Creating excellence, together.

# SUPPLIER QUALITY MANUAL

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## Nemak

Nemak is a leading provider of innovative light weighting solutions for the global automotive industry, specializing in the development and manufacturing of aluminum components for powertrain and body structure applications. The company employs more than 23,000 people at 38 facilities worldwide.

## Mission

Nemak provides innovative light weighting solutions for the global automotive industry and the advancement of sustainable mobility.

We exceed expectations while driving growth and profitability.

## Vision

Become the world leader in light weighting for the mobility industry

## Values

- Customer Focus
- Innovation
- Trust & Collaboration
- Respect & Responsibility

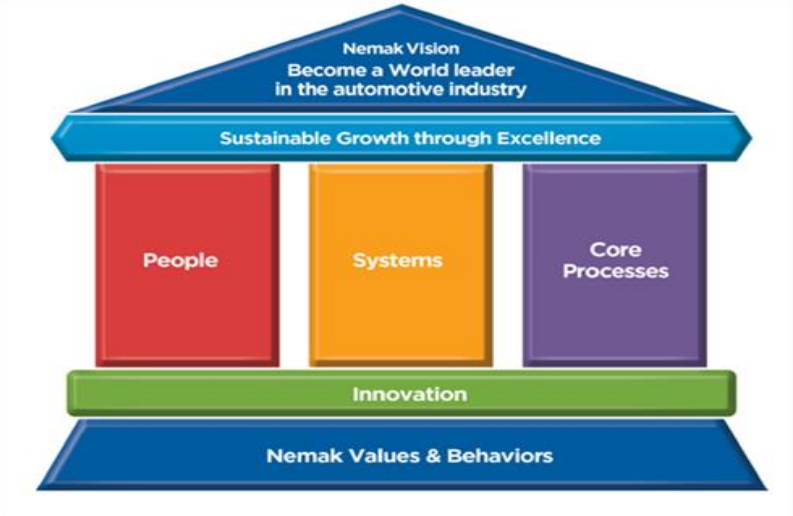



**Figure 1**. Nemak Core Values

## Scope

This manual describes Nemak's Quality Requirements for suppliers, who provide materials, products, processing and other related services, either directly to Nemak plants or to its customers, on behalf of Nemak. This manual specifies additional requirements for Nemak Suppliers and does not supersede customer drawings or specifications, which shall be reviewed and understood completely, in addition to these requirements.

Direct suppliers are required to cascade these requirements to lower tiered suppliers throughout the supply chain.

## Purpose

These requirements are designed to support Nemak's mission which is a commitment to satisfy the needs of the global automotive industry by manufacturing high-tech aluminum components. Nemak aims to be a leading company in technology, cost, quality, response time and strives to be responsible to the environment.

The purpose of this manual is to inform Nemak Suppliers of core expectations regarding their quality management and manufacturing systems. After reviewing this manual, a supplier should have a clear understanding of what is expected of them to ensure that all Nemak requirements and expectations are being met.

The Nemak Supplier Quality Representative will work with the supplier to ensure that any deviation from these requirements does not negatively affect the finished part requirements or customer expectations.

# 1.0 Communication

Suppliers contracted by Nemak are considered to be Tier II to Nemak customers and as such all communications should flow through the designated Nemak representative. Nemak suppliers are not to contact or deliver information directly to a Nemak customer unless specific written authorization has been granted by the appropriate Nemak representative.

## 1.1 Notification of organizational changes

Changes to the Supplier's organization that may affect quality and/or finance, shall be reported in advance to Nemak. These changes include, but are not limited to; company ownership, company name, manufacturing location, quality approvals, and significant changes to processes or inspection techniques.

## 1.2 Confidentiality

The supplier shall in every way, ensure the confidentiality of Nemak contracted products and projects under development.

# 2.0 Supplier Qualification and Evaluation

## 2.1 Audits

The supplier shall establish an annual audit program (product and process audits) that includes internal production and subcontract, to verify compliance related to Nemak contracts. The audit program shall be prioritized based on the subcontractors, product and process risk.

Nemak and their customers are authorized to check whether the quality assurance measures of the supplier guarantee the Nemak requirements with advance notification through a process, product or system audit.

In case of quality problems, which have been caused by the services and/or deliveries by subcontractors of the supplier, the supplier must, on the request of Nemak, carry out an audit at the subcontractor site (if necessary, with participants from Nemak and their customers) and disclose the results to Nemak.

Nemak reserves the right to conduct an assessment at the supplier's location at any time. The duration of the assessment will vary based upon the reason for review.

### 2.1.1 Layered audit

The supplier shall establish layered audit system to

a) Reduce the number of non-conformances to existing procedures and policies

b) Increase the frequency at which various levels of management perform audits

c) Remove roadblocks to correcting unsatisfactory items

d) Standardize types of items audited/checked by plant personnel. Supplier is free to use its own checklist.

## 2.2 Deadlines for submitting the action plan and follow up

The action plan (process audit guide format) of the audited supplier for nonconformities evidenced during the audit, must be submitted to Nemak supplier representative according to audit results. Nemak supplier representative team will carry out an evaluation of the action plan validating its coherence. Evidence for the implementation of the proposed actions should be sent to the Nemak supplier representative within the deadlines set forth in the action plan.

## 2.3 Verification of effectiveness

The verification of effectiveness will be carried out through the next scheduled audit with the supplier, following the criteria:

A) Verification on site of the nonconformity (s) detected in the previous audit;

B) In case of recurrence the note of the item in question will remain for the current audit.

C) According to severity will be apply escalation process.

## 2.4 Quality Management System Requirements

Suppliers for components, services (e.g. heat treatment, surface treatment, machining etc.) and material (foundry and master alloys) must have a certification according to the ISO 9001/VDA 6.1 as a minimum.

Suppliers for calibration of measurement equipment and measurement of products must have an accreditation according to ISO 17025 or national equivalent.

Suppliers must have an effective quality management system in place with adequate resources to comply with all Nemak and Nemak customer(s) requirements.

Suppliers with internal or outsourced "special processes" as identified by the Automotive Industry Action Group (AIAG), may be required to show conformance with relevant AIAG Special Process documentation. The Nemak Supplier Quality Representative will provide guidance in such situations. When requested, suppliers of their outsourced sub-suppliers are expected to comply with these requirements and take effective corrective action to address any noted concerns.

The expiration of a certificate without a scheduled re-certification must be communicated to Nemak at least three months prior to the expiration date. New certificates are to be sent to the supply quality contact of Nemak without being prompted. Withdrawal of a certificate must be reported immediately.

## 2.5 Environmental, Health and Safety Certification

Nemak takes pride in their responsibility to the environment and fully expects that their suppliers do the same. Suppliers shall establish and maintain a robust environmental management system (e.g. ISO 14001 EMAS). At a minimum, they are expected to maintain a responsible Environmental Management System which complies with all applicable legal requirements.

Nemak promotes a safe and healthy work environment for its employees and expects that their suppliers provide the same for its employees. It is encouraged that suppliers require its employees to accept responsibility for working safely.

It is recommended that suppliers are certified to the most current edition of ISO 45001(OHSAS 18001) Occupational health and safety management system

### 2.5.1 Global Business Code for Suppliers

The supplier shall demonstrate compliance with the minimum standard of Business Ethics & Compliance, Environment & Product Safety, Human Rights, Working Conditions and Implementation and Compliance as specified in the Nemak Global Business Code for Suppliers.

Source: www.nemak.com

## 2.6 Customer Specific Requirements

Supplier must comply all the specific requirements of OEM/ Nemak, during the program life and assure to update any changes on their quality system. The supplier will be responsible for verifying customer specific requirements.

## 2.7 Contingency plans

The supplier shall establish business continuity plans that identify, analyze, evaluate and mitigate risks. Furthermore the supplier shall perform a risk assessment that include risk identification, analysis evaluation, treatment, monitoring and regular activities to ensure the effectiveness.

When the supplier becomes aware of an impending production interruption, the supplier shall make every attempt to notify the Nemak receiving plant's Production Control & Logistics within 24 hours. The nature of the problem shall be communicated with the immediate actions taken to assure continuous supply of product. Production interruptions may include (but are not limited to) natural disasters, political unrest, war, capacity issues, quality issues, labor strikes, planned down time or other events that prevent the supplier from meeting the specified capacity volumes. The supplier shall advise Nemak of the plan for recovery and work toward minimizing its effect on the Nemak plant and final customer.

### 2.7.1 Shut down/ start up plan

The supplier shall officially submit to Nemak supplier representative. The Restart aims to:

A) Reinforce productive controls;
B) Add controls in addition to the standard operational control plane;
C) Check the packaging conditions;
D) To guarantee the operation of Error Proofing;
E) Ensuring that historical claims do not occur (recurrence)
F) Avoid official complaints from the final customer (assembler).

Being that, this will always be requested when there is:

A) General stop of the productive process over 10 calendar days;
B) Collective holidays;
C) Or when requested by Nemak Supplier Quality.

Note 1: This plan shall be validated by Supplier Quality and shall be implemented as defined in the above items
Note 2: The identification of the lots in these periods will be agreed together with the Quality of Supplier
Note 3: The supplier must submit the restart plan within a maximum period of 10 calendar days after shipment.

## 2.8 IT Security Requirements

Suppliers has to ensure the compliance with IT Security requirements according to ISO 27000. Information Security Assessment (e.g. according VDA) can be requested and provided by supplier on request. Please contact to Nemak Supplier Representative for more details

# 3.0 Production Part Approval Process

## 3.1 Quality Planning

For product and process development, it is critical that suppliers take a systematic approach and utilize the current AIAG, Advanced Product Quality Planning (APQP) or VDA standard according to customer requirements to ensure all core requirements are being met. Cross functional teams should be formed at the start of development to ensure a full range of input by various team members.

During the planning phases of a program launch, controlled conditions are identified, implemented, and documented for prototype and production phases. It is the supplier's responsibility to use the proper tools to track progress and ensure on-time completion of defined items during the planning process.

Any changes in the agreed upon controlled conditions must be presented and approved by Nemak via the change management process. Suppliers are expected to conform to the AIAG "core tools" standards (APQP/CP, PPAP, MSA, SPC, FMEA), along with any additional OEM specific requirements, to support planning and on-going quality control and production requirements.

Nemak follows the AIAG PPAP requirements and has adopted the "Phased PPAP" approach to safeguard new program launch and other critical changes requiring PPAP submission. Suppliers are mandated to comply with these standards. The following section will further define these requirements.

## 3.2 Advanced Product Quality Planning (APQP) and Nemak Product Development System (NPDS)

The APQP (Advanced Product Quality Planning) or VDA standard provides guidelines for the development of new products and / or new processes. These guidelines establish requirements which, if they are met with

discipline, will provide support for the delivery of a quality product or service / processes that satisfies the final customer in accordance with the established technical requirements, the development schedule and the cost provision for the program. Nemak requires its suppliers to comply with all APQP steps, except when requested by the customer, the use of another new product development methodology (for example, VDA, ANPQP, etc.).

In order for the APQP to be fulfilled according to the Nemak Vision, the NPDS methodology (Nemak Product Development System) for the development of new products. This practice, which is used internally in Nemak, defines and synchronizes the actions of the organization during the process of development of new products and their manufacturing systems. Thus, the NPDS is also used as an internal counselor to control the program from the supplier. The operational principle of the NPDS is "Identifying and as soon as possible ", and for this principle to be fulfilled, the follow-up and control of Milestones.

(Delivery phases), which are:
· M-2: Advanced Engineering of new products
· M-1: Technical, Economic & Strategical Analysis
· M0: Program Kick - Off
· M1: Manufacturing Plan & Program Contract
· M2: Virtual Product & Manufacturing Development
· M3: Production Intent Prototypes
· M4: Production Process Definition
· M5: Equipment & Tooling MTOs at Supplier Site
· M6: Equipment, Tooling & Personnel Validation and Readiness at Nemak
· M7: Pre-production Runs
· M8: Nemak PSO
· M9: Post Mortem

For each Milestones above (delivery phases), there are exclusive delivery processes which will provide support for product / service development. Of these, the Outsource Development process was idealized for the management and control of new programs in suppliers. This process ensures that the supplier and the Nemak team are in sync and oriented to the desired result. The supplier is heard, oriented and supported through a Nemak Supplier Representative who throughout the development phases will apply a unique methodology for controlling the program at the supplier. It is the methodology consists of deliveries, which are presented to the supplier during development, monitored and assessed according to the risk to the program.

In this way, Nemak guarantees compliance with the APQP (or methodology chosen by the client) during the development of the product and passes the NPDS operating principle as a good practice to the supplier "Identifying and Solve problems as soon as possible."

### 3.2.1 APQP Timing

APQP meeting need to be scheduled and the supplier shall join the meeting as Nemak required. If there is anything delayed, the supplier shall provide the recovery plan to Nemak team and be approved by Nemak. Nemak supplier representative will release the supplier complaint to supplier according to the risk and require the root cause analysis and improvement report to avoid this kind of timing issues in the future.

### 3.2.2 APQP Samples

The supplier shall provide the samples according to the APQP timing plan and make sure the samples will meet the quality requirement for each milestone as Nemak requirement. If there is any quality issues for APQP samples, Nemak supplier representative will release supplier complaint according to the risk and require root cause analysis and improvement report to avoid this kind of quality issues in the future.

The supplier shall submit the APQP documents on time as Nemak required. Nemak supplier representative will review the documents based on the IATF 16949, AIAG and Nemak special requirements. If there is any issue or timing delay for the APQP documents, Nemak supplier representative release a supplier complaint according to the risk and require root cause analysis and improvement report to avoid this kind of issues in the future

### 3.2.3 Capacity Planning

Each supplier must develop, submit, and acquire approval of, from the appropriate Nemak Supplier Quality Engineer, at a minimum, the Nemak Supplier Capacity Planning and Verification worksheet prior to the issue of equipment purchase orders. Other program specific requirements and OEM customer specific capacity planning documents may also apply and should be spelled out in the specific Statement of Work.

The purpose of the Nemak Supplier Capacity Planning and Verification worksheet is to assure that the supplier has an adequate equipment and work plan to support the average weekly production requirements within the designated operating pattern as indicated in the Statement of Work, have achieved a production readiness state, and can demonstrate process potential at the Phase 0 Run @ Rate and verify full program capacity at the Phase 3 Run @ Rate.

All required capacities are stated in the SOW or contract specific for the product or program and reflect acceptable shippable product produced within a specified operating pattern.

The supplier capacity/availability will be describe into the SOW /Contract of the product or program.

All capacity planning must be based on surrogate OEE data derived from similar product lines and/or equipment operating in the supplier's facility. In the event this is a new product/process to the supplier, the surrogate OEE data can be supplied by the machine OEM. Using this OEE data as a basis, the supplier should estimate unplanned downtime in the Nemak Supplier Capacity Planning and Verification worksheet to reflect projected equipment efficiency.

Ideal Cycle Times in the planning phase is a reflection of a supplier's best estimate based on surrogate data derived from similar processes or cycle time quotes received from machine manufacturers. The supplier

should make every attempt to state these as accurately as possible as this element can have a significant impact on the number of machines and tooling approved for the program. Caution should be taken to properly assess load/unload as external or internal to the machine cycle time and account for this in the overall process cycle time as required. When significant changes to planned cycle time occur in the development stage (i.e. unplanned double pass required for quality that increases CT or tool change sequence time reduced, decreasing CT) the supplier should update the plan to assure that it can still support program requirements.

Once all elements of the plan have been completed and the plan has been approved, the supplier should be authorized to proceed with machine and tooling purchases. Note that this authorization must come from the responsible Nemak Purchasing representative.

When developing the capacity plan, the supplier must clearly state the projected scrap rate for each operation, including the foundry scrap rate stated in the SOW, and account for the added capacity requirements for operations upstream of the scrap producing operation (i.e. stated capacity in the SOW is 100 a day, and Op 20 has a projected scrap of 2%, then Op 10 capacity requirements become 102 a day).

Note: The supplier is responsible for assuring similar capacity planning activities are conducted with their suppliers (Nemak sub-suppliers). Please see attached format otherwise apply according to OEM required.

## 3.3 Phased PPAP

It is a requirement of the IATF Standard that the Production Part Approval Process (PPAP) be documented and followed by both customer and suppliers. The PPAP process defines the necessary steps and results which demonstrate continued compliance to Nemak, and its affiliated customer requirements.

Unless exempt through an approved Nemak Waiver, suppliers may not ship production parts to Nemak or its customer facilities without an approved Part Submission Warrant (PSW).

Suppliers must follow the PPAP methodology, as defined in the AIAG/VDA/ PPAP manual, for all product launches and change management PPAP submissions.

For the phased PPAP process, a different form is required that indicates Phase, as well as interim approval stage.

