Supplier Quality Manual

April 2025

- ❖Quality Management Requirements
- ❖Implementation Specific procedure A for satisfying.
- ❖Implementation Specific procedure B for APQP, PPAP, FMEA, MSA or SPC

THAI SUMMIT MITSUBA ELECTRIC MANUFACTURING COMPANY LIMITED.
Supplier Quality Control Department and Purchasing Department.

To: Correspondent Firms of

THAI SUMMIT MITSUBA ELECTRIC MANUFACTURING COMPANY LIMITED.

Supplier Quality Manual

Dear Partners;

The contents of this “Supplier Quality Manual” have been fully revised, and we deeply appreciate that all of you are taking appropriate action to ensure your quality assurance activities in accordance with this Manual.

This time, we have revised partially and added some contents on Feb 2025 revision.

We wish you to read and follow the Manual carefully, in order to secure the quality assurance for all products which you supply to Thai Summit Mitsuba Electric Mfg. Co., Ltd.

The revision of this manual is effective as of Feb 2025. (Revised for incorporation of the requirements of IATF16949 & Revised for incorporation of the Customer-specific-requirements & MITSUBA Corporation Supplier Quality Manual.

The Manual is now delivered in email. Every supplier is allowed to make the necessary number of hard copies of the Manual, provided that they ensure the confidentiality of the information contained therein.

(Note) If you possess any of the previous editions, please dispose of them in such a manner that ensures confidentiality.

Best regards.

Quality System Control Department and Purchasing Department.

Thai Summit Mitsuba Electric Mfg. Co., Ltd.

❖ Record of Manual Establishment and Revisions

History of original, revision		
Edition No.	Enforcement date	Content
1.0	Aug-07	-New Document
2.0	Sep-09	-Revise Format Control
3.0	Nov-13	-Revise detail in item change control -Record and keeping document control -Matrix IPP and add flow chart control IPP.
4.0	Jun-14	-Add Item drawing control.
5.0	Jun-17	-Revise specification IPP control table , -Safety part control -Change control table-Document record control -Add supplier evaluation-Audit Supplier-Contaminate control -Poka-yoke control, -5Why Analysis.
6.0	May-18	-Revised for incorporation of the requirements of ISO9001:2015 and IATF16949:2016. -Revised for incorporation of the Customer-specific-requirements - Revise for incorporation of the MITSUBA Corporation Supplier Quality Manual Ver.8.00
6.1	4 Oct 18	-Revised revise record retention page 13 item 7.5.3.2.1
6.2	15 May 19	-Annually update. - Revise for incorporation of the MITSUBA Corporation Supplier Quality Manual Ver.8.01
6.3	14 Aug 20	-Add safety product control.
6.4	14 June 21	- Revise for incorporation of the MITSUBA Corporation Supplier Quality Manual Ver.8.03
6.5	14 Sep 22	-Add PCR/DCR in manage the change work flow, update follow MITSUBA Corporation Supplier Quality Manual Ver.8.04
6.6	14 Feb 24	- Revise for incorporation of the MITSUBA Corporation Supplier Quality Manual Ver.8.05
6.7	14 April 25	- added climate change requirements in Context of the organization (P.9)

Signature	Print Name	Position	Function
	Mr.Jamrus K.	Purchasing Vice President	Issue Department
	Mr.Sakon S.	Quality System DGM.	Preparing Department

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❖ Quality Management Requirements

1 Objective

(1) TS Mitsuba Supplier Quality Manual constitutes the quality management system requirements for the suppliers of TS Mitsuba (hereinafter referred to as "TS Mitsuba").

(2) TS Mitsuba basic policy is "**We will make TS Mitsuba the brand of choice on a global scale**". "Will Make TS Mitsuba the brand of choice"

A. In the increasingly competitive age, basic conditions such as quality and price need to achieve a certain level to satisfy customers and win long-term business relationship.
On top of that, only when TS Mitsuba makes a proposal that is unique and has a clear advantage and when the customer approves it, the customer will choose TS Mitsuba.
And making these efforts helps earn customer's trust.
TS Mitsuba aims to become a company that earns trust based on the customers' recognition, "We would like to choose TS Mitsuba. We would love to use TS Mitsuba products".

B. "Brand of choice on a global scale"
When a company's name or product's name wins a unique meaning and value, the company name or product name becomes synonymous with the value. We aim that the company name TS Mitsuba itself becomes synonymous with the values, "technology in harmony with society and the environment" and "pleasure and peace of mind" and will make TS Mitsuba the brand of choice on a global scale.

(3)TS Mitsuba developed this Supplier Quality Manual for many suppliers in the TS Mitsuba supply chain to understand the above quality policy and quality control / quality assurance procedures that are in line with the quality policy.

2 Structure

(1) TS Mitsuba Quality Management System Requirements for the supplier consist of the

A. following ISO9001 and IATF16949 Quality Management Systems
This is the basis of TS Mitsuba Quality Management System Requirements.

B. TS Mitsuba Corporation Supplier Quality Manual
This Quality Manual

C. Referenced standards, implementation procedures, and specific requirements

(2)If there is any inconsistency between the requirements described in the three types of documents above, the requirements in "C. Referenced standards, implementation procedures, and specific requirements" have the first priority, and those in "B. TS Mitsuba Corporation Supplier Quality Manual" have the second priority.

3 Implementation of the Quality Standard

3.1 Scope of application

(1)This Quality Manual applies to the suppliers from which TS Mitsuba purchases raw materials, indirect materials (e.g. grease and seal material), parts and finished products.

(2) However, the Supplier Quality Manual does not apply to the following suppliers:

A. suppliers of packaging materials such as containers and cardboard boxes
B. transportation companies and measuring equipment calibration service provider
C. contractors (side-work contractors with which TS Mitsuba provides Work
D. Instruction) suppliers manufacturing prototypes only
E. suppliers manufacturing commercial products (not delivered to automobile manufacturers) only

(3) TS Mitsuba Purchasing Department determines suppliers to which this Quality Manual should apply, and provide them with the Manual

(4) This Supplier Quality Manual applies to TS Mitsuba affiliates both in Japan and overseas regardless of whether

or not TS Mitsuba develops a Control Plan for them.
In addition, the group standards shall be applied with priority for the scope that this document overlaps with the group standards.

3.2 Handling of Quality Standard

(1) The supplier shall manage the latest version of this Quality Manual.

(2)The supplier shall get its sub-suppliers (including 3rd- or lower-tier suppliers of TS Mitsuba) familiarized with the latest version of this Quality Manual and provide them with appropriate trainings based on it so as to allow them to comply with this Quality Manual.

(3)The suppliers are requested to instruct the Tier-n suppliers (including Tier-2 or lower-tier suppliers of TS Mitsuba) to comply with this Quality Manual.
When distributing a copy of this Quality Manual for Tier-n suppliers (including Tier-2 or lower-tier suppliers of TS Mitsuba) for the purpose of communication and training, the supplier shall clarify the person responsible for managing this Quality Manual based on the supplier's management responsibility to ensure the confidentiality.

3.3 Required standard

(1) The supplier shall obtain the following standard.
A. ISO9001 and IATF16949 Quality Management Systems
- Specific requirements regarding ISO9001: 2008 application for auto manufacturers and related service parts organizations
(Japanese version available from Japanese Standard Association.)

(2) The supplier shall obtain the following standards when they are referenced in the drawing.
A. MES: TS Mitsuba Engineering Standard – Engineering standard of TS Mitsuba. Please request our Purchasing Department.
B. JIS: Japanese Industrial Standards – (Available from Japanese Standard Association)

(3)The supplier shall make an effort to improve knowledge and skill regarding the following reference manuals issued by AIAG (Automotive Industry Action Group). (Japanese versions available from Plexus Japan.)
A. APQP: Advanced Product Quality Planning and Control Plan
B. PPAP: Production Part Approval Process
C. FMEA: Potential Failure Mode and Effects Analysis
D. MSA: Measurement System Analysis
E. SPC: Statistical Process Control
F. CQI: Continues Quality Improvement-Special Process System Assessment
* Refer to "8.5.1 Control of production and service provision (3)" for details.

3.4 Definition of terms

Terms specific to TS Mitsuba are as follows.

	Term	Meaning
1	Supplier	A provider (as specified in ISO9001 and IATF16949) to TS Mitsuba
2	Sub-supplier	A provider to the supplier
3	Customer	A purchaser of TS Mitsuba products (mainly car makers).
4	Control Plan	A plan to control manufacturing processes, including the contents of conventional QC process chart and inspection standards.
5	Importance	TS Mitsuba classifies the severity of quality characteristics, products, and parts into four classes; S, AR, A and B, based on the function of the part. 1. Critical safety characteristics and parts: S

	Term	Meaning
		Quality characteristics that immediately affect people's lives in case of failure. 2. Regulatory characteristics and parts: AR Quality characteristics that conflict with laws of Japan and overseas in case of failure. 3. Significant characteristics and parts: A Quality characteristics that lead to the loss of basic function of the vehicle in case of failure. 4. General characteristics and parts: B Quality characteristics that lead to the loss of function of the product (TS Mitsuba product) or marketability and comfort of the car in case of failure.
6	Special characteristics	Critical Safety characteristics (S), Regulatory characteristics (AR), Significant characteristics (A), Functional Safety characteristics, and Fitting characteristics (FIT) in the characteristics of the product. The customer may specify them.
7	Functional Safety characteristics	The characteristics that affect the achievement of functional safety goals when a failure occurs. Indicated with "FS" mark on the drawing. The product and process characteristics that are specially controlled to guarantee the functional safety of the Functional safety products.
8	Fitting characteristics	The area used by customers when fitting TS Mitsuba product. Indicated with "FIT" mark on the drawing. Example: Wiper motor's fitting hole with car body, coupler to be connected with power supply wire harness and cord clip fitting hole of bracket. It is difficult to detect nonconformity in this area in TS Mitsuba manufacturing process, and nonconformity on this area is likely to cause customers important trouble.
9	Special process	The special process differs from general assembly process and requires the specific skills or technology for its process planning and quality assurance. The characteristics of the product processed in the special process cannot be judged at glance so that requires special inspection or destructive test. Also, such a characteristic may not show their defect apparently immediate after the processing, and also may grow to the critical quality issue. TS Mitsuba specifies the following as special processes but not limited to: Heat treatment, soldering, welding, brazing, surface finishing (painting, plating and anodizing), sintering, ~~crimping/caulking~~ and adhesion.
10	Pass-through parts	The parts directly delivered from suppliers or TS Mitsuba affiliates to customers not via TS Mitsuba manufacturing plants. Because TS Mitsuba cannot detect nonconformity of these parts, they are likely to cause customer's trouble. Ex. Window washer tank
11	Quality control division of receiving plant	A quality control division of the manufacturing plant to which parts are delivered.
12	Section in charge of process quality	Development Quality Section 1 and Section 2 of Development Quality Department, Quality Management Section 1 of Quality Management Department, Electronic Process Development Section of Production Engineering Department, and **Manufacturing Engineering Section of each plant.**
13	Receiving rejection	Defectives attributable to a supplier which are found in a Mitsuba's process.

	Term	Meaning
14	Delivery claim	Defectives delivered to a customer and found by the customer.
15	Market claim	Defectives caused after sales to users,
16	Inspection tool	Inspection tool used to judge fail or pass in place of measurement with caliper, micrometer, etc.
17	Poka-yoke (Error-proofing)	“Error proofing” defined in IATF 16949. Product and manufacturing process design and development to prevent manufacture of nonconforming products

3.5 Reference procedures

(1)This Quality Manual references the Implementation Procedure A and B of the Supplier Quality Manual. These Procedures include the following.

A. Implementation Procedure A

1. QARP Registration Notice
2. Supplier drawings
3. Production preparation activities
4. Process QA matrix
5. Control Plan
6. Inspection Standard
7. Setting of packaging specifications
8. Initial Production Part (IPP) control
9. Process change control
10. Control of changes
11. Critical safety part control
12. Lot control
13. Initial production control
14. Actions to be taken when a failure occurs
15. Quality Instructions Sheet
16. Temporary deviation approval (TDA)
17. Supplier quality audit
18. Supplier quality assessment
19. Annex

B. Implementation Procedure B

1. APQP
2. PPAP
3. FMEA
4. MSA
5. SPC

(2)Generally, the supplier shall refer to “Implementation Procedure A” and “Implementation Procedure B, 3. FMEA”. If TS Mitsuba requests APQP report submission, the supplier shall also refer to the “Implementation Procedure B”.

3.6 Establishment / Revision

(1) The Supplier Quality Manual is created and maintained by Quality Assurance Department.
The supplier shall confirm with Purchasing Department whether or not this Quality Manual is the latest edition.

(2) TS Mitsuba provides an explanation on this Quality Manual to new suppliers. In addition, TS Mitsuba is willing to respond to questions and concerns about this Quality Manual on an as-needed basis. So, please feel free to contact the responsible section of our Purchasing Department.

Note: TS Mitsuba requires suppliers to be compliant with IATF16949.
In other words, IATF16949 requirements constitute a part of TS Mitsuba requirements.
Shown below are changes and additions made by TS Mitsuba to IATF 16949 requirements.
IATF16949 specifies requirements including the requirements of ISO9001.

4 Context of the organization

4.1 Understanding the organization and its context (See ISO9001 requirements.)

The organization shall determine whether climate change is a relevant issue.

4.2 Understanding the needs and expectations of interested parties. (See ISO9001 requirements.)

The organization shall determine interested parties can have requirements related to climate change

4.3 Determining the scope of the quality management system. (See ISO9001 requirements.)

4.3.1 Determining the scope of the quality management system. – Supplemental

4.3.2 Customer-specific requirements

TS Mitsuba distributes the quality control standards and forms of TS Mitsuba customer to the supplier who deliver pass-through parts as needed. The supplier shall manage those documents and apply them to their own Quality Management System. In addition, TS Mitsuba may ask the supplier to submit documents in the form specified by TS Mitsuba customer.

4.4 Quality management system and its processes

4.4.1 (See ISO9001 requirements.)

(1) **Requirement for third party certification**: Same as IATF16949 standard requirements

A. TS Mitsuba requires the supplier to obtain a third-party certification to ISO9001 and comply with IATF16949. If the supplier is a trading company, TS Mitsuba requires the third-party certification of an actual manufacturing site (sub-suppliers).
The supplier should also strive to obtain a thirdparty certification to IATF16949 (assessment and registration by a certification body).
However, if a customer of Mitsuba obliges its supply chain to obtain an IATF16949 certification, TS Mitsuba will require the supplier to obtain the same.
TS Mitsuba may require the suppliers to submit a copy of a third-party certificate. The supplier shall submit it to our Purchasing division upon request. When the certificate is renewed, the supplier shall submit an updated copy. The supplier shall gather and submit the copies of the certificates of Tier-n suppliers (including Tier-2 or lower-tier suppliers of TS Mitsuba).

B. Third party certification means the maintenance of a certificate issued by a certification body accredited by, for example, any of the following authorities:
Japan: JAB, United States: ANAB, United Kingdom: UKAS, Netherlands: Rva, China: CNAS, Germany: Dakks, etc.

C. “Compliance with IATF16949” means to establish, document, implement and maintain a quality management system and continuously improve its effectiveness according to the IATF16949 requirements so as to prevent problems and reduce variations and wastes in a supply chain.

D. For TS Mitsuba, the customer specific requirements to IATF16949 correspond to this Quality Manual.
E. The headings of this Quality Manual conform to IATF16949. And this Quality Manual states difference between IATF16949 requirements and TS Mitsuba requirements.

(2) **Requirements for establishing SOC (Substances of Concern) management system**

A. Organization

1. The supplier shall clarify the division of roles regarding Substances of Concern (hereinafter referred to as SOC).
   Example: Management of laws & regulations and customer requirements, instructions on and management of Tier-n suppliers, material composition data entry and management, etc.

B. Policy

1. The top management of the supplier shall announce the policy for SOC management to its employees.
   Example: Quality/environment policy, morning meeting, etc.
2. The supplier is responsible to manage and ensure that all components and materials comply with TS Mitsuba requirements.

C. Man and equipment

1. The supplier shall train experts who are capable of judging between conformance and nonconformance to SOC related laws and regulations and customer requirements.
2. The supplier shall train operators of IMDS and JAPIA sheet which are the standard tools in automotive industry.
3. The supplier shall provide employee trainings on SOC appropriate for the business contents.
4. The supplier shall be capable of analyzing substances contained in components and materials (with in-house equipment or by an external analytical body).

D. Control standard

1. The supplier shall inform its employees of the laws & regulations, customer requirements and internal control items regarding SOC.

E. Response to TS Mitsuba requests

1. The suppliers shall submit the material composition data* with IMDS or JAPIA sheet.
   For the details, refer to the “Implementation Procedure A, 2.5. Submission of material composition data.
   *Material composition data: Specifications of chemical constituents of material
2. In addition, the contained substances may be checked upon request of TS Mitsuba customers. In that case, TS Mitsuba specifies the format, deadline and so on for the survey according to the situation. Responses regarding customer requirements shall be made without delay.
   E.g. Confirmation of conformity with the customer's list of regulated substances / specific laws and regulations, confirmation of non-inclusion of specific constituents
   In case of response delay, please inform TS Mitsuba accordingly.

F. Product design

1. If the supplier engages in product design, the supplier shall provide instructions on SOC control with the outputs of product design (e.g. drawings and specifications).

G. Process design

1. The supplier shall provide instructions on SOC control with the outputs of process design (e.g. Control Plan and Work standard).
   (SOC contained in indirect materials such as marker and ink and export packaging materials are also the subject of control.)
2. If there are risks of SOC inclusion due to misuse, mixing, contamination and chemical change of

material and component parts, the supplier shall consider them.
Example: Plating and soldering
(This clause applies if there are the above-mentioned risks at the supplier.)

H. Purchasing (sub-supplier)

1. The supplier shall include SOC management status in the assessment items for selection or continued appointment of sub-suppliers.
2. The supplier shall inform the sub-supplier of its own SOC management standard.
   Example: Green Purchasing Guideline
   (This clause can be omitted if the supplier thinks that the sub-supplier has sufficient knowledge about SOC management.)
3. If needed, the supplier shall verify the SOC management state of the sub-supplier with the documents submitted by the sub-supplier or by visiting it.
4. The supplier shall request the sub-supplier to submit all the material composition data at early stage.
5. The material composition data obtained shall be managed, not as personal data, but as the data shared within the company.

I. Monitoring and measurement

1. According to the risk of each material/part, the supplier shall make sure that the material/part contains no SOC.
   *Acquisition of material composition data, internal/external analysis.

J. Lot management

1. The supplier shall manage the traceability (history of materials and parts used).

K. Change control

1. In the case of change in the supplier's process, sub-supplier or material, the supplier shall check for SOC depending on the change content.
   Example: Process verification, acquisition of material composition data, material analysis and verification of sub-supplier's process.

L. Nonconforming parts

1. The supplier shall define the procedure to respond SOC-related issues.
   Example: Rules for controlling nonconforming parts
2. The supplier shall report SOC-related issues to TS Mitsuba.

M. Evaluation and improvement

1. The supplier shall conduct a periodic audit of internal SOC management conditions.
   Example: Divisions such as product design, process design, purchasing, manufacturing, inspection and shipment.
2. The audit results shall be reported to the top management and necessary improvement actions shall be taken.

4.4.1.1 Conformance of products and processes

4.4.1.2 Product safety

4.4.2 (See ISO9001 requirements.)

