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Appendix 1
Version 03

Supplier Quality Assurance Manual
Appendix 1
(SQAM Appendix 1)

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NSK Ltd.
Quality Assurance Division Headquarters

1. Preface

This document summarizes the quality control procedures in the Supplier Quality Assurance Manual. The quality control procedures have two types; one is that the NSK representative requests to the supplier and the other is that the supplier reports to the NSK representative. The format of the quality form is attached with this manual. However, the supplier shall follow the instructions from the NSK representative as several formats of the quality forms are used by the plants.

The address of each form shall be issued the form in accordance with the company name to supply the products/parts, the plant name, and the department name.

2. List of management procedures

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Procedure 1: Notification of quality assurance head and environmental management head

(1) Scope

This applies when the Quality Assurance Officer and the Environmental Management Officer from the supplier are appointed newly or changed.

(2) Purpose

In order to actively promote various matters related to quality assurance and environmental management for products/ parts delivered by supplies, the purposes are to register the Quality Assurance Officers and the Environmental Management Officers to NSK and operate quality assurance activities and environmental management activities smoothly.

(3) Responsibilities and Selection of Quality Assurance Officer

The main Quality Assurance Officer is responsible as the Executive Officer for Quality Assurance operations at the Supplier. Therefore, the registrant shall be the Executive Officer at the Quality Assurance.

(4) Selection of Deputy Quality Assurance Officer

1) The deputy Quality Assurance Manager shall be selected the practical representative who can take practical actions (general manager of the Quality Assurance Department) for each plant or each product type. However, the Quality Assurance Department Manager is responsible for this task even if it may be duplicated.
2) For the trading company, the officer of quality assurance at the manufacturing company shall be the Quality Assurance Executive Officer.

(5) Responsibility and Selection of the Environmental Management Officer

The Environmental Management Officer shall take responsible as the Executive Officer of Environmental Management operations at the supplier. The registrant shall be the Executive Officer at Environmental Management.

(6) Notification procedure

The supplier shall fill in and submit the suppliers' name, the title, name and selection for the main Quality Assurance Officer/ deputy Quality Assurance Officer and Environmental Management Officer, and the date of selection/ change in the "Notification of Selection/ Change of Quality Assurance Officer and Environmental Management Officer" (Form 1-1).

For the Deputy Quality Assurance Officer, the supplier shall enter the name of the plant or manufacturing company and the others.

(7) Change notification procedure

When the supplier needs to change the main Quality Assurance Office/ deputy Quality Assurance Officer and Environmental Management Officer by organizational changes or personnel changes, the supplier shall submit the selection/ change notification to each NSK representative.

Procedure 2: Management and Notification of Environmentally Harmful Substances

(1) Scope

This applies to the management of environmentally harmful substances contained in products/ parts which the supplier delivers to NSK, and the management of the "NSK Group Green Procurement Standards".

* Specific examples for the products to be delivered

Usage	Content	Specific example for delivered product
Parts/ Materials	Parts/ materials used in products, finished products, semi-finished products, etc.	Regin, rubber, grease, oil, solder, surface treatment (plating etc.), steel, nonmetal materials, machined parts, screw, sensor, motor, controller, electronic components, etc.
Auxiliary materials	Material that are used and adhered for products and shipped	Rust-preventive oil, adhesive, paint, tape, label, instruction manual, ink, markers, etc.
Production auxiliary materials	Tools used in the production process such as oils, grindstones, cutting tools, jigs, etc.	Heat treatment oil, processing oil (forging/ cutting/ grinding), surface treatment chemicals, cleaning liquids, solvents (thinner, etc.), intermediate rust-preventive oil, cutting tools, grindstones, jigs, etc.
Packaging Packing materials	Materials used for carriage and transporting products	Plastic boxes, trays, plastic bags, plastic sheets, stretch film, cushioning materials, pallet, wooden frame, cardboard, tape, cable ties, labels, printing inks, etc.

(2) Purpose

The purpose is to manage and comply with environmentally harmful substances contained in or adhered to products/ parts that the supplier delivers to NSK.

(3) Definition of Terms

1) NSK Group Green Procurement Standards

Procurement standards for parts and materials established to comply with environmental laws and regulations and NSK self-regulation standards

2) Environmentally Harmful Substances（Substance of Concern）

Substances that interfere with the conservation of the environment, including ecosystems, or the maintenance of human and animal health, and substances that may cause such problems

3) ELV (End of Life Vehicle) Directive: Directive for discarded automobiles in Europe

European Directive on restrictions on the Use of Hazardous Metals (Cadmium, Lead, Mercury, Hexavalent Chromium) in Automobile Parts

* In principle, the use of these four substances is prohibited in automobiles sold after July 2003.

4) IMDS (International Material Data System)

System for managing information such as material standards, weight and contained chemical substances

Automobiles require disclosure of a chemical composition with over 90 Mass% using IMDS.

5) Intentional inclusions

Items that are intentionally added and contained to maintain the characteristics, appearance, and quality for products

6) Non-intentional inclusions (impurity)

Substances that are inevitably contained from the raw material stage and which substances cannot be excluded from the refining of raw materials and substances that are mixed through the manufacturing process of materials and parts

7) Allowable concentration (threshold)

Maximum concentration of chemical substances to allow including in or adhering to products (Mass%)

The concentration is calculated with "homogeneous materials" as the denominator. Metals and their compounds are the concentrations of metals

(For example, for cadmium and its compounds, it is the concentration of cadmium, not the concentration of the cadmium compound).

8) New design

Designs that adopt parts/ materials, auxiliary materials, production auxiliary materials, and packaging materials with a chemical composition that NSK has never used in the past

(4) Management classification and management standard for environmentally harmful substances

For properly managing the environmentally harmful substances contained in products (*1), NSK classifies them into prohibited substances, reduced substances, and controlled substances, and establish management standards.

For prohibited substances, reduced substances, and observation substances, the supplier shall refer to the "NSK Environmentally Harmful Substances List" attached to the NSK Group Green Procurement Standards (*2) posted on the NSK website. When the contents are under the threshold value, it shall be handled as out of management.

*1: Products are general terms for parts, materials, auxiliary materials, production auxiliary materials, packaging materials, etc.

*2: Jananese version URL

https://www.nsk.com/jp/csr/supplier/green_procurement_standards/

English version URL

https://www.nsk.com/sustainability/supplier/green_procurement_standards/

1) NSK prohibited substances

The products and applications specified in the NSK Observation Substances List are targeted.

2) NSK reduced substances

The supplier shall prohibit the use of the products and applications specified in the NSK Observation Substances List for newly designed products. When the existing products contain

NSK Reduced substances with a total abolition deadline, the supplier shall make a decommissioning plan and abolish them by the due date. When NSK Reduced Substances without a total abolition deadline are contained in the products, the supplier shall select replacements and complete the evaluation.

3) NSK observation substances

When using for the newly designed products, the supplier shall consider alternative parts and materials. When it is unavoidable to use NSK observation substances, the supplier shall clarify the site and application of use and grasp the amount of the content.

(5) Threshold for Environmentally Harmful Substance

1) No threshold is applied when intentionally contained environmentally harmful substances. All of the above (4) are applied as the management classifications and management standards for environmentally harmful substances.

2) Thresholds are applied when unintentionally included environmentally hazardous substances. When the threshold is exceeded, the paragraph (4) above shall be applied as the management classification and management standards for environmentally harmful substances.

＊ Examples for unintentional inclusion of environmentally harmful substances

a) Impurities contained in raw materials (Including recycled materials)

b) Raw materials or solvents remaining in the products

c) Unreacted materials of reactive materials such as thermosetting resins, adhesives and Paints

d) Reactive products produced during or after production process

(6) Management of environmentally harmful substances

1) Correspondence to environmentally harmful substance information

The supplier shall gain environmentally harmful substances information from NSK and related organizations, review management regulations and standards, and deploy them internally.

2) Correspondence to non-containing instructions for environmentally harmful substances

The supplier shall follow the "Non-Containing Environmentally Harmful Substances" instruction including NSK's customer requirements in the specifications or drawings submitted by NSK and manage environmentally harmful substances such as products.

3) Switching support for new products

The supplier shall confirm from the environmentally harmful substance data (*3) that the inclusions of prohibited substances in new products are under the standard value.

*3 Environmentally harmful substance data means Safety Data Sheets (SDS), ingredient tables, and analysis results. The analysis results include that the four prohibited substances subject to the ELV Directive are listed.

4) Supplier Audit

NSK audits whether the supplier complies with the requirements stated in the NSK Group Green Procurement Standards. NSK also audits the supplier materials, processes, and change

management of the Tier-N suppliers after the secondary suppliers. Audits are conducted by either self-audits (in-house audits) or actual audits (NSK audits) as the NSK requests.

5) Records management period

The record of the measurement results for environmentally harmful substances shall be stored for at least 15 years.

However, NSK instructs separately when NSK customers request.

(7) Documents to be submitted as stipulated in the NSK Green Procurement Standards

The documents to be submitted could be downloaded from the site of the NSK Group Green Standards (access from the previous section: (4)) on the NSK website.

- Form 1: Consent Form for Environmental Efforts
- Form 2: Company information registration sheet
- Form 3: Environmental conservation activity survey sheet
- Form 4: Product environmental impact reduction item survey sheet
- Form 5: Environmentally harmful substances survey sheet
- Form 6: Delivered product chemical composition survey sheet
  (Disclosure of 100 mass% in principle)
- Form 7: [ELV and RoHS target substances] Analysis result report
- Form 8: Non-inclusion certificate
- Form 9: NSK Environmentally Harmful Substance Guarantee System check sheet

Procedure 3: Management of Designated critical products

(1) Scope

This applies to the following cases for products/ parts delivered by the supplier.

・When NSK designates as the object of critical security/ legal regulations, etc.

・When used for special applications such as aircraft, bullet trains, high speed rail, and nuclear reactors

・When requested special functions or performances from the customers

(2) Purpose

The purpose is to critically designate products/ parts that directly affect human lives or require the high degree of safety, the supplier shall perform special management, and prevent the outflow of quality concerns.

(3) Designated critical products

1) Types of designated critical products

Designated critical products are a general term for "designated critical safety products," "legally designated products," "specially designated products," and "specially management designated products." Each designation will be described in drawings and specifications by NSK. The supplier shall make sure to manage according to the characteristics.

2) Definition of designated critical products

Name of characteristic	Applicable varieties	Designation mark	Definition
Designated critical safety product	-Steering -Bearing	- Designated product (指)(SHI)	- Products within the range where automobile customers do not hinder safety and pollution prevention by making minor changes to the structure and equipment of automobiles.
	-Steering -Column -Joint -Ball screw -Bearing Others	- Safety product (保)(S)(HO)	- Products that may lead to serious accidents such as personal injury or vehicle fire by product defects, malfunctions or quality concerns by handling. Customer-designated products such as automobiles, construction machinery and agricultural machinery manufacturing, and products with safety characteristics specified by the Product Design Department.

		- Critical functional characteristic (F)	- Products with quality characteristics that may lead to non-conformities from the market by the deteriorations of performance and function in early stage - Products with quality characteristics that are difficult to install on vehicles or assemble with other parts, and lead to confusion in the customer's production line
	-Bearing	- Exhaust gas related (排)(HAI)	- Exhaust gas related products designated from automotive customers
Legally designated product	Various type	- Legally designated product (法)(SR)	- Products designated by laws and regulations such as safety standards/ technical standards on the Road Transport Vehicle Act
Specially designated product	Bearing Ball screw	- Aircraft engine control bearing (AJ) - Bearings excepts for aircraft engine control (A) - Bearings for the bullet trains and high-speed rail (車)(SHA) - Japan Railway Company (JR) Quality Control Bearings (ケ)(KE) - Bearing for supercharger (B) - Bearings for nuclear reactor bearings/ Ball screw (原)(GEN) - Submarine electric motor bearings/ Ball screw (潜)(SEN) - Military water ship for electric motor	- Products that have the necessary functions for special applications such as aircraft, railway vehicles, and nuclear reactors, and that are quality-assured under a management system that meets the customer's technical and management specifications - Products designated from the Product Design Department

		bearings (水)(SUI)	
Specially management designated product	-Steering -Joint -Bearing	- Specially Management designated product (＋)	- Products used in important customer products such as automobiles, construction machinery and electrical machinery that lead to serious consequences related to the customer or the market for the defects or failures of products. Products that clarify the specific functions and clearly assure the quality of specially management items and management methods. - Products designated from the customer's application and importance by the Product Design Department - Might be specified when the Product Design Department instructs traceability and special manufacturing conditions for parts

3) Management representatives and their roles

For designated critical products, the supplier shall appoint the management representative (Quality Assurance Department Manager) to perform special management, and plan / implement self-audits of the implementation status to ensure thorough management.

4) Implementation of special management

a) Consideration of the prevention for quality concerns

The supplier shall take measures against quality assurance issues during production preparation, establish process assurance by Process FMEA, and prevent quality concerns in the mass production stage.

b) Securing and maintaining process capability

Designated products (指)(SHI), Safety products (保)(S) (HO), Important functional characteristics (F), Exhaust gas related (排)(HAI), legally designated products (法)(SR), Quality characteristics that lead to disruption of customer lines ■For characteristics, check the quality status regularly and manage whether the following standards are satisfied.

(Cpk: Process Capability index, Ppk: Process Performance Index, P: Defect rate / Scrap rate)

・Multiple lots:

Measuring value characteristic; Cpk≧1.33/ Counting value characteristic; P<0.01%

・Single lot:

Measuring value characteristic; Ppk≧1.67/ Counting value characteristic; P<0.0001%

5) Display of Safety products (保)(S) marks

For important designated parts, the supplier shall display the designated product mark, characteristic mark, etc. in the process and security agreements so that workers can recognize the importance of the parts and raise quality awareness.

6) Educational training for Workers

Workers engaged in special processes (heat treatment, welding, plating processes; see Procedure 4) that incorporate the critical characteristics on important designated products must be educated and certified. In addition, the supplier shall check whether their skills are maintained regularly.

7) Initial sample management

The supplier shall follow "Initial Sample Delivery" (Procedure 19).

8) Traceability

Important designated products shall record the transfer information between processes and conducted quality management.

9) Management of repair and rework parts

The supplier shall obtain permission from the NSK representative in advance when repairing or reworking important designated parts.

The record of repairs and rework shall keep for the details of the repairs and rework, and the results of 100% inspection including the characteristics affected by the repair and rework and the lot number.

10) Record keeping of quality status

The supplier shall keep quality records of important designated products for at least 15 years from the production date.

However, NSK instructs separately as customer requested.

(4) Designation of critical characteristics

1) Types of critical characteristics

When NSK's customer or NSK deems the item to be important assurance items, the critical characteristic shall mark with 重 or C on the purchase specifications or drawings. Moreover, KC characteristics (key characteristics) designated by aircraft customers might be indicated with ⊕ or ⊖.

2) Management of critical characteristics

The supplier shall perform quality assurance based on the concept of 100% inspection or 100% guarantee (condition management, replacement characteristic management, etc.) for the items designated as critical characteristics. Moreover, the supplier shall reflect that it is a critical characteristic in the quality control document managed by the supplier.

Procedure 4: Management and notification of critical control processes

(1) Scope

This applies when NSK designates a supplier's or a supplier's Tier-N supplier's process as the critical control process.

(2) Purpose

NSK requires the special control for the processes that lead to serious quality concerns, processes in which it is difficult to find the quality concerns in post-processes, and processes in which serious quality concerns occur. These processes are called "critical control processes", and the purpose is to clarify the control points in the process by displaying (重) and (C) (critical control process) that the supplier distinguishes from general processes.

(3) Critical control process

The followings are the definitions and designated processes for critical control processes.

Special processes and conditional control processes are determined the conditions for non-defective products and conducted the conditional controls.

