STEMCO
SUPPLIER QUALITY REQUIREMENTS MANUAL (SSQRM)

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1. Introduction

1.1 Scope

1.1.1 This requirements manual defines the fundamental quality systems and procedures required for suppliers who provide production material (**a product that directly impacts the quality of production parts and assemblies**) to STEMCO unless otherwise noted on the purchase order. This document applies only to those suppliers who have been identified by STEMCO Purchasing and Quality Assurance as "**Approved**" vendors.

1.1.2 This requirements manual is part of the purchase order issued by STEMCO and **acceptance of the purchase order constitutes acceptance of this manual.** The supplier's obligations can only be waived by STEMCO in writing.

1.1.3 The requirements of this manual shall be satisfied in addition to the detail requirements on engineering drawings and in specifications, any "special" quality procedures specified on the purchase order, and other elements of the purchase order. STEMCO reserves the right to change this manual as needed.

1.1.4 If quality requirements specified on engineering drawings conflict with this requirements manual, engineering drawings shall prevail.

1.1.5 The supplier's quality system is subject to STEMCO's review. When instances occur which warrant the review of a subsupplier's process or control system, the supplier will coordinate such reviews as requested.

1.1.6 Special requirements for heat-treated and plated parts (Section 6.1) are also included in this requirements manual.

1.1.7 Nothing in this manual shall in any way limit the supplier's obligation to ship 100% defect-free parts.

1.2 General Requirements

1.2.1 **Purpose:** Reflecting STEMCO's operating philosophy, it becomes necessary to define and describe performance requirements for suppliers since the purchased materials can directly impact the quality of STEMCO products. Where suppliers have proprietary process/design information and are required to include it in their quality documentation, STEMCO will respect the confidentiality of this information.

1.2.2 **Quality Policy:** Suppliers are expected to have a clearly stated quality policy that includes a commitment to quality, continuous improvement, and total quality principles. This policy should be visibly displayed and documented. It is the responsibility of the supplier's management to assure that all work-related actions of the supplier's employees are in concert with the quality policy and that the policy is understood, implemented and maintained at all levels in the organization.

1.2.3 **Quality System:** Suppliers are responsible for developing and maintaining a quality system (Section 2.1) which ensures that each product complies with all the requirements included in the drawing and prescribed on the purchase order. The supplier is also responsible for maintaining facilities in support of this requirement.

This quality system must also establish inventory control methods, which assure positive lot control. All incoming material must be labeled by the supplier to include: All incoming product must be labeled by the supplier to include Supplier name, STEMCO part number, Lot # or date, at a minimum. Subsequent operations at STEMCO facilities may be negatively impacted by excess variation caused by the out-of-sequence shipment of supplier material. Out-of-sequence shipment of material also creates major difficulty in identifying the start/finish dates of a non-conforming problem. Packaging must meet STEMCO Engineering design intent and Supply Chain robustness requirements. * Bulk product must meet the Plant & Product specific requirements to ensure it is preserved during shipping and handling.

1.2.4 **Product Quality:** Suppliers are fully responsible for the quality of their products. Suppliers are responsible for furnishing parts, assemblies, materials, and services to the requirements of current engineering drawings and specifications as identified on the purchase order. Suppliers are not to rely on STEMCO

Receiving Inspection or PPAP Approval to determine the quality of their products. Zero Defects are required from all suppliers.

1.2.5 **Engineering Drawings:** Suppliers are responsible for understanding and complying with the requirements on engineering drawings. Suppliers are also responsible for assuring security and confidentiality of STEMCO drawings and specifications. If any questionable areas appear to exist prior to receipt of a purchase order, or if issues arise after the receipt of the purchase order, the supplier is to immediately contact STEMCO Purchasing for prompt clarification. It is expected that these issues will be resolved during Advanced Product Quality Planning activities. Drawing clarifications are to be resolved before production tooling is finalized and production parts are made, and in no case are the engineering drawings and specifications superseded by any informal agreements. STEMCO will strive for expedient resolution of issues regarding engineering drawings and specifications.

1.2.6 **Special Characteristics:** Certain purchased parts include dimensions and/or specifications, which affect either compliance with governmental standards, or other important fit and functional characteristics of the final product. Those characteristics will be designated on the drawings or specifications as Special Characteristics. Special emphasis is given to Special Characteristics as outlined in this specification. The supplier's quality documentation (FMEA, Control Plan, Flow Chart, etc.) must address all Special Characteristics and requires review by a STEMCO representative. This review will take place during the Advanced Product Quality Planning activities.

1.2.7 **Quality Methods:** Suppliers must show evidence of a functional Quality Management System (QMS) that is function and evident. The design and operation of the supplier's quality system must direct the quality approach towards defect prevention through process controls, rather than defect detection by inspection techniques. This type of system also offers the opportunity to increase productivity and to promote continuous improvement in quality, both of which mutually benefit STEMCO and the supplier.

1.2.8 **Non-conforming Material:** The supplier is responsible for repairing or replacing non-conforming material to specifications in order to meet STEMCO timing requirements (Section 2.9). In some cases, the non-conforming material may be sorted or reworked by STEMCO at the supplier's expense. The supplier is expected to focus quickly on containment of the problem. The

Supplier QMS must include an 8D response system to the non-conforming product found at STEMCO. STEMCO may require utilizing our format of CCA or 4 Block Corrective action tracking forms. The timing required is as follows:

- Initial response with acknowledgment of issue and containment within 24 hours of notification of the issue.
- Update response with root cause and interim corrective actions within 2 weeks of notice of the issue.
- Completed CCA with permanent corrective actions and validation within 1 month.

1.2.9 **Opportunities:** Suppliers who meet the requirements of this manual and their other commitments to STEMCO and who provide quality and competitively priced products delivered on time, will continue to be considered to supply current and new products to STEMCO. Nothing in this manual shall commit STEMCO to purchase products from suppliers. Suppliers failing to meet the requirements of this manual will be subject to action by STEMCO up to and including termination as a supplier.

1.2.10 **Sub-supplier Quality Requirements:** The supplier is responsible to ensure that the QMS and quality of their supplied products meet the STEMCO requirements. For sub-suppliers of steel and raw materials, it is acceptable to control quality by requiring certification of each lot or shipment from the sub-supplier. The certifications should be maintained and available to STEMCO upon request.

1.2.11 **Preventative Maintenance:** The supplier is expected to have implemented a Preventative Maintenance (PM) Program. Documentation (equipment maintenance records, PM schedules, checklists, uptime and downtime charts, tool wear charts, etc.) should be retained on file for STEMCO's review.

1.2.12 **Additional Requirements:** Suppliers manufacturing STEMCO designed products are expected to have and maintain ISO-9001 certification at a minimum. Suppliers of "Off-the-Shelf" items are not required to adhere to this standard, but parts will be verified by STEMCO quality to be dimensionally correct. There may be specific and/or additional requirements that are not detailed in this manual. These additional requirements will be provided to the supplier by STEMCO. Any additional requirements will be consistent with the intent of this document.

1.2.12.1 The supplier is responsible for providing a permanent identification on all tooling, fixtures, gauging, and test equipment paid for by STEMCO. This identification must

include part number, revision level, and property of STEMCO. No changes to tooling or product that affect form, fit or function may be performed without previous STEMCO authorization in writing (electronic approval is acceptable). Any changes performed that do affect form, fit or function or new tooling, or tooling refurbishment mandates capability studies and PPAP re-submission and approval (Singed PSW) prior to shipment of product and shall be approved in advance of said changes.

1.2.12.2 Quality system records (quality plan, inspection instructions) must be maintained for one (1) year after the last shipment of items affected by these documents. Quality performance records (SPC data, inspection results) must be retained for one (1) year. Suppliers shall immediately present all quality records when requested by STEMCO. Electronic Records should be maintained indefinitely.

