

METAMIC-HT RAIs

Dr. Kris Singh
Executive Engineer
Holtec International

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SCOPE OF PRESENTATION

To Present SFST Holtec's Understanding of the
Outstanding Questions and to Provide the Road
Map for their Closure

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PRINCIPAL RESPONSE STRATEGY

- Include the Additional Coupon Tests Carried Out Subsequent to the Submittal of Rev. 0 of the Metamic-HT Sourcebook.
- Address All Outstanding Questions in a Holistic Manner.

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CHANGES/ENHANCEMENTS IN REVISION 1 OF THE METAMIC SOURCEBOOK (Report HI-2084122)

The Metamic-HT sourcebook has been revised to incorporate several changes and enhancements largely prompted by USNRC review of this document in Docket No. 71-9325. The following is a summary of the changes:

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CHANGES/ENHANCEMENTS IN REVISION 1 (continued)

- The use of the statistical approach (mean minus two sigma) has been abandoned. The MGW is required to be less than the “Minimum Measured Value” of the property from the entire universe of data in the database. This change eliminates concerns of data scatter and lot-to-lot variability.

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CHANGES/ENHANCEMENTS IN REVISION 1 (continued)

- Additional coupons tested since the issuance of Rev. 0 report to broaden the data base for all properties have been added to the respective data tables. The number of coupons tested for each strength and thermo-physical property now equals 30 (up from Rev. 0 count of a maximum of 12). In particular coupons for previously less extensively characterized properties, such as coefficient of thermal expansion, were added to eliminate concern regarding the size of the database. Now, the coupons data includes separate data sets of 30 coupons each for as-extruded as well as thermally aged and irradiated coupons at different temperatures.

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CHANGES/ENHANCEMENTS IN REVISION 1 (continued)

- An expanded discussion on the appropriateness of the use of MGWs for critical characteristics has been presented. Three properties, namely density, coefficient of thermal expansion, and specific heat have been reclassified as those for which use of the “mean” rather than MGW is more appropriate.

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CHANGES/ENHANCEMENTS IN REVISION 1 (continued)

- Representative probability distribution of the mechanical and thermal property data sets have been plotted which show that the “normal distribution” profile is approximated to varying degree for different properties. To avoid normal distribution concerns statistical treatment of data is replaced by a determinate approach described above.

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CHANGES/ENHANCEMENTS IN REVISION 1 (continued)

- The role of each property in the safety evaluation of dry storage casks is more fully explained to place the use of MGTV in the context of ensuring a conservative safety evaluation. The discussion helps segregate the properties for which the use of MGTV is necessary and those for which a mean value is appropriate.

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CHANGES/ENHANCEMENTS IN REVISION 1 (continued)

- The production sampling plan has been expanded to establish the link between in-production testing and the required level of reliability of the material's property.
- The discussion of the experimental approach for measuring emissivity has been included, along with a discussion of the variability in the measured data.

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CHANGES/ENHANCEMENTS IN REVISION 1 (continued)

- A discussion on relevant issues such as the lot-to-lot variability of material properties, reason for discarding (a very limited number) of spurious outlier data and increased scatter in some properties has been incorporated.
- The data on thermal diffusivity, which is a derived property, has been replaced by specific heat, which is a fundamental property.

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ESSENCE OF OUTSTANDING QUESTIONS

- Inadequate Sample Population for Certain Properties - RAI M.11, M.12, M.14 & M.16
- Allowable stress in the manner of the ASME code not defined – RAI M.1 (addressed in the Structural Presentation)
- MGTV Not Appropriate for Certain Properties – RAI M.5, M.6.
- Underlying Assumptions of “Mean – 2*Sigma” Not Validated – RAI M.2
- Provide Metamic-HT Sampling Plan – RAI M.7
- Evaluate Lot-to-Lot Variability – RAI M.8
- Irradiated Material not considered – RAI M.3
- Provide Basis for Identifying Outlier Data – RAI M.9
- Identify Reasons of Increased Scatter in As-Extruded -40°C Data – RAI M.10
- Inaccuracies in Statistical Analysis Tables – RAI M.4

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INADEQUATE SAMPLE POPULATION FOR CERTAIN PROPERTIES –RAI M.11, M.12, M.14 & M.16

- The Sample Population of Properties is Expanded to 30 coupons.