Process	Definition	Designated process
Special process	a) In post-process inspections, processes in which quality confirmation is technically difficult and quality concerns are difficult to find b) Processes that might cause fatal defects or processes that inspect fatal defects such as raw materials, cracks, and foreign materials c) Non-destructive inspection processes Inspections that comply with JIS Z2305 and ISO9712 which stipulate the qualifications and certifications of engineers engaged in non-destructive testing	・Heat treatment ・Welding ・Soldering ・Plating (Including hydrogen embrittlement removal treatment) ・Magnetic particle inspection ・Ultrasonic inspection ・Eddy current flaw detection inspection ・Radiation transmission inspection ・Penetrant inspection
Condition controlled process	It is a process in which it is difficult to find quality concerns in post-process inspections, and a process that requires conditional management with more control items and more frequent inspections than in general processes	・Plating ・Grease packing ・Adhesion ・Press fitting ・Staking ・Rubber vulcanization ・Cleaning ・Screw tightening ・Deoiling ・Injection molding ・Casting ・Forging ・Painting
Quality concern occurrence process	Processes in which a serious quality concerns (Critical Customer Quality Concerns: CCQC) occurred (Designated by NSK's Quality Assurance Department manager on a case-by-case basis)	N/A

＊ The supplier shall reflect the processes designated by NSK as critical controls in your quality

control documents.

(4) Notification of control status

The supplier shall submit the “Notification of Management Status of Critical Control Processes” (Form 4-1).

In addition, when needed to change the control status, the supplier shall resubmit it according to the Process Change Application” (Procedure 30).

Procedure 5: Notification for use of the Tier-N supplier

(1) Scope

This applies for products/ parts that the supplier delivers to NSK when using the secondary and the subsequent Tier-N suppliers, including materials and parts purchased by the supplier.

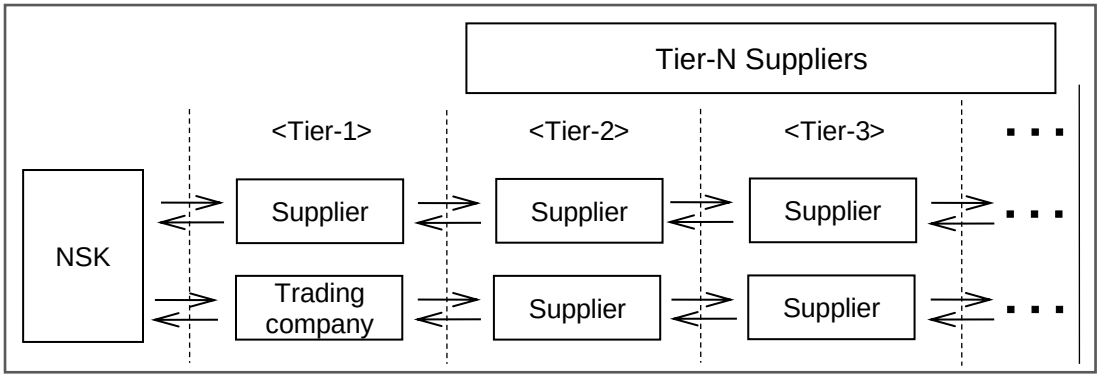
(2) Purpose

The supplier shall notify NSK in advance when the supplier is the Tier-N supplier that purchases products/ parts, partly processed products, or finished products. NSK advises the supplier on the use of the Tier-N suppliers and various measures to be taken in the event of a disaster as necessary. NSK also cooperates with the suppliers in improving their quality assurance systems, understanding the extent of damage in the event of a disaster, and speeding up recovery.

(3) Usage criteria for the Tier-N suppliers

1) Tier-N suppliers

The relationships between NSK and the suppliers, and between the suppliers and the Tier-N suppliers are shown below.



2) Usage criteria

a) NSK allows the use of Tier-2 suppliers for general parts. However, the supplier shall evaluate and select Tier-2 suppliers for their abilities to meet business contract requirements, including quality assurance requirements.

For "electric parts" and "designated critical products", the supplier shall obtain approvals from NSK regarding the use of Tier-2 suppliers. However, NSK prohibits the use of Tier-2 suppliers in principle for aerospace applications, nuclear energy applications and the bullet train and high speed rail applications.

b) The suppliers shall require having the pre-audit by NSK for the use of Tier-2 suppliers involved in critical characteristics of designated critical products.

c) For the use of Tier-2 suppliers, NSK allows the use when we recognize that the control abilities of the supplier and Tier-2 suppliers are sufficient.

The supplier shall have ultimate responsibilities for the quality of the Tier-N suppliers.

d) In order to ensure and maintain the quality of the Tier-N suppliers, supplier shall manage the items specified in this manual in the same manner as the supplier.

(4) Notification procedure

When using the Tier-N suppliers, the supplier shall fill in the necessary items in the "Tier-N Supplier Usage Notification Form" (Form 5-1) and the "Tier-N Supplier List" (Form 5- 2) and submit them to the NSK representative.

(5) Management of the Tier-N supplier

For the Tier-N suppliers, the supplier shall make the document for the requirements (part names, part numbers, drawing numbers, specifications, inspection standards, control plans), etc. in the supplier's regulations, periodically ensure to perform the audits and the quality checks, provide instruction, and maintain the quality improvement.

The supplier shall check the following items in particular.

a) The supplier shall ensure 5M (Man, Machine, Method, Material and Measurement) + 1E (Environment) that can guarantee 100% non-defective products
   ・5M+1E means: The initial letters of the words affecting change points

b) The supplier shall ensure process capability (confirm as needed/ regularly)

c) The supplier shall manage 4S activities (Japanese words: Seiri, Seiton, Seiso, and Seiketsu, or English meanings: Sort, Set in order, Scrub (clean up), and Standardize) and secure quality
   ・4S activities means: Workplace environmental maintenance and development activities

d) The supplier shall organize standard operating procedures in place

e) The supplier shall prepare quality records such as control charts and check sheets (maintenance of quality records)

f) The supplier shall manage changes and change points

g) The supplier shall manage lots for products/ parts

h) The supplier shall perform start-up inspections and periodic inspections for equipment and off tools.
   For Special processes such as heat treatment, welding, and plating, the supplier shall include condition management items in the start-up inspection

i) Weighing equipment shall be calibrated periodically under controlled conditions, and shall be included in the start-up inspection

j) The distinction between good products (conforming products), non-conforming products, prototypes, and trial products shall be clearly identified

k) The supplier shall establish rules for handling when occurring non-conformities

l) The presence or absence of environmentally harmful substances in parts, materials, and manufacturing processes shall be confirmed

NSK might verify whether the products contracted by the supplier with the Tier-N suppliers comply with the requirements.

(6) Application by changes

For the changes of the Tier-N suppliers, the supplier shall follow the "Process Change Application" (Procedure 30) and handle this procedure "the Tier-N supplier usage notification".

(7) Others

Submitted supply chain information might be used to provide information to NSK customers in the event of a disaster.

Procedure 6: Management of NSK supplied parts

(1) Scope

This applies when NSK supplies materials and parts to the suppliers.

(2) Purpose

The purpose is to disclose information and maintain the quality of our products on acceptance judgments and management methods for materials and parts that NSK supplies to suppliers.

(3) Management of NSK supplied parts

1) Definition of NSK supplied parts

NSK supplied parts are materials, raw materials, parts, jigs and tools that are supplied directly from NSK or directly from the NSK suppliers for the processing or assembly of products delivered by the suppliers to NSK.

2) Management guidelines for NSK supplied parts

NSK supplied parts shall be managed in accordance with the following guidelines, from the supplier acceptance to shipment.

a) Acceptance

a-1) Confirmation of supplied parts (inspection)

Supplied parts shall be checked (inspected) the following items for each delivery lot.

Check item		Confirmation details
Tag		Verify that there are no discrepancies by comparing the contents of the tag with delivery slips such as delivery slips and shipping slips
Appearance		Check for damage or other unsuitable conditions
Number		Verify that there are no discrepancies by checking with delivery slips such as shipping slips and shipping slips
Steel Bar only	End label (over φ30)	Verify that there are no discrepancies by comparing the steel grades on the shipping label and the end face label
	End face identification color (under φ30)	Be painted on all

a-2) Judgment and measures

Pass：When all of the confirmation results in item a-1) above are met, accept the product as "passed".

Fail：When even one item is found to be non-conforming as a result of the above a-1), identify it as "failed" and isolate the supplied parts so that those will not be used.

＊ Notification of failed parts

The supplier shall notify the NSK Quality Assurance Department for the occurrence of non-conforming products by submitting the "Supplied Part

Non-Conforming Occurrence Report/ Investigation Request Form" (Form 6-1).

* The Quality Assurance Department as the NSK contact responds to the supplier on how to deal with the non-conforming product after receiving the "Notification of Non-Conformity of Supplied Products and Request for Investigation Measures".

a-3) Confirmation (inspection) record and storage

The supplier shall submit the record and storage of the confirmation result for the supplied parts as follows when NSK requested.

Supplied part classification	Recording method	Storage period
Direct delivery steel	Keep the confirmation record in the "Steel Materials Acceptance Ledger" (Form 6-2) or the recording method set by the supplier.	Over 15 years from the date of use for the supplied parts
Others	Keep the confirmation record in the delivery slip of the supplied item or in the recording method set by the supplier.	Over 15 years from the date of use for the supplied parts

b) Storage

The supplier shall determine the place to store the products in consideration of the prevention of damage, deterioration, loss, contamination, etc.

c) Use

c-1) The supplier shall follow the “Lot Control” (Procedure 24) on a first-in, first-out basis when using.

c-2) When any non-conformity is found during use, the supplier shall immediately stop processing or assembly for the lot concerned, contact the NSK contact person, receive instructions on how to deal with it, and submit the "Request for Investigation Countermeasures Request Form" (Form 6-1).

3) Management guidelines for inspection tools and jigs

a) Acceptance Record: Keep the record of acceptance results.

b) Actual product display: Display the name, identification number, etc. to clarify the owner and manager. (e.g., vibrating pen, tag, etc.)

c) Ledger registration: Register and manage the inspection tools and jigs to be managed in the ledger.

d) Regular calibration: Request NSK for calibration within the specified period.

The supplier shall contact the NSK representative immediately when any non-conformity is found.

Procedure 7: Advanced Product Quality Planning and Control Plan (APQP)

(1) Scope

This applies when the supplier conducts the development towards mass production of new products/ parts.

(2) Purpose

The purpose is for the supplier to newly plan and develop products/ parts, create schedules and systems according to the procedures up to mass production, visualize development, eliminate omissions and conduct mass production.

The supplier shall create and operate Advanced Product Quality Planning (APQP) towards mass production.

(3) Operation

The supplier shall prepare the Advanced Product Quality Plan (APQP) (Form 7-1) and submit it to the NSK contact at development milestones or before the start of mass production based on the mass production launch schedule presented by NSK.

(4) Quality Assurance Activity Items

1) Robust product design

Products designed by the Product Design Department might cause unexpected problems in the market. The cause might be the operating environment conditions, the deterioration of the parts, the variation of the parts, etc.

Product design is required to operate stably even under these severe conditions.

・Design FMEA

・Kakotora Recurrence Prevention

Kakotora means past problems, and activities to prevent defects by accumulating past cases of quality concerns and the knowledge obtained from them.

・Reliability test

・Clarification of reliability and change points

・Clarification of critical control processes, etc.

2) Robust manufacturing process

Products produced in Manufacturing Department might cause unexpected issues in the market.

The supplier shall adopt a manufacturing method that non-conforming products produce less likely to occur and introduce the system that it is easy to detect non-conforming products through quality control of the process.

・Process Design

・Process FMEA

・Preparation of equipment, jigs and tools and inspection tools

・Kakotora Recurrence Prevention

・Clarification of novelty and change points
・Setting manufacturing conditions
・Production trial and process improvement
・Proofreading of weighing equipment
・Control Plan
・Work instructions
・Delivery packing style specifications
・Process capability survey, etc.

3) Mass production shipment guarantee
・Settings of limit sample
・Mass production trial
・Part Submission Warrant (PSW)

4) Initial Sample Control
・NSK delivered product quality concern
・In-process quality concerns
・Achievement of QCD (Quality, Cost and Delivery) targets: Process capability survey, Defect rate (scrap rate), Production performance, Cycle time, etc.
・Inspection of 5M (Man, Machine, Method, Material, Measurement) + 1E (Environment)

(5) Submission and completion of Advanced Product Quality Plan (APQP)

NSK might confirm the progress at the milestone of mass production launch.

For the completion of the APQP, the supplier shall submit to the NSK contact together with the application for cancellation of the initial sample control period.

Procedure 8: Design FMEA

(1) Scope

This applies to products designed by the supplier based on NSK requirements, and to newly deliver or conduct design changes. The supplier shall submit the Design FMEA (Failure Mode and Effects Analysis) when requested from NSK.

(2) Purpose

At the product design stage, the purpose is to anticipate problems including how to be used in the market, conduct qualitative evaluations, identify problematic failure modes, minimize risks, and reduce the possibility of failures, and improve the reliability of the product.

(3) Design FMEA creation and operation guidelines

1) The creation and verification of the "Design FMEA" (Form 8-1) shall be conducted by CFT (Cross Functional Team), as cross departmental team involved in product realization, including the Product Design Department, the Manufacturing Department, Quality Assurance Department and Manufacturing Technology Department.
2) The materials shall be prepared specification drawings (required specifications), manufacturing drawings, Kakotora lists, and usage conditions when creating the Design FMEA.
3) The Design FMEA shall basically create for each NSK delivered product, however, when it is similar by a type, it may be presented as a family product group.
4) In the Design FMEA, mark the symbols that identify safety characteristics (保) (S) (HO), important functional characteristics (F) , regulatory characteristics (法) (SR), and quality characteristics (■ mark) that lead to confound on customer lines.
5) When revising the Design FMEA, the supplier shall keep a record in the revision history table and history ledger.
6) The review of the Design FMEA shall conduct when any of the following situations occur and updated and resubmitted to NSK as necessary.
   a) When changing product design
   b) When the process is unstable, and the design is changed
   c) When there are issues in the process capability and the design is changed
   d) When the design is changed due to the occurrence of the delivered product quality concerns
   e) When the design is changed due to market quality concerns
7) See the table below for each rank of risk priority number RPN of Design FMEA = Severity x Occurrence x Detection.

