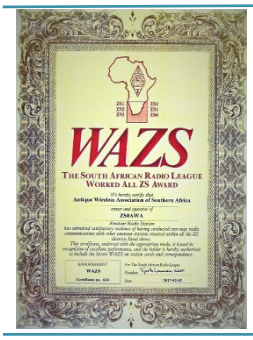
Newsletter

The Antique Wireless Association of Southern Africa

 # 161

December 2019

A Member of the SARL



Inside this issue:

AWA Committee:

* President and Western Cape—John ZS1WJ
* VicePresident—Renato ZS6REN
* Technical Advisor—Rad ZS6RAD
* Secretary/PRO—Andy ZS6ADY
* KZN—Don ZS5DR
* Historian—Oliver ZS6OG
* Member—Jacques ZS6JPS

Reflections:

Dare I be a bit sombre in this column this month ?

After losing another friend in the prime of his life to a disease that has struck so many down, unfairly in our eyes, one comes to realise how short life actually is, and why people say we should live it to its fullest while we have the chance.

Daryl ZS6DLL, was one of those people who made an instant impression in my life. His enthusiasm for things in general, never mind just Amateur Radio, made me stop and think about how much time and effort we actually put into doing the things that really interest us and matter to us.

He was the kind of person who took many things by the horns and tamed them for his own use.

In amateur radio, he became infatuated with CW, had a mentor teach him and guide him, and while he was still getting into sending and receiving, he heard of a few guys who were interested in learning CW and immediately, without hesitation, offered to be a mentor to them. He guided them through a process of learning CW while at the same time was still learning himself.

I do believe that in a small way, he played a part in the restoration of CW to the ailing mode in South Africa.

People who learned from him are now spearheading a group of other enthusiasts into using CW more and more. I believe it is part of Daryl's enthusiasm that has ignited this flame in them.

So while I wax philosophical and think of all these things, I think the lesson that I learned from Daryl, after being in ham radio since the early 80's, is that we should be enthusiastic about what we do. We should take on people who want to do new things and help them along. It is really amateur radio as I remember it when I first started. There were so many helping and guiding hands that you could not fail at it.

It is that which has kept me, going through my radio career. So many of the friends I have made, some less enthusiastic than others, but there to guide and encourage.

I had a boss once who said to me, we all only have a short time on this earth, but when your time comes to leave it, make sure you leave some small thing behind for others to remember you by.

Hopefully something good.

Best 73

DE Andy ZS6ADY

SK

Sadly we have to record the passing of another of our members. Daryl ZS6DLL passed away in the early hours of Sunday 01 December.

Daryl, still fairly new to Amateur Radio, was awarded the CW trophy in November 2018 for his efforts in running a CW class for 4 students who became quite proficient . He could be heard on a regular basis calling CQ in CW on the bands and was the start of a small revival in CW.

Our deepest condolences to his wife Kim and daughters Kevon and Bianca.

HF Happenings:

The 5 and 10 MHz WAZS and WAGS Weekend

Most radio amateurs will spend time on 80 and 40 metres looking for contacts for their Worked All ZS and Worked All Grid Squares awards. But there are radio amateurs who like a challenge and therefore over the weekend of 7 and 8 December 2019, we will hold the 5 and 10 MHz WAZS and WAGS Challenge.

This is NOT a contest! It is an opportunity to get the necessary QSOs for your WAZS and WAGS using the 60 and 30 metre bands. It is also an opportunity to collect information about the propagation on these two bands.

The challenge runs from 00:00 CAT on Saturday 7 December to 23:59 CAT on Sunday 8 December. Please note that SSB activity on 30 metres is only during local daylight hours, CW and digitals modes are 24/7.

For the propagation study, please send a copy of your log to zs4bfn@mweb.co.za. And if you have the required QSOs, apply for your Worked All ZS and Worked all Grid Squares on 60 and 30 metres.

Results of the ZS5 Sprint

The contest committee received 16 logs for the ZS5 Sprint held in July 2019, 15 were contest logs and there were 1 check log.

1st Deon Fraser, ZS5DCF – 110 points
2nd Woody Collett, ZS3WL – 82 points
3rd Highway ARC, ZS5HAM – 52 points
4th Northern Natal ARC, ZS5NAK – 47 points
5th Johan Steyn, ZS6DC - 31 points
6th Hans Kappetijn, ZS6KR – 28 points
7th Johan van Zijl, ZS4DZ – 25 points
8th Werner Swanepoel, ZS2WS - 24 points
9th Wynand Nel, ZS6WY - 19 points
10th Eric Lewis, ZS5EL - 14 points
11th Mathew Lyle, ZS5PG and Anthony Rouquette, ZS6ANT – 13 points
13th Albert Schreuder, ZS6SE - 12 points
14th Bruce Dunn, ZS5XT – 9 points
15th Christian Baard, ZS3CRB - 3 points
Checklog Geoff Levey, ZS6C – 7 points

Calendar:

December

1 - Start of YOTA Month; World Aids Day; ZS JS8 Day
2 - Closing date for SARL VHF/UHF Analogue logs
3 - International Day for People with Disabilities
4 - Schools close
7 – ARRL FT Roundup; International Civil Aviation Day; Sneeuberg Crawl, Murraysberg
7 and 8 – 5 and 10 MHZ WAZS and WAGS Weekend
9 - Closing date for Newbie Party logs
10 - International Human Rights Day
10 to 21 - Ek lief Krismis Market, George
11 - International Mountain Day
12 to 30 - Durban Botanic Gardens Trail of Light
13 to 15 - Gabriëlskloof Favorite Things Market, Bot River
13 to 16 - Eden Kite Festival. Garden Route
14 – Geminids meteor shower
14 and 15 – ARRL 10 m contest
16 - Day of Reconciliation; Prince Alfred Hamlet Appelkoosfees
22 - Summer Solstice
23 – Ursids meteor shower
23 to 30 - Hanukkah
25 – Christmas Day
26 – Family Day
31 - End of the 2019 CQ DX Marathon and the YOTA month; get rid of the 2019 Blue Book

January 2020

1 – Download the 2020 Blue Book; New Year's Day; start of the CQ DX Marathon
3 and 4 - Quadrantids meteor shower
4 – ARRL Kids Day
4 and 5 – ARRL RTTY Roundup

DXCC News

The following operations have been reportedly approved (on the upcoming Tanzania operation Web page - http://www.i2ysb.com/idt/) for DXCC credit as well as the LoTW certificates: 5I5TT, Tanzania; Upcoming 2020 operation and 5I4ZZ, Tanzania Upcoming 2020 operations.

TQSL: New Version

A new version (v2.5.1) of LoTW's Trusted QSL (TQSL) has been released: http://www.arrl.org/tqsl-download. This version has new features as well as corrections for defects found since TQSL 2.4.7 was released. This release also includes an update to the most recent TQSL configuration file. TQSL 2.5.1 can be installed to upgrade any older version of TQSL. On all three supported platforms (Windows, MacOS and Linux), installing TQSL 2.5.1 will replace older versions of Trusted QSL while preserving your Callsign Certificates, Station Locations and preferences.

Radio Tower Safety

The Daily DX and a number of other sources mentioned Jim's, K1IR, presentation on tower safety originally given to Billerica, Massachusetts ARS. It has also spurred an active discussion on a number of different email reflectors.

This is not about technique, it is about tower safety, what the rate of "failures" in performing tower work on amateur radio towers tells us and some suggestions on what practices need improvement to increase tower safety. https://blog.thedrivenelement.com/2019/11/amateur-radio-tower-safety-presentation-for-the-billerica-ars/

The FT Roundup

The FT Roundup is last year's FT8 Roundup, renamed to reflect the inclusion of the new FT4 mode and potential follow-on FT modes in the future. This year, the contest happens the weekend of 7 December2019. The contest sponsors are suggesting specific frequencies for particular modes-seethe rules. While stations can use any legal power level, any power level OVER 100 watts qualifies as a CHECKLOG. See the rules for particular details, such as the use of multiple streams and country-specific segments. https://www.rttycontesting.com/ft8-roundup/

Where FT8 and FT4 communications are happening

Rich, N1IXF,compiled a chart of where FT8 and FT4communications are happening. These are the conventional frequencies and DXpeditions usually publish special frequencies where they will be operating. https://groups.io/g/RTTY/message/47684

Version v2.1.2 of WSJT-X

Version v2.1.2 of WSJT-X has just been released that addresses several regressions in version 2.1.0 and supersedes released-for-a-day v2.1.1.A list of program changes since WSJT-X 2.1.0 can be found in the cumulative Release Notes. https://physics.princeton.edu/pulsar/k1jt/wsjtx.htmlandhttps://physics.princeton.edu/pulsar/k1jt/Release_Notes.txt.

New SO2R box

There is a new SO2R box in town, brought to you by NN1C, K1XMandW1UEhttp://nn1c.org/so2r/. Features of this new Arduino-based hardware/software product include:

- All inputs/outputs are standard 3,5 mm stereo cables
- No external power supply required-works on USB-supplied voltage
- Win Key emulator and CW steering
- PTT Footswitch input and PTT steering
- Mike Input and Steering
- Headphone Audio-AA, BB, A Band Latch
- Headphone Audio transformer isolated
- Small and lightweight--about4 x 2 x 2.5" and 8 oz
- Uses only one USB port
- Compatible with major logging programs
- Price point expected to be$50-60
- Easy to assemble kit, or options to purchase assembled units
- No switches or LEDs -logging program to control unit

While some have seen pre-production units at a Yankee Clipper Contest Club meeting, it has also been tested on the air in recent contestswww.3830scores.com/showrumor.php?arg=kLapzBmffafm4.

DTR and RTS Signals

"When I boot up my *Microsoft Windows* PC, the PTT and CW keying lines I am driving from a USB serial port pulse my equipment. Why? How do I stop this? " Bob, N6TV, outlines what is going on and what you can do about it in his PDF on how to tame DTR and RTS signal line changes onWindowsbootuphttps://bit.ly/FTDItip.