5 Leadership

5.1 Leadership and commitment (See ISO9001 requirements.)

5.1.1 General (See ISO9001 requirements.)

5.1.1.1 Corporate responsibility

5.1.1.2 Process effectiveness and efficiency

5.1.1.3 Process owners

5.1.2 Customer focus (See ISO9001 requirements.)

5.2 Policy

5.2.1 Establishing the quality policy (See ISO9001 requirements.)

5.2.2 Communicating the quality policy (See ISO9001 requirements.)

5.3 Organizational roles, responsibilities and authorities

(1)In order to facilitate quality assurance for deliveries to TS Mitsuba, the supplier shall select a Quality Assurance Responsible Person (QARP) and a Sub Quality Assurance Responsible Person (Sub-QARP) and submit QARP Registration Notice to TS Mitsuba.

(2) The QARP shall have comprehensive responsibility and authority to respond to TS Mitsuba requirement.

(3) For registration of QARP, see the Implementation Procedure A “QARP Registration Notice”.

5.3.1 Organizational roles, responsibilities and authorities – supplemental-

5.3.2 Responsibility and authority for product requirements and corrective actions

6 Planning

6.1 Actions to address risks and opportunities (See ISO9001 requirements.)

6.1.1 (See ISO9001 requirements.)

6.1.2 (See ISO9001 requirements.)

6.1.2.1 Risk analysis

6.1.2.2 Preventive action

6.1.2.3 Contingency plans

6.2 Quality objectives and planning to achieve them

(1) The supplier shall take into account TS Mitsuba intent when setting and reviewing its own quality target.

(2) It is recommended to consider a trend over past three years.

(3)The supplier shall analyze the differences between initial plans and their results (completed and not completed).

6.2.1 (See ISO9001 requirements.)

6.2.2 (See ISO9001 requirements.)

6.2.2.1 Quality objectives and planning to achieve them –supplemental-

6.3 Planning of changes

7 Support

7.1 Resources

7.1.1 General (See ISO9001 requirements.)

7.1.2 People (See ISO9001 requirements.)

(1)The supplier shall get its employees and supply chain familiarized with this Quality Manual and provide them with appropriate trainings based on it. The supplier is encouraged to willingly participate in briefing sessions on the items referenced in the Quality Manual (e.g. FMEA, SPC) held by TS Mitsuba.

(2)TS Mitsuba may hold a briefing session on this Quality Manual on an as-needed basis (e.g. when TS Mitsuba recognizes the supplier's noncompliance with this Quality Manual or the supplier's quality performance deterioration).

7.1.3 Infrastructure (See ISO9001 requirements.)

(1) The supplier shall prepare the following infrastructure.
A. Computer environment that supports the use of e-mail, Word, Excel, and PowerPoint
B. Antivirus measures for computer
C. System to process the ordering information from TS Mitsuba

7.1.3.1 Plant, facility, and equipment planning

7.1.4 Environment for the operation of processes (See ISO9001 requirements.)

7.1.4.1 Environment for the operation of processes –supplemental

(1)The supplier shall give due consideration of 2S (Sorting and Setting in order), measures for foreign matters and visual management.

7.1.5 Monitoring and measuring resources

7.1.5.1 General (See ISO9001 requirements.)

(1)The measuring equipment shall have appropriate resolution according to the object to be measured. The supplier shall select the measuring equipment that is capable of measuring dimensions down to at least one tenth of the tolerance.
Example: For the measurement of standard dimension φ10±0.1mm, the supplier shall select a measuring instrument that can measure 0.01 mm.

(2) The scope of monitoring and measuring equipment control includes measuring tools.
Measuring tools are inspection jigs used to judge between OK and NG instead of measurement with a vernier caliper or a micrometer.

(3) TS Mitsuba may require actual dimensional data of measuring tools.

7.1.5.1.1 Measurement system analysis

(1)TS Mitsuba may request the supplier to implement measurement system analysis to analyze variations in the results of measurement and test systems. This request is made on the "APQP report."

(2) For analysis method and acceptance criteria, see the Implementation Procedure B "MSA".

7.1.5.2 Measurement traceability

7.1.5.2.1 Calibration / verification records

(1)The supplier shall manage the measuring instrument with the ledger, carry out regular calibration, and keep those records.

7.1.5.3 Laboratory requirements

7.1.5.3.1 Internal laboratory

7.1.5.3.2 External laboratory

7.1.6 Organizational knowledge (See ISO9001 requirements.)

7.2 Competence (See ISO9001 requirements.)

(1)The supplier shall educate and train the operators at the production preparation stage according to the work standards, etc., to improve operator's proficiency.

(2) The supplier shall evaluate that the operators maintain the necessary competence periodically.

(3) The supplier shall make a rule to conduct periodic evaluation, and record the evaluation result.

7.2.2 Competence –supplemental

7.2.3 Competence – on the job training

7.2.4 Internal auditor competency

7.2.5 Second-party auditor competency

7.3 Awareness (See ISO9001 requirements.)

7.3.1 Awareness – supplemental-

7.3.2 Employee motivation and empowerment

7.4 Communication (See ISO9001 requirements.)

7.5 Documented information

7.5.1 General (See ISO9001 requirements.)

7.5.1.1 Quality management system documentation

7.5.2 Creating and updating (See ISO9001 requirements.)

7.5.3 Control of documented information

(1) Drawings shall be retained so as not to be damaged or lost and kept readily accessible.

(2) TS Mitsuba may make reference to MES (TS Mitsuba Engineering Standard) on drawings.

(3)The supplier shall make sure to dispose of old drawings on its own responsibility to prevent misuse. If it is necessary to retain old drawings, they shall be clearly identified as "Old" in red.

7.5.3.1 (See ISO9001 requirements.)

7.5.3.2 (See ISO9001 requirements.)

7.5.3.2.1 Record retention

(1) TS Mitsuba requirements for the retention period of records are as follows:

Records		Retention period
(1) IPP control record	IPP tag	20 years
	Test certificate	20 years
(2) Lot control record		20 years
(3) Quality record based on Control Plan (Process control data sheet, Daily check sheet, Chart, etc.)		20 years
(4) Process FMEA, Control Plan, Inspection Standard and Work standards		20 years after discontinuation of the model production *
(5) PPAP		20 years after discontinuation of the model production *
(6) Reliability test record		20 years after discontinuation
(7) Records of measures for defects		20 years
(8) Records of change control		20 years
(9) TDA Application		20 years
(10) SOC non-inclusion evidence		20 years
(11) Records of Internal Quality Audit		20 years

*A period of 20 years from the discontinuation of the model production including knock-down production and service parts production.

(2) The supplier shall submit these records immediately upon request from TS Mitsuba.
TS Mitsuba may require a longer retention period according to an applicable customer-specific requirement.

7.5.3.2.2 Engineering specifications

8 Operation

8.1 Operational planning and control (See ISO9001 requirements.)

(1) When APQP is not applied

A. When APQP is not applied, the supplier shall implement quality assurance activities including the following based on Production Preparation Plan before SOP. For details, see “3. Production preparation activities” of the Implementation Procedure A.

1. Development of Production Preparation Plan
2. Prevention of past problem recurrence
3. Process Plan
4. Process FMEA
5. Preparation of Process QA Matrix
6. Preparation of Control Plan and Production Process Flow Chart
7. Preparation of Inspection Standard
8. Maintenance of process and equipment
9. Maintenance of inspection equipment
10. Preparation of standards (Work Standard, equipment check sheet, etc.)
11. Quality assurance of sub-supplier parts
12. Establishment of lot control method
13. Operator training
14. Setting of Package Specifications
15. Quality check and assurance of process capability
16. Check of production preparation (Self audit)
17. Advance IPP application (Submission of test certificate)
18. Initial production control

(2) When APQP is applied

A. In response to the requirements or expectations of TS Mitsuba customer, the purchasing department of TS Mitsuba may request the supplier (including sub-suppliers) to submit and promote APQP (Advanced Product Quality Planning) as a production preparation plan.

B. When TS Mitsuba requests APQP application, the supplier will be informed of the request, TS Mitsuba development schedule and responsible person.

C. When APQP is applied, the supplier is encouraged to consult the Implementation Procedure B “APQP”. Refer to Implementation Procedure B “PPAP” for the required documents for submission. Also refer to “Attachment-5 Supplier PPAP Submission Data List and Examples” for details how to fill out.

D. APQP documents shall be submitted to the purchasing department of TS Mitsuba.

8.1.1 Operational planning and control –supplemental-

Acceptance criteria

(1)TS Mitsuba may request the supplier to submit acceptance criteria such as boundary sample. The submitted acceptance criteria are subject to TS Mitsuba approval.

8.1.2 Confidentiality

(1) The supplier shall ensure the confidentiality of drawings, development plans and problem information.

8.2 Requirements for products and services

8.2.1 Customer communication (See ISO9001 requirements.)

8.2.1.1 Customer communication –supplemental-

(1) The supplier shall have the ability to communicate necessary information in the language specified below.

A. Official language of the country of the company to which parts are delivered

B. Or English, if the above is not available

8.2.2 Determining the requirements for products and services (See ISO9001 requirements.)

8.2.2.1 Determining the requirements for products and services –supplemental-

8.2.3 Review of the requirements for products and services

8.2.3.1 (See ISO9001 requirements.)

8.2.3.1.1 Review of the requirements for products and services –supplemental-

8.2.3.1.2 Customer-designated special characteristics

(1) **Special characteristics**

A. TS Mitsuba may specify special characteristics on the drawing according to customer requirements / expectations.

B. Generally, special characteristics require Measurement System Analysis, confirmation of process capability index (Cpk) and Statistical Process Control.
Necessary information will be separately given to the supplier on an as-needed basis.

(2) **Functional Safety characteristics**

A. TS Mitsuba may specify the Functional Safety characteristics in the drawing. The symbol in the drawing is FS or(FS)

B. Functional Safety characteristics require a special control. The supplier shall obtain the details of special control from Purchasing division.

(3) **Fitting characteristics**

A. TS Mitsuba may specify the fitting area for customer use. Symbol displayed on drawings:FIT or(FIT)
The supplier shall obtain information regarding the fitting area for customer use from Purchasing Department of TS Mitsuba.

B. The fitting area for customer use is an area used by TS Mitsuba customer to fit the product.
It is difficult to detect nonconformity in this area in the MC's process, and is likely to cause significant problems to the customer.
It is difficult to detect nonconformity in this area in TS Mitsuba manufacturing process, and nonconformity on this area is likely to cause the customer significant problems.

C. The supplier shall exercise special control for this area including Poka-yoke and special measuring tools.
For details of the special control, see the Implementation Procedure A "Control Plan".

(4) **Pass-through parts**

A. TS Mitsuba may designate pass-through parts.
The supplier shall obtain information regarding pass-through parts from Purchasing Department of TS Mitsuba.

B. Pass-through parts mean parts directly delivered from suppliers or TS Mitsuba affiliates to TS Mitsuba overseas sites or customer sites not via TS Mitsuba plants responsible for quality assurance of such parts.
Since TS Mitsuba cannot detect nonconformity in pass-through parts, the supplier is required to exercise special control using sufficient number of Poka-yoke and 100% inspection system.

8.2.3.1.3 Organization manufacturing feasibility

8.2.3.2 (See ISO9001 requirements.)

8.2.4 Changes to requirements for products and services (See ISO9001 requirements.)

8.3 Design and development of products and services

8.3.1 General (See ISO9001 requirements.)

8.3.1.1 Design and development of products and services –supplemental

8.3.2 Design and development planning (See ISO9001 requirements.)-

(1)The supplier shall implement progress management and cope with issues at each milestone based on the Production Preparation Plan and record the results of them.

8.3.2.1 Design and development planning –supplemental-

8.3.2.2 Product design skills

8.3.2.3 Development of products with embedded software

8.3.3 Design and development inputs (See ISO9001 requirements.)

8.3.3.1 Product design input

8.3.3.2 Manufacturing process design input

(1)When TS Mitsuba designates a Critical safety part, the supplier shall indicate “Critical safety process” and “Critical safety characteristics” in the Work Standard for the critical safety process.

(2) TS Mitsuba may also require items regarding manufacturing process design.

(3)The safety protection (safety cover, safety clearance, etc.) against hazard sources of equipment (which may cut, pinch, catch, burn or electrically shock) that operators may touch shall be included in the input to the manufacturing process design.

8.3.3.3 Special characteristics

8.3.4 Design and development controls (See ISO9001 requirements.)

8.3.4.1 Monitoring

8.3.4.2 Design and development validation

8.3.4.3 Prototype program

(1) TS Mitsuba may require a pre-launch Control Plan from the supplier.

8.3.4.4 Product approval process

(1) For initial production part (IPP), the supplier shall implement IPP delivery procedure.
When delivering IPP, the supplier shall attach IPP tag and indicate IPP in ID tag for identification.

(2) For IPP delivery procedure, see the Implementation Procedure A “Initial production control”.

(3) When APQP is applied, the supplier shall follow the procedure specified in the Implementation Procedure B “PPAP”.

8.3.5 Design and development outputs (See ISO9001 requirements.)

8.3.5.1 Design and development outputs –supplemental-

8.3.5.2 Manufacturing process design output

8.3.6 Design and development changes (See ISO9001 requirements.)

8.3.6.1 Design and development changes –supplemental-

8.4 Control of externally provided process, products and services

8.4.1 General (See ISO9001 requirements.)

8.4.1.1 General –supplemental-

8.4.1.2 Supplier selection process

(1) When the supplier procures materials by itself, the supplier shall make sure that quality control is ensured.

(2)For materials procured by the supplier, the supplier is obliged to reach an agreement on material specifications with the sub-supplier (material supplier) before production start.

8.4.1.3 Customer-directed sources (also known as “Directed-Buy”)

(1) The sub-supplier shall appropriately use and store the materials specified or supplied by TS Mitsuba.

8.4.2 Type and extent of control (See ISO9001 requirements.)

8.4.2.1 Type and extent of control –supplemental

8.4.2.2 Statutory and regulatory requirements-

(1) The supplier shall conform to “TS Mitsuba Green Purchasing Guideline”.
Materials containing SOC such as lead, cadmium, hexavalent chromium and mercury are regarded as nonconforming materials.

(2)TS Mitsuba Group Green Purchasing Guideline is available in the Purchasing Information of TS Mitsuba Home page; Purchasing Information URL: https://www.mitsuba.co.jp/en/purchase.html

8.4.2.3 Supplier quality management system development

(1)TS Mitsuba requests sub-suppliers to conform to the current ISO9001. Any of the following is acceptable evidence of the conformance:

A. Third party certification of a sub-supplier according to the current ISO9001
B. Positive result of audit on a sub-supplier by the responsible person of TS Mitsuba who has a second-party auditor competency.
C. Positive result of audit on a sub-supplier by the responsible person of the supplier who has a second-party auditor competency.
However, TS Mitsuba may require sub-suppliers to comply with IATF16949, for example, if so requested by a customer.

(2)TS Mitsuba does not require the third-party certification of sub-suppliers according to the current ISO9001. However, if the supplier is a trading company, the supplier shall request the actual manufacturer (sub-supplier) to obtain the third-party certification according to ISO9001.
For the scope of sub-suppliers, conform to 3.1 Scope of application.

(3)TS Mitsuba requests the supplier to assume responsibility for quality assurance even if the deliveries to TS Mitsuba are actually made by a sub-supplier.

(4)This article aims to satisfy customer requirements and expectations by entire supply chain including TS Mitsuba, suppliers and sub-suppliers.

(5)The supplier shall communicate the contents of this Quality Manual to Tier-n suppliers (including Tier-2 or lower-tier suppliers of TS Mitsuba) so as to allow them to comply with this Quality Manual.

8.4.2.3.1 Automotive product-related software or automotive products with embedded software

For the suppliers who are engaged in the development of software or the production of parts with embedded software, TS Mitsuba requires them to implement and maintain a software quality assurance process.

8.4.2.4 Supplier monitoring

8.4.2.4.1 Second-party audits

8.4.2.5 Supplier development

8.4.3 Information for external providers (See ISO9001 requirements.)

8.4.3.1 Information for external providers –supplemental-

(1)TS Mitsuba informs the supplier of regulatory requirements directly applicable to the supplier and special characteristics of related products and processes. The supplier shall provide education and training on all the applicable requirements to workers in its manufacturing sites and those in its Tier-n suppliers.

8.5 Production and service provision

8.5.1 Control of production and service provision (See ISO9001 requirements.)

(1) Special processes

A. TS Mitsuba designates the special process in "3.4 Definition of terms" in this document.
If a customer of TS Mitsuba designates any special process other than above, TS Mitsuba will add it to the
B. above. The supplier shall prepare its own implementation procedures for special process management including process/operation qualification, operator training, determination of conditions for SOP, Lot control, storage of records and exercise reliable management.
C. **The supplier shall conduct annual self-verification of applicable processes using the process check sheets and retain the results. The results shall be available for submission to TS Mitsuba upon request.**
D. **When TS Mitsuba customer requires a system assessment using CQI standards, TS Mitsuba designates the supplier who performs assessment**.
The **designated** supplier shall perform **system assessment using CQI assessment sheets during production preparation and also every year after mass production starts.**

8.5.1.1 Control plan

(1) When APQP is applied, TS Mitsuba may request the supplier to submit Control Plan to obtain an approval from TS Mitsuba before PPAP

8.5.1.2 Standardized work – operator instructions and visual standards

(1)Work standards (Procedure) shall be prepared for each operation, from part/material receiving to shipment, which affects product quality, and shall be used to improve operators' proficiency.

(2)Work standards (Procedure) shall be stored or posted in a place where they can be easily accessible. Supervisors are required to inspect actual operations periodically to confirm that the actual work is performed according to the work procedures.

(3) The supplier shall prepare the Work standards including the following contents.

A. Prepare the Work standard for each process (receiving inspection, manufacturing, measurement, final inspection, shipping inspection, visual inspection, shipping, loading, cleaning, etc.).
B. Describe clearly the part number, check items and work procedures. (Describe the contents concretely using photos etc. to prevent misassembling.)
C. Describe and notify the importance classifications in the standards, data sheets, equipment check sheets, etc.
D. Describe the corrective actions against the risks analyzed in FMEA and the control items defined in Control Plan without omission.
E. Clearly define the judgment criteria for each operation (receiving inspection, manufacturing, measurement,

final inspection, shipping inspection, visual inspection, shipping, loading, cleaning, etc.).

F. Include the rules for operator's safety (use of protective gear) in each operation (receiving inspection, manufacturing, measurement, final inspection, shipping inspection, appearance inspection, shipping, loading, cleaning, etc.).

G. If there are reference documents (boundary samples, photos, key points) quoted in the Work standards, assign the control number to each of them, and describe those numbers in the work standard. (Example: Refer to the sample ○○ (Control No: ▲▲)).

8.5.1.3 Verification of job set-ups

(1)For operations conducted by equipment, processing points (jig, tool, cutting blade, electrode or other goods contacting workpieces) shall be verified.

(2)Work Standards for setup operations shall be prepared and education and training shall be given to operators based on the Work Standards prepared.

(3)The first-off/last-off part validation shall be performed and, where appropriate, the last-off parts should be retained for comparison with the first-off parts in subsequent runs.

8.5.1.4 Verification after shutdown

8.5.1.5 Total productive maintenance

8.5.1.6 Management of production tooling and manufacturing, test, inspection tooling and equipment

(1) The supplier shall clarify the appropriate polishing and/or replacement frequency of the consumable tools such as cutting tools, grinding wheels, and electrodes, carry out and record their regular polishing and/or replacement in order to maintain appropriate quality.

8.5.1.7 Production scheduling

(1) TS Mitsuba requirement is "100% on-time delivery".

8.5.2 Identification and traceability (See ISO9001 requirements.)

(1) Lot control

A. The supplier shall implement lot control for all parts in main processes for material, processing and assembly.
The purposes of lot control are as follows:

1. To check the quality of each production lot
2. To minimize loss at defect occurrence

B. The supplier shall minimize lot size to the extent possible and implement FIFO.
The purposes of FIFO are to limit the scope of defectives investigation when abnormality occurs and to prevent material/part/product deterioration due to stagnation.