1.2.12.3 Quality Assurance guidelines for Special Characteristics shall follow the ISO/IATF requirements.

1.2.12.4 STEMCO recommends the use of AIAG requirements for Production Part Approval Process submissions (PPAP). However, other alternative formats may be acceptable when approved by STEMCO and/or STEMCO's customer. STEMCO Quality Engineering has final authority.

1.2.12.5 For late shipments due to supplier-fault issues: Vendors are required to provide the cost of premium freight necessary to deliver parts to STEMCO. This would include any premium freight incurred to direct ship product to our customer. We require that only the dollars in excess of normal shipping be reported. An example of premium freight would be a next day air shipment or the use of an expedited carrier such as FedEx or UPS Overnight.

2. Quality System Requirements for Purchased Parts

2.1 Quality System

2.1.1 The supplier will have a quality system, which provides for control of incoming material, in-process material, and finished products. The system shall provide emphasis on prevention of defects through the use of statistical methods and shall be supported through the preparation of written procedures, which are clear, complete and current. The supplier's quality system shall be

formalized, documented in a QMS and should address the following minimum areas as appropriate:

- Manual or Procedure Approval and Revision Dates
- Engineering Change Control
- Process Change Control
- Statistical Methods/Acceptance Sampling Guidelines
- Purchased Parts Control and Sub-supplier Quality Requirements
- Failure Mode and Effects Analysis (FMEA) Development
- Documentation and Record Retention
- Measurement System Analysis including Gauge Control, Calibration, Capability, and Facilities
- Control Plans
- Process Flow Charts
- First Piece Inspection
- Procedures for Engineering Specification, Test Documentation, and Response to Failures
- Material Identification, Traceability, and Inventory Control
- Non-conforming Material Control/Corrective Action
- Returned Product Analysis/Corrective Action
- Rework/Repair Procedures
- Material Certification
- Production Part Approval Process (PPAP)
- Management Commitment (Quality Policy and Organizational Charts)
- Employee Training and Employee Involvement
- Cost of Quality
- Advanced Quality Planning
- Quality System Internal Audits
- Dock Audits and Initial Production Shipment Audit
- Continuous Improvement
- Preventative Maintenance

NOTE: Refer to the ISO 9001/IATF 16949 Quality System requirements standard.

2.1.2 The supplier must have a documented quality system internal audit performed with results of corrective actions reported to and reviewed by management. The Management Review shall result in a continuous improvement plan for any shortcomings discovered during the audit. These audits must be performed on elements of the quality system such that the total system is audited at least annually. The internal audit must be performed by personnel independent of the audited department.

2.1.3 The supplier must assure that initial production shipments have increased inspection of special characteristics to verify the predicted quality levels.

2.1.4 The supplier shall have in place a method for confirming the quality of outgoing products. A dock audit shall be conducted by the supplier beginning with a per shipment basis. The frequency may be reduced based on evidence of quality performance.

2.1.5 The supplier's quality system shall provide special emphasis for the control of heat-treating, lubrication, protective coatings (anodizing, etc.) plating and other special processes or operations (Section 6).

2.1.6 The supplier shall provide a system to record and analyze quality data to ensure that quality performance goals are achieved and to identify areas of improvement, which will increase productivity and provide continuous improvement in quality.

2.2 Production Part Approval Process (PPAP)

2.2.1 The Production Part Approval Process (PPAP) published by AIAG has been accepted by STEMCO.

The intent of this procedure is to specify uniform requirements for the supplier to follow when preparing samples and documentation for production approval. It establishes the minimum practices, procedures, and necessary documentation of records by the supplier.

STEMCO expects every part submission to be correct and accepted the first time it is submitted.
Note: Government standards may necessitate additional requirements, which will be supplied by STEMCO Purchasing.

2.2.2 **Policy:** STEMCO's intent is that all suppliers become self-certifying (Level 1) for purposes of initial samples. This goal is attained when the STEMCO requests only the Part Submission Warrant as evidence of satisfactory completion of initial sample requirements. However, STEMCO Quality activities may request any of five possible submission levels:

Level 1 - Warrant only (and for designated appearance items, an Appearance Approval Report) submitted to the customer.

Level 2 - Warrant with product samples and limited supporting data submitted to the customer.

Level 3 - Warrant with product samples and complete supporting data submitted to the customer.

Level 4 - Warrant (no product samples) with complete supporting data submitted to the customer.

Level 5 - Warrant with product samples and complete supporting data reviewed at the supplier's manufacturing location.

LEVEL 3 IS THE DEFAULT LEVEL, TO BE UTILIZED FOR ALL INITIAL SUBMISSIONS UNLESS SPECIFICALLY ADVISED OTHERWISE BY THE CUSTOMER'S PART APPROVAL ACTIVITY. Subsequent PPAP re-submissions may be a level 4 to include PSW and dimensional validation at the discretion of the SQE.

STEMCO Quality will determine, based on experience with previous initial samples, the level, and frequency that will be used for each supplier on a specific part.

2.2.3 **General Requirements:** Initial production sample approval is required prior to the first production shipment. For all submissions except Level 1 (paragraph 2.2.2), the supplier is required to submit numbered dimensional samples along with the correlating date submitted electronically in Excel format. (ISIR form for Example) (Note: Multi-cavity tools require one (1) sample per cavity). These samples are to be taken from a three hundred (300) unit minimum production run at production rate, generated from production tools and processes. STEMCO may elect to verify the run-at-rate and PPAP sample selection. These requirements may be deviated from at the discretion of STEMCO Initial samples are required for:

- New Parts
- Existing parts produced by a new supplier
- Existing parts from optional construction and/or material from a current supplier
- Existing parts from new tooling or a new process
- Change of source for designated parts, materials, or services
- Emergency sourcing changes
- Parts from each mold or cavity from multiple cavity molds/dies

Samples being submitted because of engineering change or a correction to the original part require at least the changed portion, and any other area affected by the change, to be checked and submitted.

When special characteristics have been identified: (a) on the print, (b) through the FMEA, (c) on the Control Plan, or (d) through other specifications requiring statistical process control (SPC), the supplier is obligated to perform gauge repeatability and reproducibility (Gauge R&R) studies and determine process potential results (Section 5.1) for those characteristics. A minimum process potential index of 1.33 Cpk or greater is required.

If an acceptable process potential cannot be attained by the time of sample submission, or if there are dimensional or material results that are out of specification, a corrective action plan must be developed and reviewed with STEMCO prior to sample submission.

2.2.4 **Dimensional:** The supplier must perform the necessary measurements to determine conformance with all specifications. If all required inspections cannot be performed, such services must be procured from a qualified source.

All measurements must be documented and referenced by number to the corresponding STEMCO drawing. Also, all tests required by the part drawing and related specifications are to be listed along with the result of each test. Blanket statements of conformance are not acceptable.

Any results that are outside the specifications must be documented and highlighted on the part submission documents.

2.2.5 **Material:** The supplier must perform testing as required by the material specification and Control Plan. If the producer cannot perform the required tests, services must be procured from a qualified outside source, supplier certifications, or STEMCO authorized test laboratory. All tests required by the part drawing and related specifications are to be listed along with the results of each test. Blanket statements of conformance are not acceptable. Indicate the laboratory, which tested the sample or indicate “own” if tests performed in supplier laboratory.

Any results that are outside specifications must be documented and highlighted or shown in red font on the part submission documents.

2.2.6 **Production Part Approval Status:** The supplier will be notified in writing by STEMCO as to the disposition of the submission. When the submission is approved, the supplier shall be held responsible for assuring that future production continues to meet STEMCO's requirements and is within engineering specifications. The following categories may be assigned to production sample submissions:

- **Full Production Approval** - indicates that the supplier has manufactured material that conforms 100% to all specifications and requirements.

- **Interim Approval** - Permits the shipping of material on a limited time or piece quantity basis against authorized shipping schedules. Provisional approval status will be issued for parts in the following categories:

A. Parts pending additional inspections and/or tests such as lengthy laboratory test requirements or determine appearance or other qualifications under assembly conditions.

