

MANUFACTURING EQUIPMENT PURCHASE SPECIFICATION

NEXTTEER AUTOMOTIVE

TITLE HEAT RESISTANT ALLOY CASTINGS NUMBER: SD-1000
 ISSUED BY Randy Bal DATE 11/27/95 APPROVED BY Randy Bal 1-29-18
 REVISION 104 REV. DATE 29 Jan 2018 SHEET 1 OF 8

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SPECIFICATION REVISION RECORD

Page	Symbol	Revision	Date	Issued By
All	101	Replaced Delphi Saginaw Steering Systems with Nexteer Automotive.	12 Sep 2012	R. Bal
2	102	I.F. Added unless otherwise specified.	12 Sep 2012	R. Bal
2	103	I.K. Added	12 Sep 2012	R. Bal
3	104	II.B. Added notes referring to Serialization.	06 Oct 2017	K. Gerzseny

Note: The above specifications were developed without considering whether patents may or may not be involved.
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This specification covers the Nexteer Automotive requirements for heat-resistant alloy castings. This specification supersedes Manufacturing Equipment Purchase Specifications E-1128 and E-1156.

I. GENERAL

- A. By submitting a bid, a vendor approves the design and agrees to supply castings that meet this specification.
- B. The average life of a casting must be equal to or better than the average life presently experienced by Nexteer Automotive with the subject detail. These records are available upon request. Average casting life which is less than that experienced by Nexteer Automotive requires the Foundry to supply a new quantity of subject detail (at no cost to Nexteer Automotive) to equal the equivalent average alloy to life.
- C. Any time there is a delay in the casting approval procedure, or a purchase order is placed on hold by the vendor, the Nexteer Automotive Process Engineer or designated representative is to be notified in writing.
- D. The heat analysis and foundry casting process (location of gates, vents, risers, chills, special stamps, etc.) of all casting must be available to Nexteer Automotive for inspection upon request for a minimum of two years after shipment.
- E. Metal section thickness on the drawings is the arithmetic mean dimension. Whenever draft on the section is required, the minimum draft angle should be used. Arithmetic mean = $1/2$ of (maximum thickness + minimum thickness).
- F. Unless otherwise specified, the following Alloy Casting Institute (ACI) grades shall be provided on new designs. Alternate materials may be quoted as an option.
- | | |
|--------------------|-------------------------------|
| Trays and fixtures | HU, Super 22H or as specified |
| Radiant tubes | HL, HK, Super 22H |
| Rolls | HN and 304 |
| Cast belts | HT |
| Furnace parts | HT |
| Fans | HT or superalloys |
- G. Whenever a casting is ACI heat resistant type HU with Columbium (+Cb), the castings must be solution heat-treated at a temperature exceeding 2,000 degrees F. and held at temperature for a minimum of one hour and forced-air quenched. Heat-treated alloy shall not be sand-blasted or painted as visual proof that heat-treating has occurred.
- H. The cast surface of all trays and fixtures shall be preserved by minimizing any grinding.
- I. If shipments are "not to be stacked," the pallet of castings shall be marked as such.
- J. Belts, trays, fixtures, etc., of the same detail shall be palletized for 1,000-pound minimum shipments if shipping quantity or weights are not specified on the purchase order.
- K. No welding or weld repair of castings is permitted unless specified on print.

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II. CASTING IDENTIFICATION

- A. All identification letters shall be 1/4 inch minimum and raised above the casting surface at least 1/16 inch. If the identification is located on a functional surface, the background shall be recessed so that raised letters do not exceed the surface dimension. The location of these letters will be shown on the drawing.
- B. All castings shall be marked with the proper ACI grade, the Nexteer Automotive alloy number and detail, the vendor's trademark, and the month and year cast. Castings require serialization on a per month basis. Serializing to start at 001 and will start over with 001 every month. Serialization numbers to be located in the same casting area as supplier name and pour date.
- C. If more than one tray or fixture detail is made per mold, the location of each shall be identified by an alphabetical character.
- D. Identification must be on all details made for an order. If the detail is a stock item, it must be permanently identified with a Nissan Yellow Metal Marker or equivalent.