Contact local Nemak supplier representative for guidance on forms to use.

The organization shall use level 3 as the default level for all submissions unless otherwise specified by the authorized customer representative. Please see attached format otherwise apply according to OEM required.

See Appendix A, Part submission warrant

### 3.3.1 PPAP Documentation

PPAP records must be maintained for the life of the production part, plus one year. All records must be made available for Nemak's review at any time. PPAP documentation must be prepared per the AIAG PPAP requirements and submitted to Nemak for approval prior to shipment of any parts.

#### 3.3.1.1 Customer PPAP Status

### a) Approved

Approved indicates that the part or material, including all sub-components, meets all customer requirements. The organization is therefore authorized to ship production quantities of the product, subject to releases from the customer scheduling activity.

### b) Interim Approval

Interim Approval permits shipment of material for production requirements on a limited time or piece quantity basis. Interim Approval will only be granted when the organization has:

- Clearly defined the non-compliances preventing approval; and,
- Prepared an action plan agreed upon by the customer. PPAP re-submission is required to obtain a status of "approved."

Note 1: The organization is responsible for implementing containment actions to ensure that only acceptable material is being shipped to the customer.

Note 2: Parts with a status of "Interim Approval" are not to be considered "Approved." Material covered by an interim approval that fails to meet the agreed-upon action plan, either by the expiration date or the shipment of the authorized quantity, will be rejected. No additional shipments are authorized unless an extension of the interim approval is granted.

### c) Rejected

Rejected means that the PPAP submission does not meet customer requirements, based on the production lot from which it was taken and/or accompanying documentation. In such cases, the submission and/or process, as appropriate, shall be corrected to meet customer requirements. The submission shall be approved before production quantities may be shipped.

## 3.3.2 Test Capability

Sections of the PPAP elements require testing such as performance, material and measurement. Suppliers must be capable of performing such tests or at a minimum, have outsourced resources available to carry out the necessary testing. Suppliers or outsourced suppliers must satisfy the requirement to perform these tests and generate required records of conformance to the PPAP requirements. Complete test records must be retained with the PPAP documentation and submitted when requested.

## 3.3.3 Sub-Supplier Expectations

Sub-suppliers shall be held to the same expectations and requirements defined within this manual. It is the responsibility of the supplier to cascade these requirements to the sub-suppliers.

## 3.3.4 Early production containment

Early production containment is used to reduce the risk of launch issues. EPC typically involves doubling the control plan checks, either by frequency or samples size. EPC is typically exited in 90 days after SOP if there are no issues found. These are both at the discretion of Nemak and suppliers. If issues were identified the exit criteria would typically be based on identifying the root cause, implementing an irreversible corrective

action, and demonstrating a sustained period of defect free production. Exit criteria shall be established at the time the supplier enters EPC

## 3.4 Nemak Drawings/Specifications

Suppliers must adhere to Nemak/OEM drawings and Engineering specifications. Drawings and Engineering Specifications must be reviewed, understood and agreed upon by the supplier, prior to launch. Any part of a drawing or specification that is not understood or cannot be met, must be clearly stated in writing, to the applicable Nemak Representative, prior to launch. If no questions or concerns are raised, Nemak will assume that the supplier has a clear understanding and compliance of the requirements which will be adhered to. It is required that a bubble print is created by the supplier, which identifies ALL characteristics, for example, Diameter, Depth, Angle, etc., and are individually numbered and referenced throughout the process (PFMEA, Control Plan, Work Instructions, Process Plans, etc.).

Official prints and specifications for use in quoting and production are issued by buyer or designated Nemak contact. Prints and specifications received from any other Nemak source, including engineering shall be considered "for reference only".

Please contact to local Nemak supplier representative for more details.

### 3.4.1 Design Validation Planning and Reporting (DVP&R)

When applicable, the supplier must develop and implement a product test plan. Inputs for the test plan should include; DFMEA if available, engineering specifications, and any other Nemak defined/supplied engineering requirements. The proposed DVP&R plan must be reviewed and approved by Nemak Supplier Quality Representatives prior to any testing. Results must be reported to Nemak upon test completion and the completed DVP&R form must be approved by Nemak supplier representative prior to any implementation.

## 3.5 Design Failure Mode and Effects Analysis – DFMEA

Where applicable, design responsible suppliers must develop and maintain a DFMEA throughout the life of the product. DFMEA inputs should include warranty issues, customer concerns, lessons learned, and address past 8D concerns. The DFMEA must be reviewed with Nemak to ensure accuracy and completeness.

## 3.6 Process Failure Mode and Effects Analysis – PFMEA

A PFMEA is an absolute requirement which must be developed and maintained throughout the life of the product. The PFMEA should flow from the DFMEA where available. PFMEA should also include inputs such as warranty issues, customer concerns, lessons learned, and past 8D concerns. For supplier that affect the quality of product must be reviewed with Nemak to ensure accuracy and completeness; rest of categories will be determined by Nemak supplier representative. PFMEA's must be reviewed and updated where applicable, with any product or process change.

RPN risk reduction reviews by product focused on preventing defects from leaving the work station are held to drive continuous improvement. Action plans for top issues must include:
a. Recommended actions
b. Responsibility
c. Timing.

Reverse PFMEA process is in place to identify new potential failure mode in the shop floor

According to PFMEA processes, please verify if Reverse PFMEA (On-station reviews) findings are driven back into the Process Flow, PFMEA, Control Plan, and Work Instructions as applicable.

## 3.7 Control of Special Characteristics

Nemak and/or OEM drawings may indicate special characteristics for the program/product, such as CC, Critical Characteristics, and SC, Significant Characteristics. These characteristics indicate that government, safety, environmental regulations or product function is affected. Due to the severity of these defined characteristics, it is a requirement that they are appropriately stated and controlled within the applicable processes.

All process related documentation such as, FMEA's, control plans, work instructions and process plans must note the appropriate special characteristic where applicable. For operations which produce special characteristics, long term capability of a minimum of 1.67 Cpk's must be demonstrated and provided to Nemak on regular basis (e.g. monthly), depends by the Nemak supplier representative. For each characteristic per the calculations defined in the AIAG Statistical Process Control (SPC) manual. If this Cpk's is not demonstrated, alternative control methods such as mistake proofing (preferred) or 100% testing and/or inspection are required.

Nemak expects that suppliers producing parts with special characteristics ensure that proper training is provided to its personnel to ensure that all who affect the product have a clear understanding of the reason for the significance of the special characteristics and how their operation may affect such.

Other specials characteristics may also be defined by the customer such as High Impact Characteristics (HIC's), or Pass through Characteristics (PTC's), described later in this manual. Suppliers may also identify critical process characteristics within their own process. All of these characteristics are also expected to be defined through the appropriate process documentation and treated as special within the manufacturing process capability and reporting requirements.

The supplier must share with Nemak the statistical results regarding product or process characteristics in a monthly basis in order to verify and monitor de process and establish any preventive or corrective plan.

### 3.7.1 Special process characteristics

The suppliers shall identify the special characteristics and process characteristics. The special characteristics list should be approved by Nemak. The process control methods for the special characteristics shall comply the IATF 16949/VDA requirement and SPC manual if there is no special requirement from Nemak. If Nemak provided the special requirement for the special characteristics on RFQ/SOW or technical review, the suppliers shall follow Nemak special requirement.

## 3.8 Pass Through Characteristics – PTC

Pass Through Characteristics (PTC), are product characteristics that are created or revealed during the process and have little to no chance of being detected prior to reaching the customer.

As part of the APQP process, it is a requirement that the supplier work with their Nemak representative to define and agree upon all potential PTC's. Upon defining these characteristics, the supplier is to complete the required PTC form which is to be submitted as part of the initial PPAP process.

The PTC acronym must be noted throughout the process documentation, PFMEA, Control Plan, work instructions & process plans, and when possible, must have control methods in place to protect Nemak and its customers.

Pass through Characteristics are features of the product that are not used, assembled or verified ahead of the customer. Such characteristics will affect fit, form or function at some point. It is important during the infant stages of APQP and design review that each of the products features are studied, documented and verified as to whether or not they will be passed through to the customer. Each feature will be discussed and some will require early detection methods at the supplier, rather than adding more cost or risk at the customer.

During the developmental phases, the supplier shall work with the Nemak supplier representative to develop the Pass through Characteristic (PTC) list using controlled Nemak PTC Summary

The PTC summary may coincide with the PFMEA development and each PTC should be identified in both the PFMEA and Control Plan under the Special Characteristic/Classification column. Each Special Characteristic, SC's, CC's, HIC's and PTC's, shall be addressed in training aids and must have a defined inspection method and frequency.

From previous lessons learned, Nemak realizes the importance of touch point diagrams to learn up front, where the product will be fixtured, sealed, probed or gauged throughout the process and hence, avoiding unnecessary downtime. It is strongly encouraged that the supplier begin their diagrams as fixtures, seals, probes and gauges, are being designed and developed. Maps should be shared with both the foundries as well as the OEM's. Touch point diagrams should be developed also by the OEM Customer plants and shared with the suppliers so that these defined areas are machined or inspected and verified prior to shipment to the customer.

## 3.9 Process Capability

Initial process capability studies are required by Nemak for, but not limited to, all new program launches, new equipment installations, equipment relocations, and process revisions for all characteristics identified on the customer prints, models, engineering specification, and other related documents generated by either Nemak or their customer(s) defining specific component requirements.

Long term on-going capability will be monitored for all customer defined special characteristics (i.e. safety critical, product significant) and other process critical characteristics agreed to during the APQP process using the appropriate statistical tools and reported to Nemak in the specified format on a monthly basis.

AIAG/VDA guidelines are to be considered minimum requirements when establishing and reporting process capability. Provisions outlined in this document are to be considered in addition to those required by the AIAG manual. In the event of a conflict between AIAG and this document, this document shall override the AIAG requirement.

### 3.9.1 Gauge Requirements

When available, process variable gages are permitted to be used to conduct process capability studies. In the absence of variable gages, CMM data will be used to calculate capability. All gages, including CMM, must first have passed a GRR per the requirements outlined in this manual.

### 3.9.2 Initial Process Capability

Initial process capability studies are required by Nemak for, but not limited to, all new program launches, new equipment installations, equipment relocations, and process revisions for all characteristics identified on the customer prints, models, engineering specification, and other related documents generated by either Nemak or their customer(s) defining specific component requirements.

#### 3.9.2.1 Initial Capability Sampling Plan

Unless otherwise agreed to in writing by the designated Nemak Quality representative, initial process capability studies will consist of a 100 piece sample pulled from a minimum 300 piece PPAP run for each process stream (i.e. spindle, machine, cavity). The samples will be pulled in 4 consecutive piece sample groups, beginning with the 1st 4 pieces in the run and spaced evenly across the run, ending with the last 4 pieces of the run.

The submission is required unless otherwise specified change by the authorized customer representative, and after change implementation.

#### 3.9.2.2 Initial Capability Calculation and Analysis

Process capability must be calculated and analyzed using the Minitab Capability Six-pack option. Any alternative software must be approved in writing by the designated Nemak Quality representative prior to use. Care must be taken to assure the proper analysis is conducted for the type of specifications being studied (unilateral vs. bilateral) and to validate process stability and normality prior to acceptance of the capability index calculations (Pp/Ppk). Non-Normal data must be calculated using the proper distribution model or transformation. If normality or stability cannot be established using these methods, the data cannot be used to establish the capability index (Pp/Ppk).

#### 3.9.2.3 Initial Capability Reporting

Customer Defined Special Characteristics – Capability data for all customer defined special characteristics (i.e. safety critical, product significant) and other process critical characteristics agreed to during the APQP process must be summarized in the format specified by Nemak and submitted, at a minimum, as part of the PPAP package along with the Minitab Capability Six-pack for each characteristic.

All Other Characteristics – While not required for PPAP submission, capability studies must be conducted for all other characteristics. Capability data for these characteristics must be summarized and submitted in the format specified by Nemak upon request.

In addition, a usable electronic copy of the raw data (i.e. Excel Spreadsheet, Minitab Project File) must be made available to the Nemak supplier representative upon request.

### 3.9.2.4 Initial Capability Acceptance

For Initial Process Capabilities Studies conducted using the 100 piece sampling plan as described above, the following capability index must be achieved:

| Characteristic Type | Ppk |
|---|---|
| Customer Defined Special Characteristic | 1.67 |
| Process Critical Characteristic | 1.67 |
| All Other Characteristics | 1.33 |

In the event the Nemak Quality representative has agreed in writing to a reduced sampling plan for initial process capability studies, the following capability index must be met:

| Characteristic Type | 50 Piece Ppk | 30 Piece Ppk |
|---|---|---|
| Customer Defined Special Characteristic | 1.82 | 2.00 |
| Process Critical Characteristic | 1.82 | 2.00 |
| All Other Characteristics | 1.45 | 1.60 |

Processes failing to meet the above capability index must be 100% inspected until such capability requirements are met. Any request for a sampling plan less than 100% will be evaluated on an individual basis and must be approved in writing by the designated Nemak Quality representative prior to implementation.

All 100% inspection requirements described into the SOW/Contract by the program or product must be approved alternate sampling plans must be reflected in the Control Plan until stated requirements are eliminated.

### 3.9.3 Long Term On-Going Process Capability

Long term on-going capability will be monitored for all customer defined special characteristics (i.e. safety critical, product significant) and other process critical characteristics agreed to during the APQP process using the appropriate statistical tools. Unless otherwise agreed to in writing by the designated Nemak Quality representative, SPC charting will be used to monitor and control these processes.

### 3.9.3.1 Sampling Plan

Sampling plans will be determined jointly between Nemak and the supplier during the APQP process. It is recommended that a minimum sample subset of 3 consecutive components per process stream per shift be taken to effectively evaluate part-to-part variation. The approved sampling plan must be reflected in the Control Plan.

### 3.9.3.2 Charting

Unless otherwise agreed to in writing by the designated Nemak Quality representative, the sample dimensional results will be recorded and charted on SPC X-Bar and R charts. Where manageable, individual

charts should be maintained for each process flow (i.e. CNC, Fixture, Cavity, etc.). Where it becomes necessary to combine process flows onto 1 chart, the data should be stratified.

Reaction plans to out-of-control conditions should be documented on the chart and/or in a work instruction. All out-of-control conditions must be identified on the chart at the time of the occurrence along with actions taken to correct the condition and contain suspect material per the reaction plan. All charting requirements and reaction plans must be reflected in the Control Plan.

### 3.9.3.3 On-Going Capability Calculation and Analysis

Process capability must be calculated and analyzed monthly in Minitab using the most recent 30 days or 30 sample groups worth of data, whichever is greater (Any alternative software must be approved in writing by the designated Nemak Quality representative prior to use). Care must be taken to assure the proper analysis is conducted for the type of specifications being studied (unilateral vs. bilateral) and to validate process stability and normality prior to a accepting the capability index calculations (Pp/Ppk). Non-Normal data must be calculated using the proper model distribution or transformation. If normality or stability cannot be established using these methods, the data cannot be used to establish the capability index (Pp/Ppk).

### 3.9.3.4 On-Going Capability Reporting

On-Going capability data for all customer defined special characteristics (i.e. safety critical, product significant) and other process critical characteristics agreed to during the APQP process must be summarized in the format specified by Nemak and submitted to the designated Nemak supplier representative monthly. In addition, a usable electronic copy of the raw data (i.e. Excel Spreadsheet, Minitab Project File) and copy of the SPC chart(s) must be made available to the Nemak supplier representative upon request.

### 3.9.3.5 On-Going Capability Acceptance

The following on-going capability index must be maintained for all customer defined special characteristics (i.e. safety critical, product significant) and other process critical characteristics agreed to during the APQP process:

| Characteristic Type | Cpk |
|---|---|
| Customer Defined Special Characteristic | 1.33 |
| Process Critical Characteristic | 1.33 |

Processes failing to meet the above capability index must be 100% inspected until such capability requirements are met.

Any request for a sampling plan less than 100% will be evaluated on an individual basis and must be approved in writing by the Nemak supplier representative prior to implementation.

All 100% inspection requirements and approved alternate sampling plans must be reflected in the production control plan until stated requirements are eliminated. Refer to local Nemak supplier representative for appropriate statistical software package.

Refer to Appendix B for details of process capability requirements.

### 3.9.3.6 Layout Inspection and functional testing

Annual layouts and functional verification to all engineering material performance, and durability requirements may be required. The extent of these tests corresponds to the extent of the initial sampling and may contain additional agreed features. All results shall be reported to Nemak as requested

## 3.10 Gauge R&R and Leak Tester

The supplier shall conduct Gauge R&R studies of all measurement systems referenced in the control plan. The AIAG Measurement Systems Analysis (MSA) standard is to be followed along with the requirements of this manuals

Please see Appendix C for more details.