African DX

Contacts with stations on the African continent count towards the SARL's All Africa Award (www.sarl.org.za/public/awards/awards.asp)

Malawi, 7Q.Karl, DK2WV, is active as7Q7Wfrom Lilongwe since18 November and will be in Malawi for about 3 weeks. Activity is on 40 to 6metres using CW, SSB and FT8. QSL via DK2WV.

Togo, 5V. Andy, KB9IJI is a long-term resident in Mango, Togo and has been granted “special permission to legally operate as 5V/KB9IJI" until his application for a call sign is approved, "hopefully” before the end of the year." He plans to operate SSB, CW and digital modes on all HF bands and to upload his log to both LoTW and eQSL.

The Gambia, C5. Andre, ON7YK has been active again as C5YK since 16 November and will remain in Bijilo, The Gambia until early March 2020. He operates digital modes (especially FT8), SSB and some CW on 60 to 10 metres. QSL via LoTW and eQSL, or via home call (see qrz.com for instructions); log search on http://www.on7yk.eu/.
The Gambia, C5. Paul, SA6PIS will be active holiday style as C56PIS from Bakau, The Gambia from 28 November to 13 December. QSL via home call.

Zambia, 9J. Mario, IK1MYT is active as 9J2MYT from Lusaka, Zambia until May 2020. He can be active on 80, 40, 20, 15 and 10 metres. QSL direct to IZ3KVD.

Tanzania, 5H. Chas, NK8O/VE3ISD, will once again be active as 5H3DX from Zinga, Tanzania, between 16 February and 16 March 2020. Activity will be from the paediatric hospital at Zinga. Usual operations will be holiday style. Power output will be the legal limit for Tanzania at 100 W and the primary antenna should be a Hexbeam configured for 40 to 6 metres, including the WARC bands. Operations will be primarily CW, with PSK31, FT8 and possibly SSB. He states that he will use a simple wire antenna and his KX3 with a KXPA100 amp. See QSL info on QRZ.com. Also, QSL via LoTW and eQSL. NO Bureau.

African Islands
IOTA Frequencies
CW: 28 040 24 920 21 040 18 098 14 040 10 114 7 030 3 530 kHz
SSB: 28 560 28 460 24 950 21 260 18 128 14 260 7 055 3 760 kHz
Canary Islands, EA8. Andrea, IK1PMR, is currently active as EA8/IK1PMR from Tenerife Island (AF-004) for the next few weeks. Activity is on 160 to 6 metres using all modes with a K3 and 500 W amp. He will also be in the CQ WW DX CW Contest (23 and 24 November) as a Single-Op (band(s) to be decided) entry. QSL via HB9FKK (his Swiss call sign), by the Bureau or ClubLog.

N1MM Update
N1MM Logger+ users participating in contests with contest-specific macro key definitions and call history files will find this week's program update very worthwhile. You will not have to manually download those files before contest start! According to Larry, K8UT https://groups.io/g/N1MMLoggerPlus/message/46032, "This week's update includes a new feature in which N1MM+ will detect/download/install a file for you, rather than requiring you to separately open a browser, find the file and download it. I have not updated the website documentation yet, but here is how it works:

For **Call History Files** and **Sample Function Key Files**:
In the *>File >Open Log in Database* dialog window, select the *>Associated Files* tab. Press the [CHANGE] button adjacent to the labels for Call History Filename or Function Key Filename.
If there is a file on the website that matches this contest name, a dialog window will open and ask whether you want to assign it to this contest. If you answer Yes, the file is downloaded and installed. If you answer No, a File Explorer window will open for you to choose a local file (the way N1MM+ has worked for years).
To prevent you from harm - for example, overwriting a Function Key .MC file that you customized with personal preferences - any existing file of the same name will be archived with a .BAK designation. This feature should be popular with groups like CWOPS whose Call History file changes on a weekly basis." (via N1MM Logger+ group)
Oh, *N1MM Logger+* can now answer "Oui!" to "Parlez-vous Francais?" with the new French language pack available on the logger's website in the Tools area. Vincent, F4CVQ, is the raison d'etre.

AWA AGM Nov 2019

On Saturday 09 November 2019, the gathering of the AWA Members took place at the SAIEE head office in Observatory.

There were 28 people all told and the meeting was opened at 10:00 in the auditorium of the SAIEE.

John ZS1WJ, opened the meeting and welcomed all who had come for the meeting.
A moment of silence was held for those of our members who had gone silent key during the year.

Three members flew up from Cape Town, one from Durban and the rest were mainly from Gauteng.

The usual meeting notes were done with some discussion around a few points on Taking Amateur Radio out to the world. Some good suggestions and points of interest were made.

Renato ZS6REN was inducted as President in waiting to take over the duties from 01 January 2020. Unfortunately there were no offers or acceptances for the position of Vice President, so this position remains vacant until we can coerce someone into taking the post. John ZS1WJ, outgoing president has offered to stand in as VP should it be necessary.

The Jeffrey Wright trophy for the person who has contributed the most to CW for the year went to Andy ZS6ADY after nominations were accepted during the meeting.

There wasn't much in the form of a fleamarket as very little valuable junk was made available for the exchange of hands.

