



WORK INSTRUCTION

CAST HEATERS TYPICAL FUNCTIONAL FLOW

REVISION: 02

PROCEDURE NO.: WI-8.2.4.1

DATE EFFECTIVE: 05/01/21

	Operation Description	Documentation Clarifying Characteristics (as applicable for each operation)	Monitoring & Measurement Activities	Monitoring & Measurement Records/Check Lists
1	Order for ASB4 Tooling	Pattern Shop Work Order Drawing	<ul style="list-style-type: none"> ▪ Work order date stamped ▪ Tooling status and location checked ▪ Check for ECO's 	Orders dated and filed as they enter the shop
1a	Order for New Tooling	Pattern Shop Work Order Drawing	<ul style="list-style-type: none"> ▪ Work order date stamped ▪ Visual inspection of print to determine work procedure ▪ Entered into log and pattern shop schedule 	Pattern shop work order list Current pattern shop work order schedule
1b	Pattern Construction for New Tooling	Pattern Shop Work Order Drawing	<ul style="list-style-type: none"> ▪ Shrink rule ▪ Height gage ▪ Calipers ▪ Various wood working machinery 	Pattern shop work order
2a	Elements and/or Cooling Tube Forming	Drawing	<ul style="list-style-type: none"> ▪ 1st Piece verification on set-up using tape measure and/or molds ▪ Ongoing verification based on random sample 	Order Tracker
2a1	Spot and/or TIG Weld Wires to Elements	Drawing	<ul style="list-style-type: none"> ▪ 1st Piece verification on set-up using tape measure and/or molds ▪ Ongoing verification based on random sample ▪ 100% inspection of ohms and hi-pot of elements using multi meter/ohm meter 	Order Tracker
2a2	Cooling Tube Coating (For Brass and Bronze Alloy Only)	Manufacturing Instructions to Coat Cooling Tube for Brass and Bronze Casting Alloy (WI-8.2.4.24)	<ul style="list-style-type: none"> ▪ Visual inspection 	None
2b	Pattern Request (For Sand Mold Only)	Pattern Requisition	<ul style="list-style-type: none"> ▪ Pattern requisition report (generated from order tracker) 	None



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2b1	Pull Tooling from Pattern Rack (If Applicable)	Pattern Requisition	<ul style="list-style-type: none"> ▪ Orders pulled from file per request ▪ Orders sent to pattern rack ▪ Check Cast Band program (CB Program) and pattern rack log for location ▪ Visual inspection 	<p>Requisition initiated & dated</p> <p>CB Program</p>
2b2	Compare Pattern to Drawing (If Applicable)	Drawing	<ul style="list-style-type: none"> ▪ Verification using shrink ruler 	<p>Pattern number entered on pattern requisition indicates operation complete</p>
2b3	Tooling Repair or Modification (If Applicable)	Pattern Shop Work Order	<ul style="list-style-type: none"> ▪ Visual verification per tooling print 	<p>Pattern shop work order</p> <p>CB Program</p>
2b4	Deliver Tooling to Foundry	Pattern Requisition	<ul style="list-style-type: none"> ▪ None 	<p>Order Tracker</p> <p>Copy of completed pattern requisition sent to foundry with tooling</p> <p>Copy of pattern requisition and work order sent to pattern shop office</p>
3	Sand Mold	<p>Drawing</p> <p>Alloy Marking Criteria for Sand Molds (WI-8.2.4.24)</p>	<ul style="list-style-type: none"> ▪ 1st Piece verification on set-up using tape measure ▪ Ongoing verification based on random sample ▪ Mark metal alloy grade on sand mold (not marked if alloy is Aluminum 319) 	<p>Order Tracker</p>
3a	Tooling Return	None	<ul style="list-style-type: none"> ▪ Visual inspection for damage or wear 	<p>CB Program</p>
3b	Element Set	Drawing	<ul style="list-style-type: none"> ▪ 100% verification of every mold using measuring devices 	<p>Order Tracker</p> <p>Job card is initialed to indicate the operation is complete</p>
3c	Mold Closing	Mold Marking Criteria for Foundry (WI-8.2.4.24)	<ul style="list-style-type: none"> ▪ 100% verification of every mold based on visual review ▪ Mark every mold with metal pouring temperature code 	<p>None</p> <p>Job Card</p>
3d	Metal Pouring	Metal Pouring Temperature Criteria for Foundry (WI-8.2.4.24)	<ul style="list-style-type: none"> ▪ Verify metal temperature before pouring 	<p>Job Card is initialed and pouring temperature is noted</p>