C. For lot control procedure for critical safety parts, critical regulatory AR parts, significant parts and parts specified by TS Mitsuba, see the Implementation Procedure A "Lot control".

(2) Control of similar parts

A. In the case where there is a part similar to the part to be used, a warning label stating, e.g. "Be careful of a similar part!" or a description of the feature that allows discrimination from the similar part shall be displayed on a container and/or a storage area so as to prevent erroneous use of such a similar part.

8.5.2.1 Identification and traceability –supplemental-

(1) In the event of a quality problem, the supplier shall aim for specifying the target lot and quantity for the corrective action within 2 hours. (The scope of this requirement is Critical Safety parts S, Critical regulatory

characteristics parts AR, and Functional Safety characteristics FS).

8.5.3 Property belonging to customer or external providers (See ISO9001 requirements.)

(1)The goods supplied by TS Mitsuba free of charge are considered to be customer's properties. The supplier shall be responsible for managing them in the same manner as ordinary purchased goods.

(2)The supplier shall exercise equivalent level of control for the goods supplied by TS Mitsuba for a fee. The supplier is responsible for controlling them.

(3)The molds, equipment and tools supplied by TS Mitsuba for free or for a fee are the property belonging to customer for the supplier. The supplier is responsible for managing this as same as own mold, equipment and tools.

8.5.4 Preservation (See ISO9001 requirements.)

8.5.4.1 Preservation –supplemental-

(1)The supplier shall make sure to implement FIFO, display product status (product name (labeling), before/after inspection, date, etc.) and manage old products.

(2)In order to detect deterioration, the supplier shall assess at appropriate intervals the condition of products in stock, the place and type of storage container, and the storage environment.

(3)When delivering critical safety parts, the supplier shall stamp red "Critical Safety" on a margin of every ID tag (Kanban) attached to each delivery box for identification. See the Implementation Procedure A "Control of critical safety parts".

(4)This requirement aims to specify the storage and management of indirect material, solvents and oil / grease that are used for the production in order to prevent the adhesion of constituents that negatively affect the product by misuse of indirect material, solvents and oil / grease.

8.5.5 Post-delivery activities (See ISO9001 requirements.)

8.5.5.1 Feedback of information from service

8.5.5.2 Service agreement with customer

8.5.6 Control of changes (See ISO9001 requirements.)

(1) Before implementing a process change, the supplier shall submit Process Change Report for approval.

A. When making a process change, the supplier shall submit the Process Change Report to a responsible person of Purchasing Department and obtain TS Mitsuba approval **at least 4 months (**120 days**)** before, **especially changes in raw materials, at least 7 months (210 days) before** making such a change.
In addition to the Process Change Report, TS Mitsuba may request the submission of PPAP documents. In that case, the supplier shall submit them in accordance with the Implementation Procedure B "PPAP".

B. **When TS Mitsuba requires the submission of the Process Change Annual Plan, the supplier shall provide information on process change plans. After the first submission, the supplier shall update Process Change Annual Plan every month. When TS Mitsuba customer requires an early notification, TS Mitsuba requires suppliers to submit Process Change Report 4 months and 7 months before changes based on the information in the annual plan.**

C. For the Process Change Report, see the Implementation Procedure A "Control of changes".

D. When a first-tier supplier is changed for TS Mitsuba own conveniences, the new supplier shall submit the Process Change Report.

E. In the case of special process change, TS Mitsuba will conduct process verification without fail. The supplier shall conduct a self-process verification in advance.

(2)When delivering initial parts manufactured after process/design change, the supplier shall implement initial production control. For the initial production control, see the Implementation Procedure A “Initial production control”.

(3)When implementing a process/design change, the supplier shall conduct quality assurance activities in order to prevent quality problems.
For the procedure for quality assurance activities, see the Implementation Procedure A “Production preparation activities” and “Control of changes”.

(4) The supplier shall exercise change control on a daily basis.
When any change is made, the supplier shall implement quality inspection of parts made before and after the change and keep a record to ensure the traceability. For details, see the Implementation Procedure A “Control of changes”.
It is recommended to discuss and evaluate planned changes and unexpected changes at daily meeting to prevent troubles. This activity is called Quick Response Quality Control (QRQC).

8.5.6.1 Control of changes –supplemental-

8.5.6.1.1 Temporary change of process controls

8.6 Release of products and services (See ISO9001 requirements.)

8.6.1 Release of products and services –supplemental-

(1)The supplier shall make sure to conduct the inspections specified in the Control Plan and clearly indicate the proof of acceptance on ID tag or label. TS Mitsuba may request 100% inspection depending on the importance of products.
For details, see the Implement Procedure A “Control of critical safety parts”.

(2)If periodical submission of inspection data is requested by TS Mitsuba on the Control Plan (“Data submission” field), the supplier shall submit statistic data in TS Mitsuba “Test Transcript” form (in this case, encircle “3. Periodical data” in “Insp. reason” field) or another form agreed upon by TS Mitsuba.

(3)When delivering raw materials, the supplier shall submit the material certificate (e.g. mill sheet) of each delivery lot regularly.

(4)The shipping inspection of pass-through parts is the final shipping guarantee process to the customer. The supplier shall perform three-way matching using the actual product, the actual product slip, and the verification tool to ensure conformity with the shipping instructions.

8.6.2 Layout inspection and functional testing

8.6.3 Appearance items

(1) Appearance items specified by TS Mitsuba are as follows:
For the measurement of these items, appropriate lighting specified in ISO/TS 16949 and qualified personnel are required.
A. Products which are visible outside the vehicle: Door mirror, lamp, wiper arm, wiper blade, etc.
B. Other products specified by TS Mitsuba

(2)For the product for which decision on pass or fail is made (including appearance inspection), the supplier shall prepare an appearance sample and obtain agreement and approval on it from TS Mitsuba before shifting to mass production. The appearance sample shall be submitted to the Quality Control Section of the receiving plant.

(3)The appearance sample approved by TS Mitsuba shall be registered in a ledger, identified with an ID tag and properly managed for the expiration date set by the supplier.

(4)The quality of the appearance sample shall be reviewed on a periodic basis, and if it is deteriorated, the supplier is required to prepare a new sample and obtain approval from TS Mitsuba.

8.6.4 Verification and acceptance of conformity externally provided products and service

8.6.4.1 Verification of purchased product

(1)The supplier shall conduct receiving inspection on incoming materials (including raw materials) to check for any nonconformity.

(2)If the following applies to the material purchased by the supplier, the supplier shall obtain a material certificate from the manufacturer:
For submission of prototype lot, first production lot and change control procedure, the supplier shall submit a material certificate and SDS (Safety Data Sheet) together with IPP data to the Quality Control Section of the receiving plant.

(3)If no material certificate is attached to the material supplied by TS Mitsuba, the supplier is encouraged to contact the responsible section of Purchasing Department. Then, TS Mitsuba will request the manufacturer of the material to attach it.

8.6.5 Statutory and regulatory conformity

(1)**The supplier shall ensure thorough quality compliance. In particular, ensure the consistency between the required test/inspection work and the actual work.**
Quality compliance is, in terms of "quality", the action to perform our duties fairly and equitably without violating social norms and fulfill our duties complying with customer instructions and requirements.

A. **Conformity of test data**
- **There shall be no discrepancy between the inspection data submitted to TS Mitsuba and the inspection data recorded within the supplier.**
- **When storing test data in electronic media, access to the storage folder shall be limited to prevent records from being tampered with or lost. In addition, the data shall be protected, and regular backups is required.**

B. **Validity of test method**
- **Inspections shall be conducted under the conditions, methods, frequency, and sample size specified in drawings, control plans, etc.**
- **Testing equipment shall be regularly inspected/calibrated.**

C. **Conformity of Inspection Records**
- **The inspection shall be carried out only by qualified persons. (Suppliers without a qualification system shall assign the person who has completed training).**
- **Test data shall be approved by a designated person.**
- **A substitute in case the approver is absent shall be specified. (Basically, the substitute shall be the superior of the approver).**

8.6.6 Acceptance criteria

8.7 Control of nonconforming outputs

(1)The supplier shall create its own control procedure that clearly defines the handling rules and routes for nonconforming products, and manage the nonconforming products with identification.
The supplier shall consider the following items for this:
- Prepare a storage space that can isolate nonconforming products.
- Identify the nonconforming products.
- Post the rules and routes that were prepared to where operators can immediately confirm.

(2)Nonconforming products shall be identified and put into the dedicated boxes (identified in red, therefore called "red box") placed near operators to avoid them being mixed up with conforming products. The supplier shall set up a storage area that can isolate nonconforming products from the work area, and manage that area with assigned responsible person. (For example, the control of entry and exit from the isolated area, locking the area, etc.)

(3)Rework shall be conducted by well-trained and certified operators based on Work standards in the dedicated rework area only.
Besides, the process to which reworked products are put back shall be clearly indicated in the Work standards.

(4) The supplier shall retain the records of nonconforming products and rework of them.

8.7.2 (See ISO9001 requirements.)

8.7.2.1 Customer authorization for concession

8.7.2.2 Control of nonconforming product –customer-specified process

8.7.2.3 Control of suspect product

8.7.2.4 Control of reworked product

(1) Before reworking, a risk analysis (FMEA, etc.) for reworking operation shall be performed.

(2) A reliable traceability process for reworked parts shall be established and maintained.

8.7.2.5 Control of repaired product

(1) Before repairing, a risk analysis (FMEA, etc.) for repairing operation shall be performed.

(2) Repairing operation shall be done only after TS Mitsuba approval is obtained.

(3) A reliable traceability process for repaired parts shall be established and maintained.

8.7.2.6 Customer notification

8.7.2.7 Nonconforming product disposition

8.7.3 (See ISO9001 requirements.)

9 Performance evaluation

9.1 Monitoring, measurement, analysis and evaluation

9.1.1 General (See ISO9001 requirements.)

9.1.1.1 Monitoring and measurement of manufacturing processes

(1)For new manufacturing process (new equipment and processing method), the supplier shall take special actions as initial production control, including double checking and SPC method.
For details, see the Implementation Procedure A "Initial production control" and the Implementation Procedure B "SPC".

(2)The supplier shall keep records of process events such as jig/tool change and machine repair for change control (see the Implementation Procedure A "Control of changes").

(3) The supplier shall record actual measurement values for variable data (indications such as "OK", "X" and "✓" are not allowed).

9.1.1.2 Identification of statistical tools

9.1.1.3 Application of statistical concepts

9.1.2 Customer satisfaction (See ISO9001 requirements.)

9.1.2.1 Customer satisfaction –supplemental-

9.1.3 Analysis and evaluation (See ISO9001 requirements.)

9.1.3.1 Prioritization

9.2 Internal audit

9.2.1 (See ISO9001 requirements.)

9.2.2 (See ISO9001 requirements.)

9.2.2.1 Internal audit program

9.2.2.2 Quality management system audit

9.2.2.3 Manufacturing process audit

The supplier shall systematically implement manufacturing process audit based on the method shown below.

(1) Purpose: To determine the effectiveness of manufacturing process
- Have operations been conducted as specified in the Control Plan?
- Has the target “0 defect” been achieved? Or, have improvement activities to achieve the target been promoted?
- Has the process capability Cpk been maintained and controlled?
- Is the equipment free of failure?
- Have the target cost and productivity been maintained and controlled?

(2) Implementation method:

Step 1 Verify if the planned indices have created desirable results.
(Customer complaints, nonconformity in each process, productivity, process capability, etc.)

Step 2 When the planned indices have not created desirable results, verify if causes have been clarified and appropriate measures have been taken.
(Customer’s action report, internal corrective action report, maintenance report, process improvement report)

Step 3 Verify if causes for defect have been identified and appropriate corrective actions have been exercised on site.
(Are the measures taken are presumptive ones? Is the defect in question reproducible from the cause supported by fact and/or data? Is the recurrence of the defect in question prevented by controlling the cause?)

Step 4 When the causes for the defect in question have not been identified, verify the effectiveness of the current Control Plan as for the process control method for the defect from the standpoint of reliability by checking drawings, process FMEA and Work standards.

Step 5 Check if the defect and its causes have been predicted in the FMEA.
- Not predicted ➔ Necessity for changing process FMEA implementation method must be considered.
- Predicted ➔ Method to evaluate the reliability of the measures to prevent defect occurrence and outflowing for process control must be revised.

Step 6 Check if there is a gap between the reliability of current process controls (preventive and detective) in the FMEA and actual process.
- Gap is observed ➔ Necessity for changing Process FMEA implementation method must be

considered.
- No gap ➔ Reliability of jigs and tools, operator's skill, appropriateness of work procedure, rules for managing abnormalities and level of involved persons' understanding, GR&R verification, appropriateness of inspection, and appropriateness of equipment maintenance must be verified.

9.2.2.4 Product audit

9.3 Management review

9.3.1 General (See ISO9001 requirements.)

9.3.1.1 Management review –supplemental-

9.3.2 Management review inputs (See ISO9001 requirements.)

9.3.2.1 Management review inputs –supplemental-

9.3.3 Management review outputs

9.3.3.1 Management review outputs –supplemental-

10 Improvement

10.1 General (See ISO9001 requirements.)

10.2 Nonconformity and corrective action

10.2.1 (See ISO9001 requirements.)

10.2.2 (See ISO9001 requirements.)

10.2.3 Problem solving

(1)The supplier shall prepare an analysis procedure by failure event to accelerate problem solving and prevent recurrence.

10.2.4 Error-proofing (Poka-yoke)

(1) The supplier shall use Poka-yoke depending on risks figured out through FMEA and Process QA Matrix.

(2) Poka-yoke installed in manufacturing processes shall be checked at the start of operation.

10.2.5 Warranty management systems

10.2.6 Customer complaints and field failure test analysis

(1)When TS Mitsuba notifies the supplier of the occurrence of nonconformity, the supplier shall take actions according to the instructions of TS Mitsuba, immediately investigate the causes of the nonconformity and submit an action report.

(2) The supplier shall take IPP delivery procedure when delivering the improved products.

(3)When delivering the improved products, the supplier shall take the IPP delivery procedure specified in the Implementation Procedure A "Initial production parts control".

10.3 Continual improvement (See ISO9001 requirements.)

10.3.1 Continual improvement –supplemental-

❖ Implementation Specific procedure A

0 Purpose

(1) This Implementation Procedure A is an appendix to TS Mitsuba Supplier Quality Manual andprovides a specific implementation procedure of TS Mitsuba requirements.

1 QARP Registration Notice

1.1 Designation of the quality assurance responsible person (QARP)

1.1.1 QARP

(1) The supplier shall designate one quality assurance responsible person (QARP).

(2) In principle, the QARP must be a general manager (board member) or in higher position and responsible for the quality assurance of deliveries to TS Mitsuba on behalf of the entire company.

(3) TS Mitsuba regards the QARP as an official responsible person and contact person for quality assurance. Depending on the circumstances, TS Mitsuba may request a report from the QARP.

1.1.2 Sub-QARP

(1) The supplier shall appoint one Sub-QARP from each of its sites involved with the deliveries to TS Mitsuba.

(2) The Sub-QARP shall be able to take practical actions for the quality assurance of deliveries to TS Mitsuba.

(3) The Sub-QARP can approve action reports on behalf of the QARP.

1.2 Submission of Notice

(1) When TS Mitsuba and the supplier make a new contract, the supplier shall submit "QARP Registration Notice" within one month from the start of business.

Please send the printed original of the Notice with your company seal stamped or the PDF version of it.

(2) When any change is made to the content of the Notice, the supplier shall submit a Notice within onemonth after the change.

(3) The supplier shall submit the Notice to Quality Assurance Department via the responsible

PurchasingSection of TS Mitsuba.

2.Supplier drawings

2.1 Types of supplier drawings

(1) TS Mitsuba may approve delivery drawings and specifications made by suppliers (supplier drawings). TS Mitsuba requests suppliers to indicate the specified characters/symbols shown below on the drawings made by suppliers.

Importance class	Critical safety characteristics S	Regulatory characteristics AR	Significant characteristics A	Functional Safety characteristics FS	Fitting characteristics FIT	General characteristics B
Code/ symbol	S or (S) ●	"AR" or (AR) ■	"A" or (A) ▲	"FS" or (FS)	"FIT" or (FIT)	No description

(2) Types of supplier drawings are as follows:

A. Parts
   1) Delivery drawings and specifications of parts made with die (die-cast, resin-molded and rubber parts, etc.)
   2) Delivery drawings and specifications of purchased parts (bearing, magnet, screw, electronics, etc.)
   3) Delivery drawings which suppliers must submit in response to TS Mitsuba request made at a meeting or on an IPP test certificate on the ground that trial parts or parts made with renewed diehave been rejected by the receiving inspection.

B. Raw materials
   1) Delivery specifications of raw materials (steel, resin, magnet wires, etc.)

C. Indirect materials
   1) Delivery specifications of auxiliary materials required to ensure product functions (adhesive, tape, grease, oil, powder paint, solder, varnish, coating material, etc.)

2.2 Delivery drawings of

2.2.1 partsSubmission

(1) For parts made with die and purchased parts, the supplier shall complete a "Supplier Drawing (Specification) Transmission Sheet", attach it to delivery drawing(s) and send them to the responsiblePurchasing Section.

(2) In the case that a part fails an inspection by TS Mitsuba, the supplier shall complete a "Supplier Drawing (Specification) Transmission Sheet" and submit it to the responsible Purchasing Section together with adelivery drawing and the test certificate on which a request for the submission of such a delivery drawingis made.

(3) The drawing management division of TS Mitsuba shall register each delivery drawing in Supplier Drawing (Specification) Book, put the frame of receipt stamp on it and forward it to the responsible Design Section.

2.2.2 Issuance

(1) After the delivery drawing submitted by the supplier is checked and approved by the responsible DesignSection, the drawing management division issues the approved delivery drawing just like normal (TS Mitsuba) drawings. The issued delivery drawing supersedes original TS Mitsuba drawing(s).

(2) If the content of a delivery drawing submitted by the supplier is unacceptable (incomplete or in need of correction), Purchasing Department returns it together with the associated "Supplier Drawing

(Specification) Transmission Sheet" to the supplier.

(3) Each delivery drawing shall be valid until die renewal or next design change, whichever is earlier.

(4) In order to prevent wrong use of old drawings, each supplier shall make sure to discard them on its own responsibility.
If it is necessary to store old drawings, each of them must be identified in red as "Old".

2.3 Delivery specifications of raw material

2.3.1 Submission

(1) For raw materials, the supplier shall complete a "Delivery Specifications (Raw Material) Transmission Sheet", attach it to delivery specifications prepared by it, and send them to the responsible Purchasing Section.

(2) For plastic materials, the supplier shall prepare and submit a delivery drawing without exception.
For other materials, TS Mitsuba may request suppliers to submit delivery specifications.

(3) Purchasing Department forwards the delivery specifications and the "Delivery Specifications (Raw Material) Transmission Sheet" submitted by the supplier to each section in charge of design, production engineering, and process quality.

2.3.2 Issuance

(1) After the delivery specifications received from the supplier are checked and approved by each section in charge of design, production engineering, and process quality, Purchasing Department issues the approved delivery specifications to the supplier.

(2) If the content of the delivery specifications received from the supplier is unacceptable (incomplete or in need of correction), Purchasing Department returns them together with the associated "Delivery Specifications (Raw Material) Transmission Sheet" to the supplier.

2.4 Delivery specifications of indirect material

2.4.1 Submission

(1) For indirect materials, the supplier shall complete a "Delivery Specifications (Indirect Material) Transmission Sheet" and submit it to the responsible Purchasing Section together with the delivery specifications prepared by it and a "Requirements for Material Selection" previously provided by TS Mitsuba Purchasing Department.

(2) Purchasing Department forwards the "Delivery Specifications (Indirect Material) Transmission Sheet", "Requirements for Material Selection" and delivery specifications received from the supplier to the responsible Design Section and the production engineering division and quality assurance department 1 process quality section.