The minutes of the meeting will be available on the website for those who are interested in reading the full happenings.

The fire was lit after the group photo and a very pleasant gathering was continued in great spirit.

Paul ZS1S, made a donation to the SAIEE museum of a meter he had collected while working at Escom Telecoms and a TWT from Keverne ZS1ABU who worked for PO Microwave.

Once again, our thanks to the members and staff of the SAIEE who set up the catering and for the venue that is made available for us to use.

Tube Topics

Section 2: Tube Maintenance
With the single exception of the temperature necessary to obtain proper filament electron emission, heat is the primary enemy of vacuum tubes.

2.1 Air Cooled Tubes
Air cooled power tubes generally do not require maintenance throughout their normal operating life, provided that the socket is in good condition and the filter on the cooling fan is cleaned or replaced periodically. Most equipment air cooling is done with squirrel cage blowers. It is extremely important to check the impeller blades on these blowers. The blades can fill with dirt, drastically reducing their efficiency and therefore airflow through the tube. The blades should be scrapped with either a screw driver blade or knife to remove caked on dirt.
In conditions where dirt, bugs or dust are present, the cooling fins on the anode should be checked for dirt. If they are plugged, remove the tube and use an air hose to blow the dirt from the fins. Blow the cleaning air in the reverse direction of normal air flow through the tube. Particular attention should be paid to the area of the tube where the cooling fin is attached to the anode.
The greatest blockage occurs at the point where the cooling air first hits the fins. This is also the point of maximum temperature and therefore maximum heat transfer to the airflow. Air cooled tubes require greater air flow when operated at higher altitudes because of the decreased density of the cooling air. Tube data sheets give cooling system correction information for high altitude operation. External arcing at high altitude may also require a lowering of plate and screen voltages because of the lower insulating value of air at high altitudes.
Air cooled tubes should have an air interlock switch on the cooling fan to prevent application of any voltages to the tube unless cooling air is flowing. Check the switch for proper operation. The heat generated by the filament alone can destroy a tube without cooling air flow.
Equipment should never have air duct work fastened directly to the cabinet top. Ducting increases backpressure, restricting airflow, which can result in excess tube temperature. Some exhaust ducting includes fans to help move exhaust air. However, if not properly designed, such devices can actually reduce airflow. Also, if the booster fan fails it will significantly reduce the cooling air flow. In situations where it is felt necessary to install ducting to remove exhaust air, it is advisable to construct a hood over the equipment with a six inch open air gap between the equipment and the ductwork.

2.2 Liquid Cooled Tubes
Water and vapor cooled tubes should be supplied with clean, filtered, low conductivity water, ideally from a closed system. Install a strainer on the tube input side. A screen mesh of 36 × 36 per inch should provide adequate filtering. The system must be free of solid materials such as Teflon pipe tape and rust to prevent blockage of small cooling passages and subsequent tube overheating. Install a flow interlock switch on the tube outlet line.
Certain liquid cooled tubes are sensitive to the direction of water flow. The direction of water flow may be a function of whether the tube is mounted with its anode up or down. Adequate water flow is critical in water cooled tubes to prevent localized boiling and destruction of the tube. Check the tube data sheet for information on direction of flow and cooling water volume requirements.
Vapor cooled tubes require the correct water level be maintained. Check for scale buildup on the anode every six months, as scale can destructively reduce the heat transfer from the anode to the cooling water. Water condition is very important in vapor cooled installations; steam is active chemically and will react with the materials in the system to form contaminants.

2.3 Tuning
Each equipment manufacturer provides instruction or guidelines for proper tuning and operation of their systems, which should be followed closely when adjusting the equipment.
Operate the power tubes in the equipment at their rated filament voltage whenever tuning or adjusting the equipment—not at reduced levels. This assures adequate emission levels from the tube and reduces the chances of low filament voltage masking performance levels that should be achieved through proper tuning and adjustment. After all adjustments are complete, the filament voltage may be set (as described in Section 2.5) to achieve maximum tube life.

2.4 Normal Tube Operation
Whenever a tube is received from the supplier it is a good idea to inspect the package and check the tube for physical damage as soon as possible. Tubes are fragile and subject to shipping damage despite the care taken in packaging.
Open the box and remove the tube. A check with a VOM meter can make a quick evaluation for broken filaments. Carefully lay the tube on its side and check for continuity (a short) between the two filament contacts. The filament contacts should indicate a short as the filament resistance is very low when cold. Also, check to see that there is no continuity (open circuit) between either filament connection and the other tube elements. The only continuity should be between the filament contacts, with all other elements being electrically isolated from the filament and each other. If the tube shows a short-circuit, contact the supplier. Do not attempt to install it.

2.5 Filament Voltage

The proper adjustment and regulation of filament voltage is the single most significant area where a tube user can affect tube life and performance.