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3e	Mold Knock-out	None	<ul style="list-style-type: none"> ▪ Verification based on visual review 	None
3f	Casting cleaning	Drawing	<ul style="list-style-type: none"> ▪ 100% inspection of ohms and hi-pot of elements and air flow test for cooling tube (Not required for Aluminum 319 and 356) 	None
3g	Cut to size/risers/gates	Drawing	<ul style="list-style-type: none"> ▪ 1st Piece verification on set-up using tape measure ▪ Ongoing verification based on random sample 	Order Tracker
4	Permanent Mold (Only for Aluminum 319 Alloy)	Drawing Permanent Mold Setup and Run Procedures Manufacturing Instructions to Run Permanent Mold (WI-8.2.4.24)	<ul style="list-style-type: none"> ▪ Verification of mold based on visual verification 	None
4a	Element Preheating	PM Setup Sheet	<ul style="list-style-type: none"> ▪ None 	None
4b	Element Set	Drawing	<ul style="list-style-type: none"> ▪ 100% verification of every mold based on visual verification 	None
4c	Metal Pouring	Permanent Mold Setup and Run Procedures	<ul style="list-style-type: none"> ▪ Verify metal temperature before pouring ▪ 1st piece verification based on visual review ▪ Ongoing verification based on random sample 	Job Card is initialed and pouring temperature is noted Order Tracker
4d	Cut to size/risers/gates	Drawing	<ul style="list-style-type: none"> ▪ 1st Piece verification on set-up using tape measure ▪ Ongoing verification based on random sample 	Order Tracker
5	Grinding & Casting Clean up	Drawing	<ul style="list-style-type: none"> ▪ 100% verification of every casting based on visual review 	None
5a	Media Blasting	Drawing	<ul style="list-style-type: none"> ▪ 100% verification of every casting based on visual review 	Order Tracker



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5b	Welding (If Applicable)	Drawing Welding Process W.I 8.2.4.10	<ul style="list-style-type: none"> ▪ 100% verification of every casting based on visual review 	None
5c	Outsourced (If Applicable) <ul style="list-style-type: none"> - X-ray - Heat Treatment - Outside Machining - Etc. 	Drawing Requisition	<ul style="list-style-type: none"> ▪ Quality assurance to review the product to ensure it matches the drawing before the product is outsourced 	Order Tracker
6	Machining	Drawing	<ul style="list-style-type: none"> ▪ 1st Piece verification on set-up using precise measuring instrumentation such as micrometer, Vernier caliper, bore gauges, etc ▪ Ongoing verification per Machine Shop Inspection Guideline (WI-8.2.4.54) 	Order Tracker
6a	Outsourced (If Applicable) E.G. <ul style="list-style-type: none"> - Plating - Coating - Machining - Etc. 	Drawing Requisition	<ul style="list-style-type: none"> ▪ Quality assurance to review the product to ensure it matches the drawing before the product is outsourced 	Order Tracker
7	Element and/or Cooling Tube Stripping	Drawing	<ul style="list-style-type: none"> ▪ 1st Piece verification on set-up using tape measure ▪ Ongoing verification based on random sample 	None



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7a	Terminals Crimping and/or Welding	Drawing Welding Process W.I 8.2.4.10	<ul style="list-style-type: none"> ▪ 1st Piece verification on set-up using tape measure ▪ Ongoing verification based on random sample 	None
7b	Polish Surfaces and Break Sharp Edges (If Applicable)	Drawing	<ul style="list-style-type: none"> ▪ 100% verification of every casting based on visual review 	None
7c	Cleaning	Drawing	<ul style="list-style-type: none"> ▪ 100% verification of every casting based on visual review 	None
7d	Assembly - Pick Material (if applicable) - Straps - Hardware - Terminal Box - Flanges - Gasket Material - Fittings - Perforated Tube - Lead Wires	Drawing	<ul style="list-style-type: none"> ▪ 1st Piece verification on set-up using tape measure ▪ Ongoing verification based on random sample 	None
7e	Testing (if applicable)	Drawing Electrical Testing	<ul style="list-style-type: none"> ▪ 100% inspection of ohms and hi-pot of elements using multi meter/Ohm meter ▪ IR if applicable 	None
7f	Stamping	Drawing	<ul style="list-style-type: none"> ▪ 1st Piece verification on set-up ▪ Ongoing verification based on random sample 	Order Tracker



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REVISION HISTORY

REVISION LEVEL	DATE OF REVISION	SECTIONS	DESCRIPTION OF CHANGE
00	06/01/09	All	Initial release
01	06/02/14	6a & 8	<p>Changed “ongoing verification based on random sample” to “ongoing verification per Machine shop Inspection Guideline (WI- 8.2.4.54)” in section 6a.</p> <p>Changed “Dimensional inspection and electrical test are performed on all castings” to “For dimensional inspection, use general guideline of 10% or 10 piece lot samples, whichever is greater” in section 8.</p> <p>Changed “Engineering quality check form” to “Engineering Verification form”.</p>
02	05/01/21	2, 3, 4, 5, 6, 7, & 8	<p>Steps 2a, 2a1, 2b, 2b1, 2b4, 3, 3a, 3b, 3c, 3d, 3e, 3g, 4, 4a, 4b, 4c, 4d, 5, 5a, 5b, 5c, 6a,7a, & 7d where revised</p> <p>New Step 3f was created and original 3f became 3g</p> <p>Steps 5a & 5b swapped positions</p> <p>Steps 6 & 8 were deleted and 6a & 6b became 6 & 6a</p> <p>New Step 7e was created and original 7e became 7f</p>

AUTHORIZATION

POSITION	HELD BY	AUTHORIZATION SIGNATURE OR INITIALS
Prepared By: Production Manager	Ricardo Zaragoza	
Director of Manufacturing Operations	Ananda Palanichamy	
Senior Management Representative/ Management Representative:	Samir Patel	