2.4.2 Issuance

(1) After the delivery specifications received from the supplier are checked and approved by the responsible Design Section and the production engineering division and quality assurance department 1 process quality section, Purchasing Department issues the approved delivery specifications to the supplier.

(2) If the content of the delivery specifications received from the supplier is unacceptable (incomplete or in need of correction), Purchasing Department returns them together with the associated "Delivery Specifications (Indirect Material) Transmission Sheet" to the supplier.

2.5 Submission of material composition data

(1) If any of the following A to C applies, the supplier shall submit the material composition data of the component parts and materials using the IMDS or JAPIA sheet. For the Mitsuba company ID of IMDS,the supplier shall contact the purchasing department. JAPIA sheets shall be submitted to the PurchasingDepartment.

A. New product launch

B. Change in the substances contained in component parts and materials

E.g. Change in materials and material manufacturers such as addition / deletion / integration of components due to design changes, etc.

C. Addition of restricted substances, or tightening the threshold of content ratio

E.g. Revision of "MES A 015 Restricting the Use of Hazardous Substances", GADSL, statutory regulations, etc.

(2) In the case of A or B in (1) above, the supplier shall submit the data by the time of delivery of the applicablefirst product (including prototype) and attach the "Test Certificate" to the first product.

3 Production preparation activities

3.1 Target parts and content of activities

(1) The supplier shall implement production preparation activities including the following items in order toprevent nonconformities.
Necessity for the submission of each document below will be specified in “Production Preparation Plan”prepared by the responsible purchasing department.
For the procedure for preparing a Production Preparation Plan and verifying its contents, see theProduction Preparation Verification Flow shown on page 7.
*“All parts” refer to all part, units and assemblies (ASSYs) that compose products, excluding raw, indirectand auxiliary materials.

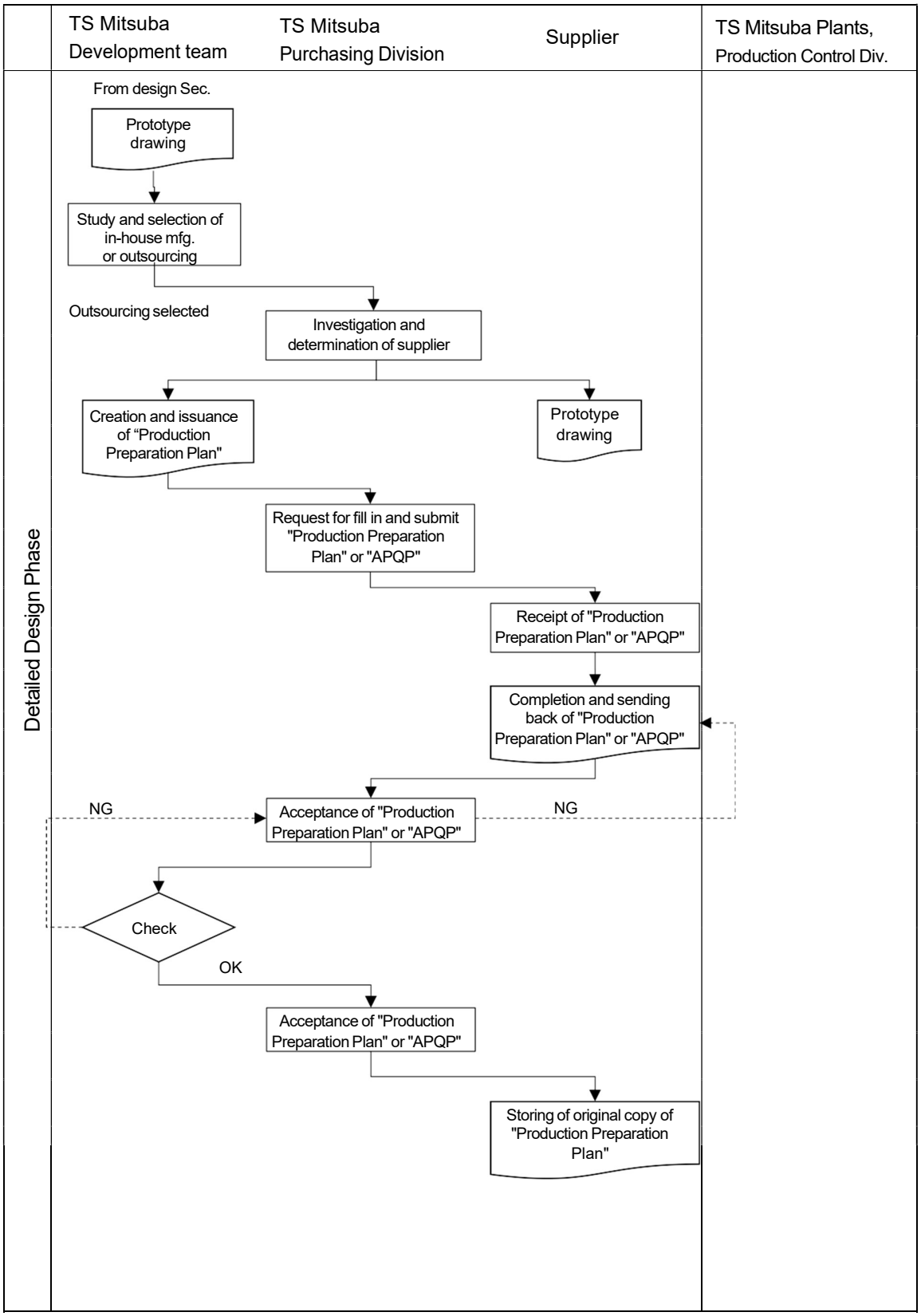
Item	Description	Target	Submission	Document
1. Preparation ofProduction Preparation Plan	The purchasing department of TS Mitsuba prepares Production Preparation Plan which specifies an overallschedule and documents to be submitted after the designation of the supplier and sends it to the supplier.The supplier shall enter necessary information in it, submit it to the contact person of TS Mitsuba and use it tomanage the progress of quality assurance activities before SOP.	Specified parts	Necessary	Production Preparatio nPlan
2. Recurrence prevention of pastproblem	The supplier shall reflect the contents of countermeasures against problems occurred inside/outside of the supplier and the past problems specified by TS Mitsuba into processes, equipment and standards.	All parts	Upon request	Optional format
3. Process Plan	The supplier shall prepare a Process Plan to clarify the specifications and the control standardsof dies, jigs and machines used.	All parts	Upon request	Process Plan
4. Process FMEA	(See TS Mitsuba SUPPLIER QUALITY MANUAL – Implementation Procedure B)	All parts	Necessary	Process FMEA
5. Preparation of Process QA Matrix	The supplier shall verify process function to detect the concerns from past problems and FMEA using a matrix.	Specified parts	Upon request	Process QA Matrix
6. Preparation ofControl Plan	The supplier shall prepare a Control Plan (a plan forprocess control).	All parts	Necessary	Control Plan
7. Preparation of Inspection Standard	The supplier shall prepare an Inspection Standard forthe finished parts specified.	Specified parts	Upon request	Inspection Standard
8. Development ofprocess and equipment	The supplier shall develop necessary process and equipment according to the Control Plan.	All parts	Upon request	Optional format
9.Preparation ofinspection equipment	The supplier shall prepare necessary measuring instrument and gauges according to the Control Plan	All parts	Upon request	Optional format
10. Preparation ofstandards	The supplier shall prepare necessary standards such as Work Standards, boundary samples, manufacturingcondition table and equipment checklist according to the Control Plan.	All parts	Upon request	Boundary sample
11. Quality assurance of partsprocessed by sub-suppliers	The supplier shall be responsible for the control of Tier-n suppliers (including tier-2 or lower-tier suppliers of TS Mitsuba). The supplier shall control production preparation / mass production of suppliers according tothis Quality Manual.	All parts	Upon request	Optional format

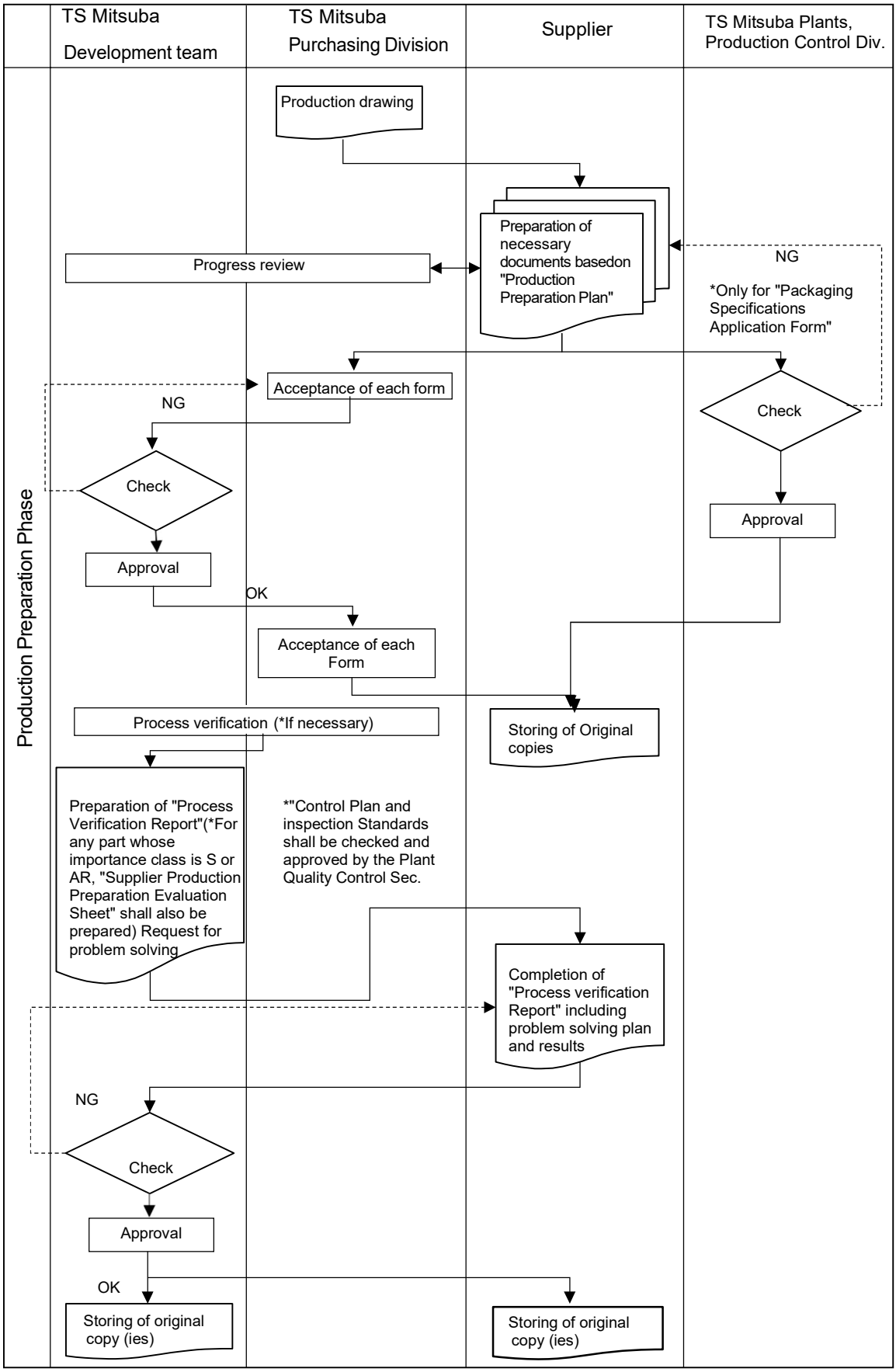
Item	Description	Target	Submission	Document
12. Determination of lot control method	The supplier shall determine the lot control method for mass produced products and incorporate it into the Control Plan.	All parts	Necessary	(To be specified in the Control Plan)
13. Operator training	The supplier shall educate and train operators using Work Standard(s) to improve their proficiency.	All parts	Upon request	Optional format
14. Setting of packaging specifications	The supplier shall define packaging specifications for the parts to be delivered, identify the parts with ID tag/label, and prevent flaw, deformation, foreign matters attachment during transportation and storage.	All parts	Upon request	Packaging specifications
15. Quality verification and Cpk assurance	The supplier shall verify the quality of parts processed with mass production equipment and, in principle, assure process capability (Cpk) equal to or higher than 1.33.For critical safety parts or parts subject to APQP, however, Mitsuba may require a Cpk of 1.67 or higher.	All parts	Upon request	Process Capability Investigation Sheet
16. Confirmation of production preparation status	The supplier shall verify the implementation status of the items 1 through 14 above.	All parts	Upon request	Process Self Audit Check Sheet
17. Advance IPP application (Submission of test certificate)	The supplier shall submit IPP samples and a Test Certificate for Advance IPP application. For details, see “8. Initial production parts control”.	All parts	Necessary	Test Certificate
18. Initial production control	In order to stabilize the quality for three months, in general, after the start of delivery of mass-produced parts, the supplier shall select major control items and implement special control activities such as inspection frequency enhancement and nonconforming part analysis.	Critical safety parts, Critical regulatory AR parts, Pass-through parts and specified parts	Upon request	Initial Production Control Plan
19. Others	In response to the requests from TS Mitsuba customers,TSMitsuba may request suppliers to implement activities other than those specified above.	Specified parts	Upon request	To be separately specified

3.2Submission of documents

(1) The supplier shall submit documents associated with production preparation activities upon request of TS Mitsuba.

3.3 Production Preparation Verification Flow




TS Mitsuba Development team
TS Mitsuba Purchasing Division
Supplier
TS Mitsuba Plants, Production Control Div.
Production Preparation Phase
Production drawing
Preparation of necessary documents basedon "Production Preparation Plan"
Progress review
NG
*Only for "Packaging Specifications Application Form"
Acceptance of each form
Check
NG
Check
Approval
Approval
OK
Acceptance of each Form
Process verification (*If necessary)
Storing of Original copies
Preparation of "Process Verification Report"(*For any part whose importance class is S or AR, "Supplier Production Preparation Evaluation Sheet" shall also be prepared) Request for problem solving
*"Control Plan and inspection Standards shall be checked and approved by the Plant Quality Control Sec.
Completion of "Process verification Report" including problem solving plan and results
NG
Check
Approval
OK
Storing of original copy (ies)
Storing of original copy (ies)

4 Process QA Matrix

4.1 Purpose

(1) The purpose of Process QA Matrix is to supplement the quality assurance functions of both TS Mitsuba andthe supplier by verifying process function to detect concerns from past problems and FMEA using a matrix.Note: For FMEA, refer to “Implementation Procedure B, 3. FMEA”.

4.2 Request for preparing Process QA Matrix

(1) The supplier shall develop a Process QA Matrix for the part designated by the Section in charge ofprocess quality of TS Mitsuba.

(2) Submission due date shall be specified by TS Mitsuba.

4.3 Preparation of Process QA Matrix

(1) The supplier shall prepare a Process QA Matrix by listing process failure modes (potential failures) along Y axis (in lines) and corresponding process names along X axis (in columns).

(2) The supplier shall clarify the assurance level of each process by using the assurance status classification symbols and the judgment criteria classification symbols shown on the top of the Process QA Matrix sheet(legend).

4.4 Receipt of Process QA Matrix

(1) The Section in charge of process quality of TS Mitsuba reviews the content of the Process QA Matrix submitted by the supplier.

(2) After the review, if any modifications are needed, TS Mitsuba issues “Document modification request” (Attachment 6)”and sends it from Quality Management Division to the supplier.

(3) The supplier shall modify the Process QA matrix based on the request, fill out an answer in the “Document modification request”, and submit the modified document together with the “Document modification request”.

5.Control Pla

5.1 Purpose

(1) Control Plan is a plan for process control. The supplier's division responsible for process setting shallprepare and manage Control Plans.
Every supplier shall prepare its own Control Plan based on drawing(s), FEMA and Process QA Matrix. Control Plans shall incorporate all the control items required in the drawings, FMEA, Process QA matrixand Inspection Standards without any difference and with consistency.

Note: For FMEA, refer to "Implementation Procedure B, 3. FMEA".Every supplier shall prepare the Control Plans.

The purpose of Control Plan is to be a basis for the creation of Work standards and the preparation ofequipment and measuring instrument.

(2) Control Plan is a living document and thus it should be updated upon design or process change for latest version management.
When revising the Control Plan, the supplier shall check the latest version of the Supplier Quality Manual and revise it in the latest format or add any missing items.

5.2 Format of Control Plan

(1) Use the first sheet of the attached Control Plan format as a cover.

(2) Draw a process flowchart in Appendix 1 of the Control Plan attached.

(3) The supplier can use any format (including its own format) for Control Plan except for the cover. However, the following items specified in IATF16949 are required to be included.

a) General data - Control Plan Number - Issue date, and revision date if applicable - Customer Information (See customer requirements) - Supplier Name / Site name - Part Number (8 digits) - Part Name / Description - Engineering Change Level - Corresponding phase (trial production, mass production) - Key Contact - Part / Process Number - Process Name / Operation Description	b) Product control - Product Special Characteristics (Class) - Other control characteristics (Number, Product or Process) - Specification / Tolerance c) Process control - Process parameter - Process Special Characteristics (Class) - Machine, Device, Jig, Tools for Manufacturing - Replacement frequency of consumables d) Methods - Evaluation / Measurement Technique - Poka-yoke - Sample Size / Frequency - Control Method e) Reaction Plan / Corrective Action - Reaction Plan (reference or include it) - Corrective Action

(4) "Reaction Plan" mentioned above mainly refers to the actions to be taken when product characteristics deviate from the specification or when a process becomes statistically unstable or deficient in capability. "Corrective Action" mainly refers to the actions to be taken when manufacturing conditions of a process deviate from the tolerance (standard).

(5) When delivering two or more similar parts, the supplier shall develop a collective (family) Control Plan by attaching and referring representative part number and specification list, instead of developing Control Plan for each product.

(6) The supplier shall check for any omissions or oversights in items described in a Control Plan before submission by use of Appendix 3 “Supplier’s Control Plan Checklist” of the Control Plan.

5.3 Control Method

5.3.1 Material control

(1) The supplier shall enter the features of raw material to be used in the first sheet of the Control Plan. Material name, number of cavities per die and method for proving non-containing hazardous substances must be included.

(2) The supplier shall enter processes beginning with material receiving and specify the material control method in the second sheet of the Control Plan. **As a material management method in the receiving process, the supplier shall set up a background verification using the material certificate (e.g. mill sheet) for each delivery lot.**

5.3.2 Tier-n supplier

(1) The supplier shall list Tier-n suppliers (including Tier-2 or lower-tier suppliers of TS Mitsuba) and the corresponding processes in Appendix 2 “Tier-n Supplier Control Table” of the Control Plan.
Change of Tier-n supplier requires submission of Process Change Report and revision of Control Plan.

(2) Even if the supplier is a trading company, the names of Tier-n suppliers must be listed.

(3) Note that the change of a sub-supplier who is actually engaged in part processing has significant impactin terms of quality assurance.

5.3.3 Functional Safety characteristics

(1) Functional Safety characteristics require a special control.

A. Maximum unit of the production lot shall be one day.
When the manufacturing method or condition changes, the lot shall be separated and managed.

B. The functional inspection equipment (QA equipment) to verify the Functional Safety characteristics shall be managed to ensure the use of the latest version of program. The supplier shall ensure the lot traceability by recording the production lot, and date and time of the first use of the latest program.

5.3.4 Fitting characteristics

(1) Since it is difficult for TS Mitsuba to detect defectives of fitting characteristics, the supplier shall ensure 100%quality assurance of those characteristics with inspection tool and Poka-yoke.
For the control method of fitting characteristics, refer to "Attachment-1 Control method by importance".

(2) If the supplier is not sure of the fitting characteristics, please consult with the Purchasing Section in charge.

