LEAR CORPORATION	**Minimum Quality Control Guidelines for Gas Metal Arc Welding**	**GSOG 9.2**
Revision Date: March 23, 2006 Effective Date: March 31, 2006	**Owner: Metals & Mechanisms Quality**	**Page: 1 of 15**

1.0) Scope/Purpose:

This guideline defines the minimum requirements for Gas Metal Arc Welding (GMAW) (also known as Metal Inert Gas or MIG) quality control. This guideline does not alter any contractual obligation, specification or responsibility. This guideline is a best practice recommendation. Satisfying these minimum requirements does not ensure that all applicable specifications and responsibilities are met.

This guideline applies to all Lear manufacturing facilities and support groups.

2.0) Responsibility

Welder: A person who performs manual or semiautomatic welding. Welders shall weld and inspect their welds. Welders may perform routine maintenance including contact tube and nozzle changes, and nozzle cleaning. Welders may adjust weld parameters within established limits.

Welding Operator: A person who operates automatic welding equipment. Welding equipment operators shall inspect their welds. Welding operators may perform routine maintenance including contact tube and nozzle changes, and nozzle cleaning.

Weld Technician: A person who sets up and performs routine adjustments to automatic welding equipment. Weld Technicians may adjust weld parameters within established limits.

Weld Engineer: A person who establishes weld parameters and weld parameter limits.

Weld Inspector: A person who performs inspection of welds.

Quality Engineer: A person who establishes and monitors the Control Plan for the product.

Product Engineer: A person who has the authority to release the Design Record for the product.

3.0) Definitions

Amperage: (Current) The measurement of the amount of electricity flowing past a given point in a conductor per second.

Arc Length: Distance or air space between the tip of the unmelted electrode wire and the work. For GMAW, arc voltage determines arc length.

Arc Voltage: Measured across the welding arc between the electrode tip and the surface of the weld puddle.

Automatic Welding: The equipment controls the electrode wire feeding and movement of the welding gun.

Base Metal: The material that will be joined by welding

Contact Tube: (Weld Tip) The contact tube transfers the current to the electrode.

Depth of Fusion: (Penetration) The depth or distance that a deposited weld metal extends into the base metal or the previous pass.

3.0) Definitions – cont'd

Design Record: As defined in the AIAG PPAP manual. A design record is the part drawing, specifications, and/or electronic data used to convey information necessary to produce a product.

Electrode: (Weld Wire) The electrode transfers the current between the contact tube and base metal.

Electrode Extension: (Stickout) While welding, the length of the unmelted electrode extending beyond the tip of the contact tube.

Fit Up: The manner in which two members are brought together to be welded.

Fixture: The jig or tooling that positions the workpieces and establishes the fit-up of the workpieces.

Fusion: The melting together of filler material and base metal (workpiece) or of base metal only which results in coalescence. Coalescence is the growing together or growth into one body of the materials being welded.

Gun Technique: The position of the gun as it progresses along the weld joint. A perpendicular technique would have the wire being fed 90 degrees into the weld. A drag technique (a.k.a. trailing or pull) has the gun pointed back at the weld as the gun is "dragged" away from the deposited weld metal. A push technique (a.k.a. leading) has the gun pointed away from the weld as the gun is "pushed" away from the weld.

Heat Affected Zone (HAZ): The portion of a weldment that has not melted, but has changed due to the heat of welding. The HAZ is between the weld deposit and the unaffected base metal. The physical makeup or mechanical properties of this zone are different as a result of welding.

Incomplete Fusion: (Cold Lap, Cold Weld) Molten metal rolling over a weld edge but failing to fuse to the base metal.

Key Characteristic (Not Relating to Safety or Legal Considerations): .As defined by the AIAG APQP manual. General Motors Fit/Function, Ford Significant Characteristic, or DCX Diamond or Pentagon Special Characteristic are Key Characteristics (Not Relating to Safety or Legal Considerations).

Key Characteristic (With Safety or Legal Considerations): As defined by the AIAG APQP manual. A General Motors Safety/Compliance, Ford Critical Characteristic, or DCX Shield Special Characteristic are Key Characteristics (With Safety or Legal Considerations).