## 3.11 Customer Property

The Supplier shall exercise care with the property of Nemak while it is under their control or being used by the Supplier. If any property of Nemak is lost, damaged, or otherwise found to be unsuitable for use, this shall be reported to Nemak and records maintained.

Nemak owned gages, equipment, and tooling shall be permanently marked so that the ownership is visible, and can be determined.

A Supplier is expected to maintain all tooling for the life of the program. All repairs and maintenance are the responsibility of the suppliers. Failure to maintain tooling in a proper manner may result in the Supplier being charged for any required tooling repairs or replacements.

# 4.0 Manufacturing under Controlled Conditions

## 4.1 Control Plan

Control plans are required for both pre-launch and production phases. Like the FMEA's, Control Plans are living documents and are expected to be reviewed and updated as process or product changes take place. The AIAG APQP/Control Plan Standard is to be referenced to ensure proper formatting is followed. Suppliers are expected to periodically audit their control plans for compliance, as part of their stated internal audit plan.

## 4.2 Work Instructions

Work instructions are an important piece of employee ownership. Suppliers must create work instructions, derived from control plans and other process documentation, for any operations which impact quality. Work instructions are to be used for training purposes and should be accessible to the employee at all times for reference.

## 4.3 Job Set-Up Verification

Verification of product is required any time that a job is set-up, changed over or out of production for a stated period of time. The supplier is to define and implement a process, using statistical control when

necessary, to verify first piece and in the event of multiple changeovers, last-off inspection is a recommended practice.

## 4.4 Identification and Traceability

The supplier must identify Nemak product throughout the manufacturing process in all stages and inventory locations. Placards, tags, lot numbers, bar codes are a few acceptable means of identification.

The status of all product must be identified to mitigate risk of suspect, non-conforming or unapproved product being used or shipped to Nemak or its customers.

Traceability of each part is necessary to identify phases or birth history of the production process. Traceability should be permanently and legibly applied to each part. Some examples of traceability types include stamping, Telesis marking, ink stamping, laser etching, etc. Locations and reasons for traceability is to be discussed during the APQP planning phase of the launch and must be reviewed and agreed upon by the applicable Nemak Representative.

## 4.5 Laboratory requirements

The premises of an internal laboratory of the organization shall have a defined scope capable of performing the Inspection, testing and calibration services; this scope shall be included in the documentation of the Quality management system. The technical requirements must meet at least the following items:

- Adequacy of laboratory procedures,
- Competence of laboratory staff,
- Product test,
- Ability to perform services correctly according to process standards (such as ASTM,
- MS, etc.), and
- Critical analysis of related records.

Note: ISO / IEC 17025 accreditation is recommended for internal laboratory to demonstrate compliance

### 4.5.1 Control of Monitoring and Measuring Devices

Measuring equipment shall be calibrated or verified at specified intervals, or prior to use, against measurement standards traceable to international or national measurement standards; when no such standards exist, the basis for calibration shall be recorded.

In addition the Supplier shall assess previous measurement results when the equipment is found not to conform to requirements. The Supplier shall take appropriate action on the equipment and any product affected. Records of results of calibration and verification shall be maintained.

## 4.6 Requirements for Special Processes

Processes of Thermal Treatments (CQI9). The heat treatment supplier must meet the requirements of the CQI9, according to the AIAG Manual version in force. This requirement applies to suppliers and sub-suppliers of the Nemak supply chain. Evaluation carried out annually by the Quality of Nemak Suppliers.

## 4.7 Chargeback Process

Supplier cost recovery will be initiated by Nemak when it has been determined that the supplier is responsible for quality and or delivery shortcomings. Costs include, but are not limited to;

- Inspection Cost – Costs include receiving inspection, layout activities, and/or functional testing.
- Rework/ Salvage costs
- Manufacturing downtime costs.
- Administrative costs.

The cost recovery details are included into the SOW / Contract

## 4.8 Reworking of faulty parts

Reworking faulty parts that are noticed either during our production or as part of a complaint must only be carried out in agreement with the Nemak quality management and must be labeled as reworked parts in each container before delivery.

## 4.9 Records

Suppliers are required to keep and maintain routine quality records which are derived from specifications discussed in the APQP phase or established as part of a corrective action. These records are to be maintained for the life of the product, plus 2 years and must be made available for review upon request within 24hrs, and according to Nemak needs.
Examples of these records include but are not limited to, capability data for all "special characteristics", reliability test results, leak test records, traceability, audits, process inspections, maintenance records, PPAP records, etc.

## 4.10 Preservation of Product

The supplier shall preserve the conformity of product during internal processing and delivery to the intended destination. This preservation shall include identification, handling, packaging, storage, and protection.

### 4.10.1 Storage and Inventory

The Supplier shall use an inventory management system to optimize inventory turns over time and assure stock rotation, such as "first-in-first-out" (FIFO). Obsolete product shall be controlled in a similar manner to nonconforming product.

## 4.11 Preventative & Predictive Equipment Maintenance (PM)

To support capacity and quality requirements, it is a necessity that suppliers develop a planned preventative maintenance system to ensure the highest level of equipment efficiency possible. Equipment Efficiency improves OEE, process variation and process capability by minimizing unplanned downtime.

As part of the PM program, suppliers shall document and review PM actions which are to become controlled records and should be made available upon request. In addition, the system shall ensure that all critical equipment is identified so that spare parts are available on site at all times to avoid unplanned downtime.

Where applicable, Nemak and/or "customer" owned tooling and equipment is to be identified, maintained and preserved.

## 4.12 Special approvals

The delivery of products with nonconformities for the specification may only be carried out once prior written approval has been given by Nemak. These deliveries may only be made for a quantity or period agreed with Nemak. Every shipment must be provided with a specially arranged label.

## 4.13 Labeling of deliveries and delivery note

Parts or containers must be labeled in an appropriate way using VDA 4902 material tags or AIAG B-3 shipping labels or special labels agreed by both supplier and Nemak. The delivery note (e.g. according to EN 10204) contains the Nemak item number of product with the corresponding revision or version status, the total quantity per delivery item, the number of shipping containers (e.g. pallets) and individual packaging units (e.g. small load carriers) with the respective quantity and includes a compliance statement.

## 4.14 Associated documents

The quoted standards must be procured either from the Verband der Automobilindustrie e.V. - Quality Management Center (www.vda-qmc.de), or the Automotive Industrial Action Group (www.aiag.org) and the latest respective version of the Specific Customer Requirements (VW Group Formel-Q; Porsche; GM (Opel); Daimler, Ford; BMW Group; Jaguar Landrover; Audi; FCA etc.)

# 5.0 Change Management

There are many reasons that a product or process may require a change during the post launch/production phase. Some reasons may include corrective action implementation due to a quality concern, to improve process efficiency, cost savings, change in supplier location, change in sub-supplier, etc. Though all of these reasons may be acceptable conditions for change, they must first be communicated to the Nemak Representative, validated, and approved by Nemak and when applicable, its customer.

To obtain this authorization, the supplier must submit to Nemak a formal request for modification of process / product, in specific form Nemak - Request for Modification Supplier Product / Process - analysis and Approval of Costs.

The supplier shall send a development schedule to monitor activities by Nemak and should be developed a new PAPP.

The supplier shall follow the Nemak Change Management System which defines how to process a change request.

Types of change approvals may be either permanent or temporary in nature.
Approval types include:

- PPAP/PSW
- SREA
- Deviation (waiver, WERS Alert, etc.)

Reference Appendix D for change management process flow and approved Supplier Request for Change form.

Please contact to local Nemak supplier representative for more details.

# 6.0 Supplier Performance Management

## 6.1 Communication, Evaluation and Development

Communication is an integral part of a supplier/customer relationship which is why Nemak is committed to providing on-going feedback to each supplier not only through the support of a Nemak supplier representative, but also in the form of a Supplier Performance Scorecard. The Scorecard is intended to encourage excellence in terms of Quality and Delivery.

As a result of the evaluation, action plans may be required to help drive closure to communicated concerns and non-compliance to required procedures and specifications. The Nemak supplier representative will help develop the plan, monitor progress towards completion and evaluate effectiveness of the corrective actions taken.

Open items will require mutually agreed upon goals, targets and timelines which will be monitored continuously until the supplier is able to meet the customer expectations. If these expectations cannot be met in the mutually agreed upon timeframe, Nemak will re-evaluate the commercial relationship with appropriate supplier management and take appropriate action.

## 6. 2 Supplier Performance Scorecard

Supplier Performance Evaluation applicable to all purchasing categories in Nemak that will allow us to properly segment and evaluate a selected base of existing suppliers in an operative and strategic basis in order to identify opportunities and potential areas of development.

The evaluation focuses on quantitative and qualitative indicators to have an integrated evaluation criteria approach. Each purchasing category to be evaluated has the potential to negatively affect the immediate and downstream customers which is why they are considered critical and will be monitored closely to avoid interruptions.

Suppliers are evaluated according to its purchasing category based on the below evaluation criteria:

**Quantitative**

- **Quality**
  - PPM Returns / PPM Scrap Monitoring
  - PPM Q notes
  - Number of supplier complaints
- **Delivery**
  - On-time delivery
  - Fill rate %

**Qualitative**

- Cost Performance
- Service
- CSR
- Certifications

Purchasing categories considered for Supplier Evaluation:

-Aluminum, Alloys & Scrap
-Production Material
-Manufacturing Services (Machining, Painting, Heat treatment process)
-Contracted Services
-Tooling, Infrastructure and Equipment (Capex)
-MRO

The term PPM (Parts per Million) describes the comparison between the number of defective parts and the number of parts inspected.

The PPM key figure is calculated based on the following formula:

$$\text{PPM within time period} = \frac{\text{Number of defective parts}}{\text{Number of delivered parts}} \times 1{,}000{,}000$$

The number of defective parts can be calculated:

PPM returns, based on the number of returned parts to supplier
PPM scrap monitoring, related to machining scrap
PPM q notes, based on supplier complaints.

Number of complaints registered in SAP via Q-Notes (Notification type 1V) considering next levels:

| Level of complaint | Description | Weight |
|---|---|---|
| >= Supplier Complaint Level 1 | Official claim reported by OEM/Nemak. E.g. Severity high, dealer returns, claim register into the system critical defect, warranty claim, recall. | 0% |
| >= Supplier Complaint Level 2 | No official claim reported by OEM/Nemak. E.g. Severity medium, complaint by email. Supplier alert by OEM. | 50% |
| >= Supplier Complaint Level 3 | Claim reported by Nemak. E.g. capacity, customer service, audit results. | 75% |
| No supplier complaint | No Claims generated and reported | 100% |

On time delivery (OTD)

Description: Date reliability measures the difference between the requested and the actual delivery date.

The difference between the requested and the actual delivery date is always calculated in working days according to the factory calendar assigned to the plant. Delays/early deliveries are scored as follows:

Fill Rate %

Description: Quantity reliability measures the difference between the requested and the actual delivery quantity

In order to calculate the quantity/on-time reliability each Goods receipt is compared with the quantity to be delivered (from purchase order scheduling line). Then the deviation in percent between both is determined and each Goods receipt is evaluated.

Qualitative

The execution of the Soft facts is based on a questionnaire with specific questions for each are.

Soft facts are grouped into 5 Classes that are divided into Categories, which are subject to Evaluation Criteria, which are equivalent to a certain number of points that are finally used in order to obtain a final value which should be 1, 5 or 10 points as options

Differentiated weighting

Vendor evaluation will be applied considering different weights depending on the purchasing category to which the supplier belongs. It is considered that the Scores automatically calculated by the system are likely to be modified according to Nemak needs. The weight for purchasing category will be from 0 to100%, will be different between purchasing categories and must be define by purchasing category management

The evaluation for hard indicators will be consider to apply monthly basis and soft indicators at least one per year or every six months. Some exceptions could be made and the evaluation of hard / soft indicators according to the needs of Nemak. The results of the evaluation should be maintained until the next evaluation.

## 6.3 Top Focus Supplier

The supplier should do everything possible to continually meet Nemak's expectations and maintain acceptable performance levels. In the event that performance levels decline below acceptable or, the supplier fails after being placed on a controlled shipping status, Nemak may add the supplier to the "Top Focus Supplier" list. This status will involve higher levels of Nemak Management to alert the supplier of their critical status and attempt to enforce necessary recommended activities to improve quality performance. The supplier will keep this status until Nemak is satisfied, through demonstrated results, that acceptable improvement has been made.

Suppliers may be identified to enter the Quality Focus Supplier process because of different reasons as followed:

1) Same quality issues repeat times and no evidence for the actions efficient.
2) In controlled shipping Level -1.
3) Continuous twice half yearly comprehensive rating result are level C.
4) For machining suppliers, the continuous 3 times monthly scorecard are lower than 70(Red).
5) Delivery complaint from Nemak PC&L team more than 3 times (included) in the past 3 months.
6) Other issues are identified as high risk issues by Nemak team.

Once a supplier is selected to enter the QFS process, the process opens with a formal notification of the supplier. This is done by postal mail or email. This letter should be sent by Nemak supplier representative based on the approval from Nemak supplier manager or other management representative and

addressed to the supplier's upper management. The supplier shall provide the detailed improvement goals together with actions plan as Nemak required. Nemak supplier representative will schedule monthly or bi-weekly management reviews to review the supplier's progress toward meeting the established goals. If goals are not being met, the issues are to be escalated. Repeated failure of the supplier to meet commitments is to be escalated to Purchasing, and may result in a recommendation of New Business Hold. The supplier exit the QFS process should be approved by Nemak representatives. The QFS process is the official escalation procedure for Nemak supplier management issues escalation.

The new business hold process will be initiated when any of the following occurs due to the supplier;

1. Major quality issues related to the SC characteristics which results in customer recalls.
2. Being placed into CSL-2 (Controlled Shipping Level 2).
3. Commitments are missed more than twice during the QFS process.

## 6.4 Escalation process

The Supplier Escalation Process defines the different stages undergone in case the performance of a supplier is not in line with Nemak's requirements.

In other words, the purpose of the supplier escalation process is to ensure that the supplier's performance meets Nemak's requirements in order to ensure a regular flow of goods delivery to Nemak's customer without complains.

The aim of the process is to implement suitable actions at the supplier's so that the products, materials and services delivered meet Nemak's and its customers' requirements again. Depending on the duration and seriousness of the problems, they are classified in one of three escalation levels.

In the event of recurring quality or logistics problems, the supplier is admitted to the Nemak escalation process.

Three stages can be employed here depending on the duration and difficulty of the problems.

**Nomination criteria's:**

**Escalation level 1 (EL1):**

- Supplier performance evaluation (C status)
- Audit result (C status)
- Recurrent customer complaints, field issues, CSR report (low impact)

**Escalation level 2 (EL2):**

- No significant improvement of Stage 1 or degraded performances
- Stage 1 too long (3 months)
- Recurrence of quality and delivery issues, CSR report (medium impact)

**Escalation level 3 (EL3):**

- No significant improvement of Stage 2 or degraded performances
- Stage 2 too long (6 months)

- Recurrence of quality and delivery issues, CSR report (high impact)
- Certification of the quality management system expired since more than six months or is invalid.
- The supplier provides inadequate cooperation on the necessary corrective actions
- Security of supply is inadequate

**Rescinding of Escalation status:**

The Supplier Escalation Board corresponding to each escalation level decides whether the supplier meet the entrance and exit criteria for the corresponding escalation stage.

The status of any escalation stage will only be rescinded once the effectiveness of the defined actions has been checked by Nemak and this has been notified to the supplier by the Nemak Purchasing department.

# 7.0 Control of Non-Conforming Product

## 7.1 Containment

As with any manufacturing process, problems are bound to occur. It is how a problem is contained, communicated and reacted to that is most important. Suppliers are expected to have a strong written procedure for containment and control of non-conforming product. All levels of management and employees must be trained and understand the procedure and its importance.

The supplier must immediately contain any known issue and notify Nemak as soon as the concern is found.

When a problem is discovered at the Customer facility, the supplier will be notified immediately and all suspect product must be contained at all locations including, supplier/sub-supplier facilities, warehouses, parts in transit to the customer or other locations, parts on customer production floor.

The supplier must provide a written description of the containment plan, inspection method and resulting certified product identification.

It is the responsibility of the supplier to coordinate all aspects of the containment including identification and quarantine of suspect material such as serial numbers for each suspect part, record of containment results, identification of a clean point with specific traceability information of the first known good part, etc. All of the above information must be communicated to the appropriate Nemak supplier representative as it is received.

It is expected that suppliers will perform all actions needed to return and replace suspect material and avoid, wherever possible, any interruptions at the customer facilities. Nemak reserves the right to charge back all costs associated with supplier caused non-conforming product, including return of material and loss of production including, labor and components, where applicable.

