Quality Assurance
Raw Materials and Metals Requirements

Quality Clauses 259/259b/277

GENERAL ATOMICS

Important Notes

- **The information contained herein falls within the scope of current terms and conditions and does not authorize or imply a change or waive a contractual requirement under any open Purchase Order (PO)**
- **Remember to contact your GA Purchasing Representative about any questions regarding open POs or your continued performance**
- **GA's current quality clause document and other requirements are available GA's procurement website:** https://www.ga.com/procurement/quality-assurance

If you have any questions regarding this training please contact us at: SM-QA@GA.com

Agenda

- **Supplier Best Practices**
- **Objective Quality Evidence Submission**
- **Quality Clause Key Takeaways:**
  - Quality Clause 259
  - Quality Clause 259b
  - Quality Clause 277
- **Materials & Process Review Checklist**
- **Tips to Avoid Common Issues**
- **Allowable Material Substitutions for 6061-T6**

Supplier Success is GA Success!

- **Supplier Best Practices:**
  - Conduct a PO review to capture and understand all requirements prior to PO acceptance:
    - Ensure proper flow down of all requirements to sub-tier suppliers.
  - When needed, engage GA:
    - Materials related questions/concerns are communicated to the buyer for resolution.
    - Engineering clarification or alternative material requests can be submitted formally to GA-EMS on Supplier Deviation Requests (SDR). Reference Quality Clause 221 and the SDR form (EMS-0196).

Supplier Success is GA Success!

- **Supplier Best Practices:**
  - Perform internal reviews of Objective Quality Evidence (OQE) documentation for conformance to all PO requirements prior to submission to GA-EMS.
  - Submit OQE documentation in a timely manner through the proper channels.

Objective Quality Evidence Submission

- **Examples of OQE include:**
  - Material Test Reports (MTRs),
  - Special Process Certifications (ex. Heat Treat Certs, Plating Certs, etc.)
  - Certifications of Conformance (CofC).
- **OQE is to be submitted to GA-EMS according to 49200P00002 "Deliverable Documentation/Data Item Submittal Instructions"**
  - https://www.ga.com/procurement/quality-assurance-requirements

QC 259 – Material Certifications Chemical and Mechanical Properties

(259) Material Certifications – Chemical and Mechanical Properties

Seller shall provide material test reports (MTRs) to Buyer along with a certification by the mill or testing facility that performed the tests certifying compliance to specific ASME or American Society for Testing and Materials (ASTM) standards. This requirement applies to all components in an assembly, as specified in the Order.

The MTRs shall provide both chemical and mechanical properties that include lot/heat/melt number and actual inspection and test values. Any subsequent heat treatment processes shall require test reports and certifications from the testing facility that shall include mechanical properties for the as-delivered condition. All MTRs shall include the typed name, signature, authority or title and shall be dated.

NOTE: If the material specification lists the testing of mechanical properties as "non-mandatory," the MTR may be limited to chemical properties (unless otherwise specified in the drawing).

All documentation provided by Seller shall be legible, and at a resolution capable of being reproduced and scanned for electronic storage.

Complete material traceability shall be maintained throughout the manufacturing processes with appropriate records maintained. Traceability records shall be available for review by Buyer, when requested.

Seller shall not use alternate materials or grades of materials without Buyer's prior written approval, even if such material has similar chemical and mechanical properties. If Seller desires to use alternate materials due to availability issues, Seller shall submit a request to Buyer using the SDR form (EMS-0196).

For plastics and proprietary materials, a CofC from the material supplier attesting the material meets its specification is acceptable (i.e., a material test report citing chemical and mechanical properties is not required).

QC 259 – Material Certifications Chemical and Mechanical Properties

- **QC 259 Key Takeaways:**
  - Applies to all industry standards including but not limited to: SAE AMS, ASTM, ASME, AWS, ANSI, NAVSEA, MIL, Federal, etc.
  - The MTR shall list and be certified to the applicable material specification and revision. Example: AMS4928W, ASTM A276/A276M-17, NAVSEA T9074-BD-GIB-010/0300 Revision 2, etc.
  - All reporting and acceptance testing requirements from the applicable material specification shall be listed in the MTR, not just Chemical and Mechanical testing requirements.

QC 259 – Material Certifications Chemical and Mechanical Properties

- **QC 259 Key Takeaways:**
  - In many cases, heat treatment of material is necessary to fulfill PO requirements. In those situations, heat treat certifications shall be provided certifying to the applicable heat treat specification and including all reporting information required per spec. Additionally, any final condition/temper product acceptance testing shall be reported.
  - Maintain material traceability per the "Lot" definition imposed by the applicable specification.
  - Alternate materials will not be accepted by GA-EMS unless an SDR has been approved by GA-EMS prior to shipment of the material.