5.3.5 Lot control

(1) The supplier shall enter the processes which form a lot, control characteristics, lot No. indication method, meaning of symbols and the maximum processing volume so as to make the lot control method understandable.

(2) For the lot formation standard, see “12. Lot control”.

5.3.6 Importance class

(1) The supplier shall clarify the Importance of each quality characteristics and set a control method

(inspection frequency, recording method, etc.) appropriate for each Importance level.

(2) Importance is classified into 4 categories of S, A, AR and B based on the effect on product functions, and functional safety characteristics “FS” and fitting characteristics “FIT” are also specified by TS Mitsuba (seeSUPPLIER QUALITY MANUAL – Requirements, 3.4 Definition of terms). The supplier is required to consider the Importance based on the Control Plan(s) of similar product(s) and put appropriate symbols. If the supplier cannot determine the Importance class, please consult with a contact person of the section in charge of process quality of TS Mitsuba.

(3) In the event that special characteristics (see “Requirements, 3.4 Definition of terms”) are specified by acustomer of TS Mitsuba, they are indicated on drawings. In that case, the symbols of such special characteristics must be indicated on the Control Plan without change.

(4) TS Mitsuba may request the supplier to modify the Importance class defined by the supplier.

5.3.7 Setup verification

(1) For each setup change in a process, the quality of the product shall be verified after the set up.

(2) For setup change verification of special processes, the supplier shall compare the last-off part beforesetup and the first-off part after setup, and confirm that there is no change in the process characteristicsand product characteristics of parts and products.

(3) The following table shows the items regarding setup to be described in Control Plans.

Setup timing	Description in Control Plan	
	Timing	Explanation
At startup	At the start of operation	Applicable to the production start of a day (start time not specified). In the case of line stop that may affect product characteristics, the time of production resumption after such line stop shall be also considered as “startup”.
At model change	At model change	Applicable when setup change that may affect product characteristics occurs in a process in association with a model change.
At jig/tool replacement	At setup (Replacement of expendables, jig setup, etc.)	Applicable when replacement of expendables (electrode, cutting tool, soldering iron tip, etc.) or jigs that may affect product characteristics occurs.
At die replacement/ adjustment	At die change (renewal) or maintenance (polishing, repair, adjustment)	Applicable when die renewal or maintenance (polishing, repair, adjustment, etc.) that may affect product characteristics occurs.
At material supply/lot Change	At material supply or lot change	Applicable when where setup change for material supply or material lot change that may affect product characteristics occurs.

5.3.8 Inspection Standard

(1) The supplier shall write down check items, standards and method of each inspection on the second sheet of the Control Plan.
For Critical safety parts or other parts specifically designated by TS Mitsuba, the purchasing departmentrequests the supplier to create an Inspection Standard through the Production Preparation Plan.
For detailed procedure, see “6. Inspection Standard”.

(2) "Inspection" mentioned herein includes receiving inspection, in-process test, final inspection, periodicsampling test, durability test and so on. TS Mitsuba may request periodic data submission per lot as needed.

(3) The supplier shall perform regular quality checks such as durability test with the frequency instructed byTS Mitsuba. If no instructions are provided, the supplier shall determine the frequency through consultation with TS Mitsuba.

5.3.9 Pass-through parts

(1) Since it is difficult for TS Mitsuba to detect nonconformity of pass-through parts, the supplier shall take special management based on a 100% check system such as use of various Poka-yoke For the information ofpass-through parts, please contact TS Mitsuba Purchasing Division.

(2) In the shipping inspection process, the supplier shall perform three-way matching using the actual product,the actual product slip, and the verification tool. The verification tool is a form that shows sample photosand information of the actual product, packing style, and the actual product slip in order to judge whetherthe actual product is correct for the shipping instruction. The supplier shall include the information necessary for the judgment as complete and clear as possible in the verification tool.
The shipping inspection shall be carried out by qualified inspectors. The supplier shall prepare andmanage a list of qualified inspectors.

5.3.10 Special process

(1) The supplier shall describe and identify the process corresponding to the special process (see "Requirements, 3.4 Definition of terms") in the Control Plan.

(2) As a special process, the supplier shall clearly determine the process control method such as inspection of product characteristics, monitoring of process characteristics, and retention of inspection records, lotcontrol, and operator qualification.

5.4 Submission timing

5.4.1 For new launch

(1) The supplier shall start preparing a Control Plan upon receiving prototype drawing from TS Mitsuba.
Necessary information can be obtained from the contact person of the section in charge of design orprocess quality.

(2) The supplier shall submit the Control Plan to the Quality Management Division of TS Mitsuba within 45 days after TS Mitsuba sends a production drawing.

(3) Catalog products are not subject to submission of the Control Plan. However, the supplier shall submit it upon TS Mitsuba request.
Catalog products are not the products designed by TS Mitsuba, but the products that have already beendistributed in the market.
However, regarding electronic parts for the first transaction with TS Mitsuba, even if they are catalog products,the supplier shall submit their Control Plans.

5.4.2 For design change

(1) The supplier shall submit the modified Control Plan within 45 days after TS Mitsuba sends a design change drawing. If TS Mitsuba specifies a submission due date, the supplier shall submit the Control Plan by the specified date.

5.4.3 For process change

(1) In the event that the supplier needs to revise the Control Plan along with any process change approved by TS Mitsuba, please perform the revision procedure. The supplier shall submit the revised Control Planwithin two weeks after TS Mitsuba approves the process change.

(2) For detailed procedure, see “9. Change control”.

5.4.4 Approval

(1) TS Mitsuba approves the Control Plan and then returns it to the supplier from Quality Management Division.

(2) If there is any objection to the contents, TS Mitsuba issues “Document modification request “(Atachment6)”and sends it from Quality Management Division to the supplier.

(3) The supplier shall modify the Control Plan based on the request, fill out an answer in the “Document modification request”, and submit the modified document together with the “Document modification request”.

5.4.5 Submission of in-process quality data (the items TS Mitsuba specifies in the Control Plan)

(1) The supplier shall submit in-process quality data immediately upon request of TS Mitsuba.

6.Inspection Standard

6.1Purpose

(1) Inspection Standard is a guideline for major quality characteristics inspections to be implemented by thesupplier for the purpose of ensuring quality of its products according to TS Mitsuba requirement specifications and it shall be created through consultation between TS Mitsuba and the supplier.

(2) “Inspections” mentioned here are not limited to the ones implemented at the final process and includevarious inspections and tests conducted in the course of manufacturing processes.

6.2 Scope of application

(1) Article 6 applies to the parts and materials TS Mitsuba specifies on “Production Preparation Plan”.

6.3 Operation

6.3.1 Steps for preparation

(1) For critical safety parts or the parts specially specified by TS Mitsuba, the purchasing department requeststhe preparation of the “Inspection Standard” in the “Production Preparation Plan”.

(2) The supplier shall start preparing an Inspection Standard in consideration of mass production uponreceiving prototype drawing of object part / material from TS Mitsuba.

(3) The supplier shall willingly obtain information to establish mass production processes from TS Mitsuba and promote early maturation of the Inspection Standard.

(4) For raw material, the material specifications created through consultation between the supplier andTS Mitsuba can be used as the Inspection Standard.

(5) The supplier shall submit the Inspection Standard by the date specified by TS Mitsuba.

6.3.2 For new launch

(1) The supplier shall write all the items to be assured in the process (including items necessary for ensuring workmanship) down on the Inspection Standard and submit it together with the Control Plan within 45days after TS Mitsuba sends a production drawing.

6.3.3 For design change

(1) The supplier shall submit the Inspection Standard within two weeks after TS Mitsuba sends a design change drawing.

(2) If TS Mitsuba specifies a submission due date, the supplier shall submit the Inspection Standard by thespecified date.

6.3.4 When agreed on delivery drawing

(1) In the event that any delivery drawing (specifications) is exchanged, submission of the Inspection Standard shall be conducted according to Article 6.3.2 (1) and 6.3.3 (1) with the terms “production drawing”and “design change drawing” replaced with “delivery drawing (with TS Mitsuba approval stamp)”.
*If submission of an interim Inspection Standard based on a prototype drawing is requested, the suppliershall submit it to the requesting division of TS Mitsuba by the date specified.

6.3.5 Implementation of inspections

(1) The supplier shall inspect mass-produced parts for the quality characteristics specified in the Inspection Standard in the defined measurement method.

(2) The supplier shall submit the inspection records of the quality characteristics which are requested to besubmitted in the Inspection Standard to the Quality Control Section of the receiving plant of TS Mitsuba. If aformat of inspection records to be submitted is specified by the receiving plant, the supplier shall use theformat.

(3) The supplier shall ensure that finished product inspection and the decision to pass or fail are implemented by the qualified persons who have abilities to correctly judge between pass and fail and to decide appropriate inspection method and procedure for handling nonconforming parts.

6.3.6 Format of Inspection Standard

(1) The supplier shall use the Inspection Standard format specified in this Manual.

(2) For the Inspection Standard for raw and indirect materials, the supplier can use its own format, providedthat items to be included shall be determined through consultation between TS Mitsuba and the supplier.

6.3.7 Entry rules

Every field with no entries shall be filled with a hyphen (“-”) or a diagonal line. (1)

Entry rules regarding revision
When correcting the Inspection Standard, draw a double line on the part to be corrected and enter acorrected content after the lined part.
Then, put a revision symbol (a number in a triangle) on the side of the corrected part.

(30) Revision symbol	Put a serial number enclosed by a triangle in the “Symbol” field △1 (in order of revision, put 1, 2, 3,…from the top field to the bottom).
(31) Revision date	Enter the western calendar date of revision.
(32) Description of revision	Enter the reason for or content of the revision. In the case of design change, put the Notice No. shown in the drawing.
(33) Approved by (supplier)	Put the signatures or seals of the person in charge of revision and the QARP of the supplier

6.3.8 Submission

(1) The supplier shall check the Inspection Standard for any omission or incompleteness using “Inspection Standard Preparation Check Sheet” and submit it to the Quality Management Division of TS Mitsuba.

6.3.9 Approval

(1) TS Mitsuba approves the Inspection Standard and then returns it to the supplier from Quality Management Division.

(2) If there is any objection to the contents, TS Mitsuba issues “Document modification request” (Attachment6)”and sends it from Quality Management Division to the supplier.

(3) The supplier shall modify the Inspection Standard based on the request, fill out an answer in the “Document modification request”, and submit the modified document together with the “Document modification request”.

6.3.10 Revision and abolition of Inspection Standard

(1) The Inspection Standard shall be controlled so that the latest version is always available.

(2) In the case that the Inspection Standard is totally revised because its content is fully reviewed or therevision field is filled up, or that it is abolished because, for example, relevant part is discontinued, the supplier shall retain the old versions as quality records for not less than 20 years.

7 Setting of packaging specifications

7.1 Application of packaging specifications

(1) If requested by the Plant Control Section of TS Mitsuba receiving plant, the supplier shall submit a “Packaging Specifications Application Form” to it within 45 days after TS Mitsuba sends a production drawing.
When the supplier delivers the same parts to two or more TS Mitsuba plants, the supplier shall apply toeach plant for the packaging specifications upon order receipt.
For domestic suppliers, please select the container to be used for delivery from the standard containerspecified by TS Mitsuba.
Standard container refers to the container described in Standard container list.
Please obtain Standard container list from the Plant Control Section of TS Mitsuba receiving plant.
For the procedure of container selection, refer to the setting standard of "Form-9 Package application".

(2) If it is necessary to change the packaging specifications as one of the measures for any failure or asimprovement activities, the supplier shall apply for such a change on an as-needed basis.

(3) The Plant Control Section of the receiving plant inspects the Packaging Specification Application Form,and if there is no problem with it, then approves it.

7.2 Notes on packaging

(1) The following are the points to be noted for packaging. If any other special instructions are given by TS Mitsuba, the supplier must follow them.

A. Prevent damage and deterioration of parts during transportation
   1) Detachment of parts (clip, holder, etc.) due to contact between parts or contact vibration between part(s) and case
   2) Deterioration due to humidity and/or temperature
   3) Deterioration due to harmful gases generated
B. In principle, use returnable plastic containers. However, for overseas destinations, or if it is difficult to reuse the containers, cardboard boxes may be used.
C. Clean containers on a regular basis and check for dirt on them before packaging parts in order to prevent soiling of parts.
D. In principle, the total weight of one package to be carried by a person in both hands shall not exceed 15kg. However, this is not the case when there are constraints or instructions of our customer or regulations of the country, or when the transportation efficiency is greatly deteriorated.
E. The shape and material of the package shall be resistant to deformation due to its own weight or load generated when stacked up.
F. Consider safety during handling including transportation and picking out.
G. Adopt a structure that allows easy storing and taking parts out of the package.
H. When stacking containers, attach ID tags (identification labels) on the same side of them so that ID tags are easily viewable.
I. Attach an ID tag (identification label) for each minimum packaging unit of parts and materials.
J. The package materials shall be reusable or recyclable and its amount shall be kept as small as possible
K. Do not use newspaper etc. as a cushioning material (auxiliary material).
L. Follow other instructions given by TS Mitsuba, if any.

(2) When using pallets or skids, the supplier shall load the packages / containers (foldable container, cardboard container, etc.) in chronological order of their production lot, and assign the skid number in thesame order.

8 Initial production parts control

8.1 Purpose

(1) In general, failures are more likely to occur when any change is made. Therefore, initial production parts(IPP) control is extremely important in terms of failure prevention.

(2) Besides, separating lots as part of initial production parts control makes it easy to limit the scope ofactivities such as sorting and recall of already-delivered products. This also brings benefits to all theconcerned including suppliers, TS Mitsuba, customers of TS Mitsuba and consumers.

8.2 IPP delivery procedure

8.2.1General

(1) When delivering IPPs, the supplier shall give a prior notice to TS Mitsuba.
There are three types of IPP:

A. Trial production lot: Shall be delivered on the designated date.
B. Initial sample: For design change samples, notice shall be given one month before the delivery, and for process change samples, one week before the delivery, in principle.
C. When delivering parts with actions taken (TDA (temporary deviation approval) parts, sorted parts, parts with temporary/permanent countermeasure, etc.), the supplier shall confirm the necessity of a prior notice with the Quality Control Section and Plant Control Section of each receiving plant.

(2) Last 3 digits of the TS Mitsuba 13-digit part number are different by plant. When delivering the same IPPsto two or more plants, the supplier shall prepare and deliver the same IPP for each plant.

(3) In order to improve the efficiency of IPP receiving inspection and reduce inspection lead time, the responsible person of TS Mitsuba may visit the supplier's facility to conduct a joint inspection or verify inspection results.

8.2.2 Trial production lot

(1) Trial production parts shall be made with mass production equipment (tooling, jigs, machines, etc.).
If any of production equipment is not available and thus provisional tooling/jigs/machines are used instead, enter their names in the test certificate.

(2) The supplier shall inspect all the items including notes shown in the drawing.
In principle, 100% inspection shall apply to critical safety and significant characteristics.

(3) In principle, the number of data to be entered in the test certificate shall be three (n=3) per cavity No. forparts made with the die that has multiple cavities, and five (n=5) for other parts.
Otherwise, the supplier shall consult with the Quality Control Section of the receiving plant and follow itsinstructions.

(4) When TS Mitsuba requests additional inspection items, the supplier shall inspect them as instructed by TS Mitsuba.

(5) Trial production parts must pass all the inspection items. However, if the supplier needs to use parts with minor non-conformities from the same reason as in the case of temporary deviation approval (see 15.1(1)), the supplier shall consult and agree with the responsible Purchasing Section and the Quality Control Section of the receiving plant in advance, put a note on such an exception in the "Supplier comments" field of the Test Certificate and submit it to the Quality Control Section of the receiving plant.

(6) In each delivery of trial production parts, the supplier shall attach a test certificate to them (one certificate for one delivery) and prefix an ID tag to each delivery box and send them to the Quality Control Sectionof the receiving plant. Attach a material certificate as well if needed.

(7) The Quality Control Section of the receiving plant puts the internal inspection results and the pass-failjudgment of the trial production samples in the test certificate and returns it to the supplier.

8.2.3 Initial samples

(1) Initial samples shall be made with permanent production equipment (tooling, jigs, machines, etc.).

(2) In principle, the number of data to be entered in the test certificate shall be three (n=3) per cavity No. for parts made with the die that has multiple cavities, and five (n=5) for other parts and **shall be entered full lay out inspection data for n=1 follow the drawing.**

Otherwise, the supplier shall consult with the Quality Control Section of the receiving plant and follow its instructions.

(3) Indicate the sample number directly on the sample or on the tag to ensure the link with the test certificatedata.

(4) TS Mitsuba puts the internal inspection results, instructions (if any) and pass-fail judgment in the test certificate submitted by supplier and returns it to the supplier. The supplier shall submit "Inspection report" in Excel worksheet for further data input at TS Mitsuba. (Submission in PDF or paper is not acceptable.)
As the time required for notice of results varies depending on the part, please contact the quality controlsection of the receiving plant.

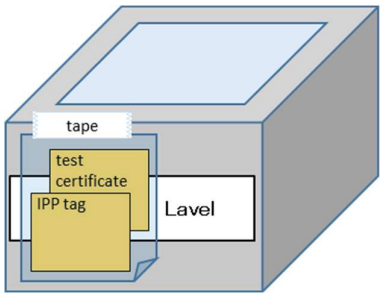
(5) Initial samples for TS Mitsuba overseas production sites are inspected at the mother plants in Japan. So,the supplier is required to submit initial samples to the relevant mother plant.
If the supplier is not certain where to submit, please contact the responsible Purchasing Section.

8.3 Delivery of IPP for mass production

8.3.1 General

(1) The supplier shall deliver IPP lot with IPP tag (copy is not acceptable) and test certificate (Inspection Data) attached andIPP mark stamped on an ID tag on each box.

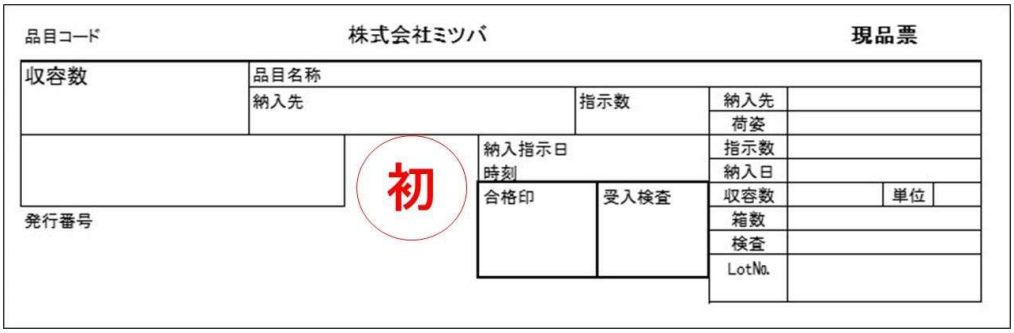
(2) The supplier shall put the IPP tag and test certificate together in a plastic bag by making the IPP tagvisible, and attach it to the front of the delivery box. The supplier shall tape only the upper part of theplastic bag so that the ID tag can be easily confirmed.



(3) The supplier is required to detach and retain the first sheet of IPP tag, and attach the second and thirdsheets to IPP.

8.3.2 IPP indication on ID tag

(1) Stamp a red IPP mark (初) in the margin of every ID tag (electronic KANBAN) of delivery lot. IPP mark shall be about 25mm in diameter.



8.3.3 Indication of IPP and attachment of IPP tag and test certificate on IPPs to be imported/exported

(1) When delivering IPPs from Japan to overseas or from overseas to Japan, the supplier shall indicate IPP(Initial Production Parts) on inner packing box (delivery box). Delivery destination shall be indicated onthe carton labels.