## 7.2 Controlled Quarantine Area/Material Review Board (MRB)

All product which is suspect or non-conforming for any reason must be properly identified and stored in a defined quarantined area, away from the production flow or shipping areas.

The supplier must have a system in place to account for each part in the quarantine area along with a written procedure outlining the process to add or remove parts, requiring approval from a defined responsible party, for example, Quality Manger or Quality Engineer.

There may be circumstances to which non-conforming material may be considered for use by the final customer, depending on its affect towards fit, form, function, etc. In such cases, a request for a waiver may be submitted for review. Supporting documentation such as dimensional reports, test results, or other applicable documents will be required by the customer to assist in potential approvals. Under no circumstances may non-conforming material be shipped without prior approval by the customer.

Review details and questions with the Nemak supplier representative on an individual case basis.

## 7.3 Controlled Shipping

It is an expectation that suppliers provide quality parts at all times and maintain positive communications with Nemak. Suppliers should take every necessary measure to ensure that Nemak's production is not negatively affected, including the addition of resources when necessary. When situations occur which adversely affect Nemak's production, Nemak has the right to initiate a controlled shipment process.

Controlled shipping may be initiated when any of the following situations occur:

- Loss of containment of a previously identified non-conformance
- Uncertainty of root cause to implement permanent corrective actions to resolve a defined non-conformance
- Safety concern
- Other non-conforming situations as deemed necessary by Nemak

Suppliers shall remain on controlled shipping status until the following exit criteria have been met:

- Permanent correction action(s) have be implemented and validated for effectiveness. In most cases, a Nemak Representative will visit the supplier site to verify the PCA in action.
- All exit criteria detailed in the written notification has been met. Details will vary.
- Nemak has provided written authorization to cease controlled shipping activities
- The parts sent in this period must have an Identification "and in place agreed with the Quality of Neman's suppliers.

### 7.3.1 Controlled Shipping Level 1 – CSL 1

Control Shipping Level 1 or CS1, requires that the supplier initiates an offline inspection process, separate to any existing in process inspection. After product has run through its intended process, parts are to be contained in a designated CS1 quarantined area where a defined inspection process will be performed by ***additional personnel***. Sort results must be maintained from each shift and reported to Nemak daily. The supplier will be responsible for all costs associated to the CS1 activities.

### 7.3.2 Controlled Shipping Level 2 – CSL 2

In some cases, the supplier's CS1 arrangement will be prove to be ineffective whereby suspect parts will continue to reach the customer. Nemak in this case will place the supplier on Controlled Shipping Level 2 or CS2. Like CS1, the supplier is required to set up an offline inspection process, separate from any existing in process inspection. Parts are to be placed in a designated quarantine area which will be set up for inspection/sorting and certification by a third party inspection group. The supplier will be responsible for all costs associated to the CS2 activities.

## 7.4 Controlled Shipping Exit Criteria

Controlled shipping exit criteria shall include;

1. 30-45 working days free from non-conforming material (as identified in the CS2 letter) from corrective action approval
2. Corrective action documentation shall show root cause and non-detection identified and verified
3. Documented evidence of error proofing considerations
4. On-site audit of corrective actions before exit of CS2.

Note 1: The supplier's certification body must be formally notified by the supplier in the event of controlled embarkation level II. Evidence to be provided to Nemak of communication.

Note 2: The supplier will remain under controlled shipment until he receives a written authorization from Nemak to exit.

# 8.0 Problem Solving

It is most unfortunately a common mistake in manufacturing to confuse problem solving with problem "mending". In the chaotic environments that many facilities are faced with, it has become practice at times to apply a "Band-Aid" to cover up a problem rather than solve it indefinitely.

Using problem solving tools will engage cross functional teams, which is absolutely necessary for success.

In order to start solving a problem, we need to understand what a problem is. A good definition of a problem is, "A variation from a recognized standard. In other words, you need to understand how things should be before you can recognize a possible cause for them not being that way." Once the problem is understood, the solving may begin.

There a various problem solving methodologies available to choose from. In most cases when a supplier has a concern, Nemak will require that an 8D be submitted. It is up to the supplier to decide which additional tools to use to assist in the D4 "Root Cause" section, to solve their problem however, in some instances, Nemak will request a particular type, depending on the severity of the issue or timeliness to solve the problem.

## 8.1 Customer complaints (Nemak and OEM)

Nemak releases the complaint to supplier. The supplier complaint is not only for any issue identified by Nemak and Nemak's customer including quality issues, delivery issues, capacity issues, service issues of mass production parts, but also for the timing issues, sample quality issues, documentation issues, service issues found during APQP activities. The supplier response requirements for the supplier complaint are followed;

- Fast response (Short term containment action) within 24hrs
- Root cause and actions (Long term action) within 5 calendar days
- Actions implementation and validation (Documentation standardization) within 10 calendar days

The time of implementation could be delayed base on the case of the complaint.

A most effective way to solve a problem is to identify the root cause and its contributing factors, and eliminate it from the system.

Complaint will be classified according to the below criticality level criteria:

- Level 1: Official claim register in OEM/Nemak system. i.e.: severity high, dealer returns, field actions, critical defect, warranty claim, recall.
- Level 2: No claim register in OEM/Nemak system. i.e.: severity medium, complaint by email.
- Level 3 : Claim reported by Nemak

Nemak does not strictly define which tool to use and when, however, the simple flow chart provided may assist in the problem solving process. There may be specific cases when the Nemak Quality Representative will require a specific problem solving tool be used and submitted, to accompany the required 8D.

## 8.2 Lesson Learn Process

Every problem solved generates at least one lesson learned, once corrective actions have been implemented. The supplier must perform lesson learned analysis and fill out the format provided by Nemak or use its own form. The lesson learned must be submitted to Nemak every complaint or improvement process.

# 9.0 Recalls

The Supplier acknowledges that the Nemak may be required to recall components that contain the Products and to initiate corrective and preventive action plans to contain any Defective Products. Nemak may be required to initiate such actions at the request of its customers, governmental authorities, or as part of the Client's internal quality assurance programs. If Nemak or any of its customers find or suspect that the Products are Defective Products, Nemak will, to the extent possible, notify the Supplier, and Supplier shall fully cooperate with Nemak in implementing any recall programs and/or corrective and preventive action plans. The Supplier acknowledges that the implementation of these actions is time sensitive, and Nemak reserves the right to carry any such actions, at the expense of Supplier. Therefore, the Supplier agrees to reimburse to Nemak of any costs associated with the implementation of such actions. In case of any legal agreement in place Supplier must comply with established terms.

Notwithstanding the foregoing, Nemak shall have the power to determine and resolve all aspects of the recall process of the Products from the market, including when and how to implement the process. The Supplier agrees to fully cooperate and to comply with the internal policies issued by Nemak regarding recalls and preventive and corrective actions.

# 10 Deviations

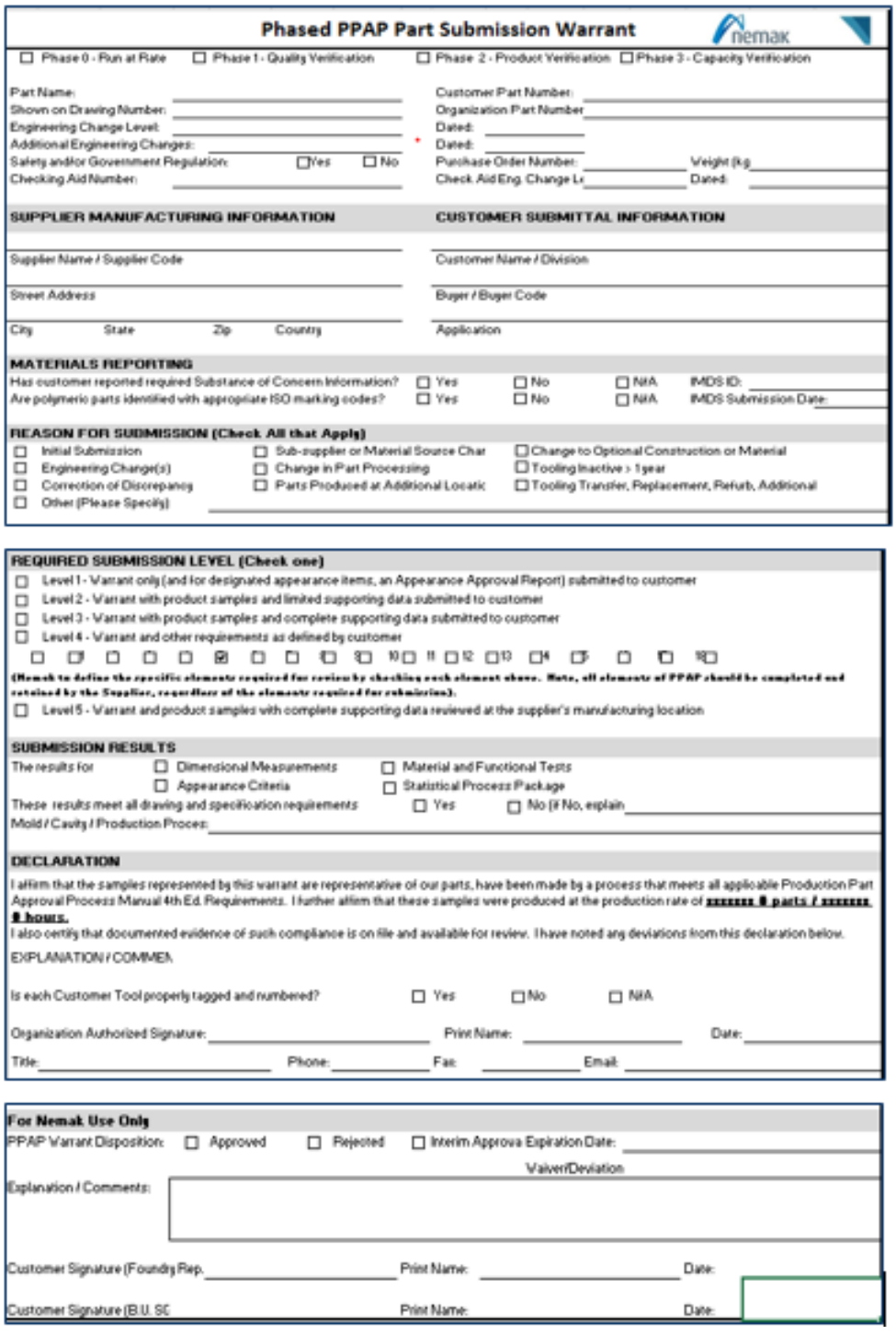
The Nemak Supplier Quality area has exclusive and formal attribution to issue deviations on the technical requirements of this Manual. Any other form of agreement aiming at the total and / or partial abolition of requirements will be considered as lacking legal tender for the purpose of applying the Manual.
Every waiver or deviation for the requirements described in this manual should be appropriately documented and formalized, and any verbal commitment.

# 11 Statement of responsibility

The Supplier commits itself, to adapt its systems and processes aimed at meeting Nemak specific requirements. Any deviation from this Manual has to be agree and confirmed by Nemak Quality Representative in written.

# APPENDIX A

## Part Submission Warrant



**Phased PPAP Part Submission Warrant**

☐ Phase 0 - Run at Rate ☐ Phase 1 - Quality Verification ☐ Phase 2 - Product Verification ☐ Phase 3 - Capacity Verification

Part Name:
Shown on Drawing Number:
Engineering Change Level:
Additional Engineering Changes:
Safety and/or Government Regulation: ☐ Yes ☐ No
Checking Aid Number:

Customer Part Number:
Organization Part Number
Dated:
Dated:
Purchase Order Number: Weight (kg
Check Aid Eng. Change Le Dated:

**SUPPLIER MANUFACTURING INFORMATION**

Supplier Name / Supplier Code
Street Address
City State Zip Country

**CUSTOMER SUBMITTAL INFORMATION**

Customer Name / Division
Buyer / Buyer Code
Application

**MATERIALS REPORTING**

Has customer reported required Substance of Concern Information? ☐ Yes ☐ No ☐ N/A IMDS ID:
Are polymeric parts identified with appropriate ISO marking codes? ☐ Yes ☐ No ☐ N/A IMDS Submission Date:

**REASON FOR SUBMISSION (Check All that Apply)**

☐ Initial Submission
☐ Engineering Change(s)
☐ Correction of Discrepancy
☐ Other (Please Specify)
☐ Sub-supplier or Material Source Char
☐ Change in Part Processing
☐ Parts Produced at Additional Locatic
☐ Change to Optional Construction or Material
☐ Tooling Inactive > 1 year
☐ Tooling Transfer, Replacement, Refurb, Additional

**REQUIRED SUBMISSION LEVEL (Check one)**

☐ Level 1 - Warrant only (and for designated appearance items, an Appearance Approval Report) submitted to customer
☐ Level 2 - Warrant with product samples and limited supporting data submitted to customer
☐ Level 3 - Warrant with product samples and complete supporting data submitted to customer
☐ Level 4 - Warrant and other requirements as defined by customer

☐ ☐ ☐ ☐ ☐ ☑ ☐ ☐ ☐ ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ ☐ ☐ 18 ☐

**(Nemak to define the specific elements required for review by checking each element above. Note, all elements of PPAP should be completed and retained by the Supplier, regardless of the elements required for submission).**

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

**SUBMISSION RESULTS**

The results for ☐ Dimensional Measurements ☐ Material and Functional Tests
☐ Appearance Criteria ☐ Statistical Process Package
These results meet all drawing and specification requirements ☐ Yes ☐ No (If No, explain
Mold / Cavity / Production Proces:

**DECLARATION**

I affirm that the samples represented by this warrant are representative of our parts, have been made by a process that meets all applicable Production Part Approval Process Manual 4th Ed. Requirements. I further affirm that these samples were produced at the production rate of **xxxxxxx 8 parts / xxxxxxx 8 hours.**
I also certify that documented evidence of such compliance is on file and available for review. I have noted any deviations from this declaration below.

EXPLANATION / COMMEN

Is each Customer Tool properly tagged and numbered? ☐ Yes ☐ No ☐ N/A

Organization Authorized Signature: Print Name: Date:
Title: Phone: Fax: Email:

**For Nemak Use Only**

PPAP Warrant Disposition: ☐ Approved ☐ Rejected ☐ Interim Approva Expiration Date:
Waiver/Deviation
Explanation / Comments:

Customer Signature (Foundry Rep. Print Name: Date:
Customer Signature (B.U. SC Print Name: Date:

# APPENDIX B

# Process Capability Requirements

**Capability Analysis**

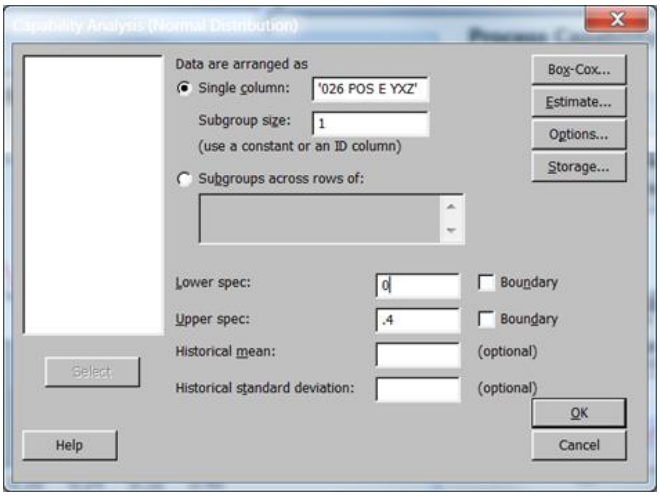
Note: All examples are created using Minitab 15

**Example 1 - Unilateral Tolerances**

Print specifications such as True Position, Surface Profile, Flatness, Perpendicularity, and Parallelism are the most common examples of unilateral tolerances.

A common mistake made when conducting the capability analysis for unilateral tolerances is to input the print specifications as a bilateral tolerance. As illustrated in Figure 7, the tendency is to insert "0" into the Lower Spec. box and the unilateral print specification into the Upper Spec. box. By doing so, Minitab (as well as other software applications) will calculate the capability as if it were a bilateral tolerance (Figure 8) and in most cases will result is a lower capability index (Ppk) number.