III. MISCELLANEOUS FURNACE COMPONENTS

- A. The approval process for castings of standard furnace replacement parts is for the Nexteer Automotive Process Engineer or designated representative to initially test and approve for conformance to print, functionality and life. This approval process does not have to be repeated on subsequent orders unless a change has been made in the pattern or process.
- B. All fan shaft/blade castings shall be dynamically balanced per alloy drawing prior to shipment. Fans shall be dynamically balanced at 1560 rpm if not otherwise specified on alloy drawings.
- C. Radiant Tubes
 1. All radiant tube assemblies shall be pressure checked at 20 psig prior to shipment.
 2. All radiant tube assemblies shall be butt-welded.
 3. Radiant tubes shall be smooth and free of weld splatter or excessive weld on the I.D.
 4. Centrifugal cast tubing shall not be weld-repaired.
 5. All radiant-tube assemblies shall be identified with ACI grade, Nexteer Automotive alloy number and detail, vendors name and trademark, and month-year cast, on the return bend. Radiant tubes shall be the same ACI grade throughout the assembly.

IV. TRAYS AND FIXTURES

- A. A 4-step casting approval process has been established by Nexteer Automotive to achieve casting quality on all orders. Production of an order shall not begin until the casting approval procedure has been completed for the specific alloy detail. The approval process does not have to be repeated on subsequent orders, unless a change has been made in the casting design or process.
 1. Design Approval
 - a. The strength of a tray or fixture is the responsibility of the designing source. The design source shall determine all loads and stresses and design castings within allowable stress limits. A copy of the casting stress calculations shall be

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submitted to the responsible Nexteer Automotive Engineer or designated representative prior to design approval.

- b. The maximum allowable design stress for steady state conditions shall be 50% of A.C.I. limiting creep stress for 1% elongation in 10,000 hours. The allowable design stress shall be reduced for thermal cycling applications.
 - c. The tray or fixture shall be designed for part retention, interchangeability, proper operation on the furnace line, processing of parts to print specifications, etc.
 - d. Fixture shall be designed so that it does not extend beyond outside rib of tray.
 - e. Positioning of tray and/or fixture on furnace rail shall be shown on assembly drawing.
 - 1. Tray shall be designed so entire length of rib rides on furnace rail.
 - 2. Fixture support posts shall be located directly over furnace rails.
2. Vendor Approved Casting Sample
- a. Vendor shall develop a sound casting for visual, functionality and destructive testing purpose.
 - b. Sample castings shall represent normal production castings. The sample shall be free and sand, gates, risers, hot tears, welds or breaks and cold laps.
 - c. The vendor shall completely inspect the casting utilizing the "Sample Casting Approval Checklist" on pages 8 and 9.
 - d. The vendor shall submit to the responsible Nexteer Automotive Process Engineer or designated representative a copy of the casting approval checklist and the casting blueprint with the following being noted:
 - 1. Location of identification on casting.
 - 2. Location of all destructive test breakpoints by a red line on the blueprint.
 - 3. Casting information, such as the location of gates, vents, risers, chills, special sands etc.
 - 4. Location of all defects found (shrinks, cold laps, hot tears, welds, etc.), by circling the area in red.
 - e. The marked blueprint, signed by vendor representative confirming accuracy, shall be submitted to the responsible Nexteer Automotive Process Engineer after each sample has been tested, regardless of test results.
 - f. If the sample casting is not approved by vendor, corrections in pattern and/or process should be made and additional samples cast until a casting is approved.
3. Casting Sample for X-ray Approval
- a. After the vendor tested and approved casting has been produced, the responsible Nexteer Automotive Process Engineer or designated representative will advise vendor to produce two (2) sample castings for X-ray.
 - b. The vendor shall X-ray one (1) of the sample castings.

