



SYSTEM PROCEDURE

Monitoring and Measurement of Product

REVISION: 04

PROCEDURE NO.: 19

DATE EFFECTIVE: 04/01/21

1. PURPOSE

1.1 To define the process for monitoring and measuring product.

2. SCOPE

2.1 This procedure applies to all of the manufacturing operations and monitoring and measuring product activities processes defined within Tempco Electric Heater Corporation's Quality Management System.

3. PROCEDURAL REQUIREMENTS and RESPONSIBILITIES

3.1 The Director of Manufacturing Operations, Director of Engineering, Production Managers, Production Supervisors, Group Leaders, Product Engineers and Quality Assurance are responsible to ensure all applicable characteristics of the product, including criteria for acceptance and/or rejection, are monitored, measured and controlled to verify that product requirements are fulfilled. This shall be carried out at appropriate stages of the production process in accordance with planned arrangements as defined in the following documents, as applicable for each operation:

- 3.1.1 Tube Tickets
- 3.1.2 Lead Wire Tickets
- 3.1.3 Specification Sheet
- 3.1.4 Manufacturing Order
- 3.1.5 Drawings
- 3.1.6 Purchase Requisition/Purchase Order
- 3.1.7 Manufacturing or Work Instructions

3.2 Processes are monitored and measured and this activity is documented on the Order Tracker, Specification Sheet, Tube Ticket or Lead Wire Ticket as identified in the respective Manufacturing Functional Flow Work Instruction which has been established for each manufacturing process. Each Manufacturing Functional Flow Work Instruction defines the stages of the product realization process where the product is appropriately verified for conformance to product requirements. An example Manufacturing Functional Flow is defined on pages 4-7.

3.2.1 The acceptance criteria are defined within the applicable Manufacturing Functional Flow Work Instruction document identified in the Documentation Clarifying Characteristics column of the Monitoring and Measurement Functional Flow Table.

3.2.2 Monitoring and Measurement Activities column of the Monitoring and Measurement Manufacturing Functional Flow Table identifies where in the product sequence monitoring and measurement/testing operations are performed and the type of measurement instruments required, if applicable. Product shall not be used until it has been inspected or otherwise verified as conforming to specified requirements as defined in the functional flow.

3.2.3 A record of the measurement results and/or indication of who verified product compliance and released the product will be maintained in accordance with Monitoring and Measurement Records/Check Lists column of the Manufacturing Functional Flow Table.

3.2.4 Test records will show actual test results data when required by the customer or specification



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sheet. Where required to demonstrate product qualification the organization shall ensure that records provide evidence that the product meets the defined requirements.

- 3.2.5 Product release and service delivery shall not proceed until all the identified requirements have been satisfactorily completed, unless otherwise approved by a relevant authority, and where applicable by the customer.
- 3.2.6 This documentation and data shall be retained per SP 2.
- 3.3 Product is verified upon receipt by utilizing the accompanying Receiving/Packing Slip and Purchase Order. Drawings are used to provide inspection criteria and are verified to the Purchase Order on the system to ensure that product is inspected to the latest revision. Inspection activities are documented on an Incoming QC form or Rejection/nonconformance Report. Outsourced operations are controlled as defined Monitoring and Measurement Functional Flow Table. Certificates of Compliance or Analysis are obtained when required.
- 3.4 Inspection and Test Reports for initial product submittals will be documented on the Engineering Verification form when required by the customer.
- 3.5 Final Quality Assurance Inspection is performed using the Specification/Drawing, Catalog Data, and Manufacturing Order as defined in the Monitoring and Measurement Functional Flow Table and based on a general guideline of a 10% or 10 piece lot sample, whichever is greater. Final Quality Assurance Inspection consists of dimensional inspections (e.g. calipers, micrometers and rulers), electrical testing (e.g. resistance, insulation resistance, hypot and line leakage), visual finish workmanship and verifying the documentation and manufacturing order description matches the drawing.
- 3.6 Final Quality Assurance Inspection is documented on QC Log Evaluation Record and with Electrical Test Data, if applicable. If specified on the Manufacturing Order Final Quality Assurance Inspection can be documented on an Engineering Verification form.
 - 3.6.1 Engineering Verification form may be used to ensure that product meets specified design requirements and/or that the design meets the customer requirements. This may be initiated for a new part, engineering change or as a result of a customer complaint.
 - 3.6.2 Engineering Verification form may be used to document a first piece/article inspection for the first time a product is manufactured.