Table: Evaluation criteria for Severity(S)

Impact	Severity of product impact（Impact to customer）	Rank
Inability to meet safety and/or regulatory requirements	When there are no precursors and potential failure modes are: ・Affect the safe operation of transportation equipment ・Lead to life-threatening defects ・Cause a serious accident ・Violate laws and regulations	10
	When there are precursors and potential failure modes are: ・Affect the safe operation of transportation equipment ・Lead to life-threatening defects ・Cause a serious accident ・Violate laws and regulations	9
Loss or significant deterioration of key functions	Inoperability of the vehicle due to loss of main function or accidents related to life-threatening or serious accidents will not occur.	8
Deterioration of key functions	Possible to operate the transport equipment, however, performance levels are degraded.	7
Loss or deterioration of secondary functions	No significant impairment of main function, however, performance is degraded, and discomfort index is very high.	6
	No big impairment to the main functions, however, performance is slightly degraded, and the discomfort index is increased.	5
Discomfort	Not interfere much with the main functions, however, performance is degraded, feel uncomfortable, and the marketability is reduced. Most customers (over 75%) notice that.	4
	No issue with the main functions, however, the product value is reduced. Many customers (over 50%) notice that.	3
	No issue with the main functions, however, the product value is slightly reduced. Customers with discriminability (less than 25%) notice that.	2
No impact	Recognized however no effect.	1

Table: Evaluation criteria of Occurrence (O)

Failure probability	Criteria: Occurrence of cause (Design life/ Item/ Equipment reliability)		Rank
Very high	Inexperienced new technology/ new design	Over 1/10	10
High	Failure is inevitable due to new designs, new applications, and changes in usage conditions.	1/20	9
	Failure might occur due to new designs, new applications, or changes in usage conditions.	1/50	8
	Possibility to occur failures is uncertain due to new designs, new applications, and changes in usage conditions.	1/100	7
Moderate	Frequent failures associated with similar designs or in simulated verifications and experiments.	1/500	6
	Occasional failures associated with similar designs or in simulated verifications and experiments.	1/2,000	5
	Failure is inevitable due to new designs, new applications, and changes in usage conditions.	1/10,000	4
Low	Infrequent failures associated with nearly identical designs or in simulated verifications and experiments.	1/100,000	3
	Unobserved failures associated with nearly identical designs or in simulated verifications or experiments.	1/1,000,000	2
Very low	Failures are eliminated by preventive controls.		1

Table: Evaluation criteria of Detection (D)

Possibility of detection	Opportunity for detection	Criteria: Possibility of detection by design control	Rank
Almost impossible	No chance of detection	No current design control. Not detectable or analyzable.	10
Very little	Nearly no detectability at any stage	Low detectability of design analysis/ detection management. Virtual analyzes (i.e., CAE and FEA) do not correlate with expected real operating conditions.	9
Little	After design completion and before mass production (NPDS production prototype evaluation meeting DR4-2/ TG2.5)	Post-design and pre-production product verification/ validation with pass/ fail test.	8
Very low		Post-design and pre-production product verification/ validation with failure test.	7
Low		Post-design and pre-production product verification/ validation with degradation test.	6
Moderate	Before design completion (NPDS prototype result evaluation meeting DR3-2/ TG2)	Product validation confirmation before design completion using pass/fail test.	5
Relatively high		Product validation confirmation before design completion using failure test.	4
High		Product validation confirmation before design completion using deterioration test.	3
Very high	Virtual Analysis - Correlated	Design analysis/ detection management is highly detectable. Virtual analysis (i.e., CAE and FEA) before design completion has a high correlation with predicted actual operating conditions.	2
Almost certainly detected	Detection is not applied: fault prevention	Failure causes and failure modes are not possible since those are completely prevented by design solutions.	1

8) The corrective actions by the Design FMEA shall determine whether or not actions to reduce risk are necessary after ranking severity, occurrence and detection, and identifying failure modes and impacts, causes and controls. Failure modes with a severity of "9" or "10" shall address with current process controls or recommended actions. Moreover, Failure modes

under severity of "8" shall deal with the cause about the highest occurrence rank or detection rank.

9) When identifying recommended actions, the supplier shall take measures in descending order based on analysis of (1) severity, (2) occurrence, and (3) detection.

10) When NSK asks any special requirements, the supplier shall follow the instructions.

11) The Product Design Department shall store the original paper and operate the Design FMEA.

12) The supplier shall keep the record for the Design FMEA for at least 15 years after the end of mass production.

13) The Design FMEA contains important information not only for NSK but also for NSK's customers. the supplier shall manage documents without any leakage of information to anyone other than those involved.

The supplier shall confirm with NSK in advance when they need to present the design FMEA to the Tier-N suppliers.

(4) Design FMEA Form

The NSK provides form, however, the supplier might use their forms if those are satisfied the requirements.

Procedure 9: Verification of change points due to specification changes

(1) Scope

This applies when the supplier develops and design a new product as the extension of existing product groups, or when a design change is conducted with partial improvement.

(2) Purpose

The purpose is to prevent quality concerns in the design and development stages by conducting verification and evaluation focusing on change points so that issues do not occur in products after mass production due to new designs or design changes by the suppliers.

(3) Operation

For considering specification changes by the supplier, NSK requests the "Change Points Validation Associated with Design Specification Changes " (Form 9-1) from the NSK contact when the following guidelines apply.

1) When considering specifications deviated from the design standards
2) When existing products are used for new applications
3) When technical verification needs to be confirmed by test
4) When it is necessary to introduce new assurance equipment in the manufacturing process

(4) Milestone management

The milestones of change point verification related to the specifications of the designed product are shown below.

1) Change points verification

The supplier shall determine whether there are any risks in performance or quality due to specification changes.

2) Preparation stage

The supplier shall verify the concerns caused by the change points and consider countermeasures.

3) Review stage

The supplier shall extract the concerns from the results of the preparation stage and determine countermeasures.

4) Implementation stage

The supplier shall verify whether the countermeasures determined in the review can be prevented performance and quality concerns.

(5) Submission of change point verification sheet

The supplier shall complete verification of change points, fill in the verification sheet in the production launch or before starting mass production and submit a copy to the NSK representative.

Procedure 10: Functional assurance confirmation

(1) Scope

This applies when NSK conducts the design and requests suppliers to present production control methods to guarantee product functionality.

(2) Purpose

The purpose is for NSK to communicate the product design intentions to the supplier, to prevent troubles due to inadequate production preparations, and to ensure stable quality at the early stage.

(3) Operation

The Product Design Department at NSK informs the design intent to the supplier using the functional assurance checklist.

For the functional assurance required by NSK, the supplier shall specify the production control methods and submit the functional assurance check sheet to the Product Design Department at the NSK representative.

(4) Submission of functional assurance mutual confirmation list

The supplier shall complete negotiations with the Product Design Department at NSK after production of products in off tool off process.

Procedure 11: Production Preparation Control

(1) Scope

This applies to the new products delivered by the supplier, and the production preparations for product design changes or process changes that have already been delivered.

(2) Purpose

The purpose is to prevent troubles due to inadequate production preparation and to ensure stable quality at the early stage by conducting production preparations for new products, design change products, and process change products.

(3) Production Preparation

Based on the "Production Preparation Request Form (New products/ Increased production products)" (Form 11-2) and "Production Preparation Request Form (Change products)" (Form 11-3) issued by NSK, the supplier shall proceed with production preparations and complete the process settings by the initial sample delivery that NSK requests. In addition, when discontinuing mass production or reducing production, the supplier shall proceed with preparations in accordance with the " Production Discontinuation & Reduced Production Request Form" (Form 11-4) issued by NSK.

1) Production Preparation Items

a) Advanced Product Quality Planning and Control Plan (APQP)
b) Design FMEA
c) Process Setting
d) Process FMEA
e) Control Plan
f) Inspection Standards
g) Preparation of process standards
h) Preparation of equipment, jigs and tools, and inspection equipment (including daily inspection and establishment of equipment maintenance plan)
i) Delivery packing style specifications
j) Process capability survey
k) HR arrangement and educational training
l) Evaluation for production preparation (process setting)
m) Initial sample control
n) Product safety (including environmentally harmful substances)
o) Measurement Systems Analysis (MSA)
p) Part Submission Warrant (PSW)
q) Initial sample control

2) Production preparation procedure

The supplier shall establish the production preparation plan, conduct forecast performance management for each item, and proceed with production preparation.

The preparation guidelines and the guaranteed treaty for the main items are shown in the next

section.

Item	Preparation procedure	Guarantee treaty
a) Advanced Product Quality Plan (APQP) Procedure 7	- Production preparation shall appoint the promotional representative, create a plan, and manage the forecast and actual. - Planning shall clarify the goals to be achieved (equipment, personnel, process capability, etc.) and proceeded.	・Advanced Product Quality Plan (APQP) Form 7-1
b) Design FMEA Procedure 8	- The Product Design Department shall take the lead in implementing, including the Manufacturing Department and Manufacturing Technology Department.	・Design FMEA Form 8-1
c) Process setting	- Implement drawing DR (confirmation of easy production and design intention). - Create purchased products drawings (material drawings, processing drawings, etc.). - Make the process maintenance plan and clarify the classification of internal and external production (the Tier-N supplier), grasp the production preparation plan, etc. - Identify problems on the specifications and submit to NSK in the "Prototype Report and VA/VE Proposal" including the prototype results. - Check the production capacity against the production plan.	・Purchased product drawings (material drawings, processing drawings, etc.) ・Process setting/ Internal/ external production Classification/ Production capacity table Form 11-1 ・Prototype (mass production) report Form 14-1
d) Process FMEA Procedure 12	- The production preparation department and the Manufacturing Department shall take the lead in clarifying the quality concerns expected in the design process and conducting risk analysis with the quality assurance and the Product Design Department.	・Process FMEA Form12-1
e) Control Plan Procedure 13	- Clarify all the conditional control items of the cause system and the quality characteristics of the result system in the manufacturing process and describe the process assurance details. - In particular, actively consider the set-up of	・Control Plan Form 13-1

	100% checking and error-proofing (poka-yoke) from the concept of 100% guarantee.	
f) Inspection standards Procedure 15	- Follow the “Inspection Standards” procedure.	・Inspection Standards Form 15-1
g) Preparation of process quality standards	- Maintain a standard that specifically indicates the conditions (factor system) and the result system and the records thereof.	——
h) Preparation of equipment, jigs and tools and weighing equipment	- Maintain equipment, jigs and tools, weighing equipment, and inspection equipment judging from quality and production capacity. - Prepare mass production equipment, mass production off tools, jigs and tools, inspection equipment, and construction methods to meet the time frame for the production plan in the production (mass production) preparation request form. - For maintaining and managing manufacturing conditions, prepare daily inspections and maintenance plans for equipment. - Prepare daily inspection and maintenance of inspection jigs and tools such as error-proofing (poka-yoke).	——
i) Delivery packing style application Procedure 23	- For the prevention of quality deterioration such as rust, scratches and dents, determine the packing method, rust prevention method, product/ parts packing style, quantity, and weight.	・Delivery Packing Style Application Form 23-1
j) Process capability survey Procedure 22	- Follow the "Implementation of Process capability survey".	・Process Capability Survey & Improvement Report Form 22-1 ・Machine Capability Survey Form 22-2
k) HR arrangement and educational training	- Make the educational training plan for workers and perform education.	—

l) Evaluation of production preparation	- Make sure to confirm that the original planned items have been completed, and that there is no maintenance omissions. Also, prevent quality concerns. - Execute 100 trials (continuous production of 100 pieces) as necessary or requested and verify the certainty of process settings. - Create and conduct the initial sample control plan.	・Advanced Product Quality Plan (APQP) Form 7-1 ・Process Capability Survey & Improvement Plan Form 22-1
m) Initial sample control	-Follow "Initial sample delivery" (Procedure 19). -Follow the “Layout inspection” (Procedure 21). - Conduct 1,000-piece guarantee activities as necessary or requested. Determine the evaluation items and cancellation criteria, evaluate the initial control period (general products: over 1-month, critical designated products: over 3 months) (quality confirmation by different person from the final inspector) And prevent the outflow of initial defective products. (When NSK or NSK's customers request, the supplier shall comply with).	・Actual product when delivering a product Identification tag Form 20-1 ・Initial Sample Delivery Advance Notice Form 19-1 ・Initial Sample Delivery Notice Form 19-2 ・Inspection Standard Form 15-1 ・Inspection Report Form 16-1 ・Layout Inspection Result
n) Product Safety	- Consider safety related to the product, such as scratches due to burrs on the product, use of harmful rust-preventive oil, etc. - Report the investigation of the Substances of concern (SOC) content related to parts, materials, Auxiliary materials (or sub-materials) and manufacturing processes.	・NSK Green Procurement Standards Obtain Form from NSK HP
o) Measurement System Analysis (MSA) Procedure 18	- Perform Gage Repeatability and Reproducibility (GRR) or Crosstab method.	・Gage R&R report Form 18-1 ・Crosstab report Form18-2 ・Control weighing equipment list

p) Part Submission Warrant (PSW) Procedure 25	- Confirm whether the tasks to be achieved in the production preparation stage satisfy the mass production conditions and confirm that the standards related to production are in place before deciding whether to ship.	・Part Submission Warrant (PSW) Form 25-1
q) Initial Sample Control Procedure 26	- Conduct the initial sample control period such as 6 months for A/ B rank of NPDS from the start of mass production, 3 months for critical designated products, and 1 month for general products. - NSK decides and notifies after receiving the cancellation application of the control period.	・Initial Sample Control Plan Form 26-1 ・Initial Sample Control Table Form 26-2

Procedure 12: Process FMEA

(1) Scope

This applies when the supplier makes a design change or a process change for the products that are newly delivered, or the products that have already been delivered.

(2) Purpose

The purpose is to improve product or process reliability by reducing the possibility of failure occurrences. The supplier shall anticipate all possible problems in the process design process in advance, conduct a qualitative evaluation, clarify the failure mode that may become a problem, and minimize the risk.

(3) Creation and Operational procedure for the Process FMEA

1) "Process FMEA" (Form 12-1) shall prepare by CFT (Cross Functional Team) involved in product realization, such as the Manufacturing Department, Quality Assurance Department, Product Design Department, and Manufacturing Technology Department within the supplier.
2) It is recommended that the personnel involved in the creation of the Process FMEA shall qualify personnel who understand the competence of production preparation work.
3) Materials when creating the Process FMEA shall include such as production drawings, work drawings, acceptance drawings, Kakotora (past problems) lists, flowcharts (standard work charts, process setting tables, etc.), layout drawings, the Design FMEA, the Process FMEA for similar products, actual products of target parts.
4) The Process FMEA is basically created for each product delivered to NSK, however, when it is similar by type, it might be presented as a family product group.
5) In the Process FMEA, the supplier shall fill in marks such as safety characteristics (保)(S)(HO), important functional characteristics (F), legally regulation characteristics(法) (SR), quality characteristics that lead to confusion in the customer line ■ mark, critical characteristics designated by NSK 重 C , KC characteristics (Key characteristics) ⊕⊖ for the aircraft industry, etc.
6) When revising the Process FMEA, the supplier shall keep a record in the revision history table and the history ledger.
7) The Product Design Department and the Quality Assurance Department shall check the Process FMEA, and the supplier shall submit to NSK after receiving approval from the Manufacturing Department manager. Moreover, when creating or revising, the supplier shall select the processes that require standards, create Standard Operation Procedures or guidance, etc., and deploy the contents to the manufacturing process.
8) The review of the Process FMEA shall conduct in any of the following cases, updated as necessary, and resubmitted to NSK.
   a) When changing the product design
   b) When the process is unstable, and the process is changed
   c) When changing the process

d) When there is a problem in the process capability and the process is changed

e) When the process is changed due to the occurrence of the delivered product quality concerns

f) When the process is changed due to the occurrence of the market quality concerns

9) The supplier shall refer to the followings for each rank table of Risk Priority Number (RPN) for Process FMEA = Severity x Occurrence x Detection.