B. Parts for which an engineering change is in-process that will alter the blueprint specifications to agree with the part as manufactured.

C. Parts pending the review and approval by STEMCO of statistical process control data which demonstrates acceptable process capability on a specified control characteristic, or gauge studies which demonstrate acceptable repeatability and reproducibility variation.

Material that subsequently fails laboratory or long-term testing, or which has not received Full Production Approval either by the expiration date or when the authorized quantity has been shipped, is automatically in Rejected status. No additional shipments are authorized unless superseded by a Full Production Approval or an extension of the Provisional Approval i.e. Advanced Deviation.

- **Rejected** - Indicates the material submitted and the group of parts it represents have failed to meet requirements. Corrected samples shall be submitted and approved before any parts are authorized for shipment.

2.2.7 **Record Retention:** The supplier shall retain adequate records at their manufacturing location showing part conformance to all physical, chemical, dimensional, metallurgical, and test specifications. The supplier shall retain a copy of the information submitted with the samples, such as the checked print and initial sample report forms. Retention requirements shall be as specified in Section 2.7 of this document.

2.3 Recertification Requirements

2.3.1 Recertification and request to re-PPAP are the prerogative of STEMCO Quality Engineering. Request with specific requirements will be sent via e-mail. A PPAP may be requested for specific requirements on an annual basis.

2.3.2 The supplier must submit samples and receive approval before production shipments can be made when any of the changes indicated in Section 2.2.3 occur. It is the supplier's responsibility to notify STEMCO Purchasing when such changes are anticipated. Changes to an optional material or an optional construction are also included.

2.3.3 Parts and data submitted for recertification will meet all drawing and purchase order requirements. STEMCO will indicate the required approval process, on-site review, delivery, self-certified with or without supporting documentation. Typically, a layout and material analysis is required as a minimum. For parts produced from multiple tools, cavities, patterns, etc., a layout inspection report in the approved format on parts from all tools, cavities, patterns, etc. is required submit 3 samples from each cavity.

Visual comparison of parts from all cavities must be made with a part for which a satisfactory inspection layout has been completed. This inspection is to assure that parts from all cavities are free from visually discernible imperfections or omissions.

2.3.4 If no production requirements occur within one year, recertification may be required with the first reactivated shipment.

2.4 Functional Testing

2.4.1 When a supplier performs functional testing for initial certification, change approval, or recertification, the supplier is required to document the test equipment, controls, recording devices, and the test procedure and present that information on PPAP submission. Test parameters, including the level of input,

temperature, pressure, travel, rates, cycle rates, etc., must be recorded and documented to verify that functional testing conforms to appropriate requirements. The supplier will maintain schematics of the complete test equipment, controls, recorders, etc. (including identification by supplier and part number) such that repetitive approvals are not required.

2.4.2 When a supplier performs functional testing from a 3rd party for initial certification, change approval, or recertification; evidence of industry accepted accreditation of the test facility must also be provided as part of PPAP.

2.5 Gauge Facility Requirements, Calibration and Control

2.5.1 Sufficient control shall be maintained over all measurement systems used in the development, manufacture, installation, and servicing of product to provide confidence in decisions or actions based on measurement data. Procedures shall be established to monitor and maintain the measurement process under statistical control, including equipment, procedures, and operator skills. When measuring processes are found to be out of control or where measuring and test equipment is found to be outside the required calibration limits, corrective action is necessary. An evaluation shall be made to determine the effects on completed products and to what extent rework, retest or rejection may be necessary.

2.5.2 The supplier must obtain STEMCO design approval of all gauges, fixtures, or test equipment proposed for inspection use if paid for by STEMCO. Approval must be obtained prior to manufacturing such gauges, fixtures, or test equipment; otherwise, the supplier shall be responsible for the cost of changes when required. All gauges must demonstrate conformance to Gauge Repeatability and Reproducibility (Gauge R&R) requirements as stated in the AIAG Measurement Systems Analysis Reference Manual.

2.5.3 The supplier must provide and maintain adequate gauges and other measuring and testing devices in quantities necessary to ensure that parts conform to the Control Plan and purchase order requirements. The devices must be checked by the supplier at sufficiently frequent intervals to ensure continued accuracy and updated to reflect any appropriate engineering changes. The supplier must prepare, maintain, and conform to a written schedule for the maintenance and calibration of such equipment. Personal gauges, if used, must be included in the calibration system.

The supplier shall include a gauge control area in their plant or subcontract this service. The gauge control area shall be temperature and humidity controlled and is used to inspect gauges, test equipment, and functional masters. The facility shall include master calibration gauges and standards that are traceable to National Standards (in the U.S. - National Institute of Standards and Technology (NIST)). Procedures for the control of gauges shall be maintained by the gauge control area to ensure that gauge accuracy is maintained in production operations.

2.6 Control Plan Requirements

2.6.1 The supplier is expected to prepare, maintain, and follow a Control Plan, which specifies the quality planning routine for a part or family of parts. The Control Plan shall cover all stages of production, from receipt of purchased materials through packaging and shipping. The Control Plan will be subject to review by STEMCO. The supplier-provided FMEA will be used in evaluating the Control Plan. Control Plans must include at a minimum: proper identification of the part and operation, date issued and approved, engineering change level, frequency and quantity of pieces or process parameters to be inspected for each characteristic, the acceptance/rejection criteria, the method of inspection (type of gauges, test equipment, etc.), and the reaction plan for suspect/non-conforming conditions. The reaction plan must address quarantine/segregation, purging of non-conforming material, and verification of corrective actions.

2.6.2 **The Control Plan must, at a minimum, address each STEMCO Special Characteristic.** The Control Plan shall also include supplier-selected characteristics or elements of the processes which impact Special Characteristics or are critical to the process.

2.6.3 Operator Instructions shall be issued for manufacturing operations based on Control Plan requirements and shall be used on the shop floor to monitor quality performance.

2.7 Record Retention

2.7.1 The supplier must retain records on all component characteristic documentation that demonstrates product compliance to drawing specifications. The records shall allow for entries to be recorded showing the date of inspection, the number of parts inspected, the number of parts found defective, description and number of defect(s), disposition of material and/or lot, and identification of the person performing the inspection. Records for STEMCO

products must be maintained for life of the product line plus 3 years minimum.

2.7.2 The supplier must retain all quality policies, procedures, records, Control Plans, operator instructions, and sub-supplier/subcontractor records for the time period identified by STEMCO. Records must be protected from potential casualty and shall be submitted upon request to STEMCO.

2.8 Material Identification, Traceability, and Inventory Control

2.8.1 The supplier (including subsuppliers, if appropriate) shall maintain a system at all times for material identification, processing, and quality status through the use of stamps, tags, routing cards or other means.

2.8.2 The system shall provide for lot control traceability from the receipt of raw material through manufacturing/processing and shipping. Lot numbers should increase, be consecutive by date, and change when a significant event occurs (i.e., shift change). The system shall assure that shipments to STEMCO are in order of manufacturing lot sequence.

2.8.3 Where special lot control and identification is required, it must be defined and identified on the Control Plan.

2.9 Non-conforming Material

2.9.1 When the supplier's quality system detects lack of conformance to requirements, the supplier must immediately identify and segregate non-conforming material to prevent the shipment of that material. Operations that produce non-conforming material shall be stopped immediately and promptly corrected. The non-conforming material must not be returned to the normal production flow until the material has been sorted and/or reworked, inspected and approved. The supplier must obtain written deviation approval from STEMCO to use operations, which differ from the normal production process to repair or salvage non-conforming material. Reworked or sorted material must receive independent quality inspection before being returned to the production flow.

The supplier must maintain a material disposition procedure that requires non-conforming material and scrap to be isolated from the normal production flow. A specific containment area, well defined with limited access (secured) and segregated from the

normal production flow, must be available. Specific identification must be attached to the non-conforming material.