A. Indicate “IPP” on the front side (on the same surface where a carton label is attached).
B. The size of IPP indication shall be 30mm long and 50mm wide.
C. For clear discrimination from products before and after IPP, indicate “IPP” on every inner packing box of the first 3-day lots.

(2) Attachment of IPP tag and test certificate

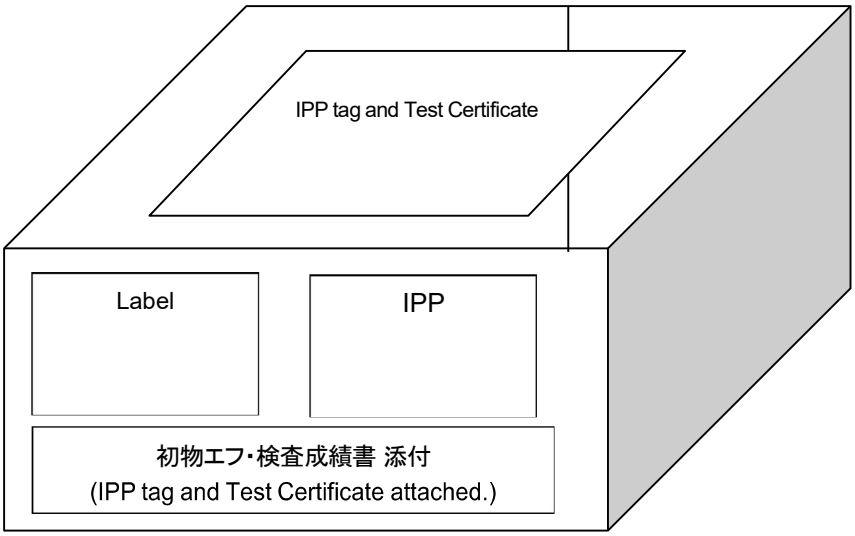
A. Put an IPP tag and a test certificate into a plastic bag and attach the bag on the top face of an inner packing box with adhesive tape.
B. The IPP tag and test certificate shall be written in both Japanese and English.

(3) Notes for inner packing box

A. Make sure that the information on a carton label correctly describes the contents of the inner packing box (part No. and quantity).
B. Indicate the packing date in the Western calendar in order of year, month and day on a carton label as shown below:

Example: January 23, 2015 ➔ 15.01.23

C. Indicate “IPP tag and Test Certificate attached” only on the face of the inner packing box on which a carton label is attached.

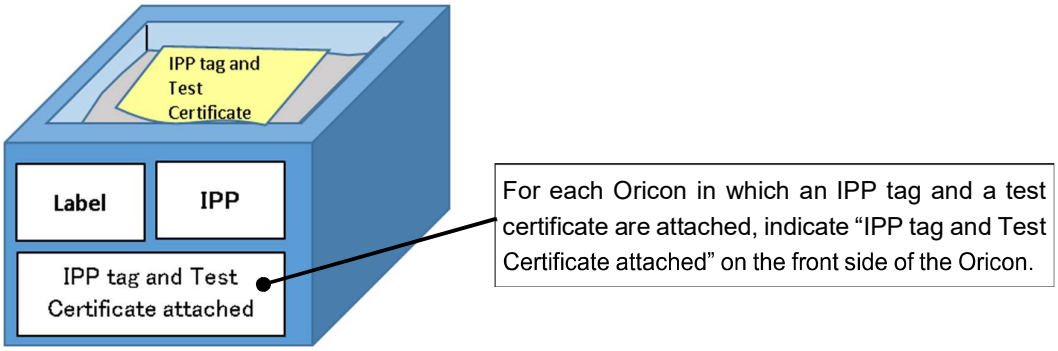


(4) See below for the indication of IPP and the attachment of an IPP tag (PSW) and a test certificate onfoldable resin containers (hereinafter referred to as “Oricon”)

A. Method of IPP indication on an Oricon

1) Indicating “IPP” on the front side

Indicate “IPP” on the front side (on the same surface where a carton label is attached).

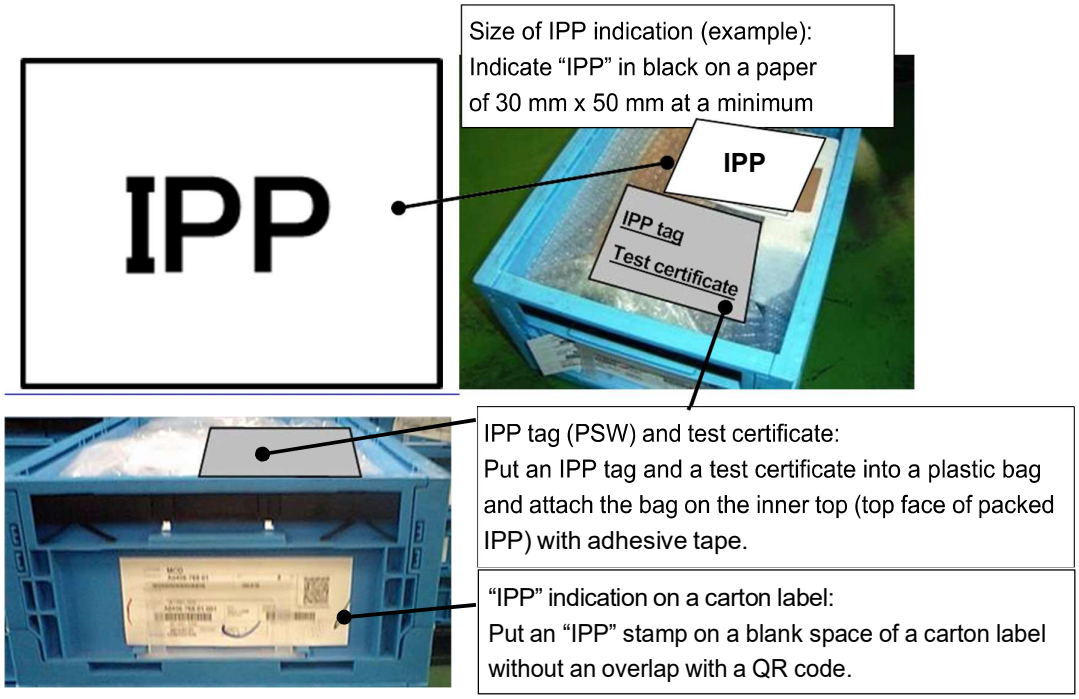


2) Indicating “IPP” inside an Oricon

If it is impossible to indicate “IPP” on the front side, indicate it on the inner top (top face of packed IPP) and put a black “IPP” stamp on a blank space of a carton label.

Make sure to put the stamp without an overlap with a QR code so as not to impair the readability of the QR code.

(Any stamp size is acceptable to the extent that the conditions above are satisfied.)



B. Indicate “IPP” in black on a paper of 30 mm x 50 mm at a minimum.
C. Put an IPP tag (PSW) and a test certificate into a plastic bag and attach the bag on the inner top (top face of packed IPP) with adhesive tape.

8.4 Scope of IPP

(1) For the scope of IPP and IPP inspection items, see “Attachment 3_Inspection items and IPP treatmentitems for changes made”
If there is anything unclear, the supplier shall contact the Quality Control Section of the receiving plantwithout making a decision at its own discretion.

9 Process change control

9.1 General

(1) Since a process change has a significant impact on quality just like a design change does, it is important to control it in a proper way.

When changing the process, the supplier shall manage the change according to "Attachment 3: Inspection items and IPP treatment items for changes" **but exception when part support to product of customer (AAT), shall manage the change according to "Attachment 7 : Requirements for Production Method Change"** and apply for changes to TS Mitsuba using the Process Change Report.

Depending on the change item, the application classification is "Submission required: Process Change Report", "Submission required: Design Change Request", "Design Change Request/Process Change Report not required: In-house control". Regardless of the application classification, the supplier shall implement the change management.

When being unable to judge the necessity of **application for changes**, the supplier shall contact theQuality Control Section of the receiving plant without making a decision at its own discretion.

The supplier shall be strictly prevented from changing product quality without **necessary application** and causing the customers so much trouble (e.g. failures at customers).

TS Mitsuba may request the supplier to provide change plan information regardless of whether or not achange to be made falls under the category **"Design Change Request/Process Change Report notrequired: In-house control".**

(2) When the supplier discontinues production or sales of parts or materials for its own reason, the suppliershould prepare a "Form 36 Notice of Production Discontinuation" and submit it to our Purchasing Division.

A. When the supplier discontinues production or sales of parts or materials for its own reason, the "Form 36" shall be submitted within one working day after deciding discontinuation.

B. When the supplier discontinues production or sale of parts or materials for the reasons attributable to the N-tier supplier, the "Form 36" shall be submitted within one working day after obtaining the discontinuation information.

*Discontinuation refers to cases where production or sales is discontinued (including cases where production is not possible at the factory due to production transfer, etc.).

(3) In the case of design change based on the supplier's proposal (e.g. VA, actions for compliance withstatutory regulations of SOC (substances of concern)), the supplier shall describe the changes in "Design Change Request" and submit it to the responsible Purchasing Section. The Design Section of TS Mitsuba will review the proposal, enter the result in the request sheet and return it to the supplier.

9.2 Quality assurance activities at process change

(1) When implementing a process change, the supplier shall plan and implement the items 1) through 9)below to prevent quality problems after the change. (See Attachment 2 "Descriptions for the case examples of problems and actions at changes".)

For a change in a special process (see "Requirements_3.4 Definition of terms"), the supplier shall undergo a process verification to be implemented by TS Mitsuba.

1) Risk analysis ("Process FMEA" or "Change Risk Assessment Sheet")
2) Preparation of processes
3) Quality verification (Comparison of process capability)
4) Check of SOC (IMDS or JAPIA sheet)
5) Revision of Control Plan

6) Preparation of Work Standard
7) Operator training
8) Process verification
9) Production trial

(2) For the process change based on supplier's own needs, the supplier shall, in principle, submit the forms 1) through 3) below to the responsible Purchasing Section through E-mail **at least 4 months (**120 days**)** before, **especially changes in raw materials, at least 7 months (210 days) before** making such a change.

1) Process Change Report
2) Process Change Report – List of 4M Changes
3) Process FMEA or Change Risk Assessment Sheet

*In the case of a process change, the supplier is requested to find out and assess any and all possiblerisks using a Process FMEA or a Change Risk Assessment Sheet so as to prevent them and submit ittogether with a Process Change Report.
In the event where the supplier requires a process change as urgent measures against quality problemor unexpected equipment failure or damage, the supplier shall immediately report accordingly to andconsult with the Quality Control Section of each receiving Plant and the responsible Purchasing Department of TS Mitsuba.

If the process change is applied not only to domestic sites but also to overseas production sites, thesupplier shall also submit the English version of the Process Change Report and related materials.

(3) **The supplier shall provide information on plans for process changes as soon as possible, taking into account the period for approval by TS Mitsuba and our customers.**

(4) **TS Mitsuba Quality Management division requires suppliers to submit the Process Change AnnualPlan. The suppliers shall describe information on all the process change plans on the form 15Process Change Annual Plan and submit it. After the first submission, the supplier shall update and submit Process Change Annual Plan every month. Even if there is no update, the suppliershall inform TS Mitsuba by email that there is no update.**

(5) **When TS Mitsuba customer requires an early notification, priority will be given to customer requests. TS Mitsuba requires suppliers to submit Process Change Report 4 months and 7 monthsbefore changes based on the information in the annual plan.**

(6) When changing the process upon TS Mitsuba request, the supplier shall also submit a Process ChangeReport by the deadline specified by TS Mitsuba.

(7) In the case that any process of a Tier-n supplier (including Tier-2 or lower-tier suppliers of TS Mitsuba) is changed, the supplier is also required to submit a Process Change Report.
When changing a Tier-n supplier, the supplier shall verify that such a sub-supplier is in conformity to "Sub-supplier (appointment / change) Check Sheet" and attach the verification result to the Process ChangeReport.

(8) TS Mitsuba makes a decision on whether or not to change the process at the "planning" stage and the "implementation" stage.

TS Mitsuba describes the result of the judgment in the submitted "Process Change Report" and returns tothe supplier.

(9) If the process change plan is "approved", the suppliers shall submit the materials necessary to approve

the process change implementation that are instructed by TS Mitsuba by the specified date.In the case of "rejected", the supplier shall not implement process change.

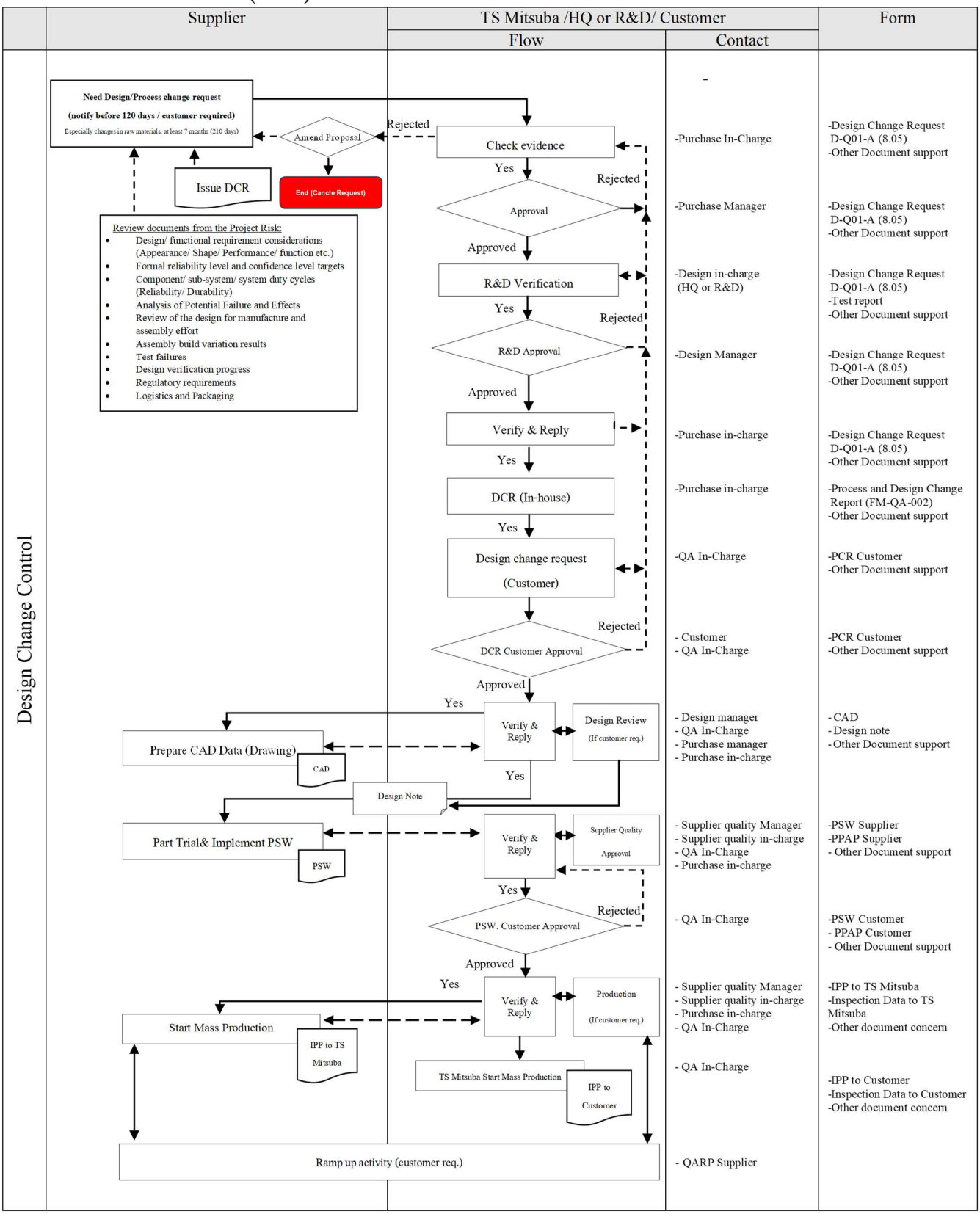
(10) Suppliers can implement the process change after receiving the "approved" process change implementation authorization. **Since the approval or rejection is determined by checking the materials instructed at the time of plan approval for process changes, the supplier shall be sure to submit all materials by the specified date.**

In the case of "rejected", the supplier shall not implement process change, but follow TS Mitsuba instructions.

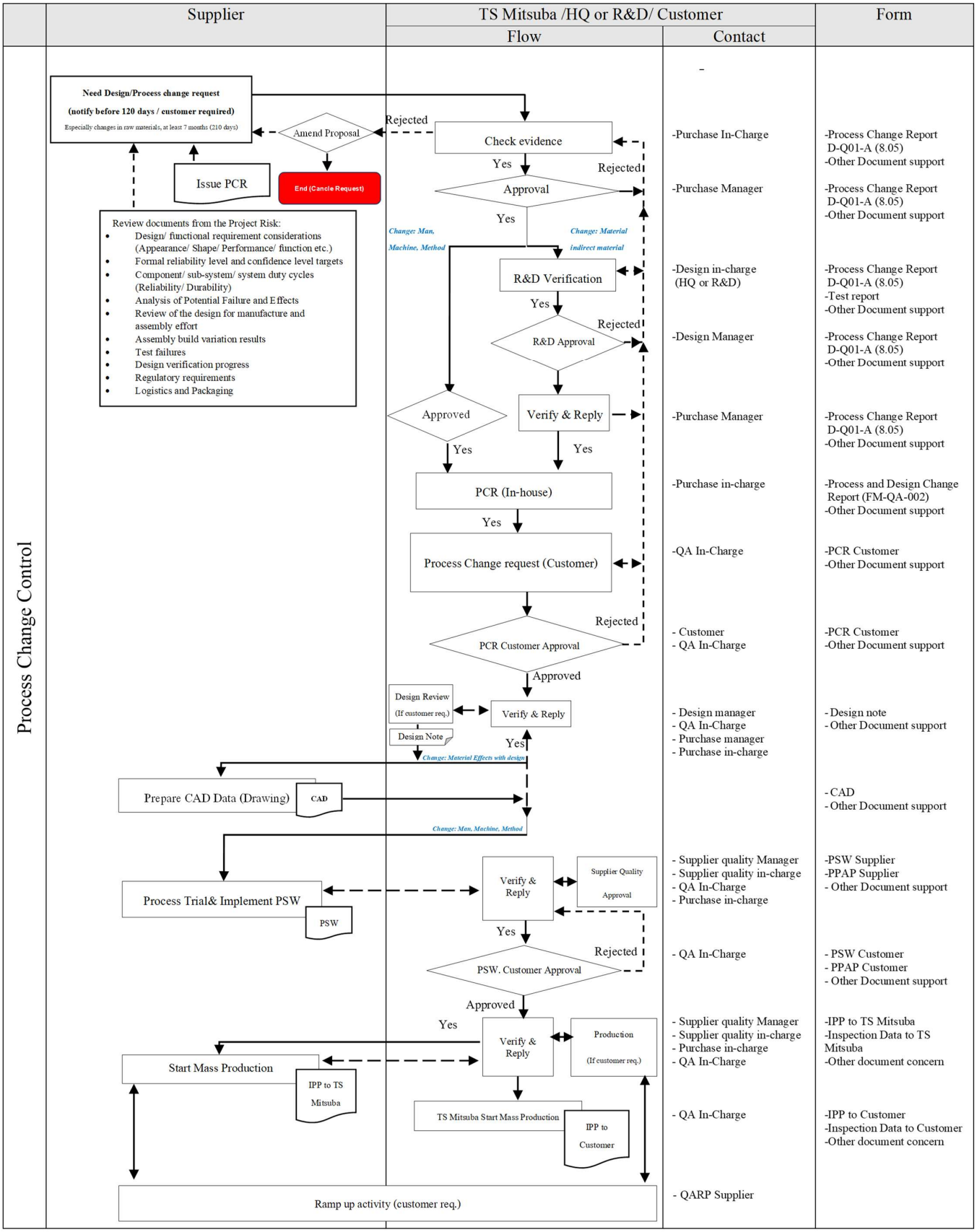
(11) For inquiries after submitting the "Process Change Report", the supplier shall contact TS Mitsuba purchasing division.