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- c. The X-ray is a reference in determining the location for checking the casting during destructive testing.
 - d. The vendor shall destructive test the sample casting not X-rayed and complete "Sample Casting Approval Checklist" on pages 8 & 9.
 - e. Nexteer Automotive will not accept castings that have shrink that extends to the surface. After breaking, all shrinks must be surrounded by sound metal. The sound metal thickness must be a minimum of 25% of the section thickness.
 - f. Vendor shall submit a signed copy of the completed sample casting approval checklist and marked casting blueprint per Item IV, A.2.d.
 - g. If the X-rayed sample casting is not approved by vendor, corrections in pattern and/or process shall be made and additional samples cast, X-rayed, and approval process repeated.
 - h. The X-ray of the final "approved" casting shall be retained by vendor for a minimum of five (5) years after pattern approval.
4. Final Nexteer Automotive Approval
- a. After one of the two sample castings has been X-rayed, tested and approved by the vendor, the Nexteer Automotive Process Engineer or designated representative will repeat tests and verify accuracy before production quantities of castings are made.
 - b. The Nexteer Automotive Process Engineer or designated representative will perform final approval testing at vendor's facility per "Sample Casting Approval Checklist" on pages 8 & 9.
 - c. A small group of castings may be requested for testing as to proper operation on the furnace line and the processing of parts to print specification. Cost for the sample casting, pattern equipment, design, and the small test group of castings will be the responsibility of the design source until all tests are approved.
 - d. Nexteer Automotive reserves the right to destructive-test one or more pieces of any tray or fixture shipment. This can occur at any future time and may be witnessed by the vendor's representative. If the tested detail does not meet these specification standards, the lot may be returned and the casting approval procedure repeated with the shipment being replaced with approved castings.
 - e. The sample casting approval includes approval of the manufacturing method or process at the foundry. The responsible Nexteer Automotive Process Engineer or designated representative is to be notified in writing prior to any manufacturing change of an approved casting. The responsible Nexteer Automotive Process Engineer or designated representative will determine if the new method (different type of molding, different molding equipment, change in chills, change of pattern equipment, etc.) will require re-approval of castings.
- B. Failure to obtain approval per this specification could subject the order to cancellation base upon the number of tests performed and the required Nexteer Automotive delivery requirements. If cancellation should occur, Nexteer Automotive shall not be held liable for any expense incurred.
- C. Vendor shall obtain design and casting approval from the responsible Nexteer Automotive Process Engineer or designated representative.

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- D. Design approval does not in any way relieve the vendor from producing a functional casting. If the design does not function properly, the design source is to develop a new design, supply new pattern equipment, a new drawing, and repeat approval process - all at no cost to Nexteer Automotive.
- E. Casting approval does not in any way relieve the vendor from producing a workable casting.

V. PATTERN EQUIPMENT

- A. Pattern equipment purchased by Nexteer Automotive shall remain the property of Nexteer Automotive.
- B. The vendor shall store pattern equipment for a minimum of two years after their last purchase order for the specific detail.
- C. The vendor shall notify the Nexteer Automotive Process Engineering Department in writing 60 days prior to returning any pattern equipment to Nexteer Automotive.
- D. Nexteer Automotive may transfer pattern equipment from one vendor to another.
- E. The vendor is responsible for the pattern and its maintenance until it is transferred to another vendor by request of the Nexteer Automotive Process Engineer or designated representative or the pattern equipment is returned to Nexteer Automotive.
- F. Sample castings must be tested and approved by the Nexteer Automotive Process Engineer before Nexteer Automotive is liable for the new pattern equipment.

