



Repair Welding of Gray Cast Iron Engine Blocks and Lower Crank Cases

1 Scope

1.1 Material Description. This standard describes welding procedures, process details, and acceptance criteria for repair of gray cast iron engine block and lower crank case castings segregated at the foundry. Both engine block and lower crankcase will be referred to as “block” in the following context.

1.1.1 This procedure is intended to be used for weld repair of unpainted, un-machined castings, and only in areas designated in the casting supplier’s process control plan. Finished machined parts may be considered for repair welding with approval from appropriate GM Powertrain Engineering Departments.

1.1.2 This procedure is not intended for repair of large casting defects. Casting porosity which does not conform to agreed upon porosity standards must not be repair welded.

1.1.3 Repair of misruns and cracks are not permitted.

1.1.4 Cylinder block regions that may be considered for weld repair include block front and rear faces, crankcase (skirt) walls, bosses (excluding head, bearing cap/bedplate, and engine mounting), and starter flange. Defects eligible for weld repair shall be agreed to between the responsible GM Design Responsible Engineer (DRE) and the supplier and shall be included in the process control plan and/or quality document. Any deviations from this specification must be approved by the responsible GM Powertrain Product Engineering Department.

1.2 Symbols. Not applicable.

1.3 Applicability. Decision to repair weld gray iron cylinder block castings with defined defect type, size and locations shall be agreed to between the responsible GM Powertrain DRE and block supplier.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3059

3 Requirements

3.1 General Acceptance Criteria.

3.1.1 Welding area shall be shielded from air flow which may cause a cross wind or draft condition.

3.1.1.1 Welding is not allowed on structural, load bearing, or sealing surfaces. Areas to be welded shall be agreed to between the responsible GM Powertrain DRE and supplier and shall be included in the process control plan and/or quality document.

3.1.1.2 Repair welding shall be performed by hot welding (preheated part), using welding rod of similar to American Welding Society (AWS) Class RCI-A (UNS F10091).

3.1.2 Equipment.

3.1.2.1 This standard requires the use of a contact pyrometer to monitor repair part temperature and allows the use of a hand grinder to prepare weld areas.

3.1.2.2 Acceptable welding methods include: Gas flame, arc welding (Metal Inert Gas (MIG) and Tungsten Inert Gas (TIG)) and stick welding. Cast iron welding rod used shall be similar to AWS Class RCI-A (UNS F10091). Other welding rod materials may be used with the approval of Powertrain Product Engineering.

3.1.2.3 Appropriate flux for cast iron that provides adequate flotation, fluidity or puddling should be used so that welds are sound and free of slag and inclusions.

3.2 Visual Acceptance Criteria.

3.2.1 Weld Quantity. No more than three repair welds shall be permitted on a block casting. The total volume of blocks that may be weld repaired is limited to 5% maximum blocks produced in a production week.

3.2.2 Weld Location. Welding is not permitted in the following areas described in Table 1.

3.2.2.1 Welding is further restricted as follows: Water jacket welds to be contained within a 10 mm diameter circle, 5 mm deep or 50% of wall thickness maximum.

Table 1: Welding Not Permitted in the Following Areas

Block and Bedplate Bulkheads	Water and Oil Passages	Casting Locators
Cylinder bores, including a 10 mm band around bores in the crankcase	Sidewalls in highly stressed areas as defined by GM Powertrain Product Engineering	Electronic Spark Control (ESC) knock sensor boss
Sealing surfaces	Engine mounting, head, and bearing cap/bedplate bolt bosses	
Any/all walls separating water from oil	Region around bedplate inserts	

Welding permitted with GM Powertrain Product Engineering approval in areas which include; Accessory Bosses, Room Temperature Vulcanizing (RTV) sealing surfaces and potentially other areas upon supplier request.

3.2.3 Weld Size. Repair weld area of all welds shall not exceed an area contained within a 30 mm diameter circle, 5 mm deep or 50% of wall thickness maximum.

3.2.4 Cracks and Craters.

3.2.4.1 Cracks in welds and base metal are not permitted.

3.2.4.2 Craters and crater cracks are not permitted.

3.2.5 Burn-through and Meltback. The weld and areas surrounding the weld shall be free of holes caused by melting through the parent material or when base material melts away and does not become part of the weld bead.

3.3 Measurable Acceptance Criteria. All welds on one production engine block shall be metallurgically analyzed to evaluate microstructure and overall integrity at all weld regions. This analysis must be completed prior to welding approval and once per month on a production basis or after any equipment/operator changes and documented per 4.7.1 and 4.7.2.

3.4 Disposition/Repair Procedure.

3.4.1 Casting Preparation.

3.4.1.1 The intent of this specification is for the repair welding of unpainted and unmachined parts. Welding of machined parts must be approved by responsible GM Powertrain Engineering departments.

3.4.1.2 Casting regions to be weld repaired shall be prepared by grinding, chipping, milling, filing, or similar means to permit weld penetration into sound metal. Grinding may be used to prepare the area provided the grinding wheel is clean and dedicated for only the iron being welded. The area must be thoroughly cleaned after grinding to remove all iron alloy dust and abrasive particles left by the grinding wheel.

3.4.1.3 Regions to be welded shall be dry, free of sand, oil, grease, dirt, paint, corrosion, and other surface contaminants to a distance beyond the heat-affected zone (HAZ).

4 Manufacturing Process

4.1 Welding Procedure.

4.1.1 Preheat. Furnace heat blocks for 60 minutes to 90 minutes to achieve a uniform part temperature of 550 °C to 680 °C. Charging zone of furnace should be in the range of 500 °C to 600 °C.

© Copyright 2015 General Motors Company All Rights Reserved