Table 1 Severity evaluation criteria (S)

Impact	Severity of product impact (Impact to customer)	Rank
Inability to meet safety and/or regulatory requirements	When there are no precursors and the potential failure modes are below: ・Affect the safe operation for transportation equipment ・Lead to life-threatening defects ・Cause a serious accident ・Violate laws and regulations	10
	When there are precursors and the potential failure modes are below: ・Affect the safe operation for transportation equipment ・Lead to life-threatening defects ・Cause a serious accident ・Violate laws and regulations	9
Loss or significant deterioration of major functions	Loss of major functions does not lead to inoperability of the vehicle, a life-threatening or serious accident.	8
Reduction of major functions	Operation of transport equipment is possible; however, performance levels are degraded.	7
Loss or deterioration of secondary functions	No significant impairment of major functions, however performance is degraded, and discomfort index is very high.	6
	There are no huge problems with the main functions, however, the performance is slightly degraded, and discomfort index increases.	5
Discomfort	There are hardly problems with the main functions, however, the performance is degraded, it feels discomfort, and the marketability is reduced. Most customers notice that (over 75%)	4
	No problem with the major functions, however, the product value is reduced. Many customers (over 50%) notice that.	3

	No problem with the major functions, however, the product value is slightly reduced. Customers with discriminability (less than 25%) notice that.	2
No impact	Possible to recognize but no impact	1

Table 2 Occurrence evaluation criteria (O)

Possibility of failure	Criteria: Occurrence of cause (Number of problems per item/ transport equipment)		Rank
Very high	Failures without Kakotora (past problem) experience	Over 1/10	10
High	Failures caused by change of conditions	1/20	9
	Failures that might occur due to changing conditions	1/50	8
	Failures that are unlikely to occur due to condition changes	1/100	7
Moderate	Frequent failures associated with similar processes	1/500	6
	Occasional failures associated with similar processes	1/2,000	5
	Rare failures associated with similar processes	1/10,000	4
Low	Very rare failures that accompanies nearly identical process	1/100,000	3
	Not found failures associated with nearly identical processes	1/1,000,000	2
Very low	Eliminate failures by preventive controls		1

Table 3 Detection evaluation criteria (D)

Possibility of detection	Chance of detection	Criteria: Possibility of detection by process control	Rank
Almost impossible	No chance to detect	No current process controls Undetectable or unanalyzable	10
very little	Almost no chance of detection at any stage	Failure modes and/ or errors (causes) are not easily detectable (e.g., random audits)	9
Little	Problem detection after machining	Post-processing failure mode detection by operator's visual/ tactile/ auditory means	8
Very low	Problem detection at the point of occurrence	Failure mode detection by operator's visual/ tactile/ auditory means at the site of occurrence, or failure mode detection using a counter gauge after finishing machining [Example: Go/ No-go gauge, manual torque	7

		check, digital torque wrench, etc.]	
Low	Problem detection after machining	Failure mode detection by workers using weighing gauges after machining, or failure mode detection by workers using weighing gauges at the site of occurrence [Example: Go/ No-go gauge, manual torque check, digital torque wrench, etc.]	6
Moderate	Problem detection at the point of occurrence	Failure mode or error (cause) detection using weighing gauges by personnel at the site of occurrence. Or failure mode or error (cause) detection by automatic control at the site of occurrence (detecting parts with quality concerns and notifying workers [e.g.: light, buzzer]). Check by gage measurement of the initial sample at the time of changeover (only if changeover is the cause)	5
Relatively high	Problem detection after machining	Failure mode detection through automated control after machining (detecting defective parts and containing to prevent further machining)	4
High	Problem detection at the point of occurrence	Failure mode detection by automated control at the site of occurrence (detecting quality defective parts and containing to prevent further machining)	3
Very high	Error detection and/or problem prevention	Error (cause) detection by automatic control at the site of occurrence (detecting errors and preventing production of quality-defective parts)	2
almost certainly detected	No detection applied: error prevention	Prevention of errors (causes) resulting from tool design, machine design, or part design Manufactured items take measures for error prevention by process/ product designs, so quality-defective parts are not produced	1

10) The corrective actions for the Process FMEA shall determine whether actions to reduce risk are necessary after identifying severity, occurrence, ranking of detection, failure modes and impacts, causes and controls. Failure modes with a severity of "9" or "10" shall address with current process controls or recommended actions. Moreover, the failure modes with a severity under 8 shall deal with the cause with the highest occurrence rank or detection rank.

11) When identifying recommended actions, the supplier shall take measures in descending order based on analysis of (1) severity, (2) occurrence, and (3) detection.
12) The supplier shall follow their instructions as requested any special requirements from NSK.
13) For the Process FMEA, the Manufacturing Department shall store and operate the original paper.
14) The Process FMEA shall store over 15 years after the end of mass production.
15) The Process FMEA contains important information not only about NSK but also about NSK's customers. The supplier shall manage documents without leaking out information to anyone except those involved.
The supplier shall confirm with NSK in advance when the supplier needs to present the Process FMEA to the Tier-N suppliers.

(4) Process FMEA Form and Submission Time

NSK Form 12-1 is presented, however, the form used by the supplier can be used if it satisfies the requirements.

For the due date, the supplier shall submit the form to the NSK representative before the delivery of mass production prototypes.

Procedure 13: Control Plan

(1) Scope

This applies when the supplier newly creates or changes the management of products and manufacturing processes.

(2) Purpose

The purposes are to create a control Plan specified the contents related the conditional management, quality assurance methods, and management of environmentally harmful substances that the supplier shall conduct in the order of the manufacturing process of products/ parts in the Manufacturing Department and inspection department, and to grasp the management activities of quality assurance and environmental harmful substances throughout the manufacturing process.

(3) Creation procedure

The control Plan shall be created for each NSK delivered product in principle. However, it might be created for a family product group when the product types are similar.

When describing the marks such as safety characteristics (保) (S) (HO), important functional characteristics (F), legal regulation characteristics (法) (SR) , quality characteristics that lead to confound on the customer's line ■ mark, critical characteristics specified [重] [C] designated by NSK and [KC] characteristics (key characteristics) ⊕⊖ for aircraft industry in the Process FMEA of Procedure 12, the supplier shall enter them in the control plan.

(4) Form and entry instructions

The entry procedure is shown as a reference using the Control Plan (Form 13-1). The supplier shall enter both the conditional control items of the cause system and the quality characteristics of the result system. As a result, NSK can grasp the whole picture of the process, and it is possible to prove that the shipping quality is 100% guaranteed with the concept of 100% guarantee in process control.

When satisfied the control items required by NSK, the supplier's form can be used.

For products/ parts used in automotive applications, make sure to clearly indicate critical characteristics (including when specified special characteristics by NSK customers on drawings and specifications) and poka-yoke (error-proofing).

(5) Submission/ Confirmation/ Action

1) Submission

When the supplier newly creates a control plan, the supplier shall submit one of copies to the NSK representative before the delivery of mass production prototypes.

In the case of family product groups, the supplier shall submit a list of applicable products (in arbitrary format).

2) Confirmation

The NSK Quality Assurance Department checks the content, make additions or corrections, and return a copy to the supplier. NSK pays due attention to the confidentiality of the submitted control plan.

3) Supplier actions after the confirmation and returning by NSK

The supplier shall check the Control plan returned from NSK, reflect the additions or corrections on the original paper, notify the relevant departments, and deploy them to each process when any changes handle such as additions or corrections. The supplier shall resubmit the Control plan that reflects the changes to the NSK representative.

(6) Resubmission with changes

The supplier shall promptly resubmit the Control Plan in accordance with item (5) above when any changes handle in the items described in the Control Plan due to design or process changes, countermeasures against quality concerns in delivered products, etc.

Procedure 14: Prototype (mass production) problem extraction

(1) Scope

This applies when the problems occur in design specifications, manufacturing processes, product packaging, etc. in the production preparation stage before the mass production at NSK.

(2) Purpose

The purpose is to eliminate various problems before the mass production and prevent quality concerns.

(3) Proposal procedure

The supplier shall use the "Prototype (mass production) Report" (Form 14-1) for problems and countermeasures that occur in the NSK's production preparation stage and submit the proposal to the NSK representative.

Once the mass production at the customer site starts, it becomes difficult to change specifications and processes.

Therefore, the early proposal shall be the key to adoption.

In addition, the possibility of adoption might increase if VA/VE has the effect in the content of the proposal.

The supplier shall also fill in the cost effect and make a proposal.

Procedure 15: Inspection standards

(1) Scope

This applies when the supplier starts mass production delivery for new products, or when the changes conduct in inspection procedures due to design and process changes.

(2) Purpose

The purpose is to clarify the inspection details and inspection procedures for the shipping quality (including reliability items) of the products/ parts guaranteed by the supplier.

(3) Creation procedure

In principle, the "Inspection Standards" (Form 15-1) shall be one page per product number, however, it might be organized by each format. When sorting by type, the supplier shall consider the differences in mutual measuring instruments for each product number and specify the points of difference.

1) Inspection items

The supplier shall agree with NSK on the measurement method for the important points on the premise of guaranteeing all points indicated in the design or manufacturing drawing and Control Plan, etc. The supplier shall describe safety characteristics (保) (S) (HO) , important function characteristics (F) , legal regulation characteristics (法) (SR) , quality characteristics ■ mark that leads to confound in the customer line, critical characteristics [重] [C] specified by NSK, [KC] characteristics (key characteristics) ⊕⊖, etc. for aircraft industry in the inspection standards when describing in the Process FMEA of Procedure 12 and the Control Plan of Procedure 13.

In addition, the supplier shall add when the control items for environmentally harmful substances in products/ parts and manufacturing processes include.

2) Inspection method

The basis of the 100% lot guarantee shall set the inspection method according to the following criteria.

a) Operation inspection and appearance inspection of critical safety parts shall be, in principle, 100% inspection.

b) Sampling inspections might be acceptable in the following cases.

However, when conducting sampling inspections, the lot must be clear, and the number of allowable defects must be zero.

ⅰ) When the process is stable and the "Process Capability Survey" (Procedure 22) sufficiently satisfies the required quality, and the same level of quality assurance as the 100% inspection is available.

ⅱ) For destructive testing

ⅲ) When analyzing material component (including environmentally harmful substances)

3) Recording method

The supplier shall keep a record by the established recording method (check sheet, recording paper, etc.) and manage it to be able to submit immediately when requested by NSK.

(4) Operation

1) Submission

When delivering new products, the supplier shall submit a copy of the "Inspection Standards" (Form 15-1) to the NSK representative before delivery of mass-production prototypes. (The supplier shall follow the instructions when requested the prior submission from NSK.)

When products/ parts are delivered without submission, the relevant delivered items will be returned as non-conforming.

2) Confirmation

After confirming the content, the NSK Quality Assurance Department gives instructions (clearly) on additions or corrections, items to be submitted in the inspection record, etc., and return a copy with a stamp of confirmation to the supplier.

3) Actions after confirmation and returning by NSK

The supplier shall check the inspection standard document returned from NSK, reflect the hierarchy, additions or corrections to the original paper for the inspection standard document, and deploy the contents to the work instructions for each process.

(5) Resubmission with changes

The supplier shall promptly resubmit the inspection standard when changing in the described items for the inspection standard.

Moreover, the supplier shall follow the "Process Change Application" (Procedure 30, Form 30-1, Form 30-2) when changing the process.

In addition, the supplier shall make sure to resubmit when changing the drawing number for the drawing. When re-submitting due to a change of the drawing number, if there is no change in the other described items, the supplier shall not confirm the details to NSK, and the procedure shall be completed by submitting a copy. In addition, when any incompleteness includes in the contents at that time, the supplier shall follow the confirmation procedure in accordance with item (4) section 2) above. The supplier shall follow the above (4) section 3) and deploy it into work instructions etc. according to the expression for the control plan.

Procedure 16: Inspection record

(1) Scope

This applies when recording the inspection characteristics of products/ parts designated by NSK.

(2) Purpose

The purpose is to understand the inspection results and quality transitions in accordance with the inspection standards for products/ parts.

(3) Submission scope and procedure

1) Submission scope

a) All inspection characteristics for parts designated by NSK are objective of the items regulated in quality reports (purchase specifications, inspection standards), etc. (Example: rubber, castings, die castings, etc.)

b) Heat treatment products and welding parts are objective to the inspection characteristics in the table below.

○・・・Objective　　△・・・indicated in quality report

Classification \ Inspection characteristic		Surface hardness	Core hardness	Quenching depth	Quenching range	microscopic tissue	Material	Penetration	welding hardness	static strength	Peel strength	Base material peeling	Nugget diameter
Heat Treatment product	Normalizing/ annealing	○	○	—	—	○	○	—	—	—	—	—	
	Quenching/ tempering	○	○	—	—	○	○	—	—	—	—	—	
	carburizing quenching/ nitriding	○	○	○	○	○	○	—	—	—	—	—	
	Induction hardening	○	—	○	○	○	○	—	—	—	—	—	
Welding parts	Melt melding	—	—	—	—	—	—	○	△	○	—	—	
	Electric resistance welding	—	—	—	—	—	—	—	—	○	△	○	

2) Submission procedure

a) Form of inspection record

The supplier shall mark symbols such as security characteristics (保)(S)(HO), important functional characteristics(F), legal regulation characteristics(法)(SR), quality characteristics that lead to confound in the customer's line ■ mark, designated by NSK Enter 重 C for

critical characteristics, KC characteristics (key characteristics) ⊕⊖ for the aircraft industry described inspection items in the inspection standards.

a-1) The supplier's form can be used if the content is equivalent to the "Inspection Report" (Form 16-1)

a-2) For welding parts, the supplier shall prepare a format that satisfies the contents for the "Welding inspection data" (example form) shown below.

b) Submission period

b-1) For heat treatment products and welding parts, the supplier shall attach and submit inspection reports and test pieces for each production lot to the delivered product. The supplier shall store the test piece for at least 6 months after confirming and returning it by NSK.

* The lot formation shall follow the Lot Control (Procedure 24).

b-2) Parts except those listed above that NSK specifically indicates shall be submitted once a month by the 10th day of the following month.

c) Number of submissions and place to submit

The supplier shall submit a copy to the NSK representative.

Chart: Welding inspection data (form example）

Supplier name				
Part number Drawing				
Part name				
Welding date				
Number of manufacturing				
Delivery date				
Number of deliveries				
Penetration	Standard：			
Sample \ Part				
Nugget diameter	Standard：			
Part				
Actual value				
Supplier inspection signature		NSK confirmation signature		

3) Retention period of inspection records

The supplier shall keep inspection records for at least 15 years from the production date.

Procedure 17: Limit sample approval application

(1) Scope

This applies when the supplier judges the characteristics of products/ parts by sensory inspection, and it is difficult to judge the good or bad.

(2) Purpose

The purpose is to prevent suppliers and NSK from making ambiguous judgments on the quality characteristics of products/ parts, and to maintain and secure quality.

(3) Definition for limit sample

The limit sample is a sample that shows the limit of whether or not the product is passed in terms of quality.

The supplier shall exchange limit samples of accepted products and limit samples of rejected products as necessary.

(4) Approval Request Form Completion Procedure

1) Limit Sample Approval Request and Response Form

The supplier shall fill in the required items in the “Limit Sample Approval Request and Response Form” (Form 17-1).

2) Limit Sample Control Sheet

The supplier shall fill in the required items in the "Limit Sample Control Sheet" (Form 17-2).

(5) Submission procedure

1) Submission period

The supplier shall submit this when the supplier or NSK judges it necessary after the prototype stage or starting the mass production delivery.

2) Number of Submissions and Quantity

	Number of submissions and quantity
Limit Sample Approval Request and Response Form	1 original paper
Limit Sample Control Sheet	2 sheets (same content)
Limit sample product	2 pieces (of the same level)

3) Place to submit

The supplier shall submit these to the NSK representative.

(6) Notification of examination results

The examination results shall be notified in the “Limit Sample Approval Request and Response Form” and “Limit Sample Control Sheet”.

In addition, "Limit sample management card" shall be issued.

(7) Storage of Limit sample

The supplier shall store the sample in a way that it is not damaged or defaced and is not change over time.

(8) Update of Limit sample

The validity period of the limit sample shall be a maximum of one year. When the limit sample loses its functionality due to damage, defacement, or deterioration over time, or when NSK notifies the supplier of the "Periodical Inspection of Limit Sample", the supplier shall bring the limit sample to the product acceptance inspection department at NSK, and request to conduct the regular inspection. When passed the inspection, the limit sample control sheet and limit sample control card will be updated.

When failed the inspection, the supplier shall create a new sample and submit it to NSK for approval.

(9) Setting for the management representative

The supplier shall appoint the management representative in order to thoroughly manage limit samples.

(10) Identification for limit sample

In order to avoid mixing the samples with non-defective products, the actual samples shall be marked any scratches or other areas except the application area so that those can be identified at a glance and store them together with the Limit sample control sheet and Limit sample control card.