2.9.2 Non-conforming material must not under any circumstances be shipped to STEMCO.

2.9.3 STEMCO Quality Assurance is to be immediately notified if it has been discovered that non-conforming material has been shipped. The supplier's procedure shall provide a reaction plan that alerts all customers when quality issues/nonconformity's are discovered with raw materials, parts, or services.

2.9.4 Non-conforming material detected at STEMCO will be returned to the supplier except when schedules dictate an immediate sort is required to support production. STEMCO determines that this sort will be performed on site either by the supplier or at the supplier's expense. The supplier will be notified by telephone, fax or email of the actions that will be taken, and when required, the supplier will have available personnel to sort on site to support production schedules.

2.9.5 Non-conforming material, which cannot be reworked, will be scrapped at STEMCO after giving the supplier the opportunity to review it. Samples will be returned to the supplier when required for analysis. Another option is that the non-conforming material will be returned to the supplier freight collect. Fourteen (14) working days after supplier notification is considered ample time for final disposition. If the supplier fails to respond within this time period, STEMCO will automatically scrap the material at the supplier's expense.

2.9.6 When a design change creates obsolescence, the obsolete material will be appropriately dispositioned as non-conforming material. Obsolete parts for which a rework procedure is deemed appropriate will be identified as non-conforming until the rework is complete. The rework procedure must have prior approval by STEMCO.

2.10 Corrective Action

2.10.1 The supplier is to provide timely corrective action when notified of non-conforming parts.

- An initial response from the supplier and product containment is required within 24 hours from the time of notification.
- Root cause analysis and interim corrective action shall be submitted and implemented within 2 weeks of notification.

- Permanent corrective actions shall be submitted, validated and implemented within one month of notification.

Extensions of time may be granted by STEMCO Quality based upon the corrective actions required or the nature of the nonconformance.

The format of the written corrective action will follow the guidelines of what is commonly known as the Eight Discipline (8D) Corrective Action.

The following reporting guidelines shall be used in completing the written corrective action:

1. Select a Problem Solving Strategy/Team

Based on the problem's complexity, establish a team with the product/process/people knowledge, skills, and authority to resolve the problem and implement corrective actions. A facilitator shall be selected by the group to monitor and document the process and oversee the problem's successful and permanent resolution.

2. Define and Describe the Problem

Problem description shall include the problem as reported by STEMCO and any further redefinition developed by the supplier. It shall include the number of parts involved and dates or date codes of the parts.

The team will develop a problem definition, which identifies the deviation in standard from the expected ("should") performance and the "actual" performance. Narrow and focus the definition by using customer terms and specific **"5W/2H" (Who, What, When, Where, Why, How, How Many)** factors. Define the goals/measurements for an improved process.

3. Protect the Customer through Containment Action(s)

Take immediate actions to isolate the effect of the problem from customers until permanent corrective action(s) are implemented. Verify that these containment actions are effective. The interim action shall include estimated or actual timing for implementation. An interim action is typically containment oriented and is usually accomplished via 100% inspection. Identify what actions were taken to isolate the effect of the problem. Note what actions were taken to support production and assure delivery of acceptable parts.

4. Identify and Evaluate Root Cause(s)

As an aid to determining the root cause, define the current process using process mapping techniques that include: **Inputs** (internal/external supplier requirements) - **Process** (internal actions depicted by a flowchart) - **Outputs** (internal/external customer requirements). Also, define the customer-driven desired outcomes and performance goals/measurements for an improved process.

Identify potential root cause(s) of the problem using the process map, 5W/2H, “is/is not” comparisons, cause-and-effect diagrams, brainstorming, process analysis, etc. Evaluate the potential root causes through data collection, testing and analysis using check sheets, histograms, Pareto charts, SPC charts, scatter plots, etc.

Root cause shall be fully investigated and defined - not just a superficial analysis. The initially reported root cause(s) may change as the investigation progresses. The final report shall indicate the ultimate root cause(s). **Operator error is not an acceptable root cause.**

5. Determine and Implement Permanent Corrective Action(s)

Create and evaluate the effectiveness of the proposed solution alternatives designed to eliminate the root cause(s). The permanent corrective action solution(s) must meet **all** of the minimum internal/external supplier and customer requirements **(“musts”)** and as many preferred requirements **(“wants”)** as possible. Implement the best permanent corrective action solution(s) through process and/or product changes with on-going controls to ensure that the root cause(s) are eliminated. Permanent Actions shall include estimated or actual timing for implementation. A permanent action is of a preventative nature and is typically process oriented.

6. Verification

Verification shall include data, which indicates both before and after levels of performance, thereby substantiating the results and effectiveness of the action taken. This applies to both Interim and Permanent actions.

7. Modify the System(s) to Prevent Recurrence

Modify **all** systems, procedures, processes, FMEA's, Control Plans, work instructions and provide appropriate training to **prevent** the recurrence of this and similar problems. Document these changes and distribute to other potentially affected areas and similar parts. Monitor and measure the process on a continuing basis to ensure there are no repeat problems, and that all improvements are maintained.

8. Recognize Team's Success

Provide "positive reinforcement" to the team by recognizing the success of the dedicated and cooperative efforts of all team members in permanently solving the problem.

2.10.2 Corrective actions shall always be directed at providing conforming material in a timely manner to minimize the impact to STEMCO. Towards that end, the supplier shall:

A. Identify/segregate non-conforming material.

B. Make provisions to provide conforming certified material. (Certified meaning free of the specific defect, this may be done through sorting or replacing material.) Any certified material should be identified so it can be easily distinguished at STEMCO.

C. Work closely with STEMCO for "A" and "B" above and for coordinating the identification of "Certified" conforming stock.

2.11 Subcontracted Services

2.11.1 Whenever it is necessary for a supplier to subcontract services such as heat-treating, plating, lubrication, protective coatings, subassembly, etc., the supplier will be responsible for the subcontractor's quality to assure conformance to original drawing and engineering specification requirements. The control system used to assure that subcontracted material must meet STEMCO requirements and shall include one, or a combination of the following:

- Verification to specification using statistical techniques
- Receiving Inspection and/or tests of material
- Subcontractor certification

- Verification by production process

2.11.2 Suppliers shall have an effective system for selecting, assessing and monitoring the performance of subcontractors. The assessment shall assure that the subcontractor has the quality systems and procedures to consistently produce material to STEMCO's requirements.

2.11.3 The sub-supplier's plant must not be used as a shipping point without specific prior STEMCO approval. When approved, direct shipment of parts from a sub-supplier shall be recorded on the supplier's Control Plan.

2.11.4 In the case of significant services being subcontracted, STEMCO reserves the right to review and approve subcontracted services. This provision does not alter the rights and responsibilities that exist between supplier and sub-supplier.

2.12 Certification

2.12.1 If dictated by government regulations or when specified by the purchase order, written certification of product quality will be required. Details of procedure forms, characteristics, types of inspection and testing frequency and sample sizes required will be communicated to the supplier by STEMCO.

2.12.2 All basic raw materials as specified on the engineering drawing used to fabricate components must be covered by a material certification.

2.12.3 Certifications must also be available for any additional processing of parts such as heat treat, painting, coating, stress relieving, plating, etc.

2.12.4 STEMCO may periodically validate certifications.

2.12.5 Certification information is to be retained on file at the supplier and is subject to STEMCO review. Optionally, STEMCO may request that this information be provided with each shipment. If the required certifications do not accompany the material at the time of receipt, STEMCO will not accept the material until it is received.

2.13 Handling, Storage, Packaging, Preservation and Delivery

2.13.1 The supplier shall establish, document, and maintain procedures for handling, storage, packaging, preservation, palletizing,

labeling, receipt, dispatch and delivery of material. These procedures shall be established and validated during the quality planning stages, prior to product release (PPAP) from STEMCO. The packaging and labeling processes shall be controlled to assure conformance to specifications and maintenance of product quality and integrity.