Non-Key Characteristic: As defined in the AIAG APQP Manual. All product characteristics that are not identified as Key Characteristics are Non-Key Characteristics.

Semiautomatic Welding (SA): The equipment controls only the electrode wire feeding. The welding gun movement is controlled by hand.

Weld Parameters: Weld parameters are the parameters of the process that directly impact the heat of fusion. For GMAW, these include work-to-tip distance, amperage/wire feed/voltage, and other settings.

Weld Schedule: The record that includes the weld parameters and technique for the equipment, fixture(s), and work position that was used to qualify the welding procedure used to produce the weld.

3.0) Definitions – cont'd

Weld Technique: As used in this document, the geometric orientation of the welding torch relative to the workpiece. Weld technique includes work to tip distance, gun technique, work angle, and travel speed.

Workpiece: A part that is to be joined by welding.

Work Position: The position of the work. Work position is also known as table angle or position an as fixture angle or position.

4.0) Procedure

4.1) General: This guideline breaks the quality control of welding into five elements:

- Training (4.2) of personnel involved in the welding process
- Process Quality Controls (4.3) to monitor the conformance to the weld schedule
- Product Quality Controls (4.4) to monitor the conformance to the weld specifications
- Control Plan (4.5) with frequencies for the product and process controls, traceability for the products, and the reaction plans for issues detected by the controls
- PPAP (4.6) to record the qualification of the welding procedure and controls

4.2) Training & Qualification: Personnel shall be trained. The plant shall establish training and qualification programs for personnel including welders, welding equipment operators, weld technicians, weld engineers, weld inspectors, and quality engineers for welding processes. See also GSOG 18.3, Qualification and Training Requirements for GMAW Personnel.

4.3) Process Quality Controls: Process quality controls shall be established to monitor the conformance to the weld schedule and the qualified welding process. The process quality controls must cover all essential elements of the welding process. The minimum required process quality controls are addressed in Paragraph 4.5. The essential elements of process quality control include:

- Workpieces
- Fixtures
- Weld Technique per the Weld Schedule
- Weld Equipment and Parameters per the Weld Schedule
- Change Controls

4.3.1) Workpiece Controls: Important characteristics of the workpiece dimensions and material must be identified through the APQP process. At a minimum, consider:

4.3.1.1) Workpiece Characteristics: Characteristics shall normally include workpiece material composition, dimensions near the joint, and dimensions on the fixtured features of the part. These characteristics shall be controlled. These controls are normally instituted at the production process for the workpiece and/or at receiving inspection. The frequency and method of control of these characteristics shall be included in the appropriate control plan.

4.3.1.2) Fitup & Gaps: Controls for gaps shall be implemented. All gaps shall be checked against limits established in the weld schedule. This may be done using feeler, pin, taper gages, or other methods. Frequency shall be determined through the APQP process and recorded in the control plan. Gap control can be established by annual capability studies that utilize all fixtures and product streams.

4.3.2) Fixture Controls: Important characteristics of the fixture(s) shall be identified through the APQP process. Characteristics shall normally include errorproofing sensors and fixture details. These characteristics shall be controlled. The frequency and method of control of these features shall be included in the appropriate control plan.

4.3.2.1) Fixture Details: All fixture details shall be checked at the start of each shift for spatter, looseness, or damage. All fixture details shall be checked by maintenance personnel as part of the preventative maintenance program in the plant. In addition, certain fixture details, as identified in the APQP process, may need to be checked for wear using gages or other methods.

4.3.2.2) Errorproofing Sensors: All errorproofing sensors shall have known bad parts (also known as *red parts* and *white rabbits*) or other methods to test the function of the sensors. Special attention should be paid to clamping and part presence sensors that may be performing an errorproofing function. Frequency shall be determined through the APQP process.

4.3.2.3) Errorproofing Fixture Details: All errorproofing fixture details shall be noted in work instructions. Known bad parts or other methods shall be used to check the function of the fixture details. Frequency shall be determined through the APQP process.