(12) When any process change affects the contents of a Control Plan, it shall be revised accordingly.
In that case, the supplier shall submit the revised Control Plan within 2 weeks after the issue date ofabove-mentioned verification result notification.

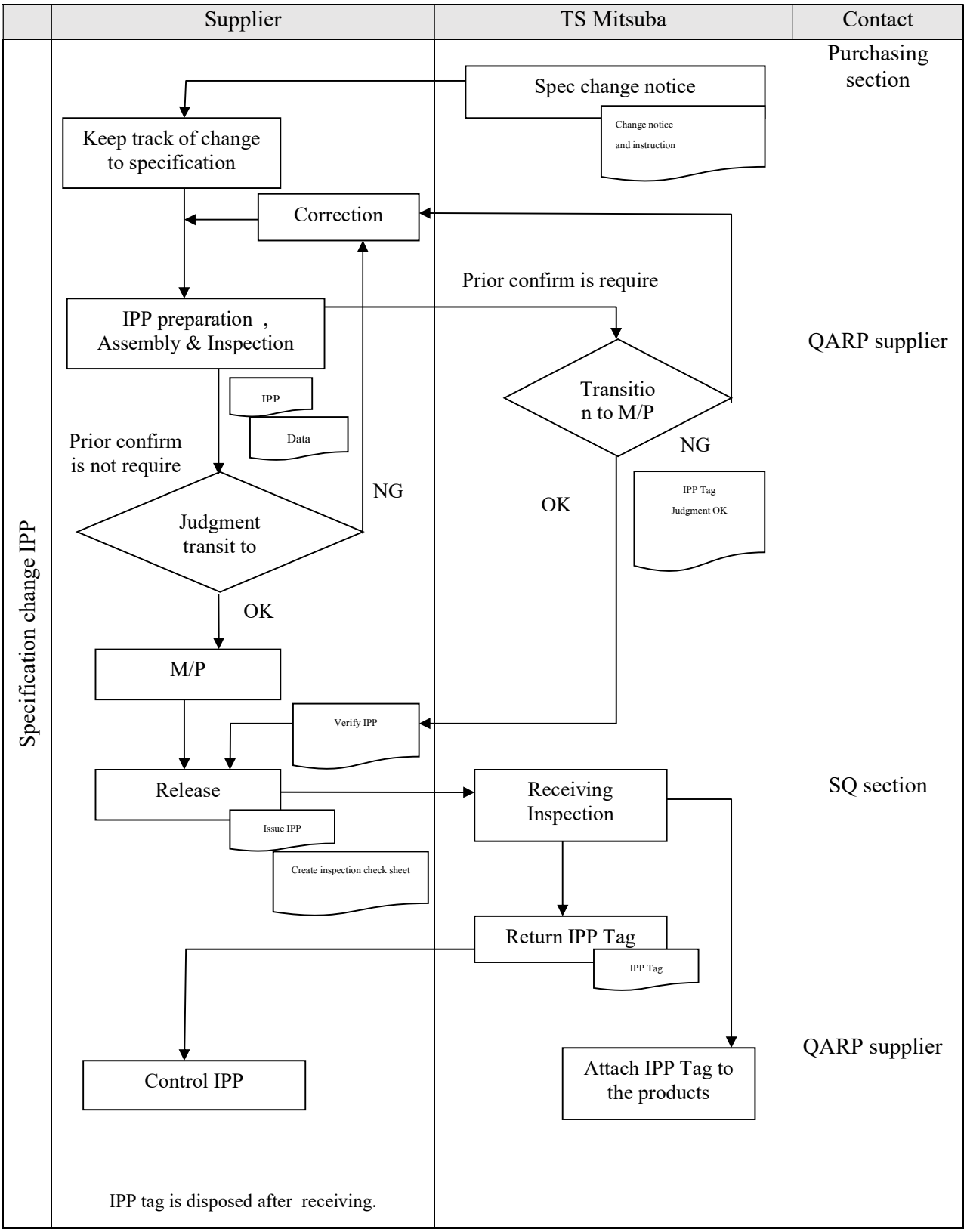
9.2.2 Flow Chart Process (DCN)



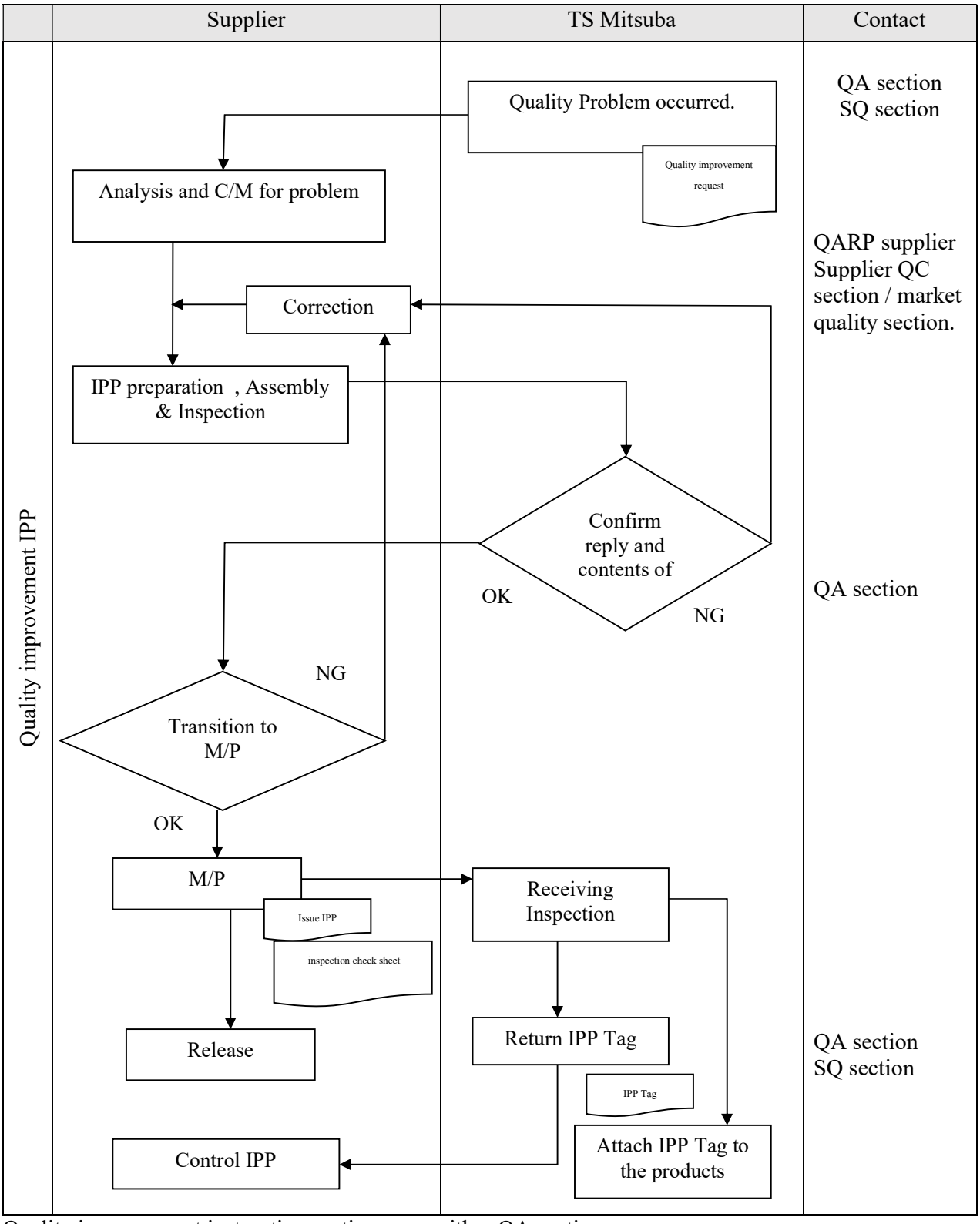
9.2.2 Flow Chart Process (PCR)



9.2.3 Flow Chart Specification change IPP



9.2.4 Flow Chart Quality improvement IPP



Quality improvement instructing section mean either QA section.

10. Control of changes

(1) As for the items which may change suddenly, the supplier shall clarify how to control them, decide the control procedure and record them together with other necessary information.
*For predictable changes (e.g. planned absence of operator, layout change), see “9 Change control”above.

(2) Sudden changes associated with 4M (material, machine, method and man) plus measurement andenvironment include the following cases:

A. Sudden interruption of operation and change of operator
B. Stop (incl. power outage) and restart of production line
C. Process changes due to equipment failure
D. Actions for operation delay

(3) The change record shall include at least the following items:

A. Change contents
B. Date of occurrence or discovery of change
C. Production date and issue date
D. Record of retrospective investigation (inspection of items before change)
E. Inspection result of product affected by change

11 Critical safety part control

11.1 General

(1) The purpose of critical safety part control is to apply a special quality control to parts that may causeserious effects on human lives when failure occurs.

(3) The supplier shall comply with the requirements shown in Attachment 1 “Control Method by Importance”.

(3) The supplier shall prepare and manage its own implementation procedure for the control of critical safetyand significant parts.

11.2 Designation of critical safety parts

(1) “Critical safety part” refers to a part with critical safety characteristics that may directly harm human liveswhen a failure occurs. Critical safety characteristics are quality characteristics which may affect thefollowing events:

1) Unable to stop
2) Unable to turn
3) Fall over
4) Catch fire

(2) TS Mitsuba notifies the supplier of critical safety parts and critical safety characteristics (importance class) through the approval process of Control Plan or with drawing(s). The symbols of Critical safety characteristics are S, Ⓢ or ◉.

11.3 Control of critical safety parts

(1) The supplier shall clearly indicate “Critical safety process” in the on-site critical processes and the associated Work Standards and “Critical safety characteristics” in the Work Standards.

(2) The supplier shall ensure and maintain a process capability of Cpk ≥ 1.33 and run a control system which can prevent outflow of nonconforming parts with 100% inspection as a base.
When a process capability of Cpk ≥ 1.67 is ensured, the supplier may introduce sampling inspectionafter consultation with TS Mitsuba.
The supplier shall carry out trend management using the control charts for the quantitative data. Whenan anomaly occurs, the supplier shall describe the cause and the corrective action on the control chart.

(3) In principle, 100% inspection for quality assurance shall be implemented by hardware such as Pokayoke and inspection equipment.

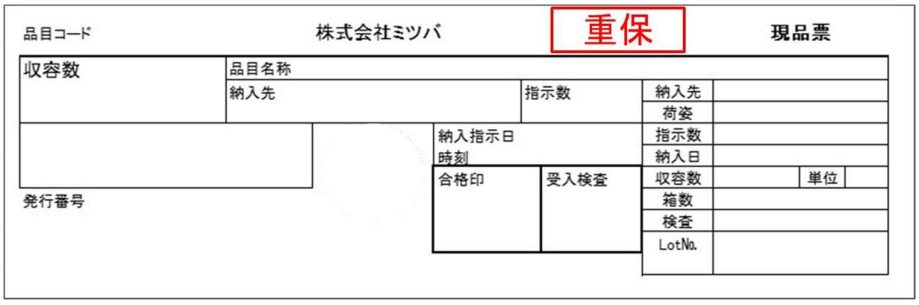
(4) Every work process for critical safety parts shall be performed by certified operators who have finishedtheir training on manufacturing process control, critical safety part control, and education, including thereason for Importance, based on other major in-house quality control standards.

(5) The QARP shall audit the control status of corresponding parts (incl. lot control record) at least once every 6 months in principle.

(6) In principle, processing of critical safety parts by Tier-n supplier is prohibited.
However, if it is inevitable, the supplier shall clearly state the use of Tier-n supplier in the Control Plan andobtain approval from TS Mitsuba.

11.4 Delivery of critical safety parts

When delivering critical safety parts, the supplier shall stamp a red critical safety mark (重保) in the margin of every ID tag (Kanban) attached for each package (for each box) for identification. As for products manufactured at overseas factories, if it is difficult to prepare a stamp in Chinese character, the supplier can use English notation such as "Critical Safety" or "Critical Safety Part" in consultation with TS Mitsuba.



11.5 Retention of quality records

(1) The quality record of each critical safety part shall be retained for at least the period shown below:

A. IPP control history (IPP tag and IPP test certificate): 20 years
B. Lot control record: 20 years
C. Product characteristics record, control chart and startup check record: 20 years
D. Records of part receiving inspection, shipping inspection and material performance test: 20 years

* TS Mitsuba may require a longer retention period according to an applicable customer-specific requirement.

12.Lot control

12.1 General

(1) The purpose of lot control is to clarify the production record (background of quality) of outgoing parts and consequently minimize the quantity of parts to be recalled.

(2) In general, lot control for parts made with special processes (see “Requirements, 3.4 Definition of terms”)is important.

(3) Lot control is extremely important for companies to fulfill their social responsibility and minimize loss caused by quality problems.

(4) The supplier shall consider these as minimum requirements.
Improved lot control brings benefits to both TS Mitsuba and the supplier from a long-term standpoint.

12.2 Lot control method

(1) The supplier shall enter the contents of lot control such as processes forming a lot, control characteristics, lot No. indication method and maximum processing volume in the Control plan.

(2) For lot formation, the following shall be complied with:

A. In principle, parts made under the same manufacturing conditions in the processes where quality characteristics to be controlled are built shall be controlled as the same lot.

B. Basically, lot size shall be 25,000 pieces at the maximum and shall be reduced to the extent that the supplier can control.

C. Shown below is the basic lot formation standard.

Lot formation standard

No.	Item	Lot
1	Material	Form a lot per material charge No. or batch.
2	Processing conditions and method	Form a lot per change of processing / assembling conditions or processing method.
3	Machine, device and die	If two or more same machines, devices or dies are used , form a lot per each of them.
4	Inspection equipment	If inspection equipment setting has significant impact on inspection values, form a lot per change of the setting.
5	Work shift	Form a lot per production date or shift
6	Heat treatment	In principle, form a lot per material charge No. or batch

(3) Example of lot No. indication method:

(Example) XX X XX X
1 2 3 4

1: Production year: Last 2 digits of the western calendar year.
2: Production month: 1 to 9 for January to September, and O, X and Y for October, November and December, respectively
3: Production date: 01 to 31 for 1st to 31th.
4: Suffix that identifies changes during the same production date (Use alphanumeric characters)

For raw materials and auxiliary materials (grease, sealing agent, etc.), the supplier is requested to consult the receiving Plant of TS Mitsuba on how to read lot numbers.

(4) FIFO rule shall be observed especially for lot control parts.

(5) If there are any instructions on lot control method from TS Mitsuba, the supplier shall follow them

12.2.2 Lot No. indication at delivery

(1) Indicate lot No. on ID tag (electrical KANBAN) and attach it to every delivery box to TS Mitsuba.

12.2.3 Retention of quality records

(1) The supplier shall prepare “Lot Control Book” and keep the production records of outgoing parts so as to ensure the traceability of them.

(2) The supplier shall record lot number, production date, shipment date and date of delivery to TS Mitsuba. The Lot Control Book shall also include production volume record per lot and process change history so as to make it possible to trace the causes of failures. For the process change history, indirect materials suchas cutting oil, grease, soldering, sealant, and adhesives shall be also considered.

(3) The Lot Control Book shall allow quick reference to the lot(s) and the number of parts for which some actions are needed when a quality issue occurs.
In the event of a quality problem, the supplier shall aim for specifying the target lot and quantity for the corrective action within two hours. (The scope of this requirement is Critical Safety parts S, Critical regulatory characteristic parts AR, and Functional Safety characteristics FS).

(4) These lot control records and Lot Control Part Designation Notice shall be kept for 20 years.

13 Initial production control

Initial production control aims to verify the effect of production volume ramp up in production phase compared to trial production (line trial) phase and to control changes for the first 3 months of mass production in order to ensure stable supply of products.

(1) In order to make sure that quality is maintained and delivery requirements are observed during earlyperiod of mass production (SOP), the supplier shall specify a special control activity plan in Initial Production Control Plan and put it into effect.
Whether the Initial Production Control Plan should be submitted or not will be specified in “Production Preparation Plan”. When Mitsuba instructs to submit the Initial Production Control Plan, the supplier shallsubmit it to the TS Mitsuba Purchasing division.

(2) In principle, the period of initial production control shall be 3 months after SOP.
For low-volume production, it shall be a sufficient period to ensure stable production of products (e.g., aperiod until production volume exceeds 1,000 pieces).

(3) The supplier shall establish a company-wide activity organization and it shall arrange meetings on quality, delivery time, etc. to review the control activities.

(4) The supplier shall give operators sufficient education and training and implement corrective actionsagainst issues through understanding of process capability and evaluation of process defect rate.

(5)The details of the special control are shown in Attachment 1 “Control Method by Importance”.

14 Actions to be taken when a failure occurs

14.1 Notification of failure

(1) When any failure attributable to the supplier occurs at TS Mitsuba, TS Mitsuba customers or in the market (receiving rejection, delivery claim or market claim), TS Mitsuba notifies the supplier accordingly. The supplier is required to immediately report the measures against that failure to TS Mitsuba. The same shall apply when a failure is found during initial production part inspection or receiving inspection.

(2) In the case that the supplier finds any failure in process(es) of its own or Tier-n suppliers (including Tier- 2 or lower-tier suppliers of TS Mitsuba) and there is a possibility that nonconforming parts have already been delivered to TS Mitsuba, the supplier shall report it immediately to Quality Control Section of the receivingplant of TS Mitsuba.

14.2 Actions to nonconforming parts

(1) The supplier shall take actions to nonconforming parts delivered to TS Mitsuba or TS Mitsuba customers in accordance with the instructions of Quality Control Section of the receiving plant or Quality Management Department of TS Mitsuba.

14.3 Cause investigation and corrective action

(1) The supplier shall immediately investigate the causes of failure and take recurrence prevention measures.

(2) The following shall be considered in cause investigation and recurrence prevention:

A. Occurrence
   1) Phenomenon 2) Content of complaint 3) # of cases 4) Contents of action taken
B. Comprehension of facts
   1) Confirmation results of part(s) in question 2) Quality status of production parts
   3) Investigation of part feature 4) Cause analysis (result of process study)
C. Investigation of causes
   1) Process of failure occurrence (incl. reproduction test)
   2) Causes of failures (incl. why-why analysis)
   3) Causes for outflowing of nonconforming parts 4) Prediction of occurrence
D. Appropriate measures
   1) Measures to prevent occurrence 2) Measures to prevent outflow
E. Conformation of the effectiveness of measures
   1) Quality performance after taking measures 2) Process verification after taking measures
F. Information feedback to the root cause process
   1) Reflection of measures into regulations and standards
   2) Application of measures to similar parts and processes

14.4 Report of countermeasure

14.4.1 Receiving rejection or delivery claim

(1) The supplier shall complete the form specified by Quality Control Section of the receiving plant (e.g. “Countermeasure Request & Report”), obtain an approval from the supplier’s QARP (or Sub-QARP) andthen submit it to Quality Control Section of the receiving plant by the specified deadline for approval. The Quality Control Section of the receiving plant determines the deadline considering customer request and urgency.

(4) When it is impossible to resolve the nonconformity or determine countermeasures by the specified date,

the supplier shall notify the Quality Control Section of the receiving plant in advance. TS Mitsuba will checkthe contents together with the supplier and agree a future plan. -

14.4.2 Market claim

(1) The supplier shall compile a report including the information on causes of, countermeasures against and handling of nonconformity in the form specified by the Section in charge of market quality of TS Mitsuba (e.g. “Countermeasure Request & Report”, “8D Report”, etc.), obtain an approval from the supplier’s QARP(or Sub-QARP) and then submit it to the responsible market quality section of the Quality ManagementDepartment by the date specified.
Market Quality section of the Quality Management Department specifies the deadline for the submission considering the customer request and urgency.
The basic deadline for general parts is within ten days (Within 17 days for electronic components).