4. TYPICAL FUNCTIONAL FLOW

The functional flow on pages 4 through 7 defines the sequence and interaction of the primary process steps of the Monitoring and Measurement of Product.

5. RECORDS

- 5.1. Tube Tickets
- 5.2. Lead Wire Tickets
- 5.3. Order Tracker
- 5.4. Specification Sheet
- 5.5. Purchase Requisition/Purchase Order



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- 5.6. Engineering Verification form
- 5.7. Manufacturing Orders
- 5.8. Drawings
- 5.9. Manufacturing or Work Instructions

6. REVISION HISTORY

REVISION LEVEL	DATE OF REVISION	SECTIONS	DESCRIPTION OF CHANGE
00	4/27/09	All	Initial release
01	5/30/15	3.5	Added <u>Catalog Data</u> to first line
02	01/29/18	3.2.6	Was Procedure 8.2.4. Updated procedure number in section 3.2.6
03	01/27/20	3.1 & Authorization	Changed and updated responsible parties (Director of Manufacturing Operations, Director of Engineering, Production Managers, Group Leaders) Replaced Abe Joseph with Ananda Palanichamy and changed prepared by position Replaced Abe Joseph with Samir Patel as Management Representative
04	4/1/21	3.2 & 5	Changed the Referenced Example Design on pages 4-7 Added 5.7 Manufacturing Order, 5.8 Drawings 5.9 Manufacturing or Work Instructions

7. AUTHORIZATION

POSITION	HELD BY	AUTHORIZATION SIGNATURE OR INITIALS
Prepared By: Director of Manufacturing Operations	Ananda Palanichamy	
Senior Management Representative: Chief Financial Officer	Paul Wickland	
Management Representative:	Samir Patel	



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HIGH DENSITY (HD) CARTRIDGE HEATERS TYPICAL FUNCTIONAL FLOW

	Operation Description	Documentation Clarifying Characteristics (as applicable for each operation)	Monitoring & Measurement Activities	Monitoring & Measurement Records/Check Lists
1a	Tube Cutting	Tube/Cable Tickets	<ul style="list-style-type: none"> ▪ 1st Piece Verification on Set-up using tape measure ▪ Ongoing Verification based on Random Sample ▪ Tube/Cable Tickets are date stamped to monitor due dates compliance 	Tube/Cable Ticket has a hole punched and attached to the tubes to indicate the operation is complete
1a1	Sandblasting	Tube Tickets or specification sheet	<ul style="list-style-type: none"> ▪ Verification based on Visual Review 	Order Tracker Tube Ticket or specification sheet is initialed on the back to indicate the operation is complete
1a2	Apply End Disc	Tube Tickets	<ul style="list-style-type: none"> ▪ Verification based on Visual Review 	Tube Ticket is initialed on the back to indicate the operation is complete
1a3	Weld End Disc	Tube Tickets	<ul style="list-style-type: none"> ▪ Verification based on Visual Review 	Order Tracker Tube Ticket is initialed on the back to indicate the operation is complete
1b	Lead Wire Cutting	Lead Wire Tickets	<ul style="list-style-type: none"> ▪ 1st Piece Verification on Set-up using steel ruler ▪ Ongoing Verification based on Random Sample 	Lead Wire ticket is attached to the product to indicate the operation is complete
1b1	Welding	Lead Wire Tickets or Specification Sheet Work instruction sheet	<ul style="list-style-type: none"> ▪ Verification based on Visual Review 	Order Tracker Lead Wire Ticket or specification sheet is initialed on the back to indicate the operation is complete
1b2	Brazing	Lead Wire Tickets or Specification Sheet Work instruction sheet	<ul style="list-style-type: none"> ▪ Verification based on Visual Review 	Order Tracker Lead Wire Ticket or specification sheet is initialed on the back to indicate the operation is complete
1c	Core Cutting	Specification Sheet Color Coded Priority System	<ul style="list-style-type: none"> ▪ 1st Piece Verification on Set-up using caliper ▪ Ongoing Verification based on Random Sample 	Order Tracker Initial & Date Specification Sheets



