

# Gettering Electron Tubes

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## Electron Tube Life

In the majority of applications, normal end of life for an Electron 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:

1. 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.
2. The residual vacuum level in the Electron 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 Electron 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.
3. 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.

## Initial Operation and Tuning

When an Electron Tube is initially installed for use in a RF Power Amplifier, the filament should be run for a period of approximately 4 to 8 days (100 to 200 hours) at its rated filament voltage. This initial operation allows the '*Getter*', which is a material that absorbs and holds residual gas, to finish the vacuum of the electron tube in its actual operating environment. After this initial run-in time, it is good practice to operate the filament at a reduced voltage, provided that proper operating parameters can be obtained at the reduced voltage.

## Degassing Older Electron Tubes

Electron Tubes that may have gassed up over time may be partially degassed by putting them in the equipment and running them for several hours with only filament voltage applied. After the initial filament-only degassing, the electron tube should be operated for an hour or so at reduced plate and screen voltages. 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.