2.13.2 The supplier shall establish and maintain a material handling system that minimizes the potential for damage throughout all operations: raw materials, purchased components, work-in-process, finished goods, and delivery. The condition of product in stock shall be assessed at appropriate intervals to assure that damage or deterioration has not occurred.

2.13.3 The supplier shall establish and maintain shipping and receiving facilities and ship all products in conformance to STEMCO requirements and transportation routings. The supplier shall arrange for the protection of the quality of the product after the last production operation through delivery to the customer destination.

2.13.4 The supplier should periodically audit these systems for use and effectiveness, record findings, and resolve issues with immediate containment action and permanent corrective action.

2.14 Drawing and Change Control

2.14.1 The supplier must maintain the latest engineering drawings and specifications authorized through STEMCO Purchasing and ensure that these drawings and specifications are present and used where needed in the supplier's facility. These drawings and specifications must be kept secure at all times to protect their confidential nature. Concurrent with the effective dates of product changes, the supplier must ensure that the obsolete information is removed from all points of use in the system. The supplier must maintain a record of change effectivity dates. This record must be available for review by a STEMCO representative.

2.15 Process Change Control

2.15.1 Changing, relocating or altering the process used to produce approved PPAP parts may affect dimensional, physical or functional characteristics of the product provided by the supplier. Because of this possibility, potential process changes must be reported to and approved by STEMCO before implementation.

3. Advanced Product Quality Planning (APQP)

3.1 Advanced Product Quality Planning is defined as a team-oriented planning process which emphasizes prevention of defects versus the detection of defects. The Advanced Product Quality Planning process combines the benefits of a disciplined step-by-step evaluation procedure with historical data to achieve conformance to requirements, customer satisfaction, and the opportunity for never-ending improvement. The objective is to create a definitive quality plan that will govern the product design, process design, pre-production and first production stages of the product cycle. This Advanced Product Quality Planning process shall be initiated at the earliest practical stage in the product development cycle.

STEMCO recommends using the current AIAG Manual.
Advanced Product Quality Planning is required in the following situations:

- During the development of new products/processes
- Prior to changes in products/processes
- When reacting to products/processes with quality concerns
- Before existing tooling is transferred to new producers/plants

3.2 The supplier should provide an organizational chart showing where quality planning activities are located within the organization, and indicating the key contact person for Advanced Product Quality Planning activities and problem resolution.

3.3 Suppliers are expected to utilize Cross-Functional Teams for the development of new/changed products. The teams will use quality planning techniques and be active throughout the development and launch stages. The composition of the supplier's Cross-Functional Team should include Design (Engineering), Manufacturing, Quality Engineering, Tooling, Production, Purchasing, Sales/Marketing, and may include representatives from STEMCO.

3.4 Training is the key to the effectiveness of the Advanced Product Quality Planning process. The supplier is expected to emphasize this through the allocation of appropriate resources with particular emphasis on the effective use of statistical techniques and project planning skills. Evidence of Operator training to documentation must be available.

3.5 STEMCO requires that suppliers utilize Advanced Product Quality Planning and have evidence of the following defect prevention techniques prior to the start of **volume** production. Suppliers are expected to implement these defect prevention methods at the earliest practical stage in the product development cycle:

- Advanced Planning Schedules
- Feasibility Reviews
- Consideration of customer needs/wants (QFD)
- Design (if applicable)/Process Failure Modes and Effects Analysis (FMEA)
- Determination of significant product/process characteristics from:
  -Special Characteristics identified on drawings or otherwise communicated by STEMCO.
  -Design/Process FMEA's
  -Items identified by the supplier based on process knowledge
  -Items based upon returned parts analysis
- Supplier determination of process control method, including:
  -Gauging/Test Equipment
  -Personnel requirements
  -Statistical techniques
  -MSA/Gauge R&R
- Determination of adequate packaging
- Development and updating of Control Plans and Flow Diagrams
- Determination of Employee Training needs
- Use of Employee Involvement

The above list is not meant to be all-inclusive but shows some of the recognized defect prevention activities that can be utilized.

3.6 The following requirements specific to the above-referenced areas as it pertains to Advanced Product Quality Planning include:

A. Blueprints and Specification - will normally be provided to the supplier within a sufficient amount of lead-time to allow completion of the Advanced Product Quality Planning process.

B. Design FMEA - suppliers responsible for the design of products they produce for STEMCO must create a Design FMEA. STEMCO has accepted the FMEA Manual published by the AIAG.

C. Feasibility Analysis - should be completed prior to submitting a response to the Request for Quote.

D. Process Flow Chart - identifies key operations and control points for cross-reference and pre-production discussions critical to the development of the Process FMEA, Control Plan, and assignment of Process Potential Studies. The supplier must submit a Process Plan/Flow Chart to STEMCO.

E. Process FMEA - helps the supplier anticipate potential problems with a process, which would adversely, affect quality and reliability

concerns. An FMEA shall be initiated upon completion of the Process Flow Chart and be continually updated as the process develops. Also, the FMEA should be revised to address quality concerns that were not originally identified on the document. The supplier must submit a Process FMEA to STEMCO.

F. Special Characteristics - (as outlined in paragraph 1.2.6 and 2.6.2) must be identified upon the completion of the Process FMEA and must subsequently be addressed in the Control Plan.

G. Control Plan - requirements are outlined in paragraph 2.6.

H. Gauge and Test Equipment - requirements are outlined in paragraph 2.5. The supplier is reminded that this item must be addressed in the Advanced Quality Timing Chart and it should indicate both availability and prove out (Gauge R&R).

I. Process Potential Studies and Pre-production Run - certain Special Characteristics require the completion of Process Potential studies as outlined in Section 5. The supplier must obtain approval from STEMCO to alter any of these requirements. A significant pre-production run must be conducted which serves to prove-out the production process and the corresponding Control Plan.

All suppliers are encouraged to participate in prototype development. In those cases where suppliers do manufacture prototype parts, the appropriate initial Advanced Product Quality Planning documentation should be provided with the prototype parts.

The supplier is expected to develop a timing chart that addresses all of the above areas. This chart must include both start and completion dates to allow the launch team an accurate assessment of program progress and identification of activities requiring special attention.

It is STEMCO's intention to work with the supplier on products that require significant Advanced Planning activities.

4. Quality Plan

4.1 Each supplier manufacturing location is expected to establish and maintain a documented and management-approved Quality Plan that indicates specific goals and objectives for continuous quality improvement. These should include process improvements, rejection rates, system improvements, customer satisfaction levels, supplier development, employee training, and other goals and objectives for continuous improvement.

4.2 The supplier is expected to develop a Gantt-type timing chart which addresses the above as a minimum. This chart shall include both “start” and “completion” dates and assign responsibilities to allow for an accurate assessment of planning progress and to highlight areas requiring special attention.

4.3 The Quality Plan, as a “living document,” must be subject to continuous review and revision. The plan must be dated and approved. It must be supported by senior management with the allocation of sufficient resources to accomplish the plan.

5. Statistical Methods

The Statistical Process Control Reference Manual published by the AIAG is accepted by STEMCO as a standard approach to statistical analysis and application of basic statistical process control techniques.

5.1 Process Potential Studies

5.1.1 Process Potential Studies are conducted using variable data on a minimum of fifty (50) samples taken from a production run of at least three hundred (300) units. The data is gathered in subgroups (typically five consecutive units per subgroup, with subgroups spaced uniformly throughout the production run) and is analyzed using Average/Range Charts or other appropriate control charts. When the chart shows all points in control without any evidence of trends or non-random patterns in the data, Process Potential may be determined by calculating the standard deviation using the control chart data. For destructive tests, the supplier should consult with STEMCO.