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2	Winding	Specification Sheet	<ul style="list-style-type: none"> ▪ 1st Piece Verification on Set-up using multimeter/ohm meter ▪ Ongoing Verification based on Random Sample 	Order Tracker Initial & Date Specification Sheets
3	Cutting - Terminal Pin - N (Normal Pin) - F (Flexible Lead)	Specification Sheet	<ul style="list-style-type: none"> ▪ 1st Piece Verification on Set-up using steel rule ▪ Ongoing Verification based on Random Sample 	Initial & Date Specification Sheets
4	Assembly - Pick material - Assembly/Filling - Wound Core - Terminal Pin/Leads - Tube - Magnesium Oxide (MGO) Powder	Specification Sheet	<ul style="list-style-type: none"> ▪ 1st Piece Verification on the Tube Length & Winding Ohms ▪ 1st Piece Verification on Ohms using multimeter/ohm meter ▪ Ongoing Ohms verification based on a random sample ▪ 100% Ohms 100% Hypot on Thermocouples Only ▪ Visual Verification 	Order Tracker Initial & Date Specification Sheets
5	MGO Loading	Specification Sheet	<ul style="list-style-type: none"> ▪ 100% Hypot prior to load ▪ Visual Verification 	Order Tracker Initial & Date Specification Sheets
6	Marking if applicable	Specification Sheet	<ul style="list-style-type: none"> ▪ Visual Verification 	Order Tracker Initial & Date Specification Sheets
7	Baking - Teflon Only	Work Instruction sheet	<ul style="list-style-type: none"> ▪ Visual Verification 	No Initial off required



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	Operation Description	Documentation Clarifying Characteristics (as applicable for each operation)	Monitoring & Measurement Activities	Monitoring & Measurement Records/Check Lists
8	Swaging	Specification Sheet	<ul style="list-style-type: none"> ▪ 1st Piece submitted to the Lathe for a length dimension check ▪ 1st Piece Operator checks the Ohms ▪ Resistance verified on a periodic random basis 	Order Tracker Initial & Date Specification Sheets
9	Outsourced (if applicable) - Centerless Grinding	Separate Drawing	<ul style="list-style-type: none"> ▪ Review the product to ensure it matches the specification sheet 	No Initial off required Final Quality Inspection ensures dimensional compliance
10	Lathe	Specification Sheet	<ul style="list-style-type: none"> ▪ 1st Piece dimensional check ▪ Ongoing Verification based on Random Sample 	Order Tracker Initial & Date Specification Sheets
11	In-Process Test	Specification Sheet	<ul style="list-style-type: none"> ▪ 100% Ohms Test & 100% Hypot 	Order Tracker Initial & Date Specification Sheets
12	Potting (if applicable)	Specification Sheet Work Instructions	<ul style="list-style-type: none"> ▪ Visual Verification ▪ Scale is used for epoxy mixing (as required) 	Order Tracker Initial & Date Specification Sheets
13	Outsourced (if applicable) - Die Penetration Test	Purchase Requisition/P.O. Specification Sheet – used Internally	<ul style="list-style-type: none"> ▪ Review the product to ensure it matches the specification sheet 	Supplier Tags identify conforming and nonconforming product Supplier certifications are received as appropriate (e.g. ISO 9001 Certified)
14	Termination	Specification Sheet	<ul style="list-style-type: none"> ▪ Visual Verification 	Order Tracker Initial & Date Specification Sheets
15	Outsourced (if applicable) - Electropolishing	Drawing Purchase Requisition/P.O. Specification Sheet – used Internally	<ul style="list-style-type: none"> ▪ Review the product to ensure it matches the specification sheet ▪ Visual Verification 	No Initial off required Final Quality Inspection ensures visual compliance Supplier certifications are received as appropriate (e.g. ISO 9001 Certified)



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	Operation Description	Documentation Clarifying Characteristics (as applicable for each operation)	Monitoring & Measurement Activities	Monitoring & Measurement Records/Check Lists
16	Final Test (as appropriate) - Hypot - Resistance Ohms - IR Insulation Resistance - Ground	Specification Sheet	<ul style="list-style-type: none"> ▪ 100% Ohms Test & 100% Hypot using any following option: ▪ Hypot Meter ▪ Multimeter ▪ Milliohm Meter 	Order Tracker Initial & Date Specification Sheets Hypot Meter (Dielectric Analyzer) maintains test data in the autoware software
17	Manufacturing Order & Specification Sheet are matched up	Specification Sheet Manufacturing Order	<ul style="list-style-type: none"> ▪ Verify P/N, MO#, 	No Initial off required Final Quality Inspection ensures visual compliance