Procedure 18: Measurement Systems Analysis (MSA)

(1) Scope

This applies to measurements of products produced by the supplier.

(2) Purpose

In order to gain measurement data, there are factors that affect measurement data fluctuations, such as measurement tools, software, measurement personnel, measurement methods, and measurement environments in addition to the weighing equipment. The purpose is to analyze measurement data errors and evaluate them quantitatively by Measurement System Analysis (MSA).

(3) Target of analysis

1) Measurement System described in control plan and Inspection standards

2) When the changes handle in the contents of the measurement system due to newly creation, design change or process change

3) When it is necessary to statistically evaluate the measurement system in trials for improving processes and inspections

* When the above event occurs, the weighing value measurement system analysis is shown below.

(4) Weighing Value Measurement System Analysis：Gage Repeatability & Reproducibility (GRR)

1) Brief overview

a) Measurement repeatability errors (Repeatability)

This is the range of variation when one measurer uses one measuring device to repeatedly measure the same location on the same part multiple times.

b) Measurement error by the measurer (Reproducibility)

It is the difference between the average values of each measurer when multiple measurers use the same measuring device to measure the same place on the same component.

In order to statistically evaluate the two factors above, the weighing equipment used here shall be able to measure in finer units than 1/10 of the standard width of the weighing characteristics or more.

＊ As the GRR method evaluates comprehensively, it is not possible to individually evaluate the factors of repeated measurement error and measurement error by the measurer.

2) Procedure

a) Investigation method for measurement error by "average value - range method"

a-1) For the samples used for measurement, prepare 10 samples in-spec and out-of-spec the specifications within the range allowed by the weighing equipment and for which the process capability is ensured.

a-2) One weighing equipment is used, three measurers (A, B, a) measure the same part of one product three times as shown in the table below. The supplier shall note that sampling

(measurement) of products with the same quality might result in inaccurate judgments. Moreover, non-standard products shall be included in the sampling.

Table

Measurer	Trial number	Part N＝10 (type)									
		1	2	3	4	5	6	7	8	9	10
A	1										
	2										
	3										
B	1										
	2										
	3										
C	1										
	2										
	3										

b) Preparation of the table below “Investigation report for measurement error by the average value-range method”

b-1) The main calculation formulas shall be shown below, however, the supplier shall use the “Gage R&R Report” (Form 18-1).

The supplier shall refer to the Microsoft Excel software.

Total variation TV = √([standard deviation GRR]^2 + [standard Deviation PV]^2）

Total variation % = ((each standard deviation)/(total variation TV))*100

Table: “Investigation report for measurement error by Average value-Range method”

	Measurement Unit Analysis	Total Variation %
Repeatability-Equipment Variation(EV) K1=0.5908	EV=R*K1	%EV=100[EV/TV]
Repeatability-Measurer Variation (AV) K2=0.5231	AV=√([XDIFF*K2]^2 -[EV^2/(nr)])	%AV=100[AV/TV]
Repeatability-Gage R&R(GRR)	GRR=√(EV^2+AV^2)	%GRR=100[GRR/TV]
Part Variation (PV) K3=0.3146	PV=Rp*K3	%PV=100[PV/TV]
Total Variation (TV)	TV=√(GRR^2+PV^2)	—
The number of distinct categories (ndc)	ndc=1.41(PV/ GRR)	—

3) Judgment and Action

a) The supplier shall determine and take action of the total variation % of the measurement error (GRR). Possible to use the calculation software.

・Less than error 10%・・・It is an acceptable system and no action is required.

・More than error 10% and less than 30%・・・It is a conditionally acceptable system.

However, the supplier shall contact NSK when there is a problem with the importance of application, cost of measuring equipment, repair cost, etc. The customer approval might occur.

・Over error 30%・・・It is out of acceptable and requires any improvement in the measurement system.

b) The supplier shall determine and take action on the number of divisions categories (ndc) (Truncate to be integer).

Possible to use calculation software.

・Over the number of divisions categories (ndc) 5・・・It is an acceptable system and no action is required.

・Less than the number of divisions categories (ndc) 5・・・It is unacceptable and it needs improvement.

4) Improvement

When the number of divisions categories (ndc) is less than 5, or when the measurement error (GRR) is over 30%, the supplier shall reconsider the measurement repeatability error or measurement error by the measurer and improve the problem, and then re-evaluate it.

(5) Count Value Measurement System Analysis：Crosstab method

1) Brief overview

a) The Count value measurement system based on the "Crosstab method" is a measurement system that handles a number of classifications with boundary (limits) on measured values. ”Crosstab Report” (Form 18-2).

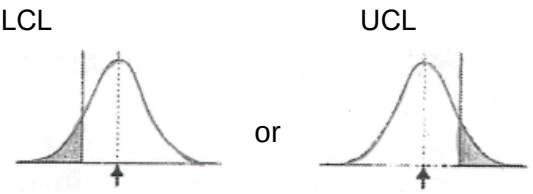
This is to be compared with the weighing value measuring system that handles continuous numbers. The most common Count value measurement system is a go/no-go gage, appearance judgment (such as scratches), etc., and this measurement result can only be applied to two types of OK/ NG.

b) For better understanding the impact of measurement system errors on product decisions, it is the case where all variations in multiple readings for a part are due to gage repeatability and reproducibility.

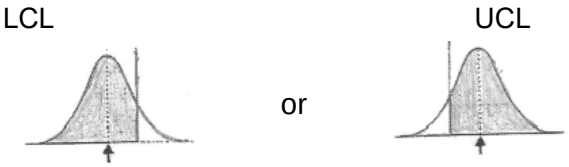
First, when the measurement process is in statistical control and has zero bias.

Wrong decisions can always be made when parts that exceed the measured distribution overlap the specification limits.

For example, as the case shown in the figure below, non-defective products are sometimes judged as "defective products". (Type 1 Error, or Producer Risk, Error Warning)

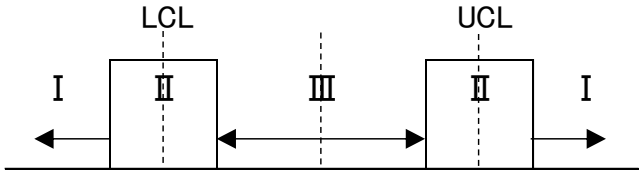


Moreover, in the following situations, defective products might be sometimes judged as “good products”. (Type 2 error, or consumer risk, error rate)



Error alarm rate + miss rate = error rate

Count value gauges, when considered in conjunction with their specification limits, have the possibility to make erroneous decisions about the part only if their measurement system error crosses the specification limits. It has the following three clear areas:



Target value

i) When defective products are always judged as defective products

ii) When it has the possibility to be made wrong decisions

iii) When good products are always judged as good products

Therefore, the variability factor of the Count value measurement system shall be minimized by using human factors and ergonomics research results.

c) Procedure

Survey method comparing each measurer to other measurers

c-1) Preparation

i) The investigator shall create a sampling plan and decide on 50 samples, 3 measurers, and 3 times measurements.

ii) The supplier shall randomly select 50 samples from the manufacturing process to cover the full range of process variations (including usage limits).

iii) For 50 samples, a pass/ fail judgment shall be made by an engineer or a skilled measurer, and two or more failed samples are used as a reference value, and the parts are numbered and prepared.

d) Measurement

The supplier shall create a Crosstab table (contingency table) between the results (pass/fail judgment results) and the standard judgment by having 3 measurers inspect the same 50 samples in random order 3 times.

Name: XXXX			Characteristic	Number of samples		Number of measurements			Measuring date
Part number: XXXX			XXXX	N=50 pcs		R=3			YY-MM-DD
Judgment by measurer: Pass judgment is “1”/ Failure judgment is “0”									
Part number	Measurer A			Measurer B			Measurer C			Criteria judgment
	1st time	2nd time	3rd time	1st time	2nd time	3rd time	1st time	2nd time	3rd time	
	A-1	A-2	A-3	B-1	B-2	B-3	C-1	C-2	C-3	
1										
2										
3										
50										
1: total										
0: total										

e) Analysis Ⅰ

The supplier shall compare the evaluation against the criteria judgment for each ~~appraiser~~ measurer.

The supplier shall investigate the number of pass judgments against pass criteria judgments, and the number of fail judgments against fail criteria judgments, and enter each measurer's data and criteria judgments in the judgment crosstab.

Table: Criteria judgment crosstab (created for each measurer)

			Criteria judgment		
			0.00	1.00	Total
Measurer name （ ）	0.00	Number of pieces			
		Expected value for number of pieces			
	1.00	Number of pieces			
		Expected value for number of pieces			
Total		Number of pieces			
		Expected value for number of pieces			

f) Analysis Ⅱ

The effectiveness survey table is created based on each measurer's criteria judgment crosstab.

The effectiveness survey table is recorded in the same manner as the criteria judgment crosstab above.

Table: Effectiveness survey table

	% Score VS Count value		
Factor	Measurer A	Measurer B	Measurer C
Total number of inspections			
Number of correct answers			
Total error			
Calculated score			

g) Analysis Ⅲ

The supplier shall calculate inspection effectiveness, error rate and false alarm rate.

・Inspection effectiveness

(Number of cases where the judgment result of the measurer agrees with the criteria judgment in all three measurements/ number of measurements)

・Inspection error rate (error of type 2)

(Number of fail in criteria judgments and pass on judgments of measurers)/ (Number of fail in criteria judgments)

・Inspection error alarm rate (error of type 1)

(Number of pass in criteria judgments and fail on judgments of measurers)/ (Number of passes in criteria judgments)

h) Summary of Effectiveness analysis

Judgment / Measurer	Effectiveness	Error rate	Error alarm rate
A	%	%	%
B	%	%	%
C	%	%	%

j) Count value measurement system evaluation

The effectiveness of the inspection, the error rate and the error alarm rate are evaluated and judged based on the criteria judgment.

Table: Criteria judgment for Effectiveness

Criteria judgment / Judgment item	Determination of the Measurement system	Effectiv e-ness	Error rate	Error alarm rate
a)	Acceptable measurement system	≧90%	≦2% ＝0%(*)	≦5%
b)	Measurement system is acceptable in minimum level: Need improvement	≧90%	≦2%	≦10%
c)	Unacceptable measurement system: Need improvement	＜90%	＞5%	＞10%

(*)Moreover, judgment criteria to be able to accept a 0% error rate for designated critical products

k) Improvement

When the judgment result is b) or c) in the criteria judgment table, the supplier shall investigate the cause, improve the competence of the measurer and the judgment method, and then re-evaluate.

(6) Submission and storage of results for Measurement system analysis

1) Submission of results

The supplier shall summarize the implementation results in the specified form and submit it to the NSK representative.

However, when evaluating by software, the format for each software can be used.

＊ The supplier shall mention the name of the software you used on the cover sheet.

2) Storage

The supplier shall keep the returned original paper for 15 years after approval by the NSK Quality Assurance Department.

The evaluation data shall be kept for 15 years even if the software is used for evaluation.

Procedure 19: Initial Sample Delivery

(1) Scope

This applies to the delivery of initial sample for which the supplier performed special management in the process change on the prototype stage and the mass production stage.

The initial sample is a product before transition to mass production, which is produced by a combination of the provisional or off process, and the prototype or off tool.

(2) Purpose

The purpose is to prevent quality concerns after the start of mass production and to ensure stable quality at an early stage through special management of initial sample.

(3) Target of initial sample

An initial sample is a product or group of products produced during the following specified period.

1) New design product: Products produced based on new drawings
2) Design change product: Products produced based on changed drawings
3) Process change product: Products produced by the changed process approved in the process change application
4) Non-conforming countermeasure product: Products produced after implementation of measures against non-conformity and market defects

(4) Initial sample management

For initial sample management, the supplier shall manage specially to ensure proper quality, early stabilization of the manufacturing process, and prevention of outflow of initial non-conforming sample.

During the control period for initial sample, in principle, the supplier shall conduct more quality control than daily control for the quality stability based on the requirements below.

<table>
<tr><th>Classification</th><th colspan="2">Type</th><th>Designated product mark</th><th>Specific mark</th><th>Initial sample management</th></tr>
<tr><td rowspan="3">Designated critical product</td><td rowspan="2">Designated critical safety product</td><td>Safety product</td><td>保 S HO</td><td>保 S HO</td><td rowspan="3">Three months of continuously produced at the beginning of manufacturing</td></tr>
<tr><td>Functional product</td><td>F</td><td>F</td></tr>
<tr><td colspan="2">Legally designated product</td><td>法 SR</td><td>法 SR</td></tr>
<tr><td>General</td><td colspan="4">–</td><td>One month of continuously produced at the beginning of manufacturing</td></tr>
</table>

The initial sample management shall be implemented from the launch of production after receiving a new drawing, changed drawing, process change response form, or after reporting a process change.

Quality during the period of initial sample control shall be confirmed and judged that the standards are fully satisfied, and the process is in a stable state based on "Process Capability Survey (Procedure 22)". When the quality assurance manager confirms that the quality assurance system is sufficient, the initial sample management period will be released.

When NSK requests Part Submission Warrant (PSW), it shall be handled after PSW approval.

Depending on the quality of the delivered product, NSK might request the extension of the period.

(5) Initial sample delivery procedure

When delivering the initial sample, the supplier shall submit the initial sample delivery notice and notification and indicate that it is an initial sample (new design product, design change product, process change product, or non-conformity countermeasure product) on the actual product, delivery note or inspection report.

1) Submission of initial sample delivery advance notice and notice

Initial sample classification	Initial sample delivery previous notice	Initial sample delivery notice
New design product	—	・Submission of New Lot Form 19-2
Design change product Process change product Non-conformity countermeasure product	・Submission before 7 days for New Lot Delivery Planned Date Form 19-1	・Same as above

However, if the first lot fails acceptance inspection at NSK and is returned, the supplier shall submit the next delivery lot as the first lot according to the procedure above.

2) Display of initial sample and submission of inspection report

Initial sample classification		Display of initial sample	Submission of inspection report
New design product	Prototype	・Display of all lots ・White tag for each container (packing style) Attach Form 20-1	・Submission of all lots ・Submission of Inspection Report for Prototype Form 16-1

	Mass production	・Consecutive 3 lot display ・White tag for each container (packing style) Attach Form 20-1	・Submission of 3 consecutive lots (*1) ・Initial sample before starting mass production Submission of Inspection Report, Form 16-1 ・Drawing all characteristics inspection result Only lots before the start of mass production Any form
Design change product Process change product Non-conformity countermeasure product	Prototype/ Mass product	・Consecutive 3 lot display ・White tag for each container (packing style) Attach Form 20-1 for packing tag -Design change product : yellow tag -Process change product : yellow tag -Non-conformity countermeasure product : green tag -Concession product : orange tag Attach Form 20-1 for countermeasure product ・Design change switch instruction No. or process change application form handling Include No. and change contents	Same as above + Initial sample delivery notice
Concession product	Prototype/ Mass product	・Suspect lot display ・Orange tag for each container (packing style) Attach Form 20-1 ・Acceptance No.	・Suspect lot ・Submission of Inspection report Form 16-1

3) Number of samples for inspection report

<table>
<tr><th colspan="2">Inspection characteristic</th><th>Number of deliveries</th><th>Number of samples</th></tr>
<tr><td>New design product</td><td>・All characteristics listed in a confirmed inspection standard (*2)
・Characteristics except the above described in the drawings (*3)
・Other characteristics designated by NSK</td><td rowspan="2">1～10
Over 11</td><td rowspan="2">Full quantity
10(*4)</td></tr>
<tr><td>Design change product
Process change product
Non-conformity countermeasure product</td><td>・All characteristics related to design changes, process changes, non-conforming countermeasures
(All characteristics including change characteristics when indicated separately)</td></tr>
<tr><td colspan="2">Characteristics determined by tool accuracy (rubber, resin, etc.)</td><td>－</td><td>3 pcs per model</td></tr>
<tr><td colspan="2">Characteristics requiring destructive inspection</td><td>－</td><td>2 pcs</td></tr>
</table>

(*1) KD (knockdown) parts shall be submitted for each delivery lot
Normal parts shall be submitted once a month by the end of the month after the 4th lot.
Process Capability Survey Results (Form 22-1) are submitted every 6 months for designated critical products.