VI. PROPOSALS

- A. The weight $\pm 5\%$ and equivalent ACI grade of all castings shall be stated in the proposal. Trade names only are not acceptable.
- B. The cost of pattern equipment is to be stated separately. If the casting is a new design, a copy of the vendors working drawings of the casting shall be supplied at time of casting approval.
- C. Vendor shall be responsible to supply drawings per SD-003, "General Drawings and Manuals Specification." All casting detail drawings to include decal that specifies material, weight, and requirement to meet this specification.
- D. The pattern construction material, flask size, and the number of details per mold shall be stated in the proposal.
- E. If sample castings are required for approval, these samples will not be considered as the castings being quoted. The cost of the sample casting shall be quoted as a separate item in the proposal.
- F. Prices quoted are to be firm through shipment.

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SAMPLE CASTING APPROVAL CHECKLIST FOR TRAYS AND FIXTURES

HEAT RESISTANT ALLOY - Page 1 of 2

DATE: _____ FOUNDRY: _____

P.O. NUMBER: _____ ALLOY NO. _____

DESCRIPTION: _____

APPROVED: _____ YES _____ NO BY: _____

A. Design Approved: _____ YES _____ NO

B. Dimensional Check:

1. Length	_____ IN.	_____ OK	_____ NOT ACCEPTABLE
2. Width	_____ IN.	_____ OK	_____ NOT ACCEPTABLE
3. Thickness	_____ IN.	_____ OK	_____ NOT ACCEPTABLE
4. Metal Section	_____ IN.	_____ OK	_____ NOT ACCEPTABLE
5. Section Uniform	_____ IN.	_____ OK	_____ NOT ACCEPTABLE
6. Weight	_____ LB.	_____ OK	_____ NOT ACCEPTABLE

C. Identification:

1. Location _____	_____ OK	_____ NOT ACCEPTABLE
2. Month and Date Cast	_____ OK	_____ NOT ACCEPTABLE
3. Alloy and Detail Number	_____ OK	_____ NOT ACCEPTABLE
4. ACI Grade	_____ OK	_____ NOT ACCEPTABLE
5. Vendor Identification	_____ OK	_____ NOT ACCEPTABLE

D. Visual Examination:

1. Warpage	_____ NONE	_____ NOT ACCEPTABLE
2. Pattern Shift	_____ NONE	_____ NOT ACCEPTABLE
3. Cold Laps	_____ NONE	_____ NOT ACCEPTABLE
4. Hot Tears	_____ NONE	_____ NOT ACCEPTABLE
5. Weld Repairs	_____ NONE	_____ NOT ACCEPTABLE
6. Grinding	_____ NONE	_____ NOT ACCEPTABLE

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SAMPLE CASTING APPROVAL CHECKLIST FOR TRAYS AND FIXTURES HEAT RESISTANT ALLOY – Page 2 of 2

E. Functionality:

- | | | |
|------------------------------|---------|---------------------|
| 1. Part positions on fixture | _____OK | _____NOT ACCEPTABLE |
| - Lug Clearance | _____OK | _____NOT ACCEPTABLE |
| - Part Stability | _____OK | _____NOT ACCEPTABLE |
| 2. Fixture position on tray | _____OK | _____NOT ACCEPTABLE |
| - No Overhang | _____OK | _____NOT ACCEPTABLE |
| - Locating Lugs | _____OK | _____NOT ACCEPTABLE |
| 3. Post Fit | _____OK | _____NOT ACCEPTABLE |
| 4. Stacking Stability | _____OK | _____NOT ACCEPTABLE |

F. X-ray examination:

- | | | |
|----------------|-----------|---------------------|
| 1. Shrinks | _____NONE | _____NOT ACCEPTABLE |
| 2. Gas Bubbles | _____NONE | _____NOT ACCEPTABLE |

G. Destructive Testing:

- | | | |
|----------------|-----------|---------------------|
| 1. Shrinks | _____NONE | _____NOT ACCEPTABLE |
| 2. Gas Bubbles | _____NONE | _____NOT ACCEPTABLE |
| 3. Welding | _____NONE | _____NOT ACCEPTABLE |

H. Pattern Material:

I. Manufacturing Method:

J. Miscellaneous Comments

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