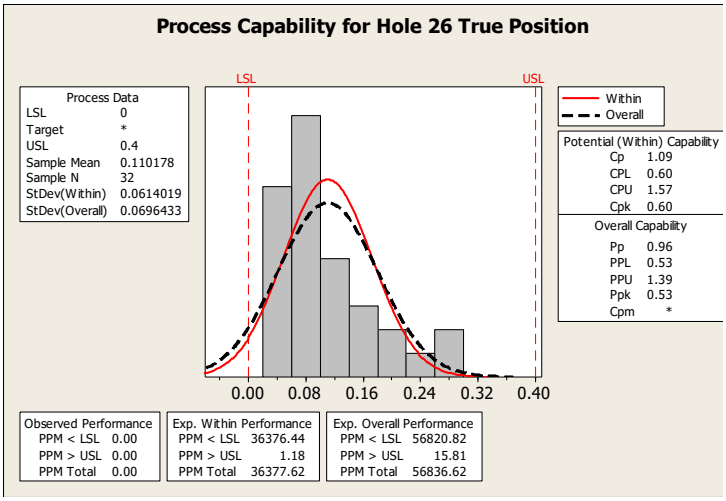
Figure 7




Some keys to recognizing that the wrong calculation was performed for a unilateral tolerance are seen in Figure 8:

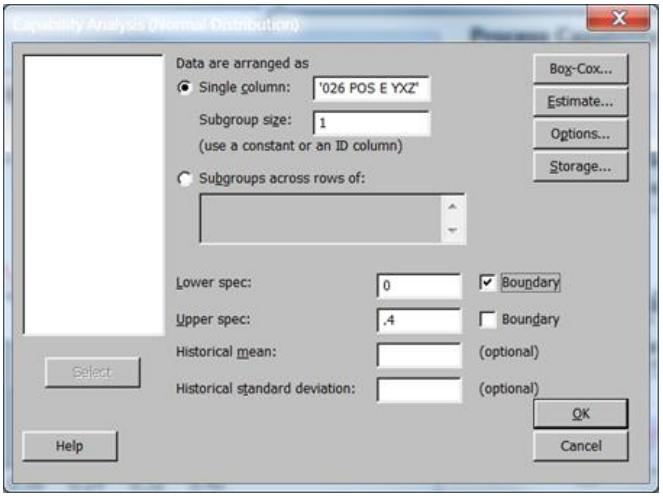
- Pp and Cp values are displayed (Only Ppk and Cpk values are displayed for unilateral tolerances)
- LSL is displayed in the Process Data box and on the graph
- PPM values are displayed for < LSL (even if 0) in the Expected Within and Overall Performance boxes

Figure 8




To assure that the unilateral calculation is performed, the boundary box adjacent to the Lower Spec. box should be checked (Figure 9)

Figure 9




Leaving the Lower Spec. box blank will produce the same statistical results as checking the boundary box (Some versions on Minitab do not have the boundary option and the Lower Spec. box must be left blank). While checking the box will display a lower boundary (LB) on the graph no boundary will appear when left blank.

Figure 11

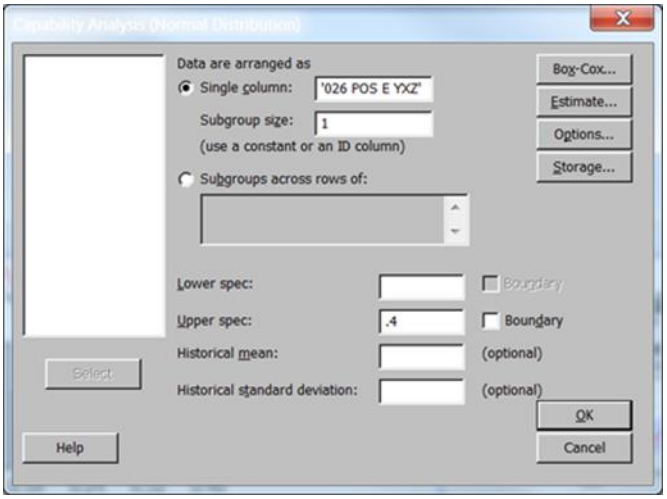
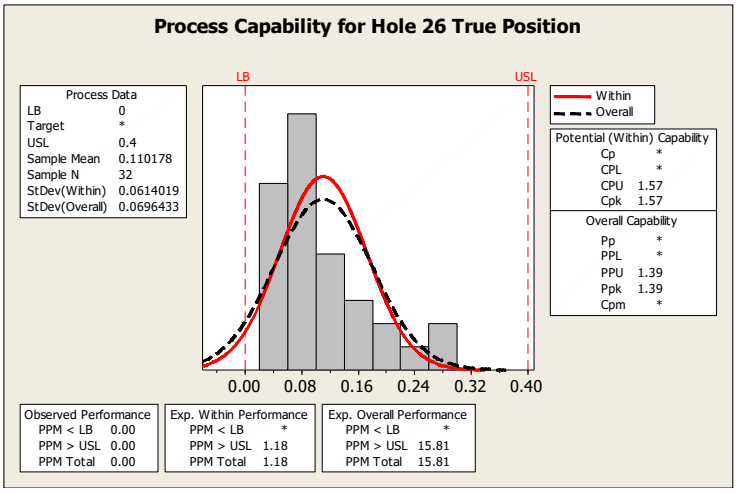



Figure 10 illustrates the results of a unilateral tolerance capability analysis.

- No Pp or Cp values displayed
- LB displayed in place of the LSL in the Process Data Box (No value displayed when Lower Spec. box left blank – Figure 4)
- PPM values are not displayed for < LSL (even is 0) in the Expected Within and Overall Performance boxes

Note: Ppk = 1.39 in Figure 5 vs. 0.53 Ppk in Figure 2

Figure 10




**Most organizations will conduct this level of capability analysis and accept the results. In this example, this process would be considered capable if used to evaluate long term on-going capability.**

**Standard statistical software (including Minitab) assumes the data to be normal and stable unless otherwise indicated and performs the analysis accordingly.**

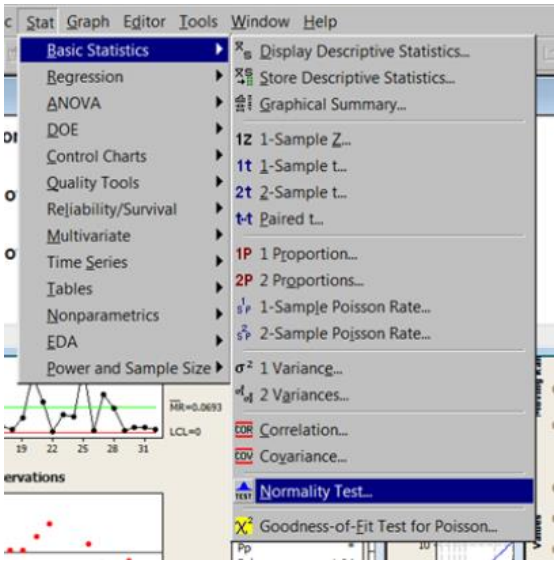
**To properly conduct a capability analysis, normality and stability must first be evaluated**

### Example 2 – Testing for Normality

Understanding the normality of the sample distribution is key to determining what tools will be used to analyze process capability. The 2 most common tools used in Minitab to test for normality are the Normality Test and the Process Capability Six-pack.

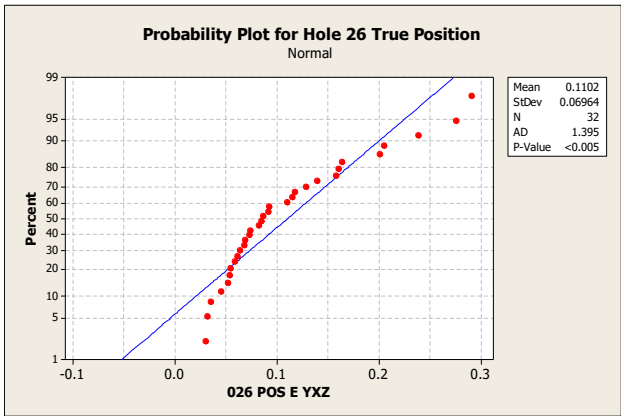
From the tool bar in Minitab, you can choose Stat > Basic Statistics > Normality Test (Figure 6) then choose the data set to check for normality. The results displayed in Figure 7 indicate that the sample distribution used in Example 1 is non-normal and therefore tools for evaluating non-normal data must be used to determine process capability.

Figure 12




2 Keys to interpreting the Normality Test is the deviation from the straight line distribution and the P-Value. Distributions with P-Values of less than 0.05 are considered non-normal distributions.

Figure 13



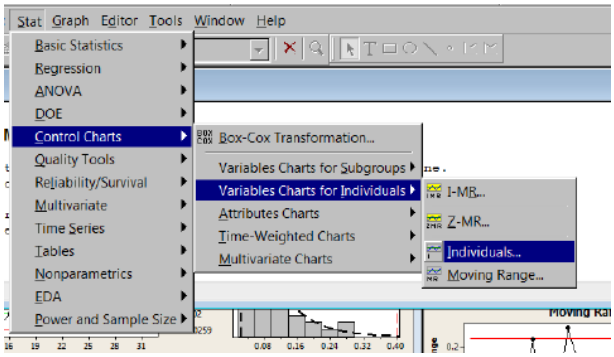

**Example 3 – Process Stability**

Process capability is highly dependent on process stability. Capability Index Numbers (Pp/Ppk) are a measurement of predictability and are directly tied to process stability. Process performance cannot be accurately predicted from unstable data.

Stability can be derived either from the SPC X-Bar and R Chart or I-Moving Range Charts from on-going process monitoring and/or from similar charts pulled from the data set in Minitab.

To assess stability in Minitab, select Stat > Control Charts > then the appropriate selection for the data set being evaluated (Figure 8). In this example we selected Variable Charts for Individuals because the data set from the Hole 26 True Position is individual samples over time. Individual (rather than I-MR) to assure the bound lower limit is taken into consideration. Similar selection process for the Moving Range chart.

Figure 14




As seen in Figure 15, all point on the individual chart are in control, indicating process stability. You'll see one point out of control in Figure 10 for the moving range. While measures should be taken to understand the cause, this single point is not considered significant and the overall process is

considered stable. It should be noted that if similar out-of-control point are detected in on-going process monitoring the process would not be considered stable.

Figure 15

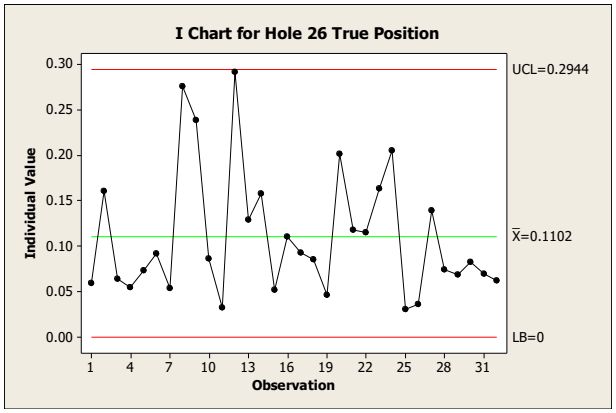
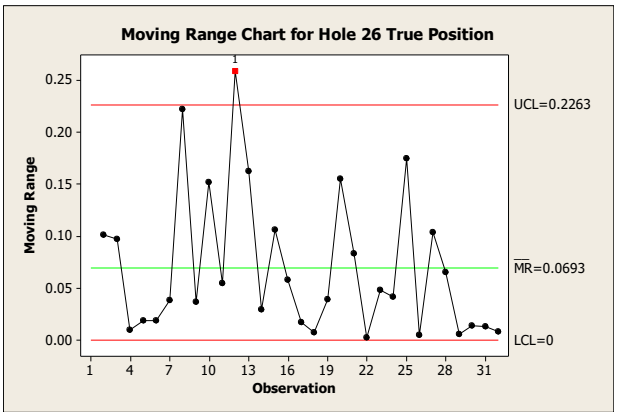



Figure 16




**Example 4 – Non-Normal Distributions**

Once a non-normal process is determined stable (Example 3), the task becomes to identify the distribution best suited for the capability analysis. The Weibull distribution is the most common and widely accepted distribution for analyzing non-normal data and is the default setting for Minitab. But before evaluating the capability using the Weibull, we must first determine if the data fits the distribution model and if there are other distribution models we would like to use.

To determine if the Weibull model is the correct distribution, and to compare other alternatives, go to the tool bar in Minitab and choose Stat > Quality Tools > Individual Distribution Identification (Figure 17).

Figure 17

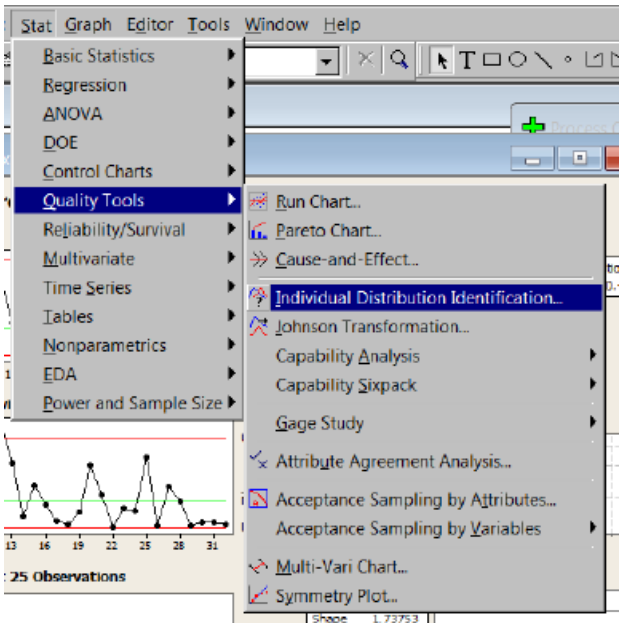



Figure 18 displays the results for all distributions and transformations for the selected data set. As seen in the table, while there are several acceptable distributions, the Weibull has a P-Value > 0.05 and is an acceptable distribution to use in determining process capability. When several distributions are acceptable for use, the AD can be used to compare and select. In general, the lower the AD the better the fit. When similar in value, choose the one you are most familiar with using. Note that using the 3-Parameter Weibull distribution may be a better choice.

The use of transformations should be reserved for when there are no acceptable distributions.

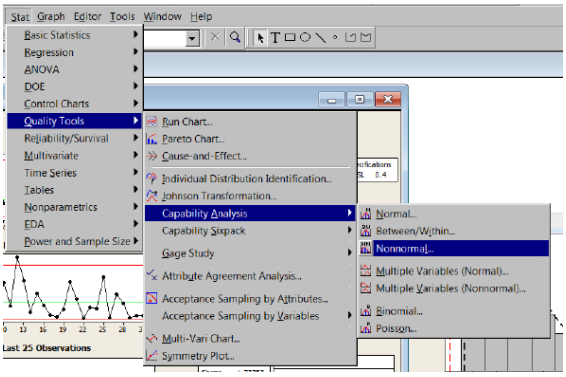
Figure 18

Goodness of Fit Test

| Distribution | AD | P |
|---|---|---|
| Normal | 1.395 | <0.005 |
| Box-Cox Transformation | 0.208 | 0.852 |
| Lognormal | 0.208 | 0.852 |
| 3-Parameter Lognormal | 0.173 | * |
| Exponential | 2.699 | <0.003 |
| 2-Parameter Exponential | 0.573 | >0.250 |
| Weibull | 0.623 | 0.097 |
| 3-Parameter Weibull | 0.225 | >0.500 |
| Smallest Extreme Value | 2.322 | <0.010 |
| Largest Extreme Value | 0.605 | 0.110 |
| Gamma | 0.451 | >0.250 |
| 3-Parameter Gamma | 0.235 | * |
| Logistic | 1.093 | <0.005 |
| Loglogistic | 0.247 | >0.250 |
| 3-Parameter Loglogistic | 0.194 | * |
| Johnson Transformation | 0.162 | 0.940 |

Once a distribution has been chosen, a capability analysis can be conducted. From the tool bar in Minitab, select Stat > Quality Tools > Capability Analysis > Non-Normal (Figure 19) then choose the proper distribution from the dropdown menu.

Figure 19




Show the results for the Weibull and 3-Parameter Weibull distributions. Two important points are:

- Both Weibull distributions indicate the process not to be capable as compared to an acceptable capability result when incorrectly applying the normal distribution model. It is important to understand the normality of your data and apply the correct distribution model.
- While application of either Weibull distribution model was correct for this data set, the differences seen in this example could be the difference in accepting or rejecting a marginal process. Always choose the model that best fits the data set.