4.3.4) Weld Technique Controls: Important characteristics of the weld technique shall be identified through the APQP process. Weld engineers shall establish the technique for each weld. The weld technique used to qualify the process shall be recorded in the weld schedule. See Attachment 6.1 for an example. At a minimum, the following shall be addressed

- Sequence of welds
- Path of weld. Include start point location, end point location, any turns in the weld, length, and tolerance
- Special Pattern Techniques (e.g. weave weld)
- Position of workpieces and/or fixture during weld
- Gun Technique. Push, Pull, or Perpendicular
- Travel Angle and tolerance of Travel Angle
- Work Angle and tolerance of Work Angle
- Contact Tube to Work Distance and tolerance
- Work Position / Table Angle

4.3.4.1) Automatic Weld Technique Controls: The setup sheet may reference robot encoder data or actual attitude of the torch for all angles. However, if encoder data is used, then the torch and fixture attitude must be checked against a reference standard. Encoder data alone is not sufficient because damage or movement of the torch would not be detected. Audits may reference "save date" on programs. Quality engineers and weld engineers shall ensure that the controls are sufficient given the particular features available on the welding equipment.

4.3.4.2) Semiautomatic Weld Technique Controls: The work instructions shall address all of the path controls. Special consideration must be made in during the APQP process to ensure that welds may be made without undue difficulty or ergonomic issues. In some circumstances, it may be necessary to establish alternative paths for welders of varying abilities. However, in these circumstances, the paths must still be established and validated through proper inspection practices.

4.3.4.3) Arc Monitors (Automatic) and Weld Counters (Semiautomatic): Arc monitors and weld counters can assist the operators and welders in identifying missing welds. Arc monitors shall be used on welds noted as key characteristics for automatic processes. For all other processes, these devices should be used whenever practical.

4.3.5) Weld Equipment and Parameter Controls: Important weld equipment and parameters shall be identified during the APQP process. Weld engineers shall establish the weld parameters for the job. The weld equipment and parameters used to qualify the process shall be recorded in the weld schedule. See Attachment 6.1 for an example. At a minimum, the weld equipment and parameters shall include;

- Power Supply & Wire Feeder special settings or features used
- Electrode Specification, Size, and Manufacturer
- Voltage
- Nominal Contact Tube to Work Distance (reference only for semiautomatic GMAW)
- Nominal Stickout (reference only for semiautomatic GMAW)
- Current / Electrode Feed Rate (i.e. wire feed speed)
- Nozzle to Contact Tube Distance
- Contact Tube change frequency
- Nozzle and Contact Tube Cleaning Frequency

4.3.5.1) Automatic Weld Parameter Controls: The setup sheet may reference robot data. However, if robot data is used, the proper scaling of the robot controllers to the welder power supply is necessary. The weld parameter data shall reference the scaling data and periodic calibration of the scaling shall be performed. Quality engineers and weld engineers shall ensure that the controls are sufficient given the particular features available on the welding equipment.

4.3.5.2) Semiautomatic Weld Parameter Controls: The work instructions shall address all of the weld parameters. Special consideration must be made during the APQP process to ensure that all welds may be made by all welders. In some circumstances, it may be necessary to establish alternative parameters for welders of varying abilities. However, in these circumstances, the parameters must still be established and validated through proper inspection practices.

4.3.6) Change Controls: Every facility shall establish procedures to control changes to GMAW processes.

4.3.6.1) Changes Within the Weld Schedule: Changes made within the tolerances allowed by the weld schedule shall be recorded in the change/maintenance log. Verification of the changes shall include, at a minimum:

- Visual Examination (see 4.4.1) for joint flaws
- Non Destructive Dimensional Evaluation (see 4.4.2) for location, count, and length
- Inspection for Adequate Joint Strength and/or Fusion (see 4.4.3)

4.3.6.2) Changes of the Weld Schedule: Changes of the weld schedule, including new fixtures, require requalification of the weld procedure. Changes may also require customer notification and approval.