Metering

The metering of filament voltage on the majority of equipment is not accurate. Often the metering is a multimeter that is switched to read various operating parameters. To be useful for filament metering, the meter must be calibrated to read voltage at the tube socket and must be capable of being read accurately to one tenth of a volt. Often the filament voltage is measured at the output of the filament transformer. In high current circuits such as the filament, the voltage drop in the wires going to the tube can be significant. All filament meters should be calibrated with an accurate iron-vane or rms-responding digital meter. The object is to determine the *heating value* of the power being supplied to the filament. The calibration voltage should be taken at the tube socket or connections with the filament operating. This will compensate for any line drop losses. In locations where the line voltage fluctuates more than 5 percent, the supply to the filament transformer should be equipped with a constant-voltage transformer (i.e., Sola transformer). A diagram of a filament supply circuit capable of precise adjustment over the most beneficial voltage range is shown in Figure 7. The circuit given assumes a 240 V supply to the circuit.

Specific design criteria include the following:

• **Component 1.** Sola constant-voltage transformer connected to the supply line; sized for the KVA rating of filament.

• **Component 2.** Variac variable auto transformer controlling a fixed step-down transformer connected in a buck or boost configuration; KVA rating equal to 10 percent of the filament KVA.

• **Component 3.** A 240-to-24 volt secondary fixed transformer; KVA rating ≥ 10 percent of the filament KVA.

• **Component 4.** The existing filament transformer.

Mount the variable transformer such that it is adjustable from the control panel of the equipment. This will allow adjustment of the filament voltage while the equipment is operating. Unfortunately many transmitters and most industrial equipment are built with a filament transformer that has, at the most, taps located inside the equipment for the adjustment of filament voltage. If the equipment is operated for long periods of time, the filament circuit should be modified as shown.

Filament Operation

The thoriated tungsten filaments used in power vacuum tubes depend upon sufficient filament temperature to provide adequate electron emission for normal operation. Power tubes should not be operated in the *emission-limited* mode.

The use of filament voltage to control output power is not the correct method of operation. It will destroy a tube quicker than operation at higher than permissible voltages.

The operator, by adjusting the filament voltage, can control the operating temperature. Each tube is unique; while one tube may make full operating power at a filament voltage of 7.3 V, a replacement device may require 7.4 V to attain the same power. It is for this reason that we recommend all tuning be done at the rated filament voltage. After tuning is complete, then the voltage can be reduced to provide extended life.

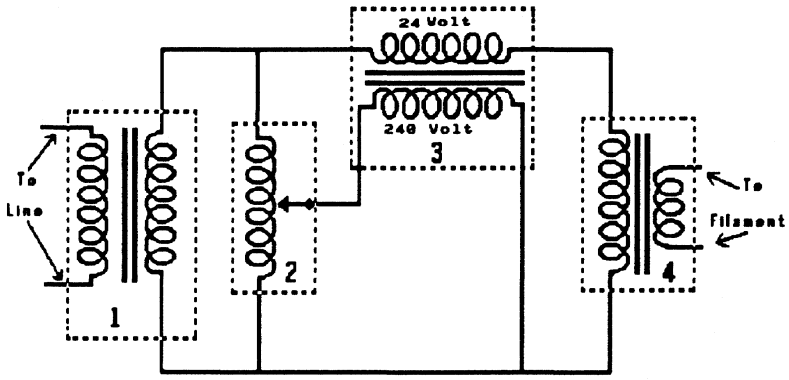


Figure 7. Adjustable filament supply circuit.

Though cathodic type tubes can be damaged by operation of the heater at reduced filament voltage, we have never seen a case where operation at the proper reduced voltage after tuning is anything but beneficial to directly heated filamentary tubes. It is important, however, to operate the tube at rated voltage for the first 100 to 200 hours before reducing it as described in the next section.

Initial Operation and Tuning

Upon initial installation, the filament should be run for a period of 100 to 200 hours at its rated filament voltage. This initial operation allows the *getters*, materials that absorb and hold residual gas, to finish the vacuum of the tube in its actual operating environment. After this initial run-in time, it is good practice to operate the filament at reduced voltage, provided that proper operating parameters can be obtained at the reduced voltage.

First, tune and run the equipment to normal operation with the filament at rated voltage; then, without changing any other adjustments, reduce the filament voltage until the tube deviates from normal operating conditions. This point is the beginning of emission limited operation. Continued operation at this point can be destructive to the tube. Raise the voltage to one or two tenths of a volt above the lowest voltage where the tube worked properly. This should maximize tube life at no reduction in performance. The one to two tenths setting above the emission limited voltage allows for minor line fluctuations and requires less frequent adjustment as the tube ages. A power tube operated in this manner will generally yield life 50 percent greater than a tube run continuously at rated filament voltage. If the tube is removed and then replaced, it is not necessary to run it at rated voltage beyond the time necessary to tune the equipment.

Figure 8 illustrates the impact of filament voltage on peak emissions with a common tetrode. Figure 9 charts filament current as a function of operating hours.