Figure 20 – Weibull Distribution

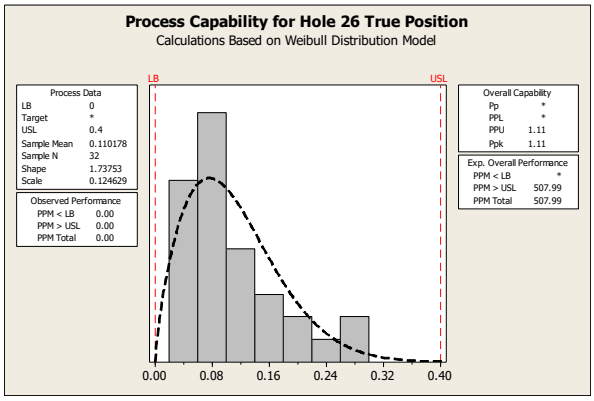
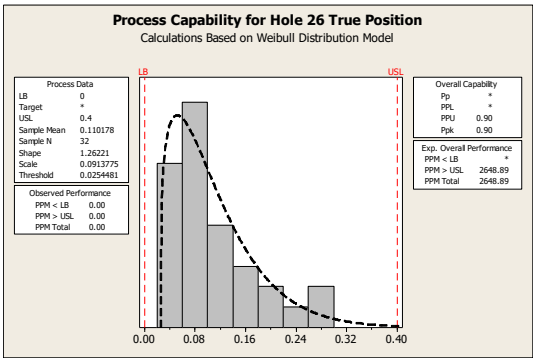



Figure 21-Parameter Weibull Distribution




**Example 5 – Data Transformations**

While every attempt should be made to identify a distribution model that fits the data set being evaluated, there will be instances where this will not be possible. In these cases, we must determine if it is possible to transform the data into a usable format for capability analysis.

Using the instructions described in Example 4, the Individual Distribution Identification was run a returned the results displayed for the study data set. Reviewing the P-Values, we see the data does not fit any of the distribution models, however, a Johnson Transformation is possible.

Figure 22

Goodness of Fit Test

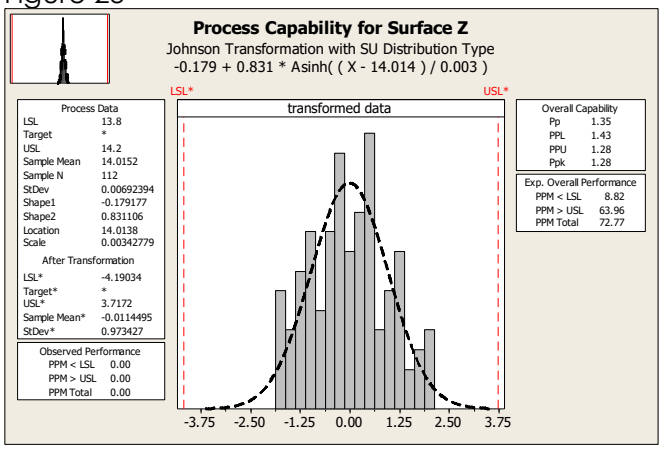
| Distribution | AD | P |
|---|---|---|
| Normal | 1.788 | <0.005 |
| Box-Cox Transformation | 1.764 | <0.005 |
| Lognormal | 1.784 | <0.005 |
| 3-Parameter Lognormal | 1.714 | * |
| Exponential | 51.325 | <0.003 |
| 2-Parameter Exponential | 16.509 | <0.010 |
| Weibull | 6.281 | <0.010 |
| 3-Parameter Weibull | 6.009 | <0.005 |
| Smallest Extreme Value | 6.290 | <0.010 |
| Largest Extreme Value | 1.188 | <0.010 |
| Gamma | 1.770 | <0.005 |
| 3-Parameter Gamma | 0.977 | * |
| Logistic | 0.867 | 0.014 |
| Loglogistic | 0.866 | 0.014 |
| 3-Parameter Loglogistic | 0.822 | * |
| Johnson Transformation | 0.399 | 0.359 |

Following the instructions outlined in Example 4, we run the capability analysis for non-normal data, this time selecting the Johnson Transformation instead of a distribution.

Displays the results of the capability analysis after transformation.

- Note that the original distribution is shown in the upper left had corner. As the data is transformed the margin of error in predicting process performance increases, thus, original distribution that appears to be well within the specification boundaries will potentially produce significantly lower capability results when transformed.
- Based on the transformation, the capability of the process represented in Figure 17 is marginal

Figure 23




**Example 6 – Unusable Data**

There are times when the data is determined to be non-normal and there are no distribution or transformation models that fit the data and/or the data is not stable. In these cases the process must be considered not capable, appropriate product certification and process corrective actions taken, and new sample data collected.

Although the original output indicates a process capability of Ppk 5.09, the capability index cannot be used due to the instability shown in the X-Bar chart and the P-Value of <0.5 on the Normal Distribution graph. Any capability evaluation should stop given the process instability.

Assuming for a moment that the process was stable but the data was non-normal, The Individual Distribution Identification fails to identify a suitable distribution or transformation model.

Figure 24

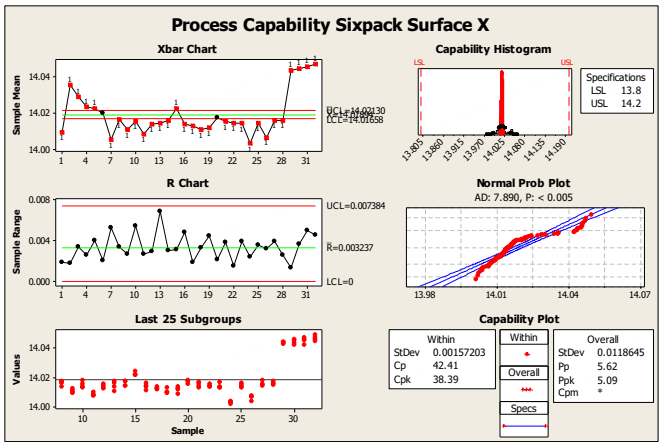



Figure25

Goodness of Fit Test

| Distribution | AD | P |
|---|---|---|
| Normal | 7.890 | <0.005 |
| Box-Cox Transformation | 7.807 | <0.005 |
| Lognormal | 7.876 | <0.005 |
| 3-Parameter Lognormal | 6.942 | * |
| Exponential | 58.622 | <0.003 |
| 2-Parameter Exponential | 11.831 | <0.010 |
| Weibull | 12.096 | <0.010 |
| 3-Parameter Weibull | 11.889 | <0.005 |
| Smallest Extreme Value | 12.109 | <0.010 |
| Largest Extreme Value | 2.949 | <0.010 |
| Gamma | 7.899 | <0.005 |
| 3-Parameter Gamma | 3.060 | * |
| Logistic | 5.824 | <0.005 |
| Loglogistic | 5.814 | <0.005 |
| 3-Parameter Loglogistic | 5.400 | * |

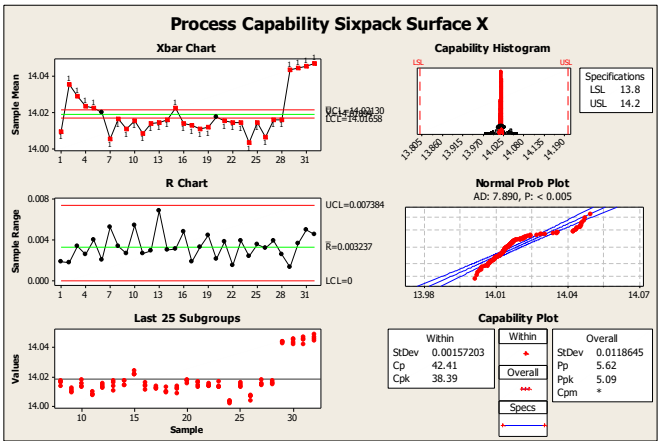
**Example 7 – Minitab Capability Six-pack**

The use of the Capability Sixpack is a valuable tool in combining several of the steps described in the earlier examples into one comprehensive view of the process and streamlining the analysis. The following 2 examples demonstrates the power of the Capability Sixpack.

A quick analysis of the process indicates:

- X-Bar chart shows process not stable. No need to proceed with capability analysis. Identify the cause of the initial drift and ending shift
- Normal Probability Plot P-Value <0.5 indicates non-normal data, probably due to the shift and drifts seen in the X-Bar chart. No need to find distribution model until issue resolved.
- The combination of the X-Bar chart and Probability Plot renders the Capability Plot invalid.
- The individual value plots in the Last 25 subgroups graph shows a tight pattern in each subgroup, indicating minimal part-to-part variation and adds validity to the within calculation in the Capability Plot.
- The Capability Histogram would indicate that elimination of the shift should lead to high capability and that, although no capability conclusions can be drawn from the data, risk to the customer should be minimal while correcting the process.

Figure 26




A similar look at the process in shows:

- Stable process as demonstrated by the I-Chart and Moving Range Charts. Continue with capability analysis.
- The process fits the Weibull distribution as seen in Probability Plot. Continue with capability analysis
- The Capability Plot indicates that the process is not capable and further actions must be taken.
- The Capability Histogram reveals a significant distribution within the tail.

# APPENDIX C

## Gauge R&R and Leak Tester

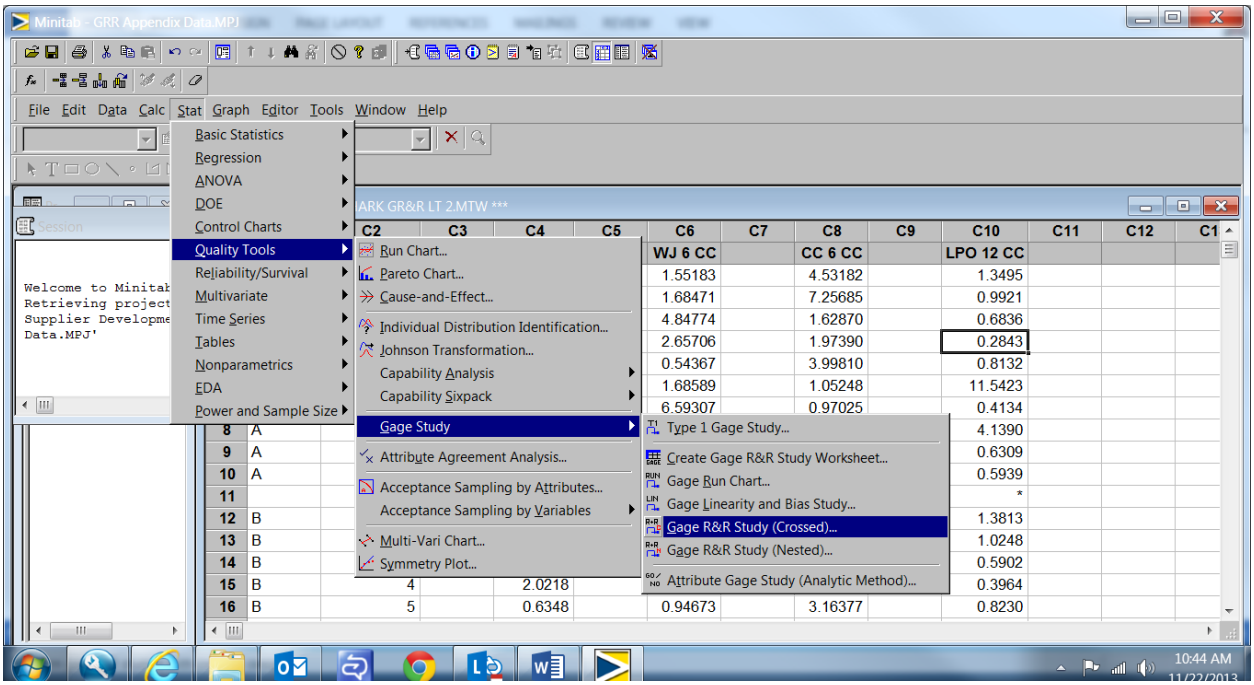
Note: All examples are created using Minitab 15

Example 1 – Standard ANOVA GRR

Most software applications, including Minitab, will return varying GRR results depending on how the options are selected. Nemak requires our suppliers to use 6 standard deviations to calculate GRR using the ANOVA method.

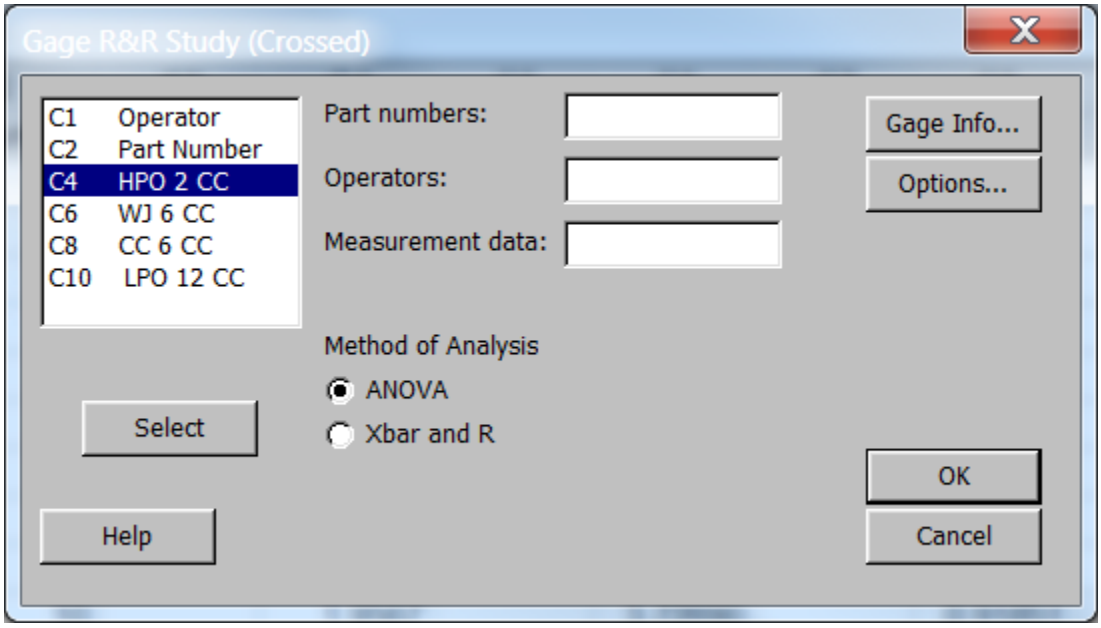
From the Minitab Stat dropdown menu (Figure 1) select the Gage R&R Study (Crossed) option

Figure 1



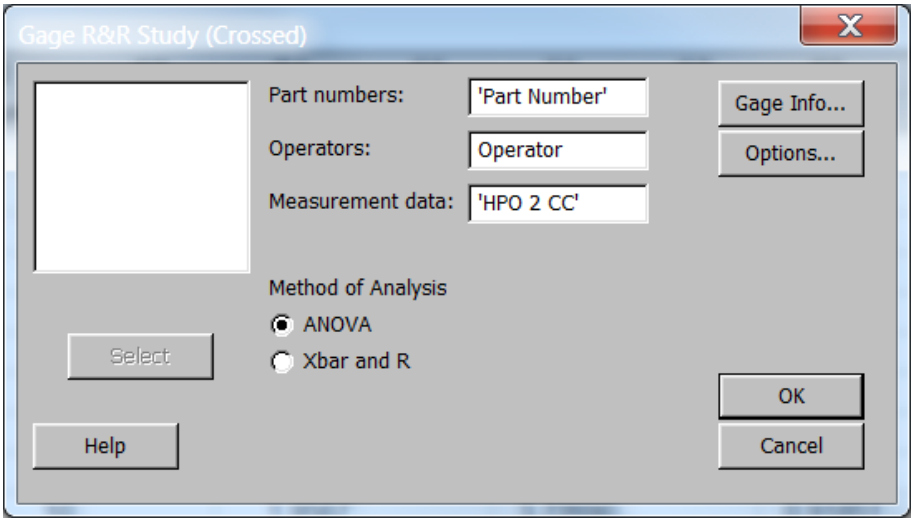

The next window (Figure 2) allows you to choose the ANOVA or Xbar and R method and to select the corresponding columns in the worksheet for the gage to be studied. It also provided access to additional windows to input gage information, input the specification tolerance, and select the study variation (standard deviations) used to calculate the GRR. Choosing the wrong inputs in any of these areas will result in an inaccurate assessment of gage performance.

Figure 2




After selecting the appropriate columns for Part Numbers, Operators, and Measurement Data (Figure 3), select ANOVA for the method of Analysis. Gage information for the GRR 6 Pack can be entered using the Gage Info button. Once this is completed, select the Options button to complete your choices for the desired gage study.