4.4) Product Quality Controls: Product quality controls monitor the conformance of the parts to the weld specifications. The design record (part print) shall indicate what specification governs the welds. The Product Engineer is responsible for determining the appropriate specification for the welds on the design record. Paragraph 4.5 defines the minimum required inspection frequencies. Product quality control includes:

- Visual Examination of Welds
- Non Destructive Dimensional Evaluation of Welds
- Examination of Strength of Joint and/or Fusion
- Records

4.4.1) Visual Examination of Welds: Welding equipment operators and welders shall perform 100% visual examination of welds. Examples of joint flaws that may be identified through visual examination include craters, meltback, burn-through, porosity, undercut, nonmetallic inclusions, cracks, and notching. See GSOG 10.4, section 4.2 and Attachment 6.1 for further information. Each facility shall establish procedures for visual examination of welds including:

- Acceptance & rejection criteria and samples
- Work Instructions
- Training requirements

4.4.2) Non Destructive Dimensional Evaluation of Welds: Non destructive dimensional evaluation of welds shall be performed at first piece inspections, changeovers and setups, audit inspections, and after all changes. Examples of issues that may be identified through non destructive dimensional evaluation include missing, short, off-location, and small welds. See GSOG 10.4, section 4.3 and Attachment 6.2 for further information. Each facility shall establish procedures for non destructive dimensional evaluation of welds including:

- Acceptance & rejection criteria and samples
- Work Instructions
- Distribution and control of equipment such as scales, fillet gages, or feeler gages
- Training requirements

4.4.3) Inspection for Adequate Joint Strength and/or Fusion: Product quality control may either examine a joint for adequate joint strength or sufficient weld fusion. The APQP process shall address the selection of an appropriate product quality control method. The Product Engineer shall specify any specific instructions for particular welds on the design record.

4.4.3.1) General Requirements: Each facility shall establish procedures for all methods used to inspect for adequate joint strength and/or fusion. These procedures shall include:

- Work Instructions
- Acceptance & rejection criteria
- Training requirements

4.4.3.2) Destructive (Pry or Chisel) Test Requirements: Procedures shall include

- Acceptance & rejection criteria based on destructive test method(s), including specific instructions for non-standard joints

4.4.3.2) Destructive Metallographic (Cut, Polish, & Etch) Examination Requirements: Procedures shall include

- Acceptance & rejection criteria

4.4.3.4) Non-Destructive Proof Load Testing Requirements: Procedures shall include

- Specifications for the minimum joint strength
- Specifications for how to load the joint
- Equipment to load test the joint
- Use of a different method to check actual fusion in joint at setup or process changes

4.4.3.5) Destructive Load Testing Requirements: Procedures shall include

- Specifications for how to load the joint
- Equipment to load test the joint
- Specifications for the minimum strength of the joint or correlation to other fusion study tests
- Approval by product engineer

4.4.3.6) Other Methods: This preceding list is not inclusive of all testing methods - other methods may be used when approved by the product engineer. These methods shall include evidence of correlation to any design specifications, including weld length and applicable Lear or customer specifications.

4.4.3.7) Grouped welds: If welds are identified on the design record as a Group of Welds they shall be controlled by the controls as listed in Attachment 6.2

4.4.4) Records:

4.4.4.1) Inspection Records: Inspection records shall be maintained. The quality control of weld records do not need to be separate records; they may be maintained as part of a larger check sheet, process control sheet, control plan matrix, or other standard procedure. In any case, quality control records for GMAW shall include, at a minimum:

- Work Instructions or Procedure Used
- Inspector name, inspection date
- Weld/joint/part date, shift, cell, fixture
- Reaction plan or corrective action for any issues identified

4.5) Control Plan: All controls shall be integrated into the control plan. Frequencies need to be checked against number of lots held in the facility. If number of lots is not large enough to facilitate the reaction plan (noted above), then increase the frequency of the check or the numbers of lots retained in the facility. The product engineer shall approve the control plan. The control plan shall reference setup sheets or weld schedules to facilitate changes to process parameters as required.

4.5.1) Frequencies: Minimum weld control frequencies are guided by the engineering specification for the weld. A summary may be found in QC Requirements Attachment 6.2 and 6.3.