(2) When it is impossible to resolve the nonconformity or determine countermeasures by the specified date,the supplier shall notify the responsible market quality section of the Quality Management Department in advance. TS Mitsuba will check the contents together with the supplier and agree a future plan.

(3) TS Mitsuba may require the supplier to make a plan up to the submission of a report and manage the progress.

14.5 Delivery of the improved parts

(1) When delivering the improved parts, the supplier shall follow the IPP delivery procedure.

14.6 Revision of standards

(1) In the case that Process FMEA, Control Plan and/or Inspection Standard are revised along with the implementation of countermeasures, the supplier shall submit them within one week after permanent measures are taken.

14.7 Cost burden

(1) Amount of claim related to failures attributable to the supplier shall be decided in accordance with theBasic Purchasing Agreement.

(2) If the supplier causes any failure related to any change without change application while such an application is required pursuant to the clauses under “9. Process change control” of this document,TS Mitsuba may charge the supplier any loss, costs and expenses arising out of such failure.

14.8 Retention of records

(2)All countermeasure reports shall be retained for 20 years.

15 Quality Instructions Sheet

15.1 Issuance of Quality Instruction Sheet

When changing any standard value, control value or manufacturing method specified in a drawing or a Control Plan, TS Mitsuba may issue a Quality Instructions Sheet.

A Quality Instructions Sheet is tentatively valid until the corresponding drawing or Control Plan is formally revised.

It is used when the content of a change instruction causes no problem on the manufacturing and quality of the concerned part and product and such an instruction is urgently required to maintain production.

15.2 Actins to be taken when a Quality Instructions Sheet is issued

When a Quality Instructions Sheet is issued by TS Mitsuba, the supplier shall make a change to a standard value, control value or manufacturing method specified in a drawing or a Control Plan according to the content of the Quality Instructions Sheet.

For parts produced as per the Quality Instructions Sheet, the supplier shall deliver them with the IPP control according to “Attachment 3_Inspection items and IPP treatment items for changes”.

The supplier shall also implement the IPP control for the first lot after the Quality Instructions Sheet is discontinued.

16 Temporary Deviation Approval (TDA)

16.1 Scope of request for TDA

The supplier may submit a request for Temporary Deviation Approval (TDA) if the following requirement is satisfied:

- Although parts show minor non-conformities, production is adversely affected without them or scrapping cost for them is extremely high.

(1)TDA allows temporary use of nonconforming parts for the reason above. So, the supplier should be careful not to apply for TDA without due consideration.

(2) The supplier cannot apply for TDA **for Critical Safety parts and Regulatory characteristics of Regulatory parts.**

16.2 TDA procedure

(1) The supplier shall submit “TDA Application Form” to the responsible Purchasing Department. Purchasing Department may request the supplier to submit TDA part sample and test certificate.

(2)In response to the supplier’s application, Purchasing Department considers TDA in consultation with the related departments.

(3)Purchasing Department notify the supplier of the result of TDA application with “TDA Result (Approved/Rejected) Report”.

(4)When delivering TDA parts, the supplier shall take the IPP delivery procedure.

17 Supplier quality audit

17.1 Quality assurance system audit

17.1.1 Type of quality assurance system audit

(1) Quality assurance system audit is classified into 3 types below:

A. Audit of new supplier
B. Periodic audit
C. Extraordinary audit

(2) Quality assurance system audit is conducted in two methods below:

A. On-site audit: TS Mitsuba visits the supplier's site and conducts an audit
   1) MQS audit or QAV1(TS Mitsuba quality standard: Organizational aspect)
   2) Process/product audit
   3) Process audit (QAV2)
B. Self-audit: The supplier conducts an internal audit (by trading account).

Reference: Table of audit types & methods

Type \ Method	On-site audit			Self-audit
	MQS audit (QAV1)	Process & Product audit	Process audit (QAV2)	Self quality system audit
New supplier audit	X	*X	-	-
Periodic audit	X	X	X	X
Extraordinary audit	X	X	X	-

17.1.2 New supplier audit

(1) New supplier audit is conducted for a supplier who had no business with TS Mitsuba.

(2) New supplier audit is focused on the evaluation of overall quality system of the supplier.

*If a part of the processing is carried out by a Tier-n supplier (including Tier-2 or lower-tier suppliers of TS Mitsuba), TS Mitsuba may conduct a process or quality system audit for that Tier-n supplier.(e.g. Sub-supplier who processes critical characteristics.)

(3) If the new supplier is a trading company, TS Mitsuba audits the company(ies) in charge of processing as well.

17.1.3 Periodic audit

(1) A periodic audit is conducted based on the quality assessment class of each supplier.

1) Quality evaluation C class supplier
   TS Mitsuba determines the Quality evaluation result based on the next Section "18 Supplier Quality Evaluation".

(2) In addition to the evaluation C class, the following target suppliers will be contacted and audited by us in Advance.

1) Business partners who delivery finished prototype (pass-through parts)
2) Suppliers of Critical Safety parts and Regulatory parts

(3) In a periodic audit, a high emphasis is placed on clarifying problems of the supplier's quality system.

(4) The frequency (interval) of a periodic audit depends on the quality assessment class of each supplier.

Quality assessment class	Frequency of audits
A class, B class	Self-audit – Once every 3 years
C and D class (Annual quality targets below target)	On-site (MQS or QAV1) audit once every year.

(5) If the supplier is a trading company, TS Mitsuba audits the company (ies) in charge of processing as well asthe supplier.

(6) *When a supplier audit is required by TS Mitsuba customer, TS Mitsuba may conduct the audit by the audit method specified by the customer.*

17.1.4 Extraordinary audit

(1) Extraordinary audit is conducted,

A. when it is needed for TS Mitsuba to satisfy customer's requirements and expectation, and
B. when TS Mitsuba assumes that it is necessary for quality system management.
C. when TS Mitsuba confirms the result of the self-audit by the supplier and assumes that an on-site audit is necessary.

17.2 SOC management system audit

(1) TS Mitsuba audits the SOC management system of suppliers.

(2) TS Mitsuba designates suppliers subject to the audit and audit method (on-site or self-audit).

17.3 Process verification

(1) The main purpose of process verification is to verify the appropriateness of the process control at thesupplier. TS Mitsuba may conduct process verification at Tier-n suppliers (including Tier-2 or lower-tiersuppliers of TS Mitsuba).

(2) Process verification is carried out from the following reasons. TS Mitsuba notifies the supplier of the necessityand timing of Process verification in each case.

A. Confirmation of preparation status including production preparation plan in SOP phase (mainly conducted by involved Design Section of TS Mitsuba)
B. Confirmation of conformity of delivered products with TS Mitsuba requirements (mainly conducted by thereceiving Plant of TS Mitsuba)
C. Confirmation of supplier's process change (mainly conducted by the receiving Plant of TS Mitsuba)
D. Investigation of causes and consideration of countermeasures for critical failures (mainly conducted by the Quality Management Department of TS Mitsuba)
E. Confirmation of implementation status of countermeasures (mainly conducted by involved plant of TS Mitsuba)
F. Others (e.g. implementation of countermeasures for critical quality issues to similar parts)

17.4 Process verification by customers

(1) Upon request of the customer, involved person of TS Mitsuba may accompany the customer to the supplier to conduct process verification.

17.5 Process verification of special processes

(1) The supplier shall conduct annual self-verification of applicable processes using the process check sheet below and retain the results. In addition, the supplier shall manage the results to be available for submission to TS Mitsuba upon request.

Form-37 Quenching and Tempering Process Check Sheet
Form-38 Soldering Process Check Sheet
Form-39 Resin Welding Process Check Sheet
Form-40 Adhesion Process Check Sheet

When TS Mitsuba customer requires a system assessment using CQI, TS Mitsuba specifies the target suppliers. Targeted suppliers shall use the CQI assessment sheet below to conduct systemassessment during production preparation and every year after mass production starts.
*The applicable CQI assessment sheet can be downloaded by purchasing the CQI book from the AIAG website. If you need a Japanese translated version, you can purchase it from the Japan Plexus Co., Ltd. website.

<Special process system assessment items>

CQI-9 Special Process: Heat Treat System Assessment
CQI-11 Special Process: Plating System Assessment
CQI-12 Special Process: Coating System Assessment
CQI-15 Special Process: Welding System Assessment
CQI-17 Special Process: Soldering System Assessment
CQI-23 Special Process: Molding System Assessment
CQI-27 Special Process: Casting System Assessment
CQI-29 Special Process: Brazing System Assessment
CQI-30 Special process: Rubber Processing System Assessment

17.6 Remediation of issues

(1) For the issues found during audits and verifications, the supplier shall investigate the causes and takeactions within three months in principle.

(2) TS Mitsuba suggests a specific improvement schedule during individual assessment/audit.

18 Supplier quality assessment

18.1 Purpose

(1) The purpose of supplier quality assessment is to determine whether each supplier is appropriate as apart of supply chain from the quality aspect in the aim of increasing customers' satisfaction.

18.2 Yearly quality assessment method

(1) The result of yearly quality assessment is used as data for evaluating the supplier.

(2) The supplier is assessed in terms of product and corporate constitution and categorized into four classes(i.e. A, B,C and D) according to the score (index).

The class of comprehensive assessment is determined based on the lower index.
Note that figures after the decimal point shall be omitted in calculating the scores.

Class	Point
A	100-90 points
B	89-75 points
C	74-60 points
D	59-0 point

Supplier assessment is divided into 3 evaluation areas: Quality, Delivery and Cost competition.
Divided into:

- Quality : Part reject PPM (30) + Quality Assurance effect (10) = 40 Points
- Delivery: Achieved CR % (30) = 30 Points
- Cost : On time delivery (25) + Service, Premium freight (5) = 30 Points

Summary = 100 Points

(3) The table below shows the composition of product and corporate constitution indices:

(4) The results of yearly quality assessment are used as the criteria for choosing suppliers subject to thequality assurance system audit in the subsequent year.

18.3 Notification of quality performance

18.3.1 Monthly quality performance

(1) You can view the "Monthly Quality Performance" on the website https://vendorportal-tsmec.com/ which shows the supplier evaluation (evaluation score). You need to login to the website to view your evaluation results.

Monthly Quality Performance Results summarize the following:

(i) PPM form critical and Important quality issues

(ii) Delivery quality problems (Late Qty and Shot Line)

18.3.2 Notification of the application of quality warning system

(1) If any of the following events occurs due to the supplier's fault, TS Mitsuba issues a Yellow Card Notice to the supplier:

(i) Critical and Important quality issues

(ii) Delivery claims from a customer for two consecutive months

(iii) Three or more receiving rejections in total for two consecutive months

(iv) Our purchased piece quality committee judges that a Yellow Card is issued.

(2) Responding to the Yellow Card Notice, the supplier shall prepare a report on identification of root causes and specification of corrective measures for the failure.
The top management of the supplier shall report the contents of the corrective measures to TS Mitsuba.

(3) If there is No improvement impact for 6 months after issuance the Yellow Card, we will Request an additional improvement by extending the period.

18.4 Supplier's quality improvement activities

(1) Upon request for preparing a quality improvement activity plan from TS Mitsuba Purchasing Department,the top management of the supplier shall develop the plan and submit it to the Purchasing Department.

(2) TS Mitsuba reviews the quality improvement activity plan prepared and submitted by the supplier and develops plans for on-site inspection of improvement status and periodic follow-up activity.

(3) The supplier shall voluntarily promote the quality improvement activity plan.

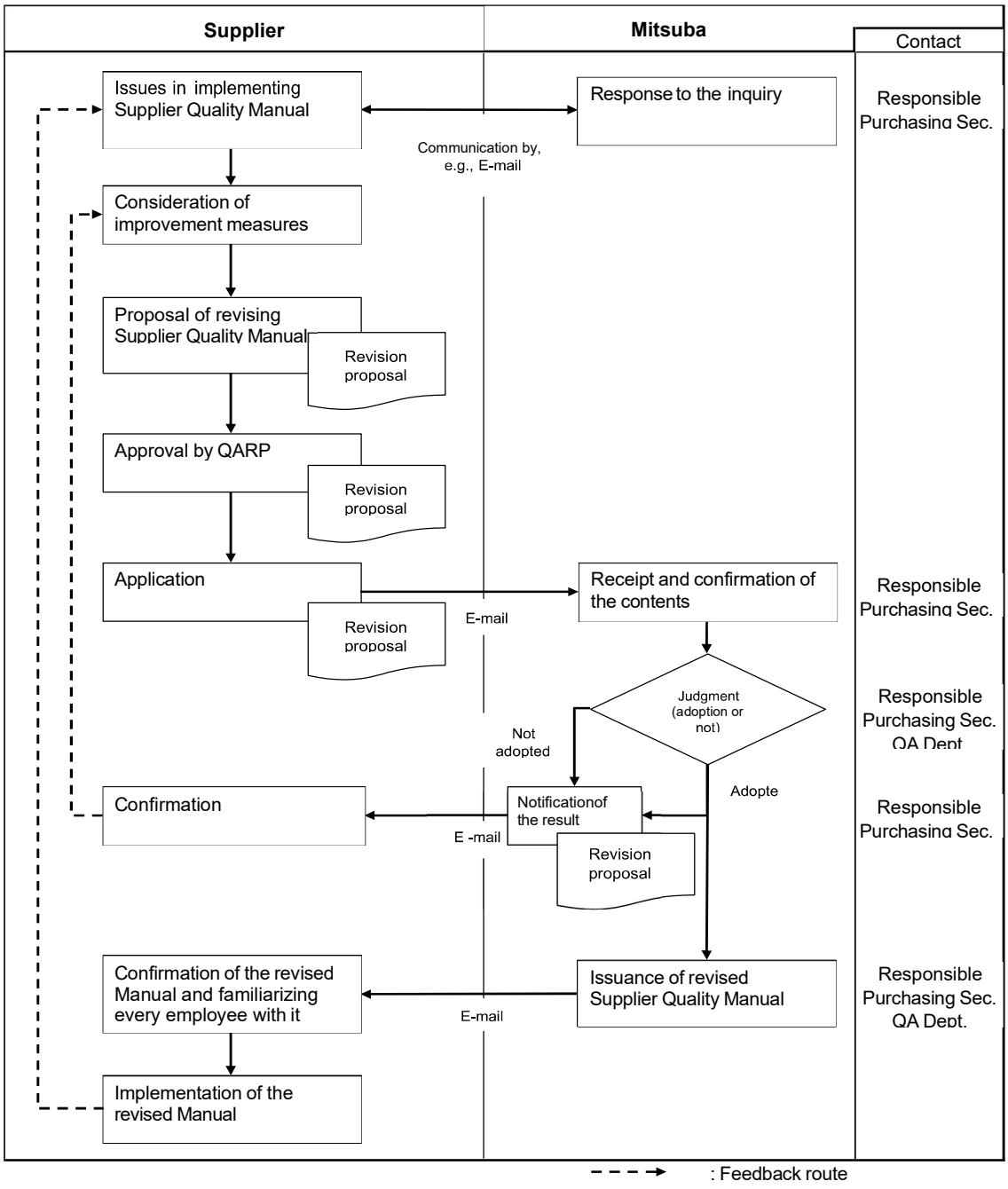
(4) For target suppliers, TS Mitsuba assesses the effectiveness of their quality improvement activity plansthrough inspection visits.

19 Annex

19.1 Proposal of revising Supplier Quality Manual

(1) When the supplier deems it necessary to revise the Supplier Quality Manual, it is encouraged to propose the revision by filling in all the necessary items on the specified form (Form-33_Proposal for Revision ofSupplier Quality Manual) and sending it by E-mail.

19.2 Flow chart for Supplier Quality Manual revision proposal



19.3 List of documents to be submitted

No.	Document name	Form	Scope				Submission timing Shall be submitted by the time limit specified below [Submission media]	D: Destination, A: Approval, C: Check, R: Retention						
			All suppliers	All parts	Corresponding part*5	Specified part*6		Resp. Purchasing Sec.	Develop. Dept. / Resp.	Production engineering	Quality Managemen	Quality Assurance	Section in charge of ProcessQuality	Quality Control Sec. ofreceiving plant * =Prod. Contr Subsec.
1	QARP Registration Notice	Form-1	X	-	-	-	(i) W/in 1 month after business start (ii) W/in 1 month after change of contents [Paper or PDF]	D	-	-	R	-	-	-
2	Supplier Drawing (Specifications) Transmission Sheet	Form-2	-	-	X	-	By the specified date [Paper]	D	A, R	-	-	-	-	-
	Delivery Specifications (Raw Material) Transmission Sheet	Form-22	-	-	X	-	By the specified date [Paper]	D, R	A	C	-	-	C	-
	Delivery Specifications (Indirect Material) Transmission Sheet	Form-26	-	-	X	-	By the specified date [Paper]	D	A, R	C	-	-	-	-
3	Production Preparation Plan	Form-3	-	-	-	X	By the specified date [Electronic file]	D, R, A	-	C	C	-	C	-
	Process Plan	Form-35	-	X	-	-	By the specified date [Electronic file]	D	-	-	-	-	C, R	-
	Process FMEA	Form-4,5	-	X	-	-	W/in 45 days after production or design change drawing is sent [Electronic file]	-	-	-	D,R	-	C, A	-
	Process Capability Investigation Sheet (Production Preparation stage)	Form-23	-	X	-	-	By the specified date [Electronic file]	-	-	-	D	-	C, R	C
	Process Capability Investigation Sheet (Mass production stage)	Form-23	-	X	-	-	By the specified date [Electronic file]	—	—	—	—	—	C	D, R, C
	Self Process Audit Sheet or QAV2	Form24, FM-QC-024	-	X	-	-	By the specified date [Electronic file]	-	-	-	D	-	C, R	C
4	Process QA Matrix	Form-6	-	-	-	X	By the specified date [Electronic file]	-	-	-	D	-	C, R	-
5	Control Plan	Form-7,8	-	X	-	-	W/in 45 days after production or design change drawing is sent W/in 2 weeks after Report on Process Change Confirmation Results issuance [Electronic file]	-	-	-	D, R	-	C, A	A

6	Inspection standard	Form-27	-	-	-	X	W/in 45 days after production drawing is sent, or w/in 2 weeks after design change drawing is sent, or by the specified date [Electronic file]	-	-	-	D, R	-	C, A	A
7	Packaging Specifications Application Form or Packing Standard	Form-9, FM-LP-015	-	-	X	X	(i) New: For the specified parts, w/in 45 days after production drawing is sent (ii) Change: As needed [Electronic file]	-	-	-	-	-	-	D*, A*, C, R*
8	Test Certificate	Form-10,11	-	-	X	-	Shall be attached to trial production parts, IPPs, samples and design-changed parts[Paper]	-	-	-	-	-	-	D, A, R
	ID tag (used when KANBAN is not issued for prototype samples etc.)	Form-12	-	-	X	-	Shall be attached to every box at delivery of raw materials, parts and products[Paper]	-	-	-	-	-	-	D
	IPP tag	Form-13 FM-QC-013	-	-	X	-	At IPP delivery [Specified form]	-	-	-	-	-	-	D, A, R
9	Design Change Request	Form-30	-	-	X	-	120 days before design change In case of changes in raw materials, 210 days before design change [Electronic file]	D, R	C, A	C	-	-	-	-
	Process Change Report	Form-14	-	-	X	-	120 days before process change In case of changes in raw materials, 210 days before process change [Electronic file]	D, R	C	-	-	-	C	A
	Process Change Report – List of 4M Changes	Form-14	-	-	X	-		D, R	C	-	-	-	C	A
	Change Risk Assessment Sheet	