Figure 3



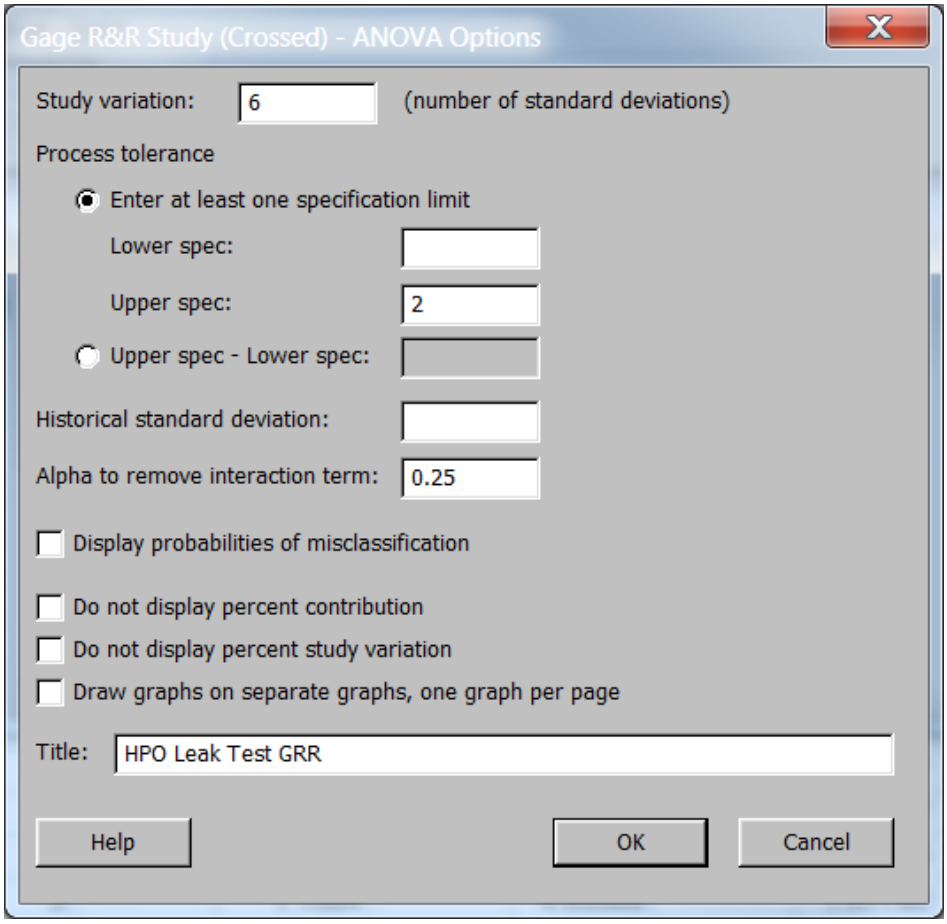
The two critical choices in the Options window (Figure 4) are the Study Variation and Process Tolerance. Nemak requires our suppliers to use 6 standard deviation for all GRR. Later versions of Minitab will default to 6, but it is important to verify as earlier versions used 5.15.

It is important to input the Process Tolerance properly to reflect weather a unilateral or bilateral tolerance applies. For unilateral tolerances, only input the upper or lower limit as it applies to the print (Figure 4) and DO NOT place a "0" for the bound limit. Doing so will treat it as a bilateral tolerance.

Bilateral tolerances can be represented by either inputting the upper and lower specification limits in the appropriate boxes or the tolerance spread.

For this example, we will demonstrate a unilateral tolerance.

Figure 4



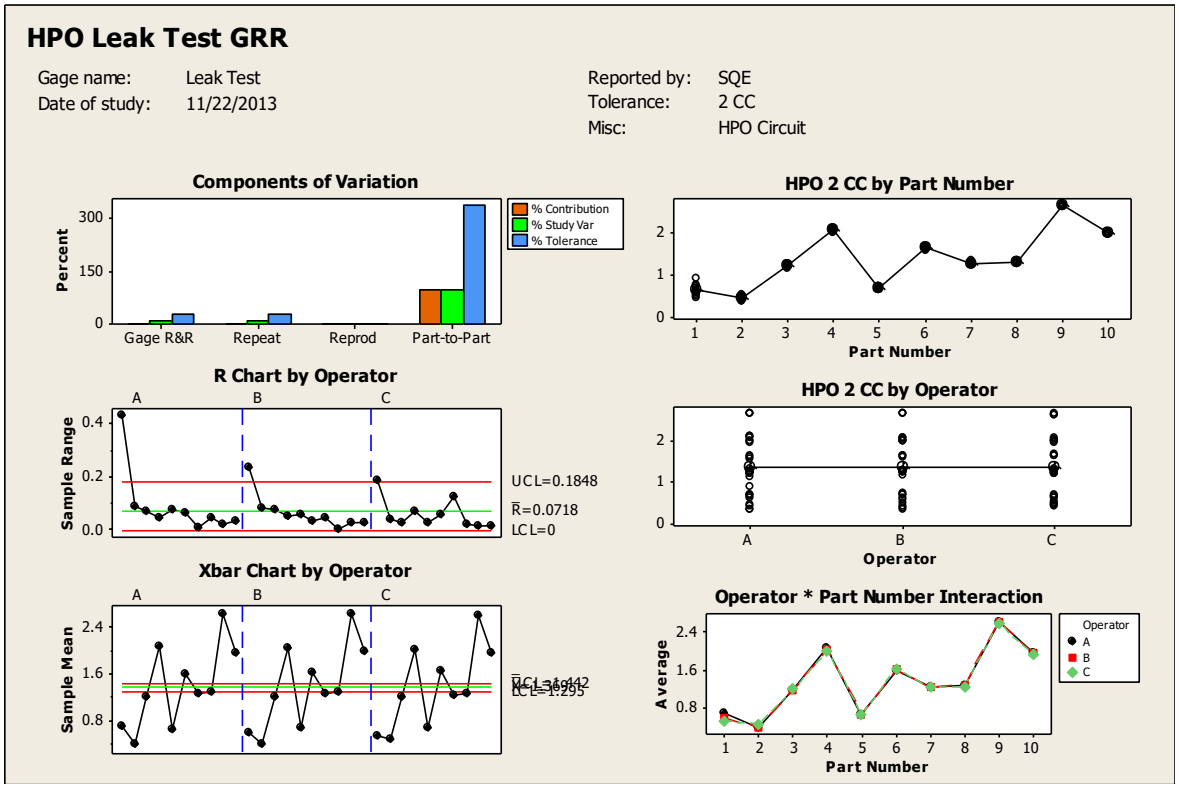
The selected choices will result the following GRR Six-pack (Figure 5) as well as the corresponding calculated results in the project session folder.

Items to look for in the Six-pack:

- Components of Variation – The bars for GRR, Repeatability, and Reproducibility should be very small to non-existent as compared to Part to Part
- R Chart by Operator – All data points should be in control and should have similar patterns
- Xbar Chart by Operator – Should be out or control due to the sample spread but similar patterns between operators
- By Part Run Chart – Tight pattern within each part
- By Operator Run Chart – Similar spread and average between operators
- Operator* Part Number Interactions – Pattern should be similar and very little to no spread on individual parts

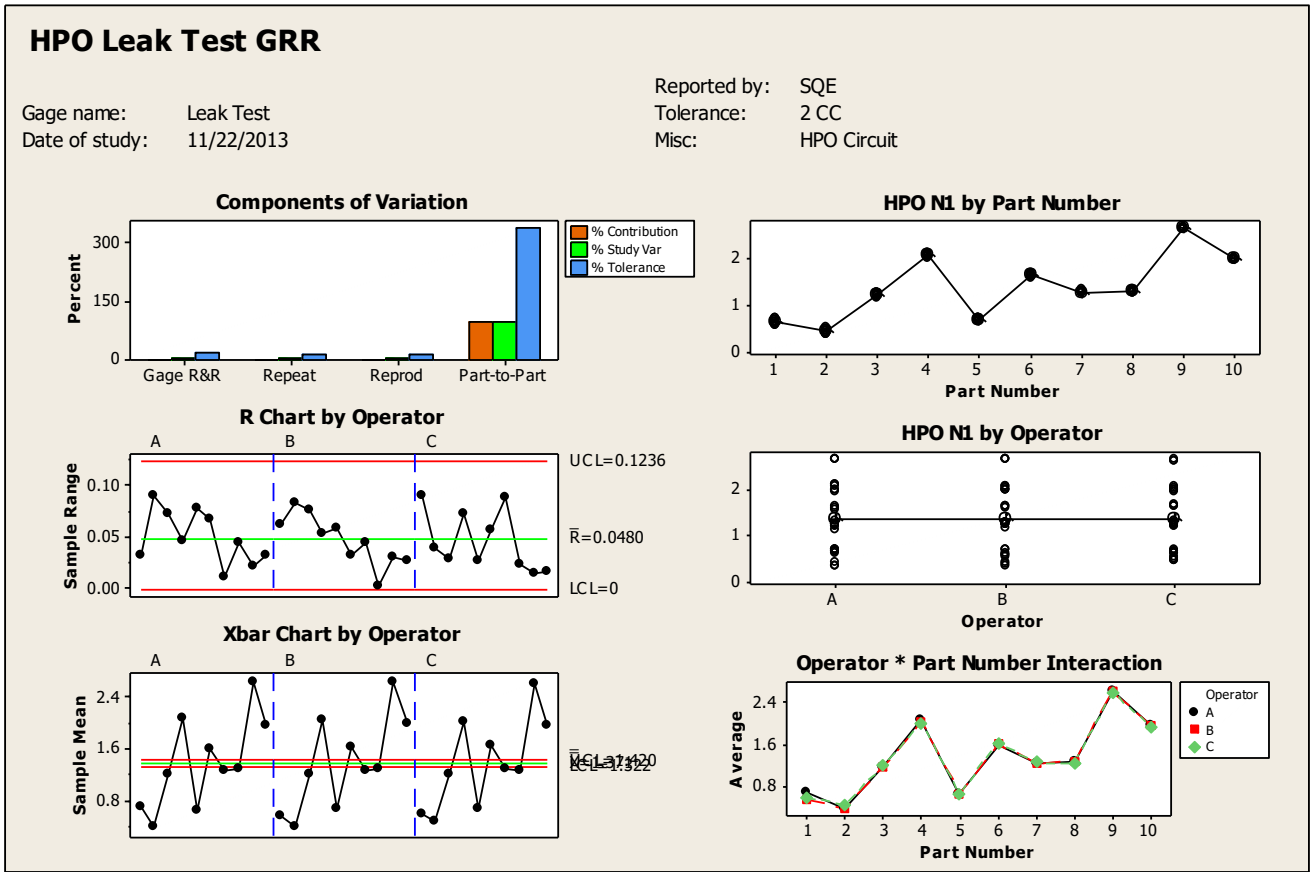
In the example seen in Figure 5, the R Chart by Operator reveals a concern with Part #1 as it is out of control for all 3 operators. Further review of the six pack show some abnormalities for part #1 in the by Part Number run chart and the Operator*Part Interaction graphs. Because all other component appear consistent, the initial analysis indicates a need to review the part before pursuing any gage modifications.

Figure 5



After determining that a raised edge on part #1 was affection GRR, the raised edge was removed and the study reran with the acceptable results shown in Figure 6.

Figure 6




This example demonstrate the importance of reviewing all elements of the measurement system, including component presentation. Applying this example a hard measurement system rather than leak test, considerations should be made toward process improvement to eliminate the raised edge if detrimental to performance or to measurement device to avoid the areas in which a raised edge could occur.

While the Six-pack gives a good visual indicator, the data must also be reviewed and understood.

As previously indicated, the calculated results are displayed in the Minitab Project Session folder.

The first element of the data to review are the P-Values in the two-way ANOVA. If there is no ANOVA table this indicates the study was completed using the Xbar & R Method. P-Values > 0.05 indicate no significant contribution while a P-Values < 0.05 indicates the potential of significant contribution.

The general expectation would be to see < 0.05 (typically "0") for the part by virtue of the sample selection for the study, and > 0.05 for the operator.

The example below (Figure 7) reflect the expected result for a good GRR.

Figure 7

**Two-Way ANOVA Table with Interaction**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Part Number | 9 | 40.9451 | 4.54945 | 1658.95 | 0.000 |
| Operator | 2 | 0.0008 | 0.00038 | 0.14 | 0.872 |
| Part Number * Operator | 18 | 0.0494 | 0.00274 | 3.30 | 0.000 |
| Repeatability | 60 | 0.0499 | 0.00083 | | |
| Total | 89 | 41.0451 | | | |

Alpha to remove interaction term = 0.25

The next element of the data reflects the % of contribution for each element. Generally, we expects of the GRR to be less than 1-1.5% with part-to-part in the high 90's. The results in Figure 8 reflect these expectations.

Figure 8

| Source | VarComp | %Contribution (of VarComp) |
|---|---|---|
| Total Gage R&R | 0.001468 | 0.29 |
| Repeatability | 0.000831 | 0.16 |
| Reproducibility | 0.000637 | 0.13 |
| Operator | 0.000000 | 0.00 |
| Operator*Part Number | 0.000637 | 0.13 |
| Part-To-Part | 0.505190 | 99.71 |
| Total Variation | 0.506658 | 100.00 |

The final element of the data reflect the actual GRR calculations. As previously stated, Nemak uses the % of Study variation as a measure of acceptance. This is primarily because the % of Study evaluates gage performance regardless specification based on the sample set presented while the % of Tolerance measures against a set value which can vary significantly from the actual population represented but the sample set. However, when large variations are seen between % of Study and % of Tolerance, further investigation must be completed prior to final sign-off.

In addition to the % Variation, the last element is reviewed the Number of Distinct Categories for a minimum number of 5 to assure the measurement system has sufficient discrimination to detect variation, and verify that the study variation is calculated using 6 standard deviations.

In Figure 9, we see that there are 26 distinct categories, validating the measurement systems ability to detect variation. We also see that the GRR for study variation is calculated using 6 standard deviation (6 * SD) and that the % of Study Variation is <10% (5.38%).

While all indicators have met the acceptance criteria and the measurement system can be accepted, we must also evaluate the disparity between % of Study and % of Tolerance seen in this study. This will be looked at in Example 2.

Figure 9

| Source | StdDev (SD) | Study Var (6 * SD) | %Study Var (%SV) | %Tolerance (SV/Toler) |
|---|---|---|---|---|
| Total Gage R&R | 0.038319 | 0.22992 | 5.38 | 18.27 |
| Repeatability | 0.028834 | 0.17300 | 4.05 | 13.75 |
| Reproducibility | 0.025239 | 0.15143 | 3.55 | 12.04 |
| Operator | 0.000000 | 0.00000 | 0.00 | 0.00 |
| Operator*Part Number | 0.025239 | 0.15143 | 3.55 | 12.04 |
| Part-To-Part | 0.710767 | 4.26460 | 99.85 | 338.97 |
| Total Variation | 0.711799 | 4.27080 | 100.00 | 339.46 |

Number of Distinct Categories = 26

## Example 2 – Effects of GRR Samples Outside of the Specification Tolerance

As stated in Example 1, the % of Study evaluates gage performance regardless specification based on the sample set presented while the % of Tolerance measures against a set value which can vary significantly from the actual population represented but the sample set. When the sample set is skewed to a tolerance limit or exceeds the limit, the resulting GRR generally results in a higher % of Tolerance variation.

In Example 1, we saw that a sample set that resulted in an acceptable GRR of 5.38 % of Study Variation also yielded a % of Tolerance Variation of 18.27% (Figure 9). Revisiting the GRR Six-pack (Figure 6), we see that samples 4, 9 & 10 appear to be at or above the specification tolerance. Review of the worksheet confirms that 4 and 9 are above the specification. Replacing these samples with parts below the specification limits but with similar variation yields the results seen in Figure 10.

It is important to understand the impact that samples above the specification have on a GRR (in this case 3.5% of Tolerance Variation) and to weigh this against the expected population.

Figure 10

| Source | StdDev (SD) | Study Var (6 * SD) | %Study Var (%SV) | %Tolerance (SV/Toler) |
|---|---|---|---|---|
| Total Gage R&R | 0.036614 | 0.21969 | 6.67 | 14.77 |
| Repeatability | 0.027114 | 0.16268 | 4.94 | 10.93 |
| Reproducibility | 0.024606 | 0.14764 | 4.48 | 9.92 |
| Operator | 0.000000 | 0.00000 | 0.00 | 0.00 |
| Operator*Part Number | 0.024606 | 0.14764 | 4.48 | 9.92 |
| Part-To-Part | 0.547866 | 3.28720 | 99.78 | 220.93 |
| Total Variation | 0.549088 | 3.29453 | 100.00 | 221.43 |

## Example 3 – ANOVA vs. Xbar and R Method

Because the operator and/or environmental conditions can have a significant impact on the measurement system, Nemak require our suppliers to use the ANOVA method to calculate GRR to account for these interactions.

As seen in Example 2, the ANOVA GRR identified 4.48 % of Study Variation and 9.92% of Tolerance Variation in Reproducibility driven by the Operator * Part interaction, which contributed significantly to the overall GRR of 6.67% and 14.77% respectfully.