(*2) When there is no confirmed inspection standard, the supplier shall follow the characteristics described in the inspection standard for similar parts.

(*3) Characteristics except the above described in the drawing shall be all characteristics with dimensional tolerances and dimensional acceptable differences. (Except the application of general tolerances such as JIS)

(*4) The supplier shall follow the instructions when there are any special instructions from NSK.

Procedure 20: Actual product identification at the time of product delivery

(1) Scope

This applies when the supplier delivers prototype initial products, initial sample for mass production, design change products, process change products, non-conformity products, concession products, etc.

(2) Purpose

The purpose is to display identification on the product or container in order to make it easier to understand the origin of the product when the supplier delivers prototype initial products, initial sample for mass production, design change products, process change products, non-conformity products, concession products, etc.

(3) Actual product identification

1) Actual tag

The supplier shall attach the actual tag to prove that it has passed the final inspection for each delivery lot.

"Identification of Actual Tag (Form 20-1) when delivering products"

2) Display

The supplier shall clearly classify the lot and attach a tag (small tag or auxiliary tag, supplier style is also acceptable) to each container for avoiding the mix lots.

The supplier shall clearly mention the part number, drawing number, lot number, and quantity on the actual tag.

Procedure 21: Layout inspection

(1) Scope

This applies when the supplier delivers the initial sample from the off tool off process before transferring to mass production.

(2) Purpose

The purpose is to check all items related to product characteristics such as all dimensions and dimensional tolerances described in drawings (including specifications) and to prevent non-conformity occurrence after the transition to mass production.

(3) Implementation procedure

1) Target parts

The target is the initial sample from the off tool off process before the transition to mass production due to a new design or process change.

Moreover, when NSK indicates at the prototype stage before the ~~main mold main process~~ off tool off process, the supplier shall comply with the request.

2) Inspection content

All characteristics described in the drawings (NSK parts drawings, specifications, or drawings received from suppliers) distributed by NSK (in the case of changed products, only the changed part can respond with inspection results) are subject to inspection.

a) Appearance
b) Shape (included, C or R chamfering, etc.)
c) Dimensions, Geometric tolerances
d) Material certificate, Mill sheet
e) Strength
f) Surface treatment, Painting
g) Others (Heat-treated product characteristics, rubber properties, etc.）
h) Survey result of environmentally harmful substances (using the form for NSK Green Procurement Standards)

3) Number of inspections

Over n=1 (The supplier shall inspect off tool for each off tools and each cavity.)

4) Submission procedure

a) Submission form

The supplier shall write the measured values in [ ] (brackets) etc. near the characteristics such as dimensions with a red ballpoint pen on the copied drawing. The supplier also shall display "inspection drawing" on the copied drawing.

b) Due date of submission

The supplier shall submit when delivering the first lot for off tool off process product before the transit to mass production.

However, the supplier shall enter the scheduled date of submission and submit the report

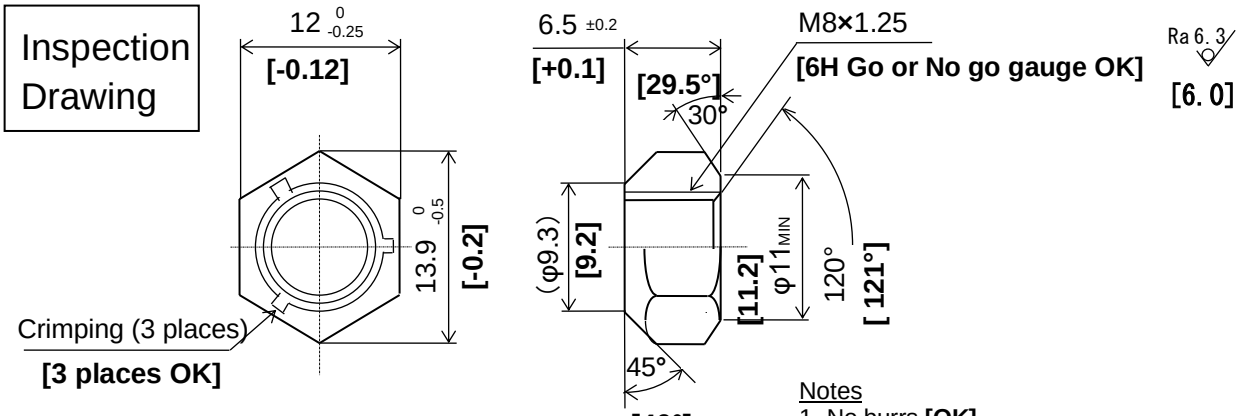
later if data submission is not possible for the first lot due to durability tests etc.

c) Entry procedure

"Entry procedure for Drawings All Characteristic Inspection" on the next page shall be referred.

【Example to enter】

Inspection Drawing



Notes
1. No burrs **[OK]**
2. After crimping three places as shown on the left
   1st **return torque is 1700~6900 mN·m [5700]**
3. Hardness is HB170 or more **[HB183]**

Lot. Number: **********
Judgment: All OK
△△Co.,Ltd.
**Plant QA Div.
QA Manager: signature

Inspector: signature

THIS PRODUCT TO BE MANUFACTURED IN ACCORDANCE WITH "NES W0210 & 0221" OR THE LATEST EDITION OF "NSK Group Green Procurement Standards"

[According to the attached analysis results OK]

[According to attached mill sheet OK]

△					Specifications	Approve	Check	Design	Draw	Customer P/N	
△					Such as plating						
△					Surface Treatment					Part	Nut
△					EP-Fe/Zn 5/CM2B	Material	S33C			name	
△	**[Galvanized 8μm OK]**					Scale	2:1	Qty.		P/N	8108-037
Code	Date	Chg. No.	Note	Changer		Date	2022/4/1			Dwg/N	4

Procedure 22: Process Capability Survey

(1) Scope

This applies when quantitatively investigating the process capability on the manufacturing process.

(2) Purpose

The purpose is to objectively and quantitatively judge the process capability for the manufacturing process using statistical methods.

NSK recommends that the products/ parts for automotive applications are operated in the process capability using the Control chart.

(3) Definition of Process capability

Process capability classifies to those that include 5M (Man, Machine, Material, Method, Measurement) + 1E (environment) elements and those that contain only mechanical elements.

The supplier shall express the range of product quality variation in the standardized process as "x±3σp".

1) Process capability

The supplier shall evaluate the control status of the process except the abnormal causes when the manufacturing process has been stabilized and standardized using the process capability index (symbols: Cp, Cpk).

2) Process performance

The supplier shall evaluate using the process performance index (symbol: Pp, Ppk) when the supplier is not sure whether the initial process capability and the manufacturing process are stable before transferring to mass production of new products.

3) Machine capability

The supplier shall evaluate the state of quality that fluctuates solely due to the influence of the machine, which is made as constant as possible with factors except the machine, using the machine capability index (symbol: Cm, Cmk).

(4) Process capability survey method

1) General precautions when taking data

There are various methods to take data for investigating process capability and machine capability, however, common items shall be shown below. Samples shall be products manufactured under conditions that allow mass production.

a) Stratification: The supplier shall stratify as much as possible and create a Control Chart (for analysis) (Form 22-3) that make intra-group and inter-group variation easy to understand.

・Man: By operator, morning and afternoon, etc.

・Machine: By machine, by tool, by bit, or by grindstone, etc.

・Material: By supplier, by lot of pre-process, etc.

・Method: By processing conditions, etc.

・Measurement: By inspector, by weighing equipment, by sampling, etc.

・Environment: By measurement room, by temperature, etc.

b) Sample size

b-1) The sample size shall be 100 pieces or more in principle.

However, when 100 or more samples cannot be acquired, 30 or more shall be desirable from the viewpoint of reliability. When 100 or more samples cannot be acquired, the supplier shall specify the reason in the process capability survey form. The NSK representative gives instructions as the customer requests.

When the number of measurement samples is small, it is important to make a judgment considering that the reliability drops. Therefore, the relationship shall be the idea below if the Cp value with the lower limit of the reliability interval for the number of samples being 1.00 is calculated based on the above idea.

Number of samples	10	20	30	40	50	60	70	80	90
Coefficient A	1.83	1.46	1.34	1.28	1.23	1.21	1.19	1.18	1.16
Coefficient B	1.43	1.18	1.11	1.08	1.06	1.05	1.04	1.04	1.03

* The supplier shall follow the instructions of the NSK representative, and the correction coefficient value shall be used the coefficient A or B above.

Example of correction: If Cpk obtained from 30 samples is 1.82,

For correction coefficient A, it is 1.34.

The corrected process capability index is Cpk=1.82/1.34=1.36.

In addition, NSK gives priority to the customer request if from the customer requests.

b-2) For the group division, the group size (n) shall be 4 to 5, and the number of groups (k) shall be 10 or more.

c) The supplier shall pay close attention to the relationship between inspection standards and processing standards, measurement position, number of times, and accuracy of weighing equipment when measuring.

(5) How to take data

1) Process Capability Survey

a) Sampling when the supplier need survey results urgently and also would like to know changes in trends

a-1) Time period: 1-5 days

a-2) Method: The supplier shall divide into equal intervals, sample one by one at random from the division and create a X-RS control chart.

a-3) Notes

・The data shall be entered in the processing order.

・The probable cause shall be described when an abnormal trend in the measured values can be seen.

・The supplier shall enter the absolute value RS = $\left| X_i - X_{i+1} \right|$ of the difference from

the previous value and pay attention to abnormal fluctuations.

b) Sampling when the supplier would like to know the overall distribution and when the supplier would like to know the distribution of each stratified group

b-1) Time frame: 1-5 days

b-2) Method: Create Histogram with Random Sampling

b-3) Precaution

・Create a stratified histogram when the items can be stratified.

・Check the points where abnormal values are found against the standard and fill in the probable cause.

c) Sampling when the management status is grasped and when there are relatively some spare times in the period of time

c-1) Time frame: 1 month

c-2) Create X-R control charts, etc. by stratified random sampling

c-3) Precaution

・Stratify when the item can be stratified.

・The size of the group (n) shall be 4 to 5, and the number of groups (k) shall be over 25.

・Enter within-group variation R = maximum value of X - minimum value of X.

Adopt a time (or number, etc.) sampling method to maintain and manage the stability of the process.

However, check the process capability index for the following requirements and secure the stability of the process.

2) Handling for various requests

a) When a system is requested by the customer,

The NSK representative instructs the customer request. The supplier shall enter the characteristics in the control plan and manage the characteristics.

b) When specified as the designated critical product in the manufacturing drawing,

The supplier shall enter the characteristics in the control plan and manage the characteristics. Even if the product is designated as the designated critical product, when the following appropriate management methods are adopted based on the confirmation of the initial process capability, the daily process capability survey may be omitted.

・Characteristics with checkers and poka-yoke (failsafe mechanism) throughout the entire process

・Characteristics determined by NSK to have sufficient process capability

c) For the daily process control, when it is determined that the variation in the process has increased, the supplier shall conduct at the judgment of the supplier's responsible process manager.

d） When setting up a new process and when specified the initial sample management

(6) How to obtain the process capability index and judgment / evaluation criteria

1) Process capability

a) How to obtain the process capability index

a-1) For both side standards: Process capability for quality characteristics that standards are described as both sides standards

①When the average value is easy to adjust and the only problem is variation

$$Cp = \frac{S_U - S_L}{6\sigma_S}$$

Cp: Process capability index
S_U: Upper limit of standard
S_L: Lower limit of standard
σ_S: Standard deviation for process capability

②When it is difficult to adjust the average value, or when the variation/ average value becomes a problem

$$Cpk = (1-k)\frac{T}{6\sigma_S}$$

Cpk: Process capability index
T: Standard width/ tolerance
σ_S: Standard deviation for process capability
k: Bias from the center of average value

However, when $k \geqq 1$, consider as Cpk=0.

$$k = \frac{2\,|M - \bar{X}|}{T}$$

M: Standard median
X: Sample mean value

a-2) For the upper standards: Characteristics that only the upper limit of the standard is indicated

$$Cp = \frac{S_U - \bar{X}}{3\sigma_S}$$

S_U : Upper limit of standard

However, when $\bar{X} \geqq S_U$, consider as Cp=0.

a-3) For the lower standards: Characteristics that only the lower limit of the standard is indicated

$$Cp = \frac{\bar{X} - S_L}{3\sigma_S}$$

S_L : Lower limit of standard

However, when $\bar{X} \geqq S_L$, consider as Cp=0.

2) Judgment/ evaluation criteria for process capability

For the weight values, multiple production lots and the number of samples shall be over 100.
The judgment of process capability by the process capability index Cp and Cpk shall be shown in the table below.

Table: Judgment/ evaluation criteria for process capability

Cp (Cpk) value	Safety characteristics	Critical characteristics	General characteristics
Cp≧1.67	Process capability is sufficient	Process capability is sufficient	−
1.67＞Cp≧1.33	Process capability is insufficient	Process capability is sufficient but needs the attention for management	Process capability is sufficient
1.33＞Cp≧1.0	−	Process capability is insufficient	Process capability is sufficient but needs the attention for management
1.0＞Cp	−	−	Process capability is insufficient

3) How to use of process capability index (Cp, Cpk)/ process performance index (Pp, Ppk)

Cp, Cpk: Process Capability −Estimate σ_P from R of $\bar{X}$−R control chart by $\bar{R}/d_2$

Pp, Ppk: Process Performance−Estimate σ_P from distribution data such as histograms

a) Explanation of process capability index Cp and Cpk

$$Cp = \frac{S_U - S_L}{6\sigma}$$

$$\sigma = \frac{\bar{R}}{d_2}$$

$\bar{R}$: Average of range R for each set of samples

d_2: Coefficients in the table below

n: Sample size for each set

Table Coefficient d2 (coefficient calculated from the control chart)

n	2	3	4	5	6	7	8	9	10
d_2	1.13	1.69	2.06	2.33	2.53	2.70	2.85	2.97	3.08

Smaller from $Cpk = \frac{S_U - \bar{X}}{3\sigma}$ or $\frac{\bar{X} - S_L}{3\sigma}$

b) Explanation for process performance index Pp, Ppk

$$Pp = \frac{S_U - S_L}{6\sigma_S} \qquad \sigma_S = \sqrt{\sum_{i=1}^{n} \frac{(X_i - \bar{X})^2}{n-1}}$$

Smaller from $Ppk = \frac{S_U - \bar{X}}{3\sigma_S}$ or $\frac{\bar{X} - S_L}{3\sigma_S}$

(7) Countermeasures/ treatments

When judged that the process capability is insufficient, or when needed a long-time-monitoring for the process, the ideas for improvement, countermeasures and treatment for phenomena shall be shown below.

1) Improvement/ countermeasures

a) The Manufacturing Department and the Manufacturing Technology Department shall improve the process capability.

・Pursue the management state through daily process control.

・Make a process improvement plan and conduct the process analysis and improvements.

When conducting process improvement, conduct a machine capability survey and utilize it.

b) Ask the Product Design Department to consider changing the standard (or drawing tolerance).

c) Conduct both a) and b) above.

