GM WORLDWIDE ENGINEERING STANDARDS	**Material Specification**	**GMW16755**

Repair Welding of Aluminum Engine Blocks and Bedplates

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This document describes welding procedures, process details, and acceptance criteria for cosmetic repair of sand cast aluminum engine block castings and low pressure die cast or squeeze cast aluminum bedplates.

1.1.1 Procedure shall be used to weld repair only un-machined and un-heat treated castings.

1.1.2 This procedure is not intended for repair of large casting defects

1.1.3 Repair of oxide films, 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 Applicability. Specific to agree upon weld repair locations between GM DRE and supplier for sand cast aluminum cylinder blocks and low pressure die cast or squeeze cast aluminum bedplates.

2 References

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

2.1 External Standards/Specifications.

AWS A5.10/5.10M

2.2 GM Standards/Specifications.

GMW5

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 Engine blocks and bedplates shall not be repaired in a machined or heat treated condition. 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 Engine blocks and/or bedplates that have been heat treated and/or machined may be considered for weld repair upon approval by the GM DRE and Materials Engineer. Special processing may be required for these parts.

3.1.2 Equipment.

3.1.2.1 Gas Tungsten Arc Welding (GTAW) Machine. Alternative names include Tungsten Inert Gas (TIG) Welding and Heliarc Welding.

3.1.2.2 Filler metal shall comply with AWS A5.10/5.10M Specification for Bare Aluminum and Aluminum Alloy Welding Electrodes and Rods or an equivalent standard.

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3.1.2.3 Filler metal 4145 per AWS A5.10/5.10M is recommended for use in weld repair of aluminum GWM5M-Al-C-S-Si9Cu3-T7 per GMW5 (Cast Aluminum Alloys). Table A1 provided in GMW5 Appendix A references typical aluminum alloy selections for sand cast cylinder blocks and bedplate applications. For alternative aluminum alloys, a filler metal of similar chemical composition as the base metal should be used.

3.1.2.4 Shielding gas shall be Argon gas with a 99.997% purity level.

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.

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. Each repair weld shall be 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.

3.4 Disposition/Repair Procedure.

3.4.1 Casting Preparation.

3.4.1.1 Repair welding shall be performed exclusively on unfinished parts.

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 aluminum being welded. The area must be thoroughly cleaned after grinding to remove all aluminum 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). Cleaning may be accomplished by the use of vapor or liquid cleaners or by solvents that are free of residues.

3.5 Weld Equipment Settings.

3.5.1 Electrode shall be 100% tungsten. Seriated and zirconiated tungsten electrodes may be used.

3.5.2 Alternating current shall be used.

3.5.3 Arc current range shall be 70 A to 150 A.

3.5.4 Shielding gas shall be 100% Argon with a flow rate range of 20 SCFH to 30 SCFH.

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