5.1.2 To ensure the process is capable STEMCO recommends referencing the appropriate AIAG manuals.

5.2 Process Capability Studies

5.2.1 The level of process capability or performance on a stable process shall be a minimum Cpk value of 1.33 for all variable Major or Critical characteristics. The supplier shall perform MSA to understand how measurement error affects the study measurements. Where no Major or Critical characteristics are identified, STEMCO reserves the right to require demonstration of initial product conformance on other characteristics. On-going

statistical monitoring of all Major or Critical product characteristics is required by the Supplier.

5.2.2 When the above criteria are not met, appropriate actions must be implemented. The supplier must immediately initiate investigations to determine the reasons for not meeting the criteria and revise the process accordingly. The implemented actions must be carried out until capability is demonstrated or until an engineering change is approved by STEMCO. The supplier must develop a written corrective action plan to improve process capability to the required levels. These plans must be available for review by STEMCO.

5.3 Statistical Process Control

5.3.1 Supplier management must include the use of statistical process control and demonstrate its use to control manufacturing processes in order to understand, improve, predict and make decisions about the process. Plant personnel must be trained and competent to record and chart data and take required actions expected of a qualified operator.

Ongoing Statistical Process Control (SPC) must be applied to Special Characteristics as described in the Control Plan. Capability indices (Cp, Cpk, etc.) must be calculated on a regular basis, monitored as an indicator for continuous improvement, and reported as required to STEMCO.

6. Special Requirements

6.1 Heat Treated and Plated Parts

6.1.1 Processes used to manufacture heat treated and plated parts (particularly fasteners) require special attention and control. Likewise, the parts produced from these operations require special inspection. Therefore, it is required that a supplier of heat treated and/or plated parts submit the following prior to production for approval by STEMCO:

- Parts
- Name of Source and Location
- Type(s) of Process
- Process FMEA,
- Process Flow Chart

- Control Plan, including checks made to verify that the process is ready to run, and ongoing checks while the process is in operation
- Lot Control/Traceability Plan

6.1.2 Changes in heat treating and plating processes (including reworking parts by “burning off” of applied coatings such as E-coatings, powder paints, etc.) must be resubmitted to STEMCO for approval. A change in sourcing of heat treating or plating is to be considered a process change. Changes to Control Plans, such as inspection method, frequency, and/or sample sizes, also require STEMCO prior approval.

6.1.3 Hydrogen Embrittlement: Process precautions must be established and enforced which will protect against the effects of hydrogen embrittlement from cleaning, plating, coating, and stripping operations. All affected electroplated, mechanically plated, phosphate-coated, and stripped parts must be processed in accordance with approved hydrogen embrittlement relief parameters.

7. Special Requirements for Raw Material Suppliers

7.1 Rubber Suppliers

7.1.1 All suppliers of rubber must comply with the specified requirements detailed in specifications indicated within STEMCO Purchasing documentation.

7.1.2 The chemical composition and other properties of the rubber must comply with the requirements detailed in the applicable STEMCO Engineering Specifications, State and federal regulations, California proposition # 65, and applicable AIAG guidelines.

7.2 Other Raw Material Suppliers

7.2.1 Other suppliers of raw materials must follow the guidelines as specified in the STEMCO Purchasing documentation, Engineering specifications, State and federal regulations, California proposition # 65, and applicable AIAG guidelines.

7.3 Bulk Commodity Raw Materials

7.3.1 Bulk Commodity Raw Materials are excluded from ISO and AIAG requirements.

7.3.2 Bulk commodity raw materials will be subject to testing and validation by STEMCO or a 3rd party lab. Failure to meet acceptable results or performance could result in STEMCO rejection of material.

8. AIAG (Automotive Industry Action Group) Requirements

8.1 All STEMCO production material suppliers are required to have a comprehensive, ISO compliant QMS in place and are subject to verification by passing the STEMCO Supplier Quality Audit. We strongly recommend that suppliers pursue ISO 9001 or IATF16949 compliance and certification as a part of their development process. STEMCO will perform subcontractor quality system development using ISO/IATF Quality System requirements as the fundamental quality system requirement.

8.2 All suppliers should have access to the **latest** AIAG publications listed below.

- ISO/IATF Standards (Quality System Requirements)
- APQP (Advanced Quality Planning and Control Plan reference manual)
- PPAP (Production Part Approval Process) FMEA manual.
- FMEA (Potential Failure Mode and Effects Analysis)
- MSA (Measurement Systems Analysis)
- SPC (Fundamental Statistical Process Control)
- Shipping/Parts Identification Label Standard (AIAG B-3)

NOTE: Copies of these documents can be obtained by contacting the AIAG (Automotive Industry Action Group).

Automotive Industry Action Group (AIAG)
26200 Lahser Road, Suite 200
Southfield, MI 48034. Phone: 810-358-3570

9. Supplier Quality Rating System

STEMCO considers four major criteria when assessing the performance of its suppliers:

- Non-conforming parts shipped
- Rejected PPM
- Volume of parts inspected
- Inspection reports (number of times parts put on Quality hold)
- Suppliers of bulk material may be exempt from these criteria. The defective bulk material will be handled on a case by case basis.

10. Supplier Certification Requirements

10.1 Supplier Certification is based upon the performance criterion established in Section 9 of this manual entitled “Supplier Quality Rating System.”

- Quality History (Defective Materials - PPM)
- Delivery Performance
- Response Performance
- Quality System

10.2 Suppliers that are performing poorly regarding the quality of the supplied product will be addressed by Quality Engineering and Supply Chain and expectations for product improvement will be communicated. Evidence of timely response to the satisfaction of STEMCO Quality Engineering and Supply Chain is the responsibility of the supplier.

10.3 Receiving inspection results must satisfy the PPAP and print criteria. Product found non-conforming at Receiving Inspection or during processing will require corrective actions, containment, product replacement, and necessary support to contain, rework or certify the product to support production. This may require personnel or 3rd party support be obtained by the supplier to manage non-conforming material.

11. Cost Recovery

STEMCO will recover all related costs associated for non-conforming product produced from the responsible supplier(s).

11.1 The charges may be debited to the supplier before the resolution of the non-conforming material investigation and additional charges may be deducted, at any time, per the discretion of STEMCO.
It is the policy of STEMCO to charge suppliers for all costs resulting from non-conforming material due to the negative impact that such material has on our cost structure, production, logistics, and product quality. The supplier is responsible for the cost of returning non-conforming material following disposition. If preferred, scrapping of non-conforming material at STEMCO may be allowed and should be negotiated with the appropriate STEMCO Materials and Quality contacts. STEMCO reserves the right to return or dispose of the non-conforming material in the most cost-efficient manner if not done so by the supplier in a timely manner.

Examples of non-conformance include but are not limited to the following:

11.1.1 Incorrect Shipping Documentation
11.1.2 Non-conforming or missing ASN's
11.1.3 Non-conforming Material
11.1.4 Early/Late Deliveries
11.1.5 Over/Short Shipment
11.1.6 Manufacturing Downtime
11.1.7 Mixed Product
11.1.8 US Customs Violations
11.1.9 Incorrect Bar Code Labels
11.1.10 Packaging Nonconformance/Shipping Damage
11.1.11 Warranty
11.1.12 Use of other than designated carriers for freight

At any time during the APQP process or production, the supplier should refer questions regarding the charges with the STEMCO facility Materials and Quality contacts.

11.2 It is a requirement that 100% of the product supplied to a STEMCO facility, whether prototype, production, and service, fully conforms to all STEMCO requirements and specifications. STEMCO will charge back to the supplier all value-added costs on 100% of the non-conforming purchased material.

11.3 The cost recovery amount will be automatically charged to the supplier as summarized on the Supplier Cost Recovery Summary Report. The standard rate for STEMCO labor associated with management and containment of non-conforming materials is $50 per hour. A minimum of five hours or $250 will be charged to all non-conforming material incidents.

