. If there is a short the meter pointer is deflected to the left side, i. e. it point to the letter „F" = Fault in the outlined part of the scale.

In each position the switch is stopped by a notch, and only the indication in this fixed position is valid. If, while the switch is turned from one position to the next, the meter shows a short deflection or if it is deflected a little to the right, it does not mean anything.

If for instance in position 9 the meter pointer moves to the range marked by „F" it indicates that there is a short between grid and plate, i. e. the tube cannot be used.

In positions 3 to 10 the meter indicates even as high a leakage as 200,000 ohms (at the edger of the outlined part of the scale). Tubes which have such a fault are already bad, because they would cause noise and distortion.

Summarizing the instruction given so far we may say: The test switch is turned slowly from position 1 to 10 and the meter pointer is watched to see that it is not deflected to the left. As soon as there is a „F" indication the test is finished because the tube has a short then. The same is true if the pointer just

touches the outlined part of the scale since such a tube has leakage. However, if the meter does not show anything in those positions, everything so far is all right and the test and measurements may be continued.

From position 10 one passes to position 12 without taking into account indications in position 11. In position 12 the DC plate current, screen grid and control grid voltages are switched into the circuit automatically. With filament tubes (yellow cards) the meter shows the deflection at once.

Green cards mean heater cathode tubes, in this case one has to wait for approximately one minute until the cathode is heated up. It is the same as with the tube in the receiver or transmitter where the tube is to be used.

The meter shows how many milliamperes of plate current flow with zero volt bias. The test card shows a picture of the meter scale where one is able to read between which indication limits the tube is „good", „weak" or „bad". Especially with older filament tubes very frequently the meter indicates much more current than there should be according to the manufacturer's characteristic.

If for a thorough knowledge of a tube more tests are necessary, the test cards says so at the upper right corner, if no further tests are to be made switch cannot be moved into positions 13 and 14, but backwards only. Most test cards of amplifier tubes show the following remark at the upper right corner:

In Stellung **13 auf Steuerwirkung** prüfen.	In position **13** is to prove the **control grid.**

In order to make this test the test switch is moved from position 12 to 13. By doing this a bias voltage of — 2 volts is switched in and thus, the plate current decreases, how much, depends on the mutual conductance of the tube under test. But in every case a decrease must take place, otherwise there would be an interruption between the control grid and the corresponding prong and the tube could not be used, therefore, when checking the control effect the indication „good" does not mean

anything but only the fact that the plate current decreases is important. If it does, no matter how much or how little, the tube is allright, if not it cannot be used.

If the control test has to be made the amplifier tube may also be tested for noise. This is done by leaving the switch in position 13 and knocking the tube with a rubber sponge hammer. If there is any noise in the speaker or earphones connected to the speaker jack the tube will make the same noise when used in a receiver, i. e. it cannot be used. It does not matter whether the speaker shows hum or not. However, this test may cause some harm to the tube for with the extraordinarily small distances between the electrodes in the latest tube types the knocking may cause internal damage to the tube. For this reason one may skip this test altogether.

If the control test has to be made, one may also **check for the vacuum** in switch position 14. Tubes with a control grid, i. e. amplifier tubes, should have a very high vacuum order not to cause distortion, although they may be all right mechanically and electrically.

However the degree of vacuum is not a fixed value for every tube, or at least exact in formation is not published by the tube manufacturer. Tubes with a small amount of gas, i. e. with a low degree of vacuum may even work better in detector circuits while in an amplifier circuit they may cause distortion Therefore, if the test does not show an extremely good or bad vacuum it is only possible to find out the quality by using the tube in the receiver in which it is supposed to be used.

For the information of the serviceman it may be said that the vacuum test works in the following way:

In a tube with negative bias voltage (i. e. test switch in position 13) no control grid current flows if the vacuum is satisfactory. Therefore when a high resistance is put in the control grid circuit no change of bias voltage should occur and thus no change of plate current. But if the vacuum is low a grid current flows and there is a voltage drop across a 1 Megohm resistor in the

grid circuit; therefore the negative bias voltage is decreased and the plate current increases. The rise of plate current by inserting a resistor in the grid circuit is therefore a measure of the degree of vacuum.

However, there are two exceptions: The same may happen if there is leakage between control grid and other electrodes; but this does not matter because for the tube performance it does not make any difference whether distortion is caused by bad vacuum or by leakage; the tube cannot be used anyway. The other exception is thermionic grid emission. If a tube has high mutual conductance the space between cathode and control grid is very small and therefore small amounts of the active emitting substance may be spread to the grid. When the tube is heated the grid becomes hot too and acts in the same way as the cathode and the same grid current flows as with low vacuum in spite of the fact that the tube is all right. If the tube has the highest possible mutual conductance of 14,000 μmhos the 1 Megohm resistor may increase the plate current by as much as 20%.

The vacuum test is made in the following way: After the tube has been tested for control effect in position 13 the test switch is turned to position 14. If then the plate current rises only a little or not at all the tube has a good vacuum, i. e. it is all right. But if the rise is larger one may assume that a bad vacuum is the reason, i. e. that the tube would cause distortion in a receiver. In this case a further test has to be made in the receiver itself for it is impossible to give a fixed limit between a good and a distorting feature because it is dependent on too many factors. However, if the deflection of the pointer is approximately the same as in position 13 it is sure that the vacuum is a bad and the tube cannot be used. With tubes with large mutual conductance (7000 to 14,000 μmhos) a rise of plate current a by 10--20% may be caused by thermionic grid emission and the tube may be all right nevertheless.

If the plate current decreased in switch position 14, it means that there are oscillations, but that the tube itself is all right.. This would not happen in a receiver since there is a 1000 ohm resistor in series with the control grid or a 100 ohm resistor in series with the screen grid which prevents oscillation. That cannot be done in a tube tester because each tube holder has to be used for many different sockets and the position of the prongs connectet whith the control and screen grid is not always the same.

The serviceman must look for the information given at the right side of the test card, i. e. near the tube number. All other information, tube data as well as maximum ratings are important only for the technician who wants to know the reatings for normal use in a receiver. There the maximum ratings are important if the tube is to be used as replacement for another tube. For test purpose it is of no importance, but only the information at the right side of the test card.

On some test cards, for instance for full-wave rectifier tubes the reading is,

Röhre hat **2 Systeme.** Das 2. System ist in Stellung **11** zu messen!	**2. System** is measurable in position **11**

In this case the test switch has to be turned back from position 12 to position 11, by means of which the second system is connected in the right way for the measurement. Here too, nothing can be made wrong since for those tubes the test switch is stopped in position 12 automatically and can not be moved in the wrong direction, as to position 13 and 14. Of course also the indication in position 11 has to be within the range „good" or „weak", if only one of the two systems is all right the whole tube cannot be used. If something else has still to be watched, it is indicated on the test card.

If multiple tubes need more test it is also indicated on the test card. Even if with the test switch in positions 2 to 10 the indications necessarily differ from the usual ones because of different socket connections it is also shown on the test card. Other differences from the normal test sequence are marked on the right side of the test card too.

3. Turn test switch back to Position „Aus".

After the test has been finished the test switch must be turned back to position 1 („Aus"), and the line is switched off automatically. Also while the test switch is turned back no indication „F" should occur in the positions 10 to 3, if there were it would mean that because of the heating the tube has developed a short would not be fit for use. It is suggested that a test strip be put around the tube after the test as mentioned there.