Mechanical Property	Room Temperature	200C	300C	350C
Yield	30	30	30	30
Ultimate	30	30	30	30
Elongation	30	30	30	30
Area Reduction	30	30	30	30
Charpy	30	30	30	30

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INADEQUATE SAMPLE POPULATION (cont.)

Thermo-Physical Property	Sample Size
Density	30 coupons@RT
Heat Capacity	30 coupons@RT,100C,200C,300C & 350C
Conductivity	30 coupons@RT,100C,200C,300C & 350C
Emissivity	30 coupons@RT,100C,200C,300C & 350C
Thermal Expansion	30 coupons@RT,100C,200C,300C & 350C

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MGV NOT APPROPRIATE FOR CERTAIN PROPERTIES – RAI M.5, M.6.

- Holtec Concurs with Staff Observation
- Sourcebook Discussion Expanded to Explain Role of Each Property
- Two Property Types Defined
 - Type 1: Significant to safety analysis
 - Type 2: Minor significance to safety analysis
- Type 1 Properties are Characterized by MGVs
 - Ultimate, Yield, Young's Modulus, Elongation, Charpy, Area Reduction, Creep, Area Reduction, Conductivity & Emissivity
- Type 2 Properties are Characterized by Mean Values
 - Specific Gravity, Coefficient of Thermal Expansion and Heat Capacity

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NORMAL DATA DISTRIBUTION

- Necessary for Use of Statistical Confidence Method.
- To Avoid Reliance on Statistically Inferred Confidence the "Mean – 2*Sigma" Approach is Discarded
- All MGVs are Required to be Less than the Lowest Measured Value for Each Property and at all Measured Temperatures
- All Data Obtained Under the Expanded Test Protocol Meets or Exceeds the Minimum Guaranteed Values (in other words the MGVs remain unchanged)

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PROVIDE METAMIC-HT SAMPLING PLAN

- Metamic-HT Sampling Plan is Defined in the Shop Operating Procedure HTSOP-108 for Metamic-HT Manufacture.
- The Sampling Plan adopts the Military Standard MIL-STD-105E Inspection Protocol for Assuring Product Quality
- The Sampling Plan to be Presented by Phil Blue
- The SAR Acceptance Testing Chapter 8 will be Modified to Incorporate HTSOP-108 by Reference

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EVALUATE LOT-TO-LOT VARIABILITY

- The Property Data Principally Comes from Six Distinct Lots
- The Properties Have been Generally Improving in Successive Lots
- The Sourcebook will Compare Variation in Mean Values from Each Lot

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IRRADIATED MATERIAL NOT CONSIDERED RAI M.3

- The MGVs are Defined to Bound Test Data Under all Measured Conditions, namely, As-Extruded, Thermally-Aged and Irradiated & Thermally Aged Conditions

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PROVIDE BASIS FOR IDENTIFYING OUTLIER DATA – RAI M.9

- Coupons Data was Discarded if it Underwent an Anomalous Condition, Such as:
 - Damaged Coupons
 - Coupons from Improperly Cropped Extrusions
 - Tensile Coupon Loading Error (coupon slack)

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IDENTIFY REASONS OF INCREASED SCATTER IN AS-EXTRUDED -40°C DATA – RAI M.10

- As Extruded Material Possesses Residual Strains Due to the Extrusion Process. These Strains are Reduced by the Thermal Conditioning Resulting in a Reduction in the Extent of Scatter.

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INACCURACIES IN STATISTICAL ANALYSIS DATA – RAI M.4

- Question withdrawn following NRC Telecon

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