4.5.1.1) All Welds: All welds will require the minimum controls as shown in Attachment 6.2 and 6.3. In addition to what is shown in the attachment, refer to these application notes:

- Visual aids for weld location and size. Visual aids may be photographs or drawings of parts, but actual parts are preferred. Weld position and length shall be noted on the visual aids.
- Visual aids of common flaws or other issues found should be displayed. These may significantly contribute to the effectiveness of the visual inspection.
- All workpieces should have gaging or other quality controls to help ensure that the welding process is isolated from workpiece nonconformances.

4.5.1.2) Welds noted as Key Characteristics (Not Relating to Safety or Legal Considerations): Welds that are noted KC (Not Safety) require more stringent controls as shown in Attachment 6.2 and 6.3. These welds are, by definition, sensitive to process variation. In addition to what is shown in the attachment, refer to these application notes:

- Audit of conformance to the weld schedule once per day. For semiautomatic welding, a visual check of proper technique and check of power supply parameters shall meet these requirements. For automatic welding, a check of the "save date" of the current program against the change log shall meet these requirements. The welding source shall designate, train, and qualify personnel to complete these audits.

4.5.1.3) Welds noted as Key Characteristics (With Safety or Legal Considerations): Welds that are identified with a severity rating of 9 or 10 on the DFMEA (PFMEA in the absence of a DFMEA) or identified as safety critical on the drawing shall have the occurrence and detections rankings reviewed to determine the appropriate method of control based on criticality. The control method may include metallographic (cut & etch), destructive testing, proof loading or a combination of these. This review shall also determine the frequency requirements for the test methods required. The results of this evaluation will appear on the control plan and be approved by product engineering.

4.5.2) Traceability: Traceability to particular date of manufacture, cell, and fixture is vital. Proper traceability enables the scope of problems to be limited, rapid sorts of suspect product, and improved identification of the root cause of a problem. Traceability shall be maintained to the next immediate customer. Tracability requirements shall be noted on the control plan. See attachment 6.2 for tracability requirements.

4.5.3) Reaction Plan: The reaction plan for each control shall be included on the control plan. Minimum requirements for the reaction plans differ by control.

4.5.3.2) For Metallographic (Cut & Etch) Nonconformances: If the depth of fusion is over 10% but less than 20%, the process may be adjusted without containment of the lot. If the depth of fusion is less than 10%, then that lot shall be considered discrepant and cannot be used without rework or 100% inspection of the welds from the suspect fixtures (i.e. non destructive pry testing).

On torsion bars, if the depth of fusion is over 5% but less than 10%, the process may be adjusted without containment of the lot.

In addition, the reaction plan shall require destructive (chisel) examination at least 20 parts per suspect fixture for at least the two previous lots or metallographic examination data that confirms an acceptable lot. Customer notification may be required.

4.5.3.3) For Destructive (Pry or Chisel) Nonconformances: The lot that failed the test shall be considered discrepant and cannot be used without rework or 100% inspection of the welds from the suspect fixtures (i.e. non destructive testing). In addition, the reaction plan shall require examination of at least 20 parts per suspect fixture for at least the two previous lots or metallographic examination data that confirms an acceptable lot. If discrepant parts are found in the previous lots, then the sort shall continue into older lots. Customer notification may be required.

4.5.3.4) For Destructive Load Testing or 100% Proof Load Testing: The reaction plan shall be approved by the product engineer.

4.6) Production Part Approval Process: The PPAP submission for a welded assembly shall include the evidence of the qualification of the welding procedure used to manufacture the assembly. The evidence includes the following items:

4.6.1) Layout of GMAW: The PPAP submission for a welded assembly shall include a layout of welds, to include visual and metallographic examination of each GMAW. See also GSOG 10.4, Inspection of GMAW. Welds noted as key characteristics on the design record shall have at least six parts per fixture included in the layout. Note: Specifications that include minimum weld size, leg, and/or throat (e.g. AWS, DIN, DCX, Ford, General Motors, Mazda, and others) require metallographic (i.e. cut and etch) examination of the leg and throat of a GMAW.

