3M Science. Applied to Life.™

3M Advanced Materials Division

3M™ Tungsten Dispenser Cathodes

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Introduction

3M™ Tungsten Dispenser Cathodes typically consist of a porous tungsten matrix, impregnated with a barium-based emission enhancing material. Depending on the application, this matrix may also be a mixed metal, such as tungsten iridium or tungsten molybdenum (for SEMBO cathodes).

Dispenser cathodes are used in all types of vacuum devices, as well as in inert and reducing atmospheres. The most common applications include TWTs, klystrons, magnetrons and plasma devices.

We are involved at each stage of the cathode manufacturing process, from basic raw materials through the manufacturing of critical components to final assembly. This includes chemical cleaning of the emitting surface to ensure open porosity.

Porosity is verified using scanning electron microscopy. All cathode heater assemblies, if applicable, are tested for proper heater operation. Our quality systems can provide fully qualified cathode assemblies with all required backward and forward material and process traceability

3M™ Remote Access Data Acquisition and Recovery System (RADAR)

The manufacture of quality components for Vacuum Electron Devices (VEDs) used in the communications, space and defense industries requires precisely-controlled and traceable process steps. Based on 60 years of industry experience, we offer customers a proven software solution that can help automate and simplify their data collection, training and documentation requirements through 3M™ Remote Access Data Acquisition and Recovery System (RADAR).

The 3M remote access data acquisition and recovery system is a suite of software communications tools. Its purpose is to establish best practices for controlling the manufacture of cathodes and cathode assemblies, and to provide customers with all required backward and forward material and process traceability. The system acts as a "bridge," allowing the exchange of data between multiple software platforms.

RADAR provides nearly instantaneous access to any combination of data, including:

- Employee Training and Task Qualification Records
- ISO Procedures and Revision Control System

Typical Physical Properties

(Not for specification purposes)

Commercial, Military or Space Qualification	
Size Range	0.010" – 8.00" (0.25 mm – 200 mm)
Tungsten Density Range	74% – 84%
Impregnant Types	4:1:1 (S), 5:3:2 (B), 6:1:2, 3:1:1 or any other required type
Sputter Coatings	Osmium Ruthenium (M), Iridium; other coatings possible
Materials	Tungsten, molybdenum, molybdenum-rhenium, rhenium, tungsten-rhenium, Kovar®, nickel, stainless steel, Monel® and others
Machined Tolerances	To ±0.0002" (±0.005 mm)
Brazes	Ranging from molybdenum-ruthenium (mp 1980°C) to low temperature alloys such as copper-gold (mp 910°C)
Operating Temperature	From 910°C_B to 1200°C_B
Emission Density	Continuous, as high as 20 A/cm^2, typically 2 – 5 A/cm^2; pulsed, as high as 120 A/cm^2, typically 30 – 70 A/cm^2
Life Expectancy	From 3,000 hours to 150,000 hours

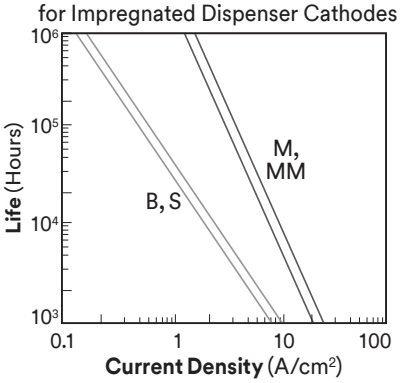
Cathode Type	Description	Work Function
B	Porous tungsten impregnated with 5:3:2 BCA	2.1 ev
S	Porous tungsten impregnated with 4:1:1 BCA	2.1 ev
M	Porous tungsten impregnated with 4:1:1 BCA or other and sputter coated with Os/Ru	1.8 ev
MM	Porous tungsten iridium impregnated with 4:1:1 BCA or other	1.8 ev

- Engineering Drawings and Methods Sheets
- Materials Data Collection and Serialization
- Equipment Process Control and Monitoring System
- SCADA Notification System
- Plant Wide Environmental Controls System

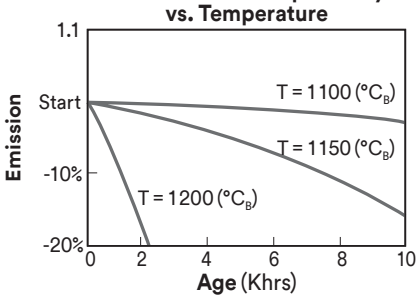
Raw data can also be made available for manipulation in the Infinity QS SPC platform or can be delivered directly to the customer for analysis. This remote access system is fully integrated and provides the user with the power of information 24/7.

3M Technical Ceramics can assist you in meeting your custom design requirements. This includes helping you determine an optimal balance of properties, such as emissions, barium evaporation rate and cathode lifetime.

Current Density vs. Life
for Impregnated Dispenser Cathodes

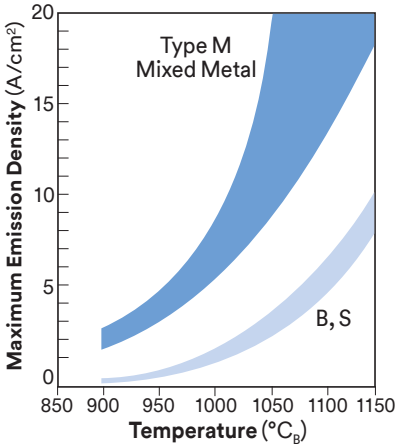


M Cathode Life Expectancy vs. Temperature



Longo, R.T. et. al. "Dispenser Cathode Life Prediction Model" IEDM1984, p. 318

Performance Comparison



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