2) Treatment for process capability index

Table: Evaluation/judgment criteria

Process capability index	Treatment
Cpk≧1.33	The process capability shall be secured, and the production shall be continued.
1.33＞Cpk≧1.0	General characteristics shall be strengthened monitoring such as sampling inspections and proceeded with caution. Designated critical products shall be improved the process to Cpk > 1.33 and produced conducting 100% inspection.
1.0＞Cpk≧0.67	Both general characteristics and designated critical products shall be improved to Cpk>1.33 to the process and produced conducting 100% inspection.

3) Judgment/ Evaluation Criteria for Process Performance Index and handling method

For weighing values, the supplier shall calculate with a single production lot and the number of samples over 100.

Table: Evaluation/judgment criteria

Pp (Ppk) value	Safety characteristics/ critical characteristics	General characteristics
Pp≧2.0	Process capability is sufficient	－
2.0＞Pp≧1.67	Process capability is sufficient but needs the attention for management	Process capability is sufficient
1.67＞Pp≧1.33	Process capability is insufficient	Process capability is sufficient but needs the attention for management
1.33＞Pp	－	Process capability is insufficient

Table: How to handle for Process Performance index

Process Performance index	How to handle
Pp and Ppk≧1.67	The process currently meets the requirements. After approval, start mass production and comply with the control plan.
1.67＞Ppk≧1.33	The process is currently acceptable. Contact the NSK representative whether if improvement is required and confirm the investigation results. Change the control plan when the improvement does not handle before starting mass production.
1.33＞Ppk	The process does not currently meet the pass/fail criteria. Contact the NSK representative to confirm the contents of the survey results.

Moreover, the process capability during the mass production requires the following.

Classification	Process Capability (Performance) Index and how to handle
When there is a customer request	Indicate the customer request. Submit a corrective action plan when customer requirements are not met.
When there is no customer request	ⅰ) Standards to be achieved 1.33≦Cpk or 1.67≦Ppk ⅱ) When Cpk＜1.33 or Ppk＜1.67 ・Manage the contents described in the response plan column of the management plan. ・Create a corrective action plan and conduct improvements.

(8) Machine capability

1) Grasping Machine Capabilities

a) Sampling when the supplier would like to grasp the machine capability and also know the trend value

a-1) Time frame: Normally within 1 day

a-2) Method: Create a control chart with continuous sampling.

a-3) Precaution

・The data shall be entered in the processing order.

・When showing an abnormal trend in the measured values, enter the probable cause.

・Enter the absolute value $R_S = |\chi_i - \chi_{i+1}|$ of the difference from the previous value, and pay attention to abnormal fluctuations.

b) Sampling when the supplier would like to have a fixed distribution of the 3Ms (Material, Man, Method) except machines

b-1) Time frame: Normally within 1 day

b-2) Method: Create histograms with random sampling or stratified sampling by a factor.

b-3) Precaution

・The data shall be entered in the processing order.

・When showing an abnormal trend in the measured values, enter the probable cause.

・Enter the absolute value $R_S = |\chi_i - \chi_{i+1}|$ of the difference from the previous value, and pay attention to abnormal fluctuations.

c) Sampling when the supplier would like to accurately grasp machine capabilities

c-1) Time frame: Normally within 5 days

c-2) Method: Create a control chart by continuous sampling

c-3) Precaution

・Set 4 to 5 consecutive samples as one group and enter in the processing order.

・Enter the range R=maximum value of χ - minimum value of χ from 4 to 5 items above.

・When an abnormal trend can be seen, enter the probable cause.

・Grasp temporal changes such as mechanical changes and wear of jigs and tools.

2) How to find the machine capability index

a) For both side standards: Process capability for quality characteristics that standards are expressed as both side standards

①When the average value is easy to adjust and the only problem is variation

$$Cm = \frac{T}{8\sigma_m}$$

Cm: Machine capability index
T: Standard width/ tolerance
σ_m: Standard deviation for machine capability

②When it is difficult to adjust the average value, or when the variation/ average value is a problem

$$Cmk = (1-k)\ \frac{T}{8\sigma}$$

Cmk: Machine capability index
T: Standard width/ tolerance
σ_m: Standard deviation for machine capability
M: Standard median
k: Bias from the center of average

$$k = \frac{2|M-\bar{\chi}|}{T}$$

However, when k≧1, consider as Cmk=0.

b) For the upper limit standard, Characteristics to indicate the only standard upper limit

$$Cm = \frac{S_U - \bar{X}}{4\sigma_m}$$

S_U : Standard upper limit

However, when $\bar{X} \geqq S_U$, consider as Cm=0.

c) For the lower limit standard, Characteristics to show the standard lower limit

$$Cm = \frac{\bar{X} - S_U}{4\sigma m}$$

S_L : Standard lower limit

However, when $\bar{X} \leqq S_L$, consider as Cm=0.

3) Judgment criteria for machine capability

Use the table below to judge the machine capability from the value of machine capability Cm obtained in the previous section.

Table: Criteria to judge with or without machine capability

Cm（Cmk）value	Judgment criteria
Cm≧1.0	Machine capability is sufficient
1.0＞Cm	Machine capability is insufficient

(9) Submission of process capability survey results and improvement reports

Investigate the items with tolerance settings in the drawing and submit a copy of the Process Capability Survey (Form 22-1) and Equipment Machine Capability Survey Results (Form 22-2) to the NSK representative.

Procedure 23: Delivery packing style application

(1) Scope

This applies when the supplier sets the delivery packing style when starting mass production or by process changes.

(2) Purpose

The purpose is to check the packing and packaging conditions during transportation, and to prevent quality concerns by the packing style of product.

(3) Delivery packing style application

The supplier shall fill in the necessary items on the "Delivery Packing Style Application Form" (Form 23-1) and submit it to the NSK representative.

(4) Display of packing style

Affix at least the label below to the package or packing style in the easily visible location.
Moreover, the lot consolidation when delivering is limited to 2 lots.

1) Manufacturer name or elision mark
2) Part name
3) Part number
4) Quantity (Quantity for 1 box and 1 lot)
5) Lot number
6) Date of manufacture

Procedure 24: Lot Control

(1) Scope

This applies to products/ parts produced by the supplier and products stored in warehouses.

(2) Purpose

The purpose is to perform the Lot Control for products/ parts and clarify the identity of products stored in warehouses as well as production lines.

Especially, when any abnormality is found after the product shipment, the scope of the object shall be identified from the manufacturing history and managed to be able to track the products.

(3) Lot Control Method

When a non-conformity occurs, the supplier shall manage to be able to take appropriate measures such as tracing, searching, investigating the cause, countermeasures, etc. for each manufacturing process history from the lot number and narrowing down the range of non-conforming products.

1) Target parts

All products supplied by suppliers to NSK, all products shipped directly from suppliers to NSK customers without NSK, materials and parts supplied by NSK to the suppliers, etc.

2) Indication of lot

a) When indicating parts individually

It is indicated by engraving or corrosion engraving, and the location of the indication is described on the part drawing, or instructed in the manufacturing drawing, work drawing, or purchase specification. When it is difficult to indicate by the engraving, the supplier shall contact the NSK representative.

b) When parts cannot be indicated individually

The supplier shall mark each container with a tag or label.

3) Lot formation

a) The supplier shall form and manage lots to be able to trace the history (material lots, parts processing lots, etc.) through all processes such as materials, processing, assembly, and shipping according to the part characteristics. The supplier shall follow the instructions when NSK instructs the lot formation.

b) For parts or assemblies, the supplier shall be able to search for a lot of assembly small parts from the lot number.

4) Precaution on Lot Control

a) The supplier shall strictly manage the first-in, first-out for products/ parts.

b) The supplier shall manage the products generated fractional items.

c) The supplier shall manage the products repaired, reworked, or suspended.

d) The supplier shall prevent mixed products between lots.

5) Lot Control record

The supplier shall create the Lot Control ledger that makes easier to search product (can be

search the history from the lot number to material lot of products/parts and delivery to NSK) and keep a record. In addition, the supplier shall manage to be able to submit when NSK requests.

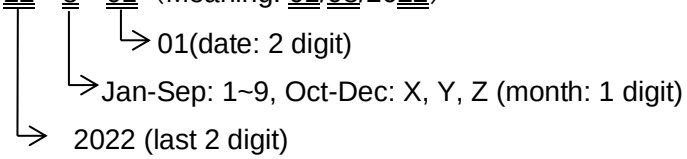
6) Lot number composition and indication when delivering to NSK

The supplier shall determine the composition of the lot number and the indication method when delivering to NSK and report the details to the NSK representative.

・Notification form: “Delivery Part Lot Control Method Notification Form” (Form 24-1)

・Example for lot number: Lot number

e.g.) 22 8 01 （Meaning: 01/08/2022）



Procedure 25: Part Submission Warrant (PSW)

(1) Scope

This applies to products/ parts taken new or process changes when the supplier transits to mass production.

(2) Purpose

The purpose is to confirm that the supplier has completed the production preparation process to transit products/ parts to mass production, and to prevent quality concerns and outflows after transiting to mass production.

(3) Operation

This is requested when NSK is required by an IATF OEM (European and American automobile and parts manufacturers, etc.) to submit the "Part Submission Warrant (PSW)" (Form 25-1).
The Quality Assurance Manager at the supplier shall confirm that all documents related to the products/ parts to transit to mass production are available, that the quality documents are exchanged with NSK, it is possible to transit to mass production.

(4) Checklists

1) Initial sample management plan
2) Design FMEA
3) Control Plan
4) Inspection standard
5) Process FMEA
6) Process capability survey result
7) Layout inspection
8) Initial sample inspection result
9) Certified Material Record (mill sheet)
10) Measurement Systems Analysis (MSA) report
(Gage Repeatability and Reproducibility, Crosstab Method)
11) Notification to use Tire-N supplier
12) Delivery packing style application
13) Limit sample approval request and answer form
14) Product/ part
15) SOC Non-containment Certificate (IMDS)
16) Process Change plan/ Application Approval result
17) Production preparation audit result

Procedure 26: Initial Product Control

(1) Scope

This applies to the initial production time after starting mass production, such as new products from suppliers, design changes, and process changes.

(2) Purpose

The purpose is to confirm that the management targets such as QCD (Quality, Cost, Delivery) determined by the supplier before mass production are conducted according to the target due to process fluctuations, and that there is no risk in quality and delivery after mass production.
NSK designates initial product control and removes it when NSK determines that there is no risk to the supplier's initial mass production and quality.

(3) Operation

NSK requests to respond to initial product control using “Production Preparation Request (New products/ Increased production products) ” (Form 11-2).
The supplier shall set goals such as QCD, create the "Initial Product Control Plan" (Form 26-1) and the "Initial Product Control Table" (Form 26-2), and monitor the control items toward the cancellation of initial product control.

(4) Requirements

1) Appointment for Initial product control/ release manager
2) QCD target setting for initial product control designated products
3) Selection of control items and setting of release criteria
4) Control target
   a) Designated critical product, Critical control process, Special control required process and Condition controlled process
   b) Inspection data for initial sample products
   c) Securing process capability
   d) QCD items set as released targets
5) Control period after starting mass production
   a) Cases that NSK assigned NPDS rank to A or B: 6 months
   b) Cases that customer instructions or NSK designated as critical designated products: 3 months
   c) Case that NSK designated as general products: 1 month

(5) How to release

The supplier shall apply for cancellation to the NSK representative when the targets listed in the cancellation requirements on the initial sample control form are achieved.
NSK notifies the supplier the cancellation of the control period after confirming the content.

Procedure 27: Procedures Against Non-conformity occurrence

(1) Scope

This applies when NSK or NSK's customers find non-conforming products or parts delivered by the suppliers.

(2) Purpose

The purpose is to promptly take corrective action against non-conformity and prevent recurrence.

(3) Report and treatment when the non-conformity occurs

1) When found within the supplier

When the supplier's quality assurance manager finds non-conformity in the process or inspection, and when the non-conforming lot is delivered to NSK, or when there is a possibility for the above, the supplier shall promptly notify the Procurement Department and Quality Assurance Department who are the NSK representative related to the following items a) to c) and shall receive instructions of handling for non-conforming products.

Suppliers shall receive instructions from NSK regarding the format (“Non-conformity Recurrence Prevention Measures Report” (Form 27-1) or “8D Report” (Form27-3))for reporting measures to prevent recurrence.

The supplier shall contact the NSK representative when there is a possibility that repairing or reworking for non-conforming products may lead to defects.

a) Non-conforming details, occurrence situation, and the estimation of occurrence cause

b) NSK delivery date, delivery quantity, part number, lot number

c) Temporary or emergency treatment by the supplier, handling against already delivered products

2) When found in the market within NSK or after shipment to the NSK customer

The supplier who receives non-conformity information from NSK shall cooperate with the Procurement Department who is the NSK contact in order to maintain the customer's production for NSK or the NSK production and conduct a selection and correction according to the instructions by the Quality Assurance Department.

The supplier shall work with the Quality Assurance Department who is the NSK contact and conduct countermeasures related to the quality assurance details such as the cause of non-conformity occurrence/ outflow, provisional measures, timing of occurrence/ outflow and non-conforming product range (lot).

3) Cause investigation and Reoccurrence prevention countermeasures

The supplier shall investigate the root cause of non-conformity and conduct countermeasures concurrently with the measures 1) and 2) above. Moreover, the supplier shall describe the non-

conformity treatment and recurrence prevention measures for the relevant parts and similar parts into "Notification of Non-conformance and Countermeasures" (Form 27-2) issued by the NSK Quality Assurance Department and submit it to the NSK Quality Assurance Department by the due date.

NSK will instruct suppliers regarding the format ("Non-conformity Recurrence Prevention Measures Report" (Form 27-1) or “8D report” (Form 27-3)) for reporting non-conformity prevention measures.

The supplier shall obtain the approval from the NSK Quality Assurance Department in advance when the report cannot be submitted within the due date.

(4) Non-conforming products delivery

1) Indication of countermeasure product

When delivering the first lot of permanent countermeasure products against non-conformity, the supplier shall attach the "Actual Part Identification Tag (F, etc.)" (Form 20-1) to all of the containers or the packaging. The supplier shall also submit the initial sample delivery notification.

The supplier shall mark the container or packaging as "Inspection OK" for the items that have been inspected as a provisional measure.

2) Submission for quality confirmation results related to countermeasure products

The supplier shall submit the "Inspection Report" (Form 16-1) to the NSK Quality Assurance Department when delivering the first lot for countermeasure products. The supplier shall submit the inspection report for 3 consecutive lots to deliver non-conforming initial sample.

3) Actual part identification tag for countermeasure product (F, etc.)

The supplier shall attach Actual Part Identification Tags for 3 first lot (Form 20-1) when delivering the initial sample for countermeasure products.

(5) Supplier quality evaluation

1) Operation

NSK conducts quality evaluations for the delivered products from the supplier.

NSK not only evaluate the quality for the delivered products at the business units and plants, but also evaluate the market quality concerns.

Quality evaluations shall be conducted feedback on a monthly, half-yearly, and yearly basis from NSK's point of contact to which suppliers deliver products/ parts.

2) Supplier quality evaluation

NSK Japan plant evaluates the quality for products/ parts delivered by suppliers based on the following scoring calculation.

Please receive the evaluation results for the delivery place since quality evaluation methods are different in overseas.

An example of calculating quality evaluation points for Japan plant suppliers is shown below.

＊ Calculation formula for quality evaluation score＝100－(A*10+B*5+C*3+D*1+E*1+F*5}

A: Quality concerns for products delivered to customers (concerns found in NSK customer sites and caused by suppliers)
The following are quality concerns found during NSK processes or acceptance inspections

B: Critical defects (quality concerns led to premature product damage, etc.)

C: Serious defects (quality concerns that products cannot be assembled and reduce the function gradually functionality)

D: Minor defects (defects that do not meet quality standards but do not affect use, defects in appearance quality, etc.)

