3M™ Microporous Metallic Boiling Enhancement Coating (BEC) L-20227

Introduction
3M™ Microporous Metallic Boiling Enhancement Coating (BEC) was developed to provide optimal boiling heat transfer coefficients with 3M™ Novec™ Engineered Fluids. 3M BEC is made with 3M™ Developmental Material L-20227, a powder composed of modified copper particles which are applied to a copper substrate and fused at elevated temperature. When properly applied, the BEC provides:

- High thermal conductivity ligaments at contact points between particles
- Optimally-sized nucleation sites for Novec fluids
- Performance properties that are relatively insensitive to processing conditions

Performance
Under uniform heat flux conditions, a horizontal BEC surface produces boiling heat transfer coefficients exceeding 10 W/cm²-K when boiling 3M™ Novec™ 7000 Engineered Fluid at atmospheric pressure. The dryout or critical heat flux (CHF) is typically 35W/cm² but will be reduced if the surface is oriented vertically. Addition of chopped copper fibers on top of the coating before fusing will extend the CHF in both orientations.

Heat sources producing much higher heat fluxes can be cooled by applying the BEC to a copper heat spreader or “boiler” that receives the heat flux. The optimal boiler thickness and area depends upon the particular application. Effective heat transfer coefficients over 15 W/cm²-K have been demonstrated at over 400 W/cm².
Applications

3M™ BEC L-20227 can be applied to make boilers in a variety of 2-phase heat transfer systems:

- Indirect thermosyphons can be used to cool microprocessors, LEDs, power electronics and thermoelectric devices.
- Single and dual sided immersion cooling can accommodate the rising heat densities of power semiconductors like MOSFETs and IGBTs.

Typical boiling heat transfer coefficients for 5cm² BEC surface with 3M™ Novec™ 7000 Engineered Fluid at P$_{as}$, Addition of copper fibers at increases dryout heat flux in both orientations.

Technical Information and Data: Technical information and data, recommendations, and other statements provided by 3M are based on information, tests, or experience which 3M believes to be reliable, but the accuracy or completeness of such information is not guaranteed. Such technical information and data are intended for persons with knowledge and technical skills sufficient to assess and apply their own informed judgment to the information.

Important Notice: This 3M material is a developmental material that has not been introduced or commercialized for general sale, and its formulation, performance characteristics and other properties, and availability are not guaranteed and are subject to change without notice. User is responsible for evaluating and determining whether a 3M material is suitable and appropriate for a particular use and intended application.

Disclaimer of Warranty: This 3M material is made available as “AS IS”. 3M MAKES NO WARRANTIES OR CONDITIONS, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING, CUSTOM, OR USAGE OF TRADE.

Limitation of Liability: Except where prohibited by law, 3M SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE TO BUYER FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, DOWNTIME, LOSS OF PROFITS, REVENUE, BUSINESS, OPPORTUNITY, OR GOODWILL) RESULTING FROM OR IN ANY WAY RELATED TO THIS 3M DEVELOPMENTAL MATERIAL. This limitation of liability applies regardless of the legal or equitable theory under which such losses or damages are sought including breach of contract, breach of warranty, negligence, strict liability, or any other legal or equitable theory.

3M and Novec are trademarks of 3M.

Used under license by 3M subsidiaries and affiliates.