11.4 Suppliers should review any and all charges. If the supplier suspects a discrepancy in the charge amount, then the supplier will

need to submit a discrepancy notification in writing to the originating STEMCO facility within 10 business days from the day the cost recovery report was sent. The discrepancy notification must clearly specify and detail the discrepancy or error for STEMCO consideration. After the 10 business days has expired, STEMCO reserves the right to not accept or consider a discrepancy letter, received after the 10 business days, requesting a change in the amount of the charge.

11.5 Charges will include the product purchase price, inbound/outbound freight and the actual cost of the additional activities required as a direct result of the nonconformance, which could include but is not limited to the following:

11.6.1	Engineering
11.6.2	Administrative
11.6.2	Investigation
11.6.3	Sorting
11.6.4	Rework
11.6.5	Material handling
11.6.6	Inspection
11.6.7	Travel
11.6.8	Tooling
11.6.9	Fixtures
11.6.10	Line shutdown
11.6.11	Premium freight
11.6.12	Customer charges

12. Glossary

Advanced Product Quality Planning is the process of preparing a plan on how to achieve the quality objectives of producing defect-free parts or services.

AIAG - Automotive Industry Action Group

Attributes are qualitative data that can be counted for recording and analysis. When a record shows only the number of articles conforming and the number failing to conform to any specified requirements, it is said to be a record by attributes. Typically, p, np, c, and u charts are used to analyze attribute data.

Bilateral (Two-Sided) Specifications are those which state both a minimum and a maximum value.

Capability Indices are numerical values used to represent the ratio of the natural process capability to blueprint specification. The two indices used are Cp (may be referred to as Pp for Process Potential results) and Cpk (Ppk). Capability indices should be computed only for processes which demonstrate stability (in control). For unilateral tolerances, Cp computation is not required; Cpk is computed to the maximum/minimum specification limit only.

Characteristics are product traits or specifications examined to determine conformance, such as height, weight, dimension, color match, etc.

Common Cause is a source of variation always present in a process and/or an inherent part of the process. Its origin can usually be traced to elements of the system which only management can correct.

Continuous Improvement is the process of continually investigating and implementing ways to improve the design, manufacture, quality and to reduce the costs of a product.

Control see the **Statistical Control** section.

Control Chart is a graphic representation of a process or a product showing plotted values of some statistic gathered from that characteristic, and statistically-based control (action) limits. It has three basic uses: to determine if a process is in control; to aid in achieving and maintaining statistical control, especially in avoiding over adjustment; and to evaluate continuous improvement efforts. For purposes of this manual, acceptable forms of control charts include X-bar and R. X-bar and s, median, moving range, np, c, n, and u charts.

Control Plan is a written description of the system required for controlling the ongoing quality of parts produced for STEMCO. The system addresses dimensions and specifications and includes all Special Characteristics and other characteristics specified by the supplier and/or STEMCO.

Cross-Functional Team typically consists of representatives from Sales, Engineering, Quality, Purchasing, and Manufacturing who share common product-based development and launch through and including customer use activities.

Special Characteristic is any characteristic that has been identified as important as determined by historical, warranty, FMEA, supplier process or other data. It will be included in the Control Plan.

The control methodology for special characteristics requires mechanisms or devices such as fixtures, machine controls, computer controls, equipment capability (Cpk $\geq$ 1.33), 100% inspections, etc., which provide high confidence that the characteristic conforms to the specification. Continuous variable or attribute data collection is not always required; however, capability reports and/or periodic data collection and analysis should be available.

Design Change is a permanent change in dimensions and/or specifications authorized by STEMCO and include changes to an optional material/design/construction.

Design Failure Modes and Effects Analysis (DFMEA) is an analytical technique utilized by Simultaneous Engineering (SE) teams as a means to assure that, to the extent possible, potential failure modes and their associated causes have been considered and addressed. End items, along with every related subassembly and detail part, shall be evaluated. In its most rigorous form, an FMEA is a summary of the SE team's thoughts (including an analysis of items that could go wrong based on experience and past concerns) as a component or system is designed. This systematic approach parallels and formalizes the mental discipline that an SE team normally goes through in the design process.

Design Verification (DV) is testing performed on pre-production or production components to verify design intent.

Detection is a past-oriented strategy that attempts to identify unacceptable output after it has been produced. Detection relies on inspection or sorting by downstream processes.

Dimensional layout includes a complete layout inspection report accompanied by a correspondingly numbered blueprint. The layout report lists every characteristic and note, its tolerance or limits, and the actual findings of each. A blueprint, marked/numbered correspondingly to the dimensional layout and showing the number of each dimension, specification, etc., as it appears on the sample layout report will be included.

Employee Involvement consists of organizing management and hourly employees into teams to draw upon their knowledge and experience to enhance improvement.

Engineering Revision Level is a term used to identify part dimensions and specifications authorized as of a certain date by a Release Number and date or a Change Letter and date.

Engineering Requirements refer to drawings, specifications, or other media established to detail the dimensional, chemical, metallurgical, physical, visual, electrical, life and performance characteristics of a part.

Engineering Specifications are documents containing information necessary to produce or evaluate parts, primarily in written form, and usually issued in conjunction with engineering drawings. An Engineering Specification is used when requirements are best described in writing, such as when specifying engineering tests, or when information applies to a number of parts. An Engineering Specification provides direction to supply, manufacturing, and Quality Assurance activities, and is used to validate production (and serves to confirm the design) as well as monitor continuing production. Such information is typically related to function, performance, and durability tests. Both test methods and required results are included.

Feasibility Analysis is a series of reviews by product engineering, process engineering, manufacturing and assembly activities to ascertain whether a proposed design can be manufactured, assembled, tested, packaged, and shipped at acceptable levels. A feasible design must permit meeting production volumes and schedules consistent with meeting engineering, quality, reliability, cost and timing objectives.

Functional Test is the evaluation performed on samples to ensure proper assembly, conformance to functional, reliability, and engineering specifications.

Gauge is an instrument of standard or special design which is used to determine the conformance of the characteristic of a part.

Gauge Repeatability and Reproducibility (GR&R) Study is a statistical method for determining gauge error resulting from variations in (1) repeatability of the gauge and (2) reproducibility by the operator.

Initial Sample is a number of parts made from production tooling and production processes and requiring STEMCO approval prior to shipment of production parts.

In-Process Tests are functional or durability tests required by product engineering to monitor a particular design feature or characteristic on a continuing basis during production. Sampling and reaction plans for these tests must be included in the Control Plan.

Inspection is the evaluation of parts, materials, or services either by visual means or by use of measuring devices to determine conformance to engineering specifications covering appearance, dimensional, material or functional characteristics.

Lock is a method used to achieve a failure occurrence probability absolutely equal to zero and includes either removal of the potential cause of the nonconformance or an automatic 100% inspection (mistake-proof the process).

Lot is a quantity of product produced under similar conditions so that the product within the lot is expected to be homogeneous in all significant attributes. Unless otherwise stated in the Control Plan, a lot shall consist of no more than eight (8) hours production produced within one day.

Lot Inspection is the inspection performed on random samples taken from a defined population of parts which are essentially alike and which were produced from the same production process. Except as noted in an Engineering Specification, lot size shall represent parts produced during a specific operating period of up to eight hours or a working shift. Production rates shall be a determining factor in establishing lot size which must be acceptable to STEMCO.

Lot Traceability is a system for tracking and identifying a batch of raw material or components through all steps in the process and identifying the final product when it is shipped to the customer.

Material Certification is a document that reports the results of a physical and/or chemical quantitative analysis of the material and is approved provided it conforms to requirements. A report that the material conforms to requirements will not be approved without a quantitative analysis of data.

Non-conforming Material consists of parts, subassemblies, assemblies, materials, processes, or services that do not meet specification requirements.

Normal Distribution is a continuous, symmetrical, bell-shaped probability distribution. Also known as a bell curve or Gaussian curve.