Figure 10 (Repeated)

| Source | StdDev (SD) | Study Var (6 * SD) | %Study Var (%SV) | %Tolerance (SV/Toler) |
|---|---|---|---|---|
| Total Gage R&R | 0.036614 | 0.21969 | 6.67 | 14.77 |
| Repeatability | 0.027114 | 0.16268 | 4.94 | 10.93 |
| Reproducibility | 0.024606 | 0.14764 | 4.48 | 9.92 |
| Operator | 0.000000 | 0.00000 | 0.00 | 0.00 |
| Operator*Part Number | 0.024606 | 0.14764 | 4.48 | 9.92 |
| Part-To-Part | 0.547866 | 3.28720 | 99.78 | 220.93 |
| Total Variation | 0.549088 | 3.29453 | 100.00 | 221.43 |

The Xbar & R method ignores this interaction, thus eliminating a significant part of the measurement system in the study and artificially inflating the MSA results as seen (Figure 11).

Figure 11

| Source | StdDev (SD) | Study Var (6 * SD) | %Study Var (%SV) | %Tolerance (SV/Toler) |
|---|---|---|---|---|
| Total Gage R&R | 0.025318 | 0.15191 | 5.14 | 10.21 |
| Repeatability | 0.025318 | 0.15191 | 5.14 | 10.21 |
| Reproducibility | 0.000000 | 0.00000 | 0.00 | 0.00 |
| Part-To-Part | 0.491558 | 2.94935 | 99.87 | 198.23 |
| Total Variation | 0.492210 | 2.95326 | 100.00 | 198.49 |

Example 4 – Using the Bilateral vs. Unilateral

As indicated in previous examples, inputting the specification limits incorrectly can significantly influence the GRR results, leading to an incorrect assessment of the measurement system. The examples shown thorough out this section have been for a unilateral tolerance. Figure 4 indicated the correct method to enter a unilateral tolerance, with the corresponding results shown in Figure 10 (repeated below).

Figures 11 and 12 demonstrate the incorrect methods of entering a unilateral tolerance. While entering the tolerance incorrectly does not affect the % of study variation, it can have a significant impact of the % of tolerance results as demonstrated in Figure 13 below.

Understand the tolerance the measurement system is designed for and use caution when entering the tolerance into Minitab.

Figure 11

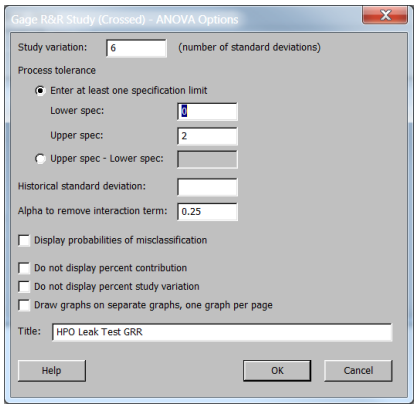



Figure 12

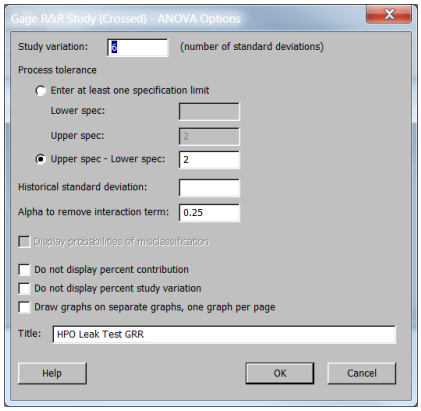



Figure 10 (Repeated)

| Source | StdDev (SD) | Study Var (6 * SD) | %Study Var (%SV) | %Tolerance (SV/Toler) |
|---|---|---|---|---|
| Total Gage R&R | 0.036614 | 0.21969 | 6.67 | 14.77 |
| Repeatability | 0.027114 | 0.16268 | 4.94 | 10.93 |
| Reproducibility | 0.024606 | 0.14764 | 4.48 | 9.92 |
| Operator | 0.000000 | 0.00000 | 0.00 | 0.00 |
| Operator*Part Number | 0.024606 | 0.14764 | 4.48 | 9.92 |
| Part-To-Part | 0.547866 | 3.28720 | 99.78 | 220.93 |
| Total Variation | 0.549088 | 3.29453 | 100.00 | 221.43 |

Figure 13

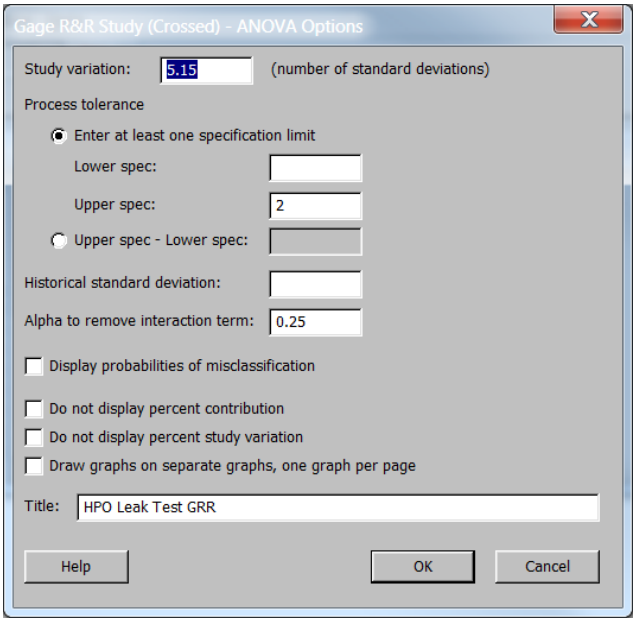
| Source | StdDev (SD) | Study Var (6 * SD) | %Study Var (%SV) | %Tolerance (SV/Toler) |
|---|---|---|---|---|
| Total Gage R&R | 0.036614 | 0.21969 | 6.67 | 10.98 |
| Repeatability | 0.027114 | 0.16268 | 4.94 | 8.13 |
| Reproducibility | 0.024606 | 0.14764 | 4.48 | 7.38 |
| Operator | 0.000000 | 0.00000 | 0.00 | 0.00 |
| Operator*Part Number | 0.024606 | 0.14764 | 4.48 | 7.38 |
| Part-To-Part | 0.547866 | 3.28720 | 99.78 | 164.36 |
| Total Variation | 0.549088 | 3.29453 | 100.00 | 164.73 |

## Example 5 – 5.15 vs. 6.0 Standard Deviations

Nemak has increased its standard deviation requirement to 6.0 to be in line with the latest AIAG standards and to minimize the risk of gage error. As shown in Figure 4 above, verify that your version of Minitab defaults to 6.0 standard deviations. If your version defaults to 5.15 (Figure 14), change the entry to 6.0 before calculating the GRR.

Figure 15 demonstrates that both the % of study and the % of tolerance are affected by the standard deviation. Figure 10 repeated below for comparison purposes.

### Figure 14




### Figure 15

| Source | StdDev (SD) | Study Var (5.15 * SD) | %Study Var (%SV) | %Tolerance (SV/Toler) |
|---|---|---|---|---|
| Total Gage R&R | 0.036614 | 0.18856 | 6.67 | 12.67 |
| Repeatability | 0.027114 | 0.13964 | 4.94 | 9.38 |
| Reproducibility | 0.024606 | 0.12672 | 4.48 | 8.52 |
| Operator | 0.000000 | 0.00000 | 0.00 | 0.00 |
| Operator*Part Number | 0.024606 | 0.12672 | 4.48 | 8.52 |
| Part-To-Part | 0.547866 | 2.82151 | 99.78 | 189.63 |
| Total Variation | 0.549088 | 2.82780 | 100.00 | 190.06 |

### Figure 10 (Repeated)

| Source | StdDev (SD) | Study Var (6 * SD) | %Study Var (%SV) | %Tolerance (SV/Toler) |
|---|---|---|---|---|
| Total Gage R&R | 0.036614 | 0.21969 | 6.67 | 14.77 |
| Repeatability | 0.027114 | 0.16268 | 4.94 | 10.93 |
| Reproducibility | 0.024606 | 0.14764 | 4.48 | 9.92 |

| | | | | |
|---|---|---|---|---|
| Operator | 0.000000 | 0.00000 | 0.00 | 0.00 |
| Operator*Part Number | 0.024606 | 0.14764 | 4.48 | 9.92 |
| Part-To-Part | 0.547866 | 3.28720 | 99.78 | 220.93 |
| Total Variation | 0.549088 | 3.29453 | 100.00 | 221.43 |

## Example 6 – All the Wrong Choices

Figure 16 below demonstrates how making all the wrong selections X- Bar and R, 5.15, Bi-Lateral) can inadvertently impact the accept/reject decision on an MSA, particularly when considering the % of tolerance.

## Figure 16

| Source | StdDev (SD) | Study Var (5.15 * SD) | %Study Var (%SV) | %Tolerance (SV/Toler) |
|---|---|---|---|---|
| Total Gage R&R | 0.025318 | 0.13039 | 5.14 | 6.52 |
| Repeatability | 0.025318 | 0.13039 | 5.14 | 6.52 |
| Reproducibility | 0.000000 | 0.00000 | 0.00 | 0.00 |
| Part-To-Part | 0.491558 | 2.53153 | 99.87 | 126.58 |
| Total Variation | 0.492210 | 2.53488 | 100.00 | 126.74 |

## Figure 10 (Repeated for reference)

| Source | StdDev (SD) | Study Var (6 * SD) | %Study Var (%SV) | %Tolerance (SV/Toler) |
|---|---|---|---|---|
| Total Gage R&R | 0.036614 | 0.21969 | 6.67 | 14.77 |
| Repeatability | 0.027114 | 0.16268 | 4.94 | 10.93 |
| Reproducibility | 0.024606 | 0.14764 | 4.48 | 9.92 |
| Operator | 0.000000 | 0.00000 | 0.00 | 0.00 |
| Operator*Part Number | 0.024606 | 0.14764 | 4.48 | 9.92 |
| Part-To-Part | 0.547866 | 3.28720 | 99.78 | 220.93 |
| Total Variation | 0.549088 | 3.29453 | 100.00 | 221.43 |

# APPENDIX D

# Change Management

The supplier is responsible for controlling all aspects of change and communicating to Nemak using the required process, outlined below.

Parts received by Nemak must always be produced by a production process approved by a PPAP, PSW, or Deviation. Suppliers must not ship, and will not be paid for shipments made without an approved PSW. Supplier PPAP documentation should always reflect the current process, and the process as approved by Nemak.

## Supplier Change Requests

Suppliers and sub-suppliers shall not make changes without written approval from Nemak, using the standardized approval process.

Types of changes include;

Location (supplier or sub-supplier)
Facilities
Processes
Process Flow
Equipment
Tooling
Material or Material Source
Product Design (or any change which may affect product design or function)

Changes to any of the above will require approval by Nemak, and in many cases, their customer(s). The Nemak Representative will refer to Customer Specific Requirements for additional approval requirements as applicable.
FMEA's and control plans shall be reviewed, as applicable, to ensure that all process related issues have been identified, addressed and resolved.
Change types may be broken down into two categories, Permanent Change or Temporary Change.

**Permanent Change Request**
Permanent changes must follow the Nemak Change process. The appropriate Nemak Supplier Request for Change must be used and submitted to the Nemak Representative for approval prior to making any changes. See Figure 1 for a sample of the Supplier Request for Change form.
If the request is rejected, the supplier cannot move forward with the proposed change.

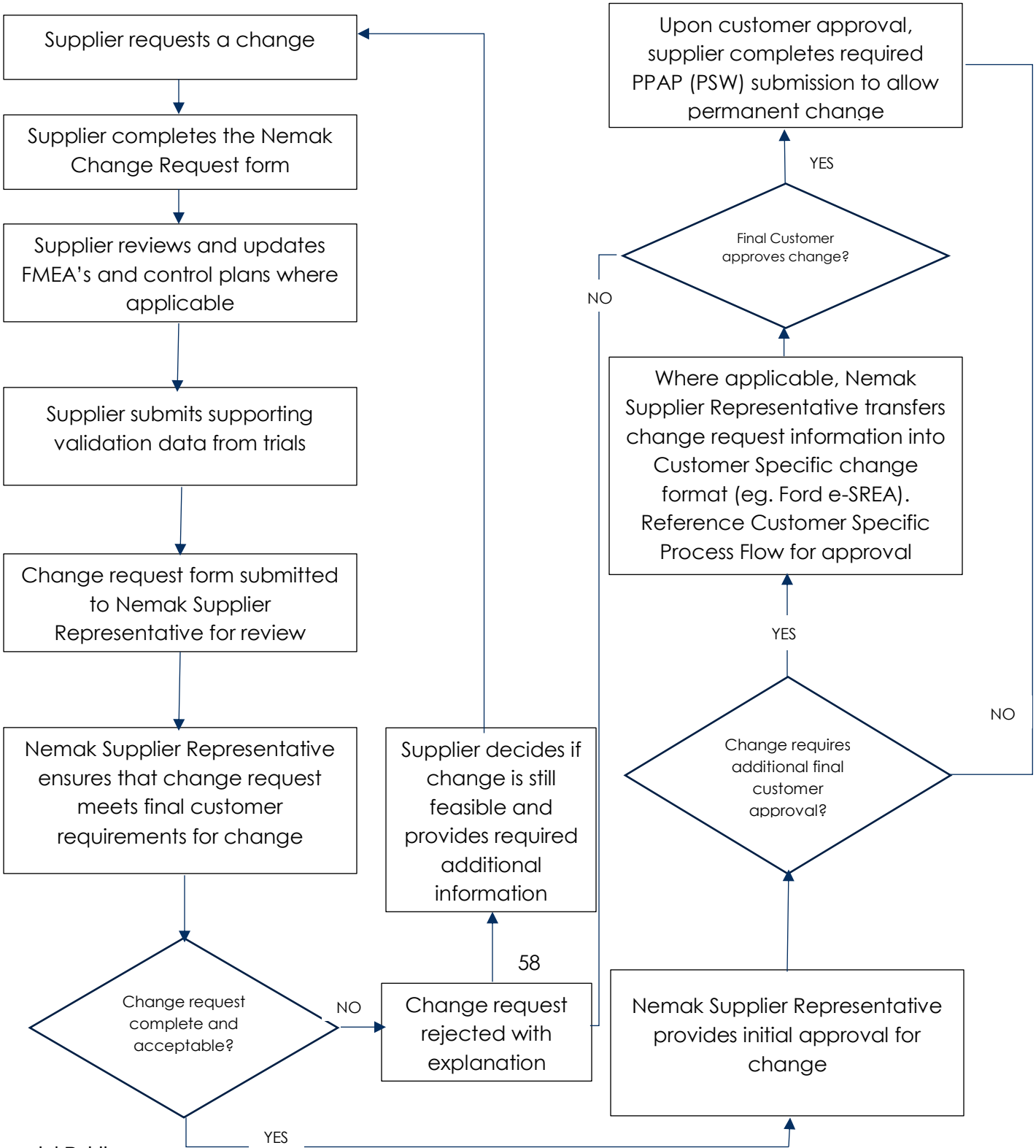
If the request is approved, the supplier is required to follow the APQP and PPAP processes to implement the change. An approved request does not mean authorization to ship changed parts or parts manufactured on a changed process.

**Temporary Change Request**

Temporary changes may be requested for various reasons and are intended for changes such as;
Minor product or process deviations which do not affect the function of the part
DOE or other trails

Such changes are temporary in nature and may not require that the Nemak Change process be followed in its entirety. Other forms of approval, such as temporary written waivers, suppliers internal change request forms or WERS Alerts, may be authorized for temporary changes. The Nemak Representative will define which process is to be used for each individual case.

**Supplier Change Request Process Flow**



## Approvals

| ***APPROVER (S)*** | | | | |
|---|---|---|---|---|
| Department | Title | Name | Signature | Date |
| Supplier Quality Assurance US/CAN | Supplier Quality Assurance Manager | Todd Stockwell | *Todd Stockwell* | 28th August 2019 |
| Supplier Quality Assurance EUR | Supplier Quality Assurance Manager | Alex Fuhr | *Alex Fuhr* | 28th August 2019 |
| Supplier Quality Assurance AS | Supplier Quality Assurance Manager | Chen, Shawn; | *Chen, Shawn;* | 28th August 2019 |
| Supplier Quality Assurance MEX | Supplier Quality Assurance Manager | Omar Munguia | *Omar Munguia* | 28th August 2019 |

## Revision History

| ***REVISION(S)*** | | | | |
|---|---|---|---|---|
| N° | Retraining (Y/N) | Date | Page (s) | Description |
| 0 | N | 07/Dec/17 | - | Initial Release |
| 1 | N | 28/Aug/19 | - | 2.5 Environmental, Health and Safety Certification<br>2.5.1 Global Sustainability Business Code for Suppliers<br>2.8 IT Security Requirements<br>11 Statement of responsibility |