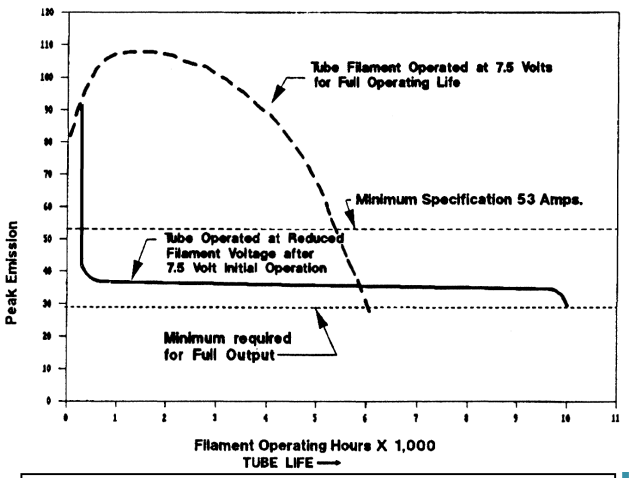


Figure 8. Filament life vs. peak filament emissions for a 4CX5000A.

2.6 Tube Life

In the majority of applications, normal end of life for a power tube is determined when, due to decarburization of the filament, the electron emission of the filament falls below the point where, at rated filament voltage, it is no longer adequate to sustain full output power or distortion levels exceed allowable limits.

Carburization is the process where in manufacturing, carbon is—under specific conditions of temperature and pressure—burned into the raw *thoriated tungsten* filament. This process is monitored by a decrease in the filament current at rated voltage. As a tube operates, carbon slowly is burned out of the filament.

Three factors are primary in determining the number of hours a tube will operate
before reaching end of life:

• The amount of carbon originally processed into the filament. The maximum amount of carbon that can be burned into a filament is limited by increasing fragility as the carbon level is increased and by a lowering of the filament temperature to the point where the tube lacks adequate emission to make power at rated filament voltage.

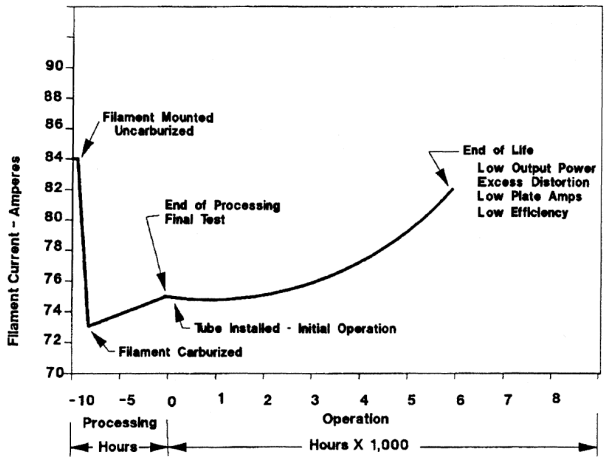


Figure 9. The effect of filament current on the operating hours of a 4CX5000A.

• The residual vacuum level in the tube. The quality of the vacuum affects life because the rate of decarburization is a function of residual gasses, primarily oxygen and nitrogen, reacting with the filament to cause decarburization. Good vacuum processing and proper gettering result in the lowest residual gas levels. Getters are materials placed within the tube envelope that when heated absorb and hold residual gasses within the tube. This gettering action improves the ultimate vacuum within the tube envelope. Gettering action continues throughout the life of the tube, however the most beneficial action occurs in the first few hours of operation.

• The rate of decarburization, which increases with the operating temperature of the filament. The filament temperature is determined by power on the filament and therefore controllable by adjustment of the filament voltage. These various items, taken together, determine the normal life of a power tube.

In broadcast transmitters that operate into a fixed load, the vast majority of failures result from a loss of emission caused by decarburization. Industrial applications, such as dielectric or induction heating, often experience a higher percentage of catastrophic failures.

Equipment problems related to tubes fall into three categories:

• Catastrophic
• Intermittent
• Performance

Table 1 lists general guidelines for extended tube life.

Table 1. Checklist for Long Tube Life

Promptly check tubes when received for shorts and freight damage.
Store tube in a dry location in its original box, safe from shock and bumping.
Install the tube and tube equipment with the filament at its rated normal voltage.
Run tube for several weeks at rated normal filament voltage.
Reduce filament voltage to increase tube life after initial run-in.
Replace or clean filters as required.
Maintain proper water quality and flow on all water and vapor cooled tubes.
Keep an accurate and up to date log of equipment behavior and meter readings.

Catastrophic Failures

A catastrophic failure can take on a number of forms, however, the symptoms are usually the same: overload relay trips and/or circuit breaker trips. Repeated attempts to restart the equipment can cause damage to the circuitry so it is good practice to troubleshoot the system immediately upon the first indication of overload.