E: Acceptance inspection (not meet with quality standards, or concerns in appearance quality, etc.)
The following are quality concerns found at the KD for parts that NSK has knocked down (KD).

F: KD product quality concerns (concerns found at KD such as overseas plants)

＊ In addition to the above, 50 points will be deducted from the month in which the defect was discovered for supplier quality concerns registered by the NSK Quality Assurance Headquarters as critical quality issues.

3) Quality improvement requirements

NSK requests quality improvement when the supplier's quality evaluation deteriorates or does not improve. NSK conducts supplier audits as required.

Procedure 28: Application for Deviation

(1) Scope

This applies to concession of products that have no performance or functional problems among the products that the supplier has agreed with NSK to be delivered.

(2) Purpose

The purpose is to clarify the application criteria for concession and to suppress the delivery time or economic loss due to alternative processing for non-conforming products.

(3) Basics for concession application

When the supplier unavoidably prefers to have partially non-conforming products or parts as concession that do not meet the prescribed quality standards such as NSK drawings and inspection standards, the supplier shall clarify the extent, quantity, the defect cause and measures in advance and apply to NSK.

However, in that case, it shall be limited only to those that fall under the following items and can be determined to be no issue in use by devising the usage conditions.

1) When the function and commercial value for the product do not decrease
2) When it is proven that the function, performance and durability of the product/ parts not to adversely affect based on the technical data.
3) When there is no issue in the post-process (including the customer)
4) When recurrence prevention measures are taken and deliveries after the relevant lot are not under concession

In principle, NSK does not accept the applications for concession for the same event/ phenomenon.

(4) Application

1) The supplier shall fill in the specified items on the “Concession Application and Response Form” (Form 28-1) and submit it to the NSK representative.
2) The supplier shall attach a sample when it is difficult to understand the non-conforming part and degree.
3) The supplier shall attach other related materials such as control plans or work standards as necessary.

(5) Decision

NSK examines the application details, and the NSK Quality Assurance Department notifies the result to the supplier.

However, even if NSK concession is approved, the supplier may be asked responsible when a market quality concern related to the concession occurs.

(6) Delivery

The supplier shall clearly indicate that the delivery parts are concession products on the delivery note and the actual product when delivering special products.

The supplier shall attach the “Actual Part Identification Tag (F, etc.) when Delivering Products” (Form 20-1) to all containers or packing styles.

In addition, the supplier shall attach the "Actual Part Identification Tag when Delivering Products" (Form 20-1) stipulated in the "Non-conforming products occurrence treatment" (procedure 27) for the initial sample of measures (The supplier shall describe the processing number for the returned Application for Deviation and Response Form on the tag).

Procedure 29: Design Change Application

(1) Scope

This applies when the supplier or the Tier-N supplier change the design for products.

(2) Purpose

The purpose is to manage changes with design changes, including cost reduction for products and countermeasures against quality concerns and prevent the occurrence of quality concerns.

(3) Design changes to require application

This applies to all products/ parts designed by the supplier.

1) When there is a change in the contents of drawings or specifications agreed with NSK
2) When the impact occurs due to changes in NSK requirements
3) When products/parts have changes in appearance such as performance, function, structure, dimensions, dimensional tolerances, geometric tolerances, materials, and colors for parts and products although the supplier has not exchanged drawings or specifications with NSK
4) When the contents that NSK has not exchanged with the supplier, and the drawings and specifications exchanged between the supplier and the Tier-N supplier affect the performance and functions of the NSK product (Include environmentally harmful substances)

＊ The supplier shall consult in advance with the Procurement Department or the Product Design Department that is the NSK contact to confirm whether or not design change procedures are required. Changes shall be also included the Tier-N supplier designed products.

(4) Design Change

1) Design Change Application

a) The supplier shall submit the original "Design Change Plan" (Form 29-1) to the Product Design Department for the NSK contact when the design change is related to item (3) above.
When a change has a significant impact on NSK products, NSK recommends the supplier to consult with the Product Design Department for the NSK representative before finalizing the change plan since it will take time to obtain the NSK customer's approval.

b) The supplier shall identify changes/ change points, and conduct “Validation for change points due to in Design Specification Changes” (Form 9-1) based on the impact on customer usage in addition to design and manufacturing. NSK attaches the form, however, the supplier may use the form if it is possible to verify.

c) NSK examines the QCD (Quality, Cost and Delivery) contents for the design change plan, determines whether it can be accepted, and returns it to the supplier.

2) Implementation for Design change

a) The supplier shall proceed with the change procedure when NSK approves the design change.
The supplier shall cooperate with NSK when NSK needs requests design change application for the NSK's customer products and when NSK requests to disclose information on changes/ change points verification results, process confirmation or sample provision.

Moreover, NSK instructs the implementation of the switchover after receiving the approval for the change application from the NSK customer.

b) The supplier shall promote the verification of changes/ change points and prevent quality concerns due to changes.

3) Production preparation

The supplier shall follow the "Production Preparation Management" (Procedure 11) and perform the “Initial Sample Delivery" (Procedure 19) when the supplier that proposed the design change manufactures the product/ parts

4) Submission of quality ledger sheet

a) The supplier shall re-register the IMDS (International Material Data System) when the environmentally harmful substances contained in the product are changed due to the design change.

b) The supplier shall resubmit to NSK when the supplier needs to change the items described in the quality ledger sheet such as process change due to design change, inspection standard, the Process FMEA, control plan, use notification related to the Tier-N supplier.

c) The supplier shall follow the “Approval Application Form for Part Submission Warrant (PSW)” (Form 25-1) before transiting to mass production.

5) The supplier shall conduct “Initial Sample Control" (Procedure 26).

Procedure 30: Process Change Application

(1) Scope

This applies when changing the process of the products/ parts for the supplier or the Tier-N supplier.

(2) Purpose

The purpose is to prevent quality concerns by changing management with process changes such as manufacturing processes, process order for inspection process and work conditions by rationalization for the supplier, reducing costs and countermeasures against quality concerns.

(3) Process Change guidelines

It shows the guidelines for each process in which the supplier submits a change request.

The supplier shall consult with the NSK representative before applying for the change including when it is not clear whether if the application is required.

The supplier shall consult with the Quality Assurance Department before finalizing the change plan since it may take some time to obtain NSK's customer approval depending on the content of the change.

Process classification	Common	Forging/ Rolling	Casting
Personnel	-Significant transition of personnel due to newly creating shifts, groups, teams and organization changes	—	—
Supplier	-Change of the Tier-N supplier -Switching of internal/ external manufacturing	-Change of the Tier-N supplier	-Change of the Tier-N supplier
Equipment	-Equipment transfer -Equipment expansion -Equipment change/ improvement -Jig/ tool change -Customer certified equipment changes	-Off tool changes to affect quality	—
Material/ part	-Change of material supplier -Material format change	—	-Change of material supplier
Method/ condition	-Process flow change -Processing methods change -Processing condition change	-Forging/ rolling method change -Processing condition change -Pre-processing change	-Casting methods change -Processing condition change -Finishing method change
Inspection method	-Inspection item change/ omission -Inspection method/ condition change -Inspection jig/ tool change	—	-Inspection method/ condition change

Process classification	Machining/ Cutting	Heat Treatment	Grinding process
Personnel	—	—	—
Supplier	—	-Change of the Tier-N supplier	—
Equipment	-Jig/ Tool change	-Customer-certified furnace change -Equipment transfer/ new installation/ expansion -Equipment improvement -Equipment overhaul -Applicable furnace change -Attached equipment change	—
Material/ Part	—	-Changes in materials, specifications, shapes and dimensional ranges that have not been used in the relevant furnace	—
Method/ Condition	-Cutting method change -Process order change/ addition/ deletion -Processing condition change -Change of processing standard and setting method -Post-processing change	-Heat Treatment (HT) method change -HT conditions change -Equipment management method changes -Pre-processing and post-processing method change	-Grinding method change -Grinding conditions change -Process order change/addition/deletion
Inspection method	—	-Inspection method/ condition change	—

Process classification	Assembly	Final inspection	Packaging/ Packing
Personnel	—	—	—
Supplier	-Change of the Tier-N supplier	-Change of the Tier-N supplier	—
Equipment	- Equipment change and improvement - New installation/ change for automatic inspection machine	-Change of Inspection equipment/ analysis equipment -Newly installation/ removal/change of automatic inspection machine -Inspection jig tool change	—
Material/ Part		—	-Packing material change
Method/ Condition	-Process order change/ addition/ deletion -Cleaning fluid/ solvent change	-Omission/ change for inspection items -Inspection level change -Inspection condition change -Measurement method change	-Packaging/ packing method change -Packing style and format change -Processing condition change -Change of anticorrosive
Inspection method	—	—	—

Process classification	Transportation/ Storage	Cleaning/ Rust prevention	Press (Parts)
Personnel	—	—	—
Supplier	—	—	—
Equipment	-Warehouse transfer/ change	-Equipment change/ improvement	-Processing equipment change
Material/ Part	—	-Change of anticorrosive -Change of cleaning liquid	-Material supplier change
Method/ Condition	-Transportation method change -Transit point change	-Changes in cleaning, deoiling, degreasing, and rust preventing methods -Processing condition change -Cleaning liquid management method change	-Press method change -Processing condition change
Inspection method	—	—	—

Process classification	Resin/ Rubber/ Grease (Material)	Resin/ Rubber/ Grease (Manufacturing)	Resin/ Rubber/ Grease (Inspection/ packaging/ storage)
Personnel	—	-Change of qualificator	-Change of qualificator
Supplier	-Change of the Tier-N supplier	-Change of the Tier-N supplier	-Change of the Tier-N supplier
Equipment	—	-Change of equipment/ manufacturing site	-Changes in equipment and surrounding environment
Material/ Part	With the same supplier -Brand and composition change of materials used (Incl. base material) -Changed polymer formulation chemicals -Change of manufacturing site Above includes supplier change	-indirect materials such as solvents and rust-preventive oil	-Indirect materials such as packing materials
Method/ Condition	-Change in the manufacturing method of materials for the Tier-N supplier	With Same supplier -Off tool, molding/ vulcanization/ tempering method, Changes to those conditions -Mixing/ dissolution/ heating/ cooling/ chemical addition/ kneading/ defoaming method, Changes to those conditions -Post-finishing method change -Change of condition management process The above includes when the Tier-N suppliers change	-Processing condition change -Change of anti-static destruction method -Change for screening/aging conditions
Inspection method	—	—	-Atmosphere change during inspection

Process classification	Steel ball (For parts/ sales)	Roller (Roughing, Turning, Heat treatment)	Roller (For parts/ sales)
Personnel	—	—	—
Supplier	-Change of the Tier-N supplier	-Change of the Tier-N supplier	-Change of the Tier-N supplier
Equipment	—	-Equipment change for forging, casting, and heat treatment	—
Material/ Part	-Material type change	-Material type change	—
Method/ Condition	-Processing method change	-Processing method change	-Processing method change
Inspection method	—	—	—

Process Classification	Surface processing (Shot blast/ barrel)	Surface treatment (Plating/ Blackening)	Painting
Personnel	—	—	—
Supplier	—	-Change of the Tier-N supplier	-Change of the Tier-N supplier
Equipment	—	-Equipment change/ improvement	-Equipment change/ improvement
Material/ Part	—	-Supplier change for chemicals used (including pre-processing)	-Supplier change for chemicals used (including pre-processing) -Brand change for paint
Method / Condition	-Surface processing method change -Pre-processing state change	-Surface processing method change -Processing condition change	-Painting condition change
Inspection method	—	-Measurement method/ condition change	-Measurement method/ condition change

Process classification	Welding	Adhesion/ bonding	Metal materials
Personnel	-Change of expert	-Change of expert	—
Supplier	-Change of the Tier-N supplier	-Change of the Tier-N supplier	-Change of the Tier-N supplier
Equipment	-Equipment change/ improvement -Jig tool change	-Jig tool change	—
Material/ Part	-Material change for processed material -Wire diameter change for electrode -Flux change	-Supplier change for processed material -Pre-processing state change	With the same supplier -Brand and composition change of materials used (Including raw materials) -Changed polymer formulation chemicals -Change of manufacturing site Above includes supplier change
Method/ Condition	-Welding method change -Welding condition change -Welding monitor change	-Adhesion method change -Adhesion condition change	-Change in the manufacturing method of materials for the Tier-N supplier
Inspection method	—	—	-Mill sheet -Material test

(4) Process change application

1) When the supplier plans to change the process, the supplier shall submit relevant materials to the NSK representative with the original paper on which necessary items such as the implementation plan are entered to the "Process Change Plan / Application Form" (Form 30-1) based on the contents of the process change in item (3) above.
Moreover, when NSK needs to apply to the NSK's customers, the supplier shall consult with the NSK representative before applying since evaluation tests and performance confirmation may be required due to the change.

2) NSK confirms the contents of the plan, describes the requirements including acceptance or rejection, and returns it to the supplier.

3) The supplier shall conduct risk analysis and verify the impact of changes and change points Based on the change plan. (NSK recommends using "the of Change Points Verification with the manufacturing Process Change" (Form 9-2) when extracting and verifying the change/ change points.)
The supplier shall follow the instructions when there is any instruction from NSK.

4) The supplier shall submit the original "Process Change Plan / Application Form" (Form 30-1) filled in with required items such as trial test results to the NSK representative. The supplier shall also submit relevant documents related to the change. In principle, the plan and application form shall be submitted 4 months before the scheduled date of process change,

and the application form shall be 2 months before at the earliest.

However, the supplier shall inform the urgency to the NSK representatives and follow their instructions when the supplier needs to change the process in urgent situation such as a sudden accident, etc.

* In principle, NSK prohibits process changes for products/ parts that have been designated by customers as critical designated products such as applications for aerospace, railway vehicle, nuclear power and defense equipment.

(5) Implementation of Process Change

The Quality Assurance Department replies whether or not the process change is possible based on the process change review result for the "Process Change Plan / Application Form" (Form 30-1) after the audit if necessary. The supplier shall change the process for the approved items after receiving the "process change review result".

The supplier shall manage the initial sample control and prevent quality concerns in the initial stage at mass production after implementing the process change.

(6) Submission for quality documents

The supplier shall promptly resubmit to the NSK representative when changing to the items listed on quality documents such as inspection standards, control plans or the Tier-N supplier usage notifications due to process changes.

(7) Delivery for process change products

The supplier shall follow the "Identification when delivering the Initial Sample" (Procedure 20) for NSK delivery related to process change products.

Procedure 31: VA/VE Proposals

(1) Scope

This applies when the supplier makes VA (Value Analysis)/ VE (Value Engineering) proposals for products/ parts.

(2) Purpose

The purpose is for the supplier to streamline, reduce costs, and improve quality by changing product/ part specifications, manufacturing/ inspection processes, process orders, and working conditions.

(3) Proposal target

・Design changes and process changes for products/ parts that NSK has requested the supplier to design and manufacture

・Process change for the Tier-N supplier change by the supplier

(4) How to apply and procedure

1) The supplier shall submit the original "VA/VE Proposal" (Form 31-1) to the NSK representative.

2) The supplier shall submit proposals one sheet by one case.

The action will be delayed depending on the judgment for each proposal when multiple proposals are listed in the proposal. The supplier shall contact the NSK representative in advance when the supplier has multiple proposals for the same phenomenon including different part numbers.

3) Relevant departments including the NSK representative determine whether if accept the proposal and respond with the results of the decision to the supplier.

4) The supplier shall follow the related procedures such as "Design Change Application" (Procedure 29) or "Process Change Application" (Procedure 30) separately when the proposal is accepted.

＊ The "VA/VE Proposal" (Procedure 31) and the "Design Change Plan/ Application Form" or "Process Change Plan/ Application Form" may be submitted together when the supplier has discussed with NSK in advance.