4.6.2) Weld Schedule: The PPAP submission for a welded assembly shall include the weld schedule with the submission of the control plan. Changes within the weld schedule do not require PPAP. Changes to the weld schedule may require PPAP; consult customer specific requirements.

4.6.3) Requirements for Key Characteristics (with Safety or Legal Considerations): The PPAP submission for a welded assembly with welds denoted as Key Characteristics (with Safety or Legal Considerations) shall include a capability study for the key welds.

4.6.4) Capability: Capability for welds may be demonstrated by measurement of either the penetration, depth of fusion, leg length, weld size, throat, or destructive load testing. Capability may also be demonstrated by “go, no-go” attribute studies (e.g. chisel checks, non-destructive proof loads); regardless of the method the approval of product engineering is required.

4.6.5) Control Plan: Include the control plan with the PPAP submission. In some cases, as noted above, the product engineer will have to sign or otherwise certify approval of the control plan; include the approval in the PPAP.

4.7) Notes

4.7.1) These recommendations provide guidance in general cases special cases require special controls.

4.7.2) Should any conflict occur between the guidelines specified herein and those specified on the engineering specification or drawing, the engineering specification or drawing has precedence.

4.7.3) Any requirements exceeding the limits of these guidelines shall be designated on the engineering drawing.

4.7.4) Destructive load testing or non-destructive proof load testing may be used as part of a comprehensive process control plan that includes depth of fusion and leg length. The process control plan must be approved by product engineering.

4.7.5) Dept of fusion (penetration) limits may be changed with the written concurrence of Product Engineering.

5.0) Required Quality Record(s)

5.1) Weld Schedule - File the weld schedule with the product's PPAP
5.2) Welding Inspection Records - File the inspection records with other records required to support the control plan
5.3) Training Records for Welding Personnel - File training records with other training documents.

6.0) Forms / Examples

6.1) Welding Parameters for GMAW
6.2) Summary of Recommended Minimum Controls for Automatic (Robotic) GMAW
6.3) Summary of Recommended Minimum Controls for Semiautomatic (Manual) GMAW

7.0) Reference

7.1) GSOG 18.3, Qualification and Training Requirements for GMAW Personnel
7.2) GSOG 10.4, Inspection of GMAW
7.3) AWS Welding Inspection Handbook (3rd Edition, C2000, American Welding Society, www.aws.org) ISBN 0-87171-560-0

8.0) Related Documentation

8.1) Quality Systems Corporate Policy Manual
8.2) Control of Quality Records
8.3) GSOG 10.4 Inspection of Gas Metal Arc Welds
8.4) GSOG 18.3 Qualification and Training of Welding Personnel

9.0) Revision History

Revision Date	Description of Revision	Approved By
Released 7/08/02	This guideline has been developed to meet Quality System requirements for all divisions and supercedes any similar guideline issued to date.	
Revised 02/23/2004	Revised to align definitions with AWS A3.0.	
Revised 3/23/06	Revised various paragraphs of guidelines to improve clarity	

LEAR CORPORATION	**Minimum Quality Control Guidelines for Gas Metal Arc Welding**	**GSOG 9.2**
Revision Date: March 23, 2006 Effective Date: March 31, 2006	**Owner: Metals & Mechanisms Quality**	**Page: 13 of 15**

Attachment 6.1) Welding Schedule

A sample of a weld schedule is attached below. This document is available in Excel format.

Weld Parameter Sheet Page of

Part Number(s)		**Cell(s)**		**Fixture(s)**		**As Of Date**	
Electrode		***Nozzle & Tip***		***Gas***		***Power Supply***	
Wire Specification		Nozzle Cleaning	Cycles	Mixture		Model	
Wire Size		Tip Change	Cycles	Flow Rate		Notes:	
Brand		Ctc tube - Nozzle	(Distance)	Pressure		Enter settings specific to the	
Stickout		Tip		Diffuser		power supply, e.g. inductance	
Liner		Nozzle					

		Allowable Range										
Ref Weld #	**Sequence & Leg**	**Fixture Position**	+10% -0% **Length**	N/a **Pattern**	N/a **Speed**	N/a **Voltage**	N/a **Current**	+/- 1/16in **Work-Tip**	N/a **Techniq**	+/- 5 deg **Tvl Ang**	+/-10 deg **Wrk Ang**	**Additional Notes**
1	3a	20 deg	20mm	straight	80 mm/s	24.0V	200A	1/8in	Perp	0	45	Arc initiation notes
	3b	-20 deg	10mm	weave	80 mm/s	24.0V	200A	1/8 in	Push	20 +/- 10	45	Where to point weld
												Wire retract, etc.
25												

Attach drawing, photo, or sample part to indicate weld leg start and end points

Changes to parameters require weld engineer approval *Changes to Key Characteristic welds require quality approval*

Weld Eng Approval		Date		Quality Approval		Date

LEAR CORPORATION	**Minimum Quality Control Guidelines for Gas Metal Arc Welding**	**GSOG 9.2**
Revision Date: March 23, 2006 Effective Date: March 31, 2006	**Owner: Metals & Mechanisms Quality**	**Page: 14 of 15**

Attachment 6.2) Summary of Minimum Recommended Controls for Automatic (Robotic) GMAW.

	Para-Graph	All Welds	KC (Not Safety) Welds	KC (Safety) Welds
Workstation				
Visual Aids for weld location and size	4.4.1	X	X	X
Weld Schedules for Parameters, Equipment, Technique	4.3.4 4.3.5	X	X	X
Change Log for weld parameters and technique	4.3.6.1	X	X	X
Operator Instructions & Checks				
Inspection of Fixtures for Serviceability -clamping, details, clean of spatter, sensor function	4.3.2	1 / fixture / shift (See Note 1)	1 / fixture / shift (See Note 1)	1 / fixture / shift (See Note 1)
First Piece Visual Examination and Non Destructive Dimensional Evaluation of welds	4.4.1 4.4.2	X (See Note 3)	X (See Note 3)	X (See Note 3)
Inspection for strength of joint and/or fusion Destructive (Operator or Inspector)	4.4.3	Setup & 1 part / week / fixture	Setup & 1 part / day / fixture	Setup & 2 part / shift / fixture
100% Visual Examination for weld flaws & length	4.4.1	X	X	X
Arc Start, Arc Monitoring			X	X
Traceability	4.5.2	Date, Shift - On Container	Fixture, Cell, Shift, Date - On Part	Fixture, Cell, Shift, Date - On Part
Process and Product Quality Audits				
Visual Examination and Non Destructive Dimensional Evaluation (by Weld Inspector)	4.4.1 4.4.2	1 part / shift / fixture	1 part / shift / fixture	2 part / shift / fixture
Metallographic (Cut & Etch) w/ 20% and 10% limits) (By Weld Inspector)	4.4.3 4.5.3.2	Layout / PPAP	Layout / PPAP or process change per Control Plan	Layout / PPAP or process change per Control Plan
Visual Record retained for strength of joint and/or fusion inspections	4.4.4.1	Layout / PPAP	Layout / PPAP	Layout / PPAP
Audit of Weld Schedule and Change Log		1 / week / fixture	1 / day / fixture	1 / shift / fixture
Change Controls				
Procedure for approval of changes	4.3.6	X	X	X
Inspection of Workpieces	4.3.1	Before Change	Before Change	Before Change
Inspection of Fixtures, Audit Weld Schedule	4.3.2	Before Change	Before Change	Before Change
Inspect for strength of joint and/or fusion to validate changes weld parameters, technique, or equipment	4.4.3	After Change (See Note 2)	After Change (See Note 2)	After Change (See Note 2)
Quality Signoff of Weld Schedule Changes	4.3.6		X	X
Personnel Training & Certification Requirements				
Automatic Welding	4.2	Trained Operator	Trained Operator	Trained Operator
Automatic Welding Repairs	4.2	Qualified Welder	Qualified Welder	Qualified Welder
Weld Technicians	4.2	Qualified Welder	Qualified Welder	Qualified Welder

Note 1: Inspection of fixtures shall be done at the end of the shift if there are more than four hours between shifts.
Note 2: Changes to the Weld Schedule or equipment, including but not limited to controllers, guns, fixtures, details, and power supplies, shall be validated with destructive Inspections for Strength of Joint and/or Fusion. Cleaning or changing tips and nozzles does not require validation when these are performed frequently enough to preclude changes of the weld. Routine replacement of consumables, including gas and wire, does not require validation.
Note 3: Last Piece inspection is also required when there are more than four hours between shifts.

LEAR CORPORATION	**Minimum Quality Control Guidelines for Gas Metal Arc Welding**	**GSOG 9.2**
Revision Date: March 23, 2006 Effective Date: March 31, 2006	**Owner: Metals & Mechanisms Quality**	**Page: 15 of 15**

Attachment 6.3) Summary of Recommended Minimum Controls for Semiautomatic (Manual) GMAW Performed by a Certified Welder.

	Para-graph	All Welds	KC (Not Safety) Welds	KC (Safety) Welds
Workstation				
Visual Aids for weld location and size	4.4.1	X	X	X
Weld Schedules for Parameters, Equipment, Technique	4.3.4 4.3.5	X (See Note 1)	X (See Note 1)	X (See Note 1)
Change Log for weld parameters and technique	4.3.6.1	X	X	X
Operator Instructions & Checks				
Inspection of Fixtures for Serviceability -clamping, details, clean of spatter, sensor function	4.3.2	1 / welder / shift	1 / welder / shift	1 / welder / shift
First Piece Visual Examination and Non Destructive Dimensional Evaluation of welds	4.4.1 4.4.2	X (See Note 2)	X (See Note 2)	X (See Note 2)
Inspection for strength of joint and/or fusion – (Operator or Inspector)	4.4.3	Setup & 1 part / week / fixture	Setup & 1 part / day / fixture	Setup & 2 part / shift / fixture
100% Visual Examination for weld flaws & length	4.4.1	X	X	X
Weld Counter or Similar			Preferred	Preferred
Traceability	4.5.2	Welder, Date - On Container	Welder, Shift, Date - On Part	Welder, Shift, Date - On Part
Process and Product Quality Audits				
Visual Examination and Non Destructive Dimensional Evaluation (by Weld Inspector)	4.4.1 4.4.2	1 / shift / welder (See Note 2)	1 / shift / welder (See Note 2)	2 / shift / welder (See Note 2)
Metallographic (Cut & Etch) w/ 20% and 10% limits (See also Note 4)	4.4.3	Layout / PPAP	Layout / PPAP or process change per Control Plan	Layout / PPAP or process change per Control Plan
Visual Record retained for strength of joint and/or fusion inspections	4.4.4.1	Layout / PPAP	Layout / PPAP	Layout / PPAP
Audit of Welders Conformance to Weld Schedule		1 / week / welder	1 / day / welder	1 / shift / welder
Change Controls				
Procedure for approval of changes	4.3.6	X	X	X
Inspection of Workpieces	4.3.1	Before Change	Before Change	Before Change
Inspection of Fixtures, Audit Weld Schedule	4.3.2	Before Change	Before Change	Before Change
Requalification of Welder upon change of Weld Schedule	4.4.3	After Change (See Note 3)	After Change (See Note 3)	After Change (See Note 3)
Quality Signoff of Weld Schedule Changes	4.3.6		X	X
Personnel Training & Certification Requirements				
Welder	4.2	Qualified Welder	Qualified Welder	Qualified Welder
Weld Technicians	4.2	Qualified Welder	Qualified Welder	Qualified Welder

Note 1: Different weld schedules should be established when the skills of the welders vary too much for a single schedule. For example, fast welders may require different wire feed speed and voltage settings than slower welders. However, each weld schedule shall be qualified with evidence included in the PPAP per section 4.6.
Note 2: Inspections for strength of joint or fusion shall be carried out when visual examination identifies any concern with the strength, penetration, or depth of fusion of the weld.
Note 3: Different weld schedules may be established for the same job. When a welder changes from one to another (e.g. increases in proficiency on the job) the welder shall re-qualify on the new schedule. See GSOG 18.3 section 4.6.