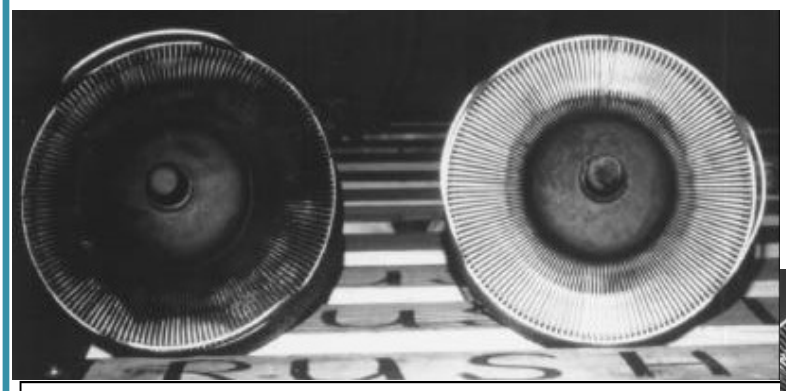
To begin, make a visual inspection of the high voltage areas of the equipment. Look for burned wires and components. If you have reason to suspect the tube, remove it, making sure that the high voltage connections are located

so as to prevent shorting to ground or other components. With the tube removed, reapply voltages. If the equipment does not trip off, then you can be
reasonably sure that the problem is the tube or the tube/circuit interface. At this point, unless a specific problem has been found, we recommend that the tube be sent to ECONCO for testing and analysis.
Catastrophic failures can be caused either by broken or warped elements shorting to each other within the tube, or a puncture in the vacuum envelope allowing air to enter the device. Air in a tube causes a loss of dielectric standoff between the internal tube elements. Both shorted elements and loss of vacuum will cause overloads in operating equipment.
Catastrophic failures that occur during initial installation are usually the result of broken elements. Those that occur after initial operation are more likely the result of a loss of vacuum. In either case, continued efforts to bring the tube up can result in considerable damage to the tube and other components. Overloads and circuit breakers are not fast enough to forestall many types of damage.

Intermittent Failures
Intermittent overloads (*kickoffs*) are the hardest to pin down. They can be caused by circuit operating conditions or internal tube failures. In transmitters, they can be the result of a broken or warped filament moving around and occasionally short-circuiting to the grid, causing loss of grid bias. Loss of grid bias in tubes requiring a bias voltage allows full plate current to flow, activating the overload protection circuit(s). In industrial applications, intermittent overloads can also be
caused by shorting across the load.

Performance Failures
Performance failures occur when the equipment will not produce normal output with the normal operating values set. One method of quickly checking to determine if low emission in the tube is the likely cause is to raise the filament voltage several tenths of a volt. If the output increases dramatically, then you can be quite sure that the problem is low emission. No danger of burning out the filament exists, as most designs are capable of temporarily withstanding twice their rated filament voltage. Raise the filament voltage to a point where the output returns to normal. If voltage in excess of rated normal is required, the tube is due for replacement. For short periods of time, you can run the filament in excess of normal rated voltage, however in a tube with a mesh or spiral filament, the risk of thermal shorting is increased. In any case, the tube should be replaced as soon as possible when full output can no longer be obtained at rated filament voltage.

2.7 Evaluating Tube Performance
Examination of a power tube after it has been removed from a transmitter or other type of generator can reveal a great deal about how well the equipment tube combination is working. Contrast the appearance of a new power tube with a component at the end of its useful life. If a power tube fails prematurely, the device should be examined to determine whether an abnormal operating condition exists within the transmitter. Consider the following examples:



a) (b)
Figure 9. Anode dissipation patterns on two 4CX15000A tubes: (a) excessive heating, (b) normal wear

• Figure 9. Two 4CX15000A power tubes with differing anode heat-dissipation patterns. Tube (*a*) experienced excessive heating because of a lack of PA compartment cooling air or excessive dissipation because of poor tuning. Tube (*b*) shows a normal thermal pattern for a silver-plated 4CX15000A. As mentioned previously, nickel-plated tubes do not show signs of heating because of the high heat resistance of nickel.

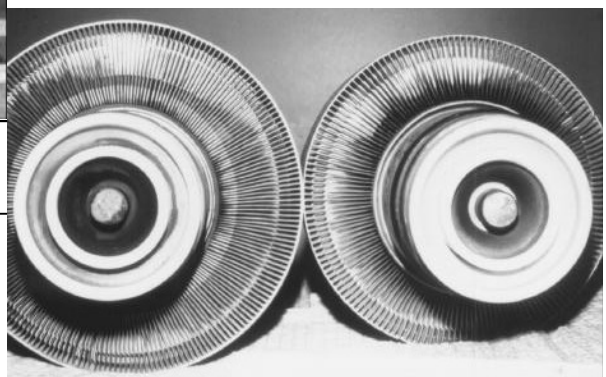
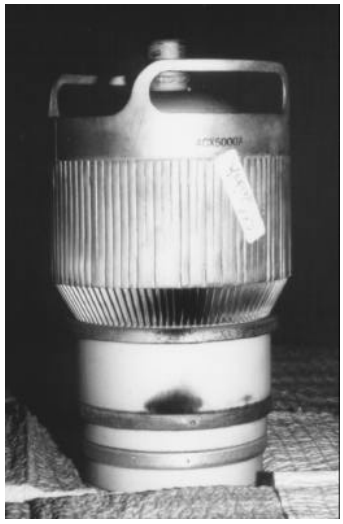
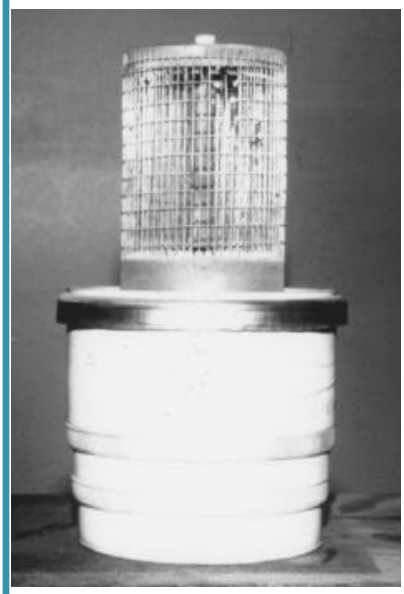