QC 259b – Certification of Titanium Material

(259b) Certification of Titanium Material

Seller shall provide a laboratory certified test report from an accredited third party testing laboratory independent from the producing mill or other applicable material processors, stating the lot of material furnished has been tested, inspected and found to be in compliance with the applicable material specifications. The test report will list the specifications, including revision numbers or letters, to which the material has been tested and/or inspected and the material lot to which it applies. The test report shall include quantitative limits for chemical, mechanical, or mechanical properties, and contain the actual test and/or inspection values obtained. All test reports shall include the printed/typed name, signature, title of the authorized representative of the third party performing the tests and date.

QC 259b – Certification of Titanium Material

- **QC 259b Key Takeaways:**
  - Requires third party testing of the material in the as shipped condition (after all thermal, mechanical or chemical processing).
  - Third party testing shall validate the material meets all product acceptance testing requirements from the applicable PO, drawing or material specification.
  - Mills and material processors are not considered third party entities. Testing must be performed by an accredited third party laboratory.
  - While the expectation is to provide mill MTRs to satisfy QC 259, they will not be used to satisfy QC 259b.

QC 277 – Special Process Certifications

(277) Special Process Certifications

Special processes include but are not limited to plating, coating, passivation, and heat treating.

Prior to each shipment of the product, Seller shall include a process certification to GA-EMS, verifying conformance to the drawing requirements, and stating the special process performed complied with an identified industry specification.

Heat treat certifications shall be accompanied by time/temperature charts and a summary description of the heat treat time and temperature data indicating the furnace and heat treat lot number. The certification shall state the name of the processor, date of processing, and the printed or typed name and signature of the responsible representative of the processor.

At a minimum, the special process certification shall include the Order number, part description, serial number (if applicable), part/drawing number with revision letter and ECN (if applicable), name and location of the special processor, and the special process being performed (must match drawing note including the specification, class, type, and color, where applicable).

QC 277 – Special Process Certifications

- **QC 277 Key Takeaways:**
  - Special Process Certification shall list and be certified to the applicable process specification and revision. Example: AMS-H-6875C, AMS2759/3J, ASTM A967/A967M-17, etc.
  - Time/Temperature charts shall be included in submissions covering heat treatments, including a summary description of the heat treat times, temperatures and quenchants (if applicable) used during processing.

QC 277 – Special Process Certifications

- **QC 277 Key Takeaways:**
  - All reporting and acceptance testing requirements from the applicable process specification shall be included in the certification(s), including the additional reporting requirements from QC 277.
  - Note: AMS2750F para 3.2.3: requires that all control, recording, and over-temperature instruments shall be digital by June of 2022. This has been a requirement of AMS2750E since July of 2015.

M&P Review Checklist (MPRC)

- **GA-EMS M&P is using checklists to review materials related OQE for:**
  - PO, drawing and quality clause requirements
  - Certification to industry standards
  - Product type, form and size
  - Melting practice
  - Material Condition/Temper
  - Heat treat and processing parameters (i.e. time, temp, quenchants, hot/cold work amounts, etc.)
  - Chemistry
  - Mechanical Properties (i.e. Tensile, Hardness, Fracture Toughness, Fatigue, etc.)
  - Material Properties (i.e. Macro, Micro, Grain Size, Conductivity, etc.)

M&P Review Checklist (MPRC)