Preventative Maintenance is an anticipatory system of machine and equipment repair, emphasizing predictive maintenance methods (i.e., recognition and repair of pending problems, as opposed to breakdown repair).

Problem Solving is the process of evolving from a symptom, to cause, to corrective action that improves process performance.

Process is the combination of people, facilities/equipment, materials, work methods, machines and tools that produce output (i.e., a product or service).

Process Capability (Cp) is the measured, inherent reproducibility of the product resulting from a process which is in statistical control, the measure of which is expressed in terms of standard deviations or variation and is unrelated to product tolerance.

Process Capability Studies are determined by continuing the control charts (begun during the Process Potential Study phase described below) with the process operating under actual production conditions until all factors likely to contribute to process variation (e.g., raw material, personnel, environment, tool wear) are reflected in the process output. When control charts for this interval show the process to be in statistical control, capability can be determined.

Process Change, as used in this specification, is any change in the processing concept which could alter the capability of the process to meet the design requirements or durability of the part. This will include new, different, rehabilitated, or relocated production machinery or equipment which might cause the characteristics of the part being processed to change; the use of engineering approved alternate materials, new processing concepts, including major changes in the sequence of operations; and changes in chemical compounds, such as adhesives, sealants, lubricants, etc. which are a part of the product.

Process Control is the gathering of data from a process and the use of statistical methods to establish a feedback loop to maintain stability and prevent the manufacture of non-conforming products.

Process Failure Modes and Effects Analysis (PFMEA) is an analytical technique utilized as a means to assure that, to the extent possible, potential manufacturing/processing concerns have been identified and

addressed. The Process FMEA identifies potential product-related process failure modes, assesses the potential customer effects of the failures, identifies the potential manufacturing or assembly process causes, and identifies significant process variables to focus controls for Process Control Plan development. It also develops a list of potential failure modes ranked according to their effect on the "customer," thus establishing a priority system for corrective action considerations.

Process Flow Chart is a graphic representation of the complete sequence of operations and checkpoints used to manufacture and inspect a part. It describes each operation from receipt of raw material to shipping the final product, inclusive of any subcontracted services.

Process Potential Studies provide a preliminary assessment of the potential of the process to produce products that meet STEMCO requirements. Since these studies are of short duration, they cannot provide information about long-term Process Capability. Process Potential Studies are conducted using variable data from samples taken from a production run of at least 300 units.

Production Validation is testing performed by the supplier to validate the production tooling, methods, and processes performed on parts representative of production design configuration and made from production tooling.

Prototype Sample is a part or assembly submitted for evaluation and a design verification purpose which is not completely produced using production tooling, materials, manufacturing sources or manufacturing methods.

Purchasing Representative, (STEMCO) as used in this specification, refers to the individual who issues the applicable purchase order(s).

Quality is defined as conformance to requirements ultimately resulting in customer satisfaction.

Quality Cost Analysis is a method of identifying all costs associated with the quality function so that these costs can be measured, improved, and controlled. Typically, cost of quality is the costs for the prevention of defects, the appraisal of plant-wide quality, internal and external failures. Each of these categories is compared as a percentage to Total Quality Cost (TQC). TQC is then compared to one common denominator such as net sales billed, productive hours, or cost of goods sold.

Quality Function Deployment (QFD) is a management system to assist in translating the "voice of the customer" into operational definitions that can be used to produce and deliver products desired by the customer.

Specifically, QFD is the development and use of matrices and supporting data to compare customer requirements with the design features of a product. QFD highlights conflicting customer requirements so that customer satisfaction can be maximized.

Quality Performance Records are inspection and test documents which show the results of inspections and tests performed on materials, parts, and assemblies.

Quality System Records include engineering drawings, Control Plans, inspection instruction sheets, laboratory test instructions, and similar documents, which define inspections and tests (including sample size and frequency) to be performed, and the gauge and test equipment to be used to determine parts assembly, and material conformance to requirements.

Random Sample is a sample of pieces drawn from a lot in such a manner that all pieces in the lot have an equal likelihood of selection as part of the sample.

Rational Subgroups are the basis for SPC data gathering. Rational subgroups are determined by the process and its patterns of variation. Their size and frequency shall be constantly under review to determine if the sampling plan can be improved. Rational subgroups are subgroups within which variations may be considered to be due only to non-assignable chance causes; between which there may be variations due to assignable causes whose presence is considered possible and important to detect.

s is the sample standard deviation.

Sample is one or more individual events or measurements selected from the output of a process (see Rational Subgroups, above).

Setup is a change in the adjustments and/or fixturing to changeover a process from the production of one product to another or a restart of a process after a shutdown.

Sigma (σ) is the Greek letter used to designate the standard deviation of the distribution of individual values for a process parameter or product characteristic.

Simultaneous Engineering is a multi-functional, team-oriented management system that focuses resources to meet company and customer goals and objectives.

Special Cause, also called an **Assignable Cause** or **Root Cause**, is the cause of variation that is unpredictable, intermittent, or unstable. Special

causes are indicated by a point on the control chart beyond the control limits, or a run or other non-random pattern of points within the control limits.

Special Manufacturing Controls are Quality Assurance methods applicable to Special Characteristics and include Statistical Process Controls, reliable 100% inspection and/or in-process or final testing, or mistake proofing identified by a Process FMEA. Special Manufacturing Controls ensure that certain selected characteristics of a part are consistently produced within specifications.

Stability is the absence of special causes of variation; the property of being in statistical control; predictable.

Standard Deviation is a measure of the variation in the process output or the spread of a sampling statistic from the process (e.g., of subgroup averages). This statistic is used in the calculation of Cpk.

Statistical Capability Monitoring consists of recording and/or graphing the measured results of process output for the purpose of reporting rather than the purpose of control.

Statistical Control is the condition of a process from which all special causes of variation have been eliminated and only common causes remain. A control chart indicates a process is in statistical control by the absence of points beyond control limits and by the absence of non-random patterns or trends within the control limits.

Statistical Process Control (SPC) is the use of statistical techniques such as control charts to analyze a process or its output so as to take appropriate actions to achieve and maintain a state of statistical control and improve the capability of the process.

Supplier, as used in this specification, refers to any facility or manufacturer which provides and is responsible for the quality of materials, parts, or services delivered to STEMCO.

Surrogate process capability data may be used to fulfill process potential requirements and is obtained from current production processes which are representative of the planned process for the new parts. The use of surrogate data must be pre-approved by STEMCO.

Testing is the evaluation of materials, parts, or results of services by use of approved testing devices to determine conformance to chemical, metallurgical, physical, electrical, life, and/or performance specifications, Engineering Specifications, or other engineering requirements.

Testing Equipment is any certified and calibrated instrument of standard or special design which is used to test for chemical, metallurgical, physical, electrical, life, and/or performance specifications, Engineering Specifications, and other engineering requirements.

Unilateral Specifications are those which state either a maximum value or a minimum value only. Examples are concentricity (diameters A and B concentric within 0.5 mm maximum) and flatness (flatness within 0.1 mm maximum).

Variable Data is measurement data recorded using a certified and calibrated gauge or other measuring devices.

Variation is the inevitable difference between individual outputs of a process. The sources of variation can be grouped into two major classes: Common Causes and Special Causes.

Visual Aids are any pictorials, graphics, parts or models which are displayed in an appropriate area and assist employees in better understanding the component function, appearance, or assembly techniques.

13. Reference Materials

- ISO/IATF 16949 Technical Specification
- ISO 9001:2015 Technical Specification
- APQP (Advanced Quality Planning and Control Plan reference manual)
- PPAP (Production Part Approval Process)
- FMEA (Potential Failure Mode and Effects Analysis)
- MSA (Measurement Systems Analysis)
- SPC (Fundamental Statistical Process Control)
- Shipping/Parts Identification Label Standard (AIAG B-3)