Figure 10. Base heating patterns on two 4CX15000A tubes: (a) excessive heating, (b) normal wear

• Figure 10. Base-heating patterns on two 4CX15000A tubes. Tube (*a*) shows evidence of excessive heating because of high filament voltage or lack of cooling air directed toward the base of the device. Tube (*b*) shows a typical heating pattern with normal filament voltage.

• Figure 11. A 4CX5000A tube with burning on the screen-to-anode ceramic. Exterior arcing of this type generally indicates a socketing problem, or another condition external to the tube.





• Figure 12. The stem portion of a 4CX15000A tube that had gone down to air while the filament was on. Note the deposits of tungsten oxide formed when the filament burned up. The grids are burned and melted because of the ionization arcs that subsequently occurred. A failure of this type will trip overload breakers in the RF generator. It is indistinguishable from a short circuited tube in operation.

• Figure 13. A 4CX15000A tube that experienced arcing typical of a bent fingerstock,
or exterior arcing caused by components other than the tube.

2.8 Shipping and Handling

Because of their fragile nature, tubes are packaged for shipment in foam filled or spring supported shipping containers. When it is necessary to ship or transport a tube from one location to another, it is good practice to put them in their original shipping containers. If the original packing is unavailable, for tubes weighing up to 25 pounds, a minimum of two inches of bubble pack will protect the device.
Larger tubes require more protection. Vacuum tubes should be removed whenever the equipment is moved. Tubes should never be left installed during an equipment move.

Storage

Tubes should be wrapped in a plastic bag to protect them from moisture and stored in their shipping boxes. If it is necessary to store tubes loose, they should be located so as to reduce the chance of accidental breakage resulting from dropping or shock. Also, the should not stored in high-moisture environments.

Handling

Power tubes are fragile. Filaments can be broken by setting the tube down too hard on a solid surface. Do not lie a tube on its side; the filaments can break if it rolls along a surface. Some radio frequency industrial equipment is routinely moved to various locations within a plant. Equipment used in this manner should be equipped with air filled casters, never solid casters

Marking

Never write on any portion of the ceramic or on any contact surface. Some engineers are in the habit of writing notes on the tube bodies for record keeping purposes, but this is not a good practice. Use a separate note card instead.

Shelf Life

Modern power tubes with metal and ceramic vacuum envelopes are not prone to *gassing up* while in storage. Experience indicates that these tube types can be stored indefinitely without deterioration. It is not necessary to periodically rotate them through an operating socket to degas the tube. Experience shows that you stand a greater chance of breaking the tube or socket fingerstock than any benefit gained by degassing.
Older designs, using glass as an insulating medium, do tend to leak gas over time. It is not the glass that is porous to gas, but the Kovar alloy used to seal the glass to metal parts in the tube. Kovar is also subject to rusting when moisture is present. Such devices should be kept in a sealed plastic bag in storage and rotated through the equipment at least once every twelve months. Physically, the larger the tube, the more surface area of Kovar, and the greater the possibility of gassing up.

Degassing

Tubes that may have gassed up can be partially degassed by putting them in the equipment and running them for several hours with filament voltage only applied.
After the initial filament-only degassing; operation for an hour or so at reduced plate and screen voltages is desirable. This allows the getter to soak up and hold any residual gasses. In directly-heated filamentary tubes, the getters are generally zirconium-bearing materials, which depend on heat to activate the gettering action.

CONTACT US:

P.O. Box 12320
Benoryn
150

Mobile: 082 448 4368
Email: andyzs6ady@vodamail.co.za

Get your backdated issues at
http://www.awasa.org.za/index.php/newsletters

Visit our Website:
www.awasa.org.za

Antique Wireless Association f Southern Africa

Mission Statement

Our aim is to facilitate, generate and maintain an interest in the location, acquisition, repair and use of yesterdays radio's and associated equipment. To encourage all like minded amateurs to do the same thus ensuring the maintenance and preservation of our amateur heritage.

Membership of this group is free and by association. Join by logging in to our website.

Notices:

Net Times and Frequencies (SAST):
Saturday 06:00 (04:00 UTC) —AM Net—3615
Saturday 07:00 (05:00 UTC) —Western Cape SSB Net— 3630
Saturday 08:30 (06:30 UTC)— National SSB Net— 7140; Sandton repeater 145.700
Echolink—ZS0AWA-L; ZS6STN-R
Relay on 3615 for those having difficulty with local skip conditions.
Saturday 14:00 (12:00 UTC)— CW Net—7020; (3550 after 15 min if band conditions not good on 40)
Wednesday 19:00 (17:00 UTC) — AM Net—3615, band conditions permitting.