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Material Certification Checklist				
	CT Number	CT000XXXXX		
	Alloy / Temper	PH 13-8Mo H1050		
	PO Number			
	Heat Number			
	Part Number, Revision			
	Specification Identification & Revision	1) SAE AMS5629H 2) SAE AMS2759G 3) SAE AMS2759/3H 4) 05492L00008 Revision W		
	Review Date	11/12/2020		
	Reviewer Name	John Doe		
	General Statement	The MTR package was found to be conforming.		
General Atomics Purchase Order Review				
Item No.		Requirement	Vote	Comment
1	PO - Description	PN DESCRIPTION: BAR, RECT, CRES, AMS5629, PH13-8MO, H1050, 4 X 2 IN	Acceptable	
2	PO - Quantity	132.00 IN	Acceptable	
3	PO - Requirement	09492L00008-GA-EMS STD Q-Clause, 200-Gen Qual Rqmnts, 221-SDR, 248-Spec. Metals, 259-Matl Certs, 277-Spec. Procs. 259: SAE AMS5629 277: SAE AMS2759/3 to H1050	Acceptable	Quality Clauses 221, 248, 259 and 277 apply.
Drawing XXXXXXX Revision - Review				
Item No.		Requirement	Vote	Comment
4	Drawing Note 4	MATERIAL: PH13-8 SS SPECIFICATION: SAE AMS 5629 4. MATERIAL: PH13-8Mo STAINLESS STEEL PER AMS5629. PRECIPITATION HEAT TREAT TO CONDITION H1050 PER AMS2759/3. TENSILE PROPERTIES TO MEET AMS5629 CONDITION H1050 PROPERTIES.	Acceptable	Material: PH 13-8Mo IAW AMS5629H. Precipitation heat treated to condition H1050 IAW AMS2759/3H.
Drawing XXXXXXX Revision - Review				
Item No.		Requirement	Vote	Comment
5	Drawing Note 4	MATERIAL: PH13-8 SS SPECIFICATION: SAE AMS 5629 4. MATERIAL: PH13-8Mo STAINLESS STEEL PER AMS5629. PRECIPITATION HEAT TREAT TO CONDITION H1050 PER AMS2759/3. TENSILE PROPERTIES TO MEET AMS5629 CONDITION H1050 PROPERTIES.	Acceptable	Material: PH 13-8Mo IAW AMS5629H. Precipitation heat treated to condition H1050 IAW AMS2759/3H.
SAE AMS5629H Review				
Item No.		Requirement	Vote	Comment
6	AMS5629H - 4.4 - Reports	The vendor of the product shall furnish with each shipment a report showing the vendor's name and country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations)	Acceptable	Mill: Carpenter Forger: Steel Industries Melted and manufactured in the USA
7	AMS5629H - 4.4.1 - Reports	The vendor of the product shall furnish with each shipment a report showing the following results of tests and relevant information: For each heat: -Composition -Macrostructure	Acceptable	
8	AMS5629H - 3.1 - Composition	Composition: Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.	Acceptable	
9	AMS5629H - Table 1 - Composition	Carbon: 0 - 0.05 % by weight	Acceptable	Carbon: -2T: 0.041 % by weight -2B: 0.030 % by weight
10	AMS5629H - Table 1 - Composition	Manganese: 0 - 0.10 % by weight	Acceptable	Manganese: -2T: 0.03 % by weight -2B: 0.04 % by weight
11	AMS5629H - Table 1 - Composition	Silicon: 0 - 0.10 % by weight	Acceptable	Silicon: -2T: 0.08 % by weight -2B: 0.07 % by weight
12	AMS5629H - Table 1 - Composition	Phosphorus: 0 - 0.010 % by weight	Acceptable	Phosphorus: -2T: 0.006 % by weight -2B: 0.005 % by weight
13	AMS5629H - Table 1 - Composition	Sulfur: 0 - 0.008 % by weight	Acceptable	Sulfur: -2T: 0.001 % by weight -2B: 0.001 % by weight
14	AMS5629H - Table 1 - Composition	Chromium: 12.25 - 13.25 % by weight	Acceptable	Chromium: -2T: 12.45 % by weight -2B: 12.46 % by weight
15	AMS5629H - Table 1 - Composition	Nickel: 7.50 - 8.50 % by weight	Acceptable	Nickel: -2T: 8.12 % by weight -2B: 8.06 % by weight
16	AMS5629H - Table 1 - Composition	Molybdenum: 2.00 - 2.50 % by weight	Acceptable	Molybdenum: -2T: 2.08 % by weight -2B: 2.07 % by weight

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17	AMS5629H - Table 1 - Composition	Aluminum: 0.90 - 1.35 % by weight	Acceptable	Aluminum: -2T: 1.06 % by weight -2B: 1.06 % by weight
18	AMS5629H - Table 1 - Composition	Nitrogen: 0 - 0.010 % by weight	Acceptable	Nitrogen: -2T: 0.003 % by weight -2B: 0.003 % by weight
19	AMS5629H - 3.5.1.1 - Macrostructure	Macrostructure: Visual examination of transverse full cross-sections from bars, billets, extrusions, and stock for forging, flash welded rings, or extrusions, etched in hot hydrochloric acid in accordance with ASTM A604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections for product 81 in^2 (523 cm^2) and under in nominal cross-sectional area shall be no worse than the macrographs of ASTM A604 shown in Table 2. For product greater than 81 in^2 (523 cm^2) in cross sectional area, the macrostructure shall meet the requirements for product under 81 in^2 (523 cm^2) and under in nominal cross-sectional area or the criteria shall be approved by the cognizant engineering authority. **Table 2 - Macrostructure Limits** -Class 1 - Freckles: Severity A -Class 2 - White Spots: Severity A -Class 3 - Radial Segregation: Severity A -Class 4 - Ring Pattern: Severity B	Acceptable	Macrostructure: -Class 1 - Freckles: Severity A -Class 2 - White Spots: Severity A -Class 3 - Radial Segregation: Severity A -Class 4 - Ring Pattern: Severity A
20	AMS5629H - 4.4.2 - Reports	The vendor of the product shall furnish with each shipment a report showing the following results of tests and relevant information: For each lot of bars, wire, flash welded rings, extrusions, and forgings: -If wire, tensile strength as solution heat treated -If product form other than wire, hardness and average grain size (see 4.3.3) as solution heat treated -All product forms, tensile properties after precipitation heat treatment	Acceptable	
21	AMS5629H - 3.5.2.1.1 - Tensile Strength - As Solution Treated	Tensile Strength - As Solution Treated: Wire shall have tensile strength not higher than 175 ksi (1207 MPa) or equivalent hardness (see 8.2). -8.2: Tensile strength to hardness conversions are presented in ASTM A370.	N/A	Not wire product
22	AMS5629H - 3.5.2.1.2 - Hardness - As Solution Treated	Hardness - As Solution Treated: -3.5.2.1.2.1: Bars: Shall be not higher than 363 HB or equivalent (see 8.3), determined at mid-radius or quarter thickness. -3.5.2.1.2.2: Forgings, Flash Welded Rings, and Extrusions: Shall be not higher than 363 HB, or equivalent (see 8.3). -8.3: Hardness conversion tables for metals are presented in ASTM E140.	Acceptable	Hardness - As Solution Treated: -Steel Industries: 331 HBW
23	AMS5629H - 3.5.2.1.3 - Average Grain Size - As Solution Treated	Average Grain Size - As Solution Treated: Shall be ASTM No. 5 or finer for product up to 3.00 inches (76.2 mm) in nominal diameter, thickness or for hexagons, least distance between parallel sides and shall be ASTM No. 4 or finer for product 3.00 inches (76.2 mm) and over in nominal diameter, thickness or for hexagons, least distance between parallel sides, determined in accordance with ASTM E112 (see 8.4). -4.3.3: Samples for average grain size (3.5.2.1.3) may be hardened to any of the conditions of Table 3 to better define the grain boundaries.	Acceptable	Average Grain Size: ASTM No. 7 Thickness: 4.45"
24	AMS5629H - 3.5.2.2 - Capability Precipitation Heat Treatment	Capability Precipitation Heat Treatment: The solution heat treated product 12 inches (305 mm) and under in nominal diameter, thickness or for hexagons, least distance between parallel sides, when precipitation heat treated for 4 hours + 30 minutes/−0 minutes to a particular condition at the temperatures shown in Table 3 and cooled at a rate equivalent to air cooling shall have the properties specified in 3.5.2.2.1 for that particular condition. Tensile tests need be made in only the H1000 precipitation heat treated condition unless purchaser specifies a different heat treated condition. **Table 3 - H1000 Condition:** -Temperature: 1000°F ± 10°F (538°C ± 6°C)	Acceptable	Capability heat treated a test sample to condition H1000

Before You Submit

- **Ensure complete and accurate documentation**
  - Adequate testing and testing frequency
  - Include stress/strain curve for tensile testing (34000S1580220 Class 3a and 4 testing only)
  - Include time/temp charts and heat treat summary (QC 277 only)
  - Legible certifications
- **Obtain SDR approval for any deviations**
  - Specification certification discrepancies
  - Alternative alloy, material condition/temper or melting practice requests
  - Product type, form and size deviations
- **Ensure traceability**

Allowable Material Substitutions for 6061-T6

- **GA-EMS M&P has been given direction from GA-EMS Engineering that allows acceptance of the following T6XX and T6XXX stress relieved tempers when a PO or drawing requires 6061-T6:**
  - T651
  - T6510
  - T6511
- **This applies only to 6061-T6. If a T6XX or T6XXX temper is required by the PO or drawing, then there are no allowable substitutions.**
- **Specification changes are not allowable for 6061-T6 without SDR approval.**

Questions

If you have any questions regarding this training please contact us at SM-QA@GA.com

Remember to contact your GA Purchasing Representative about any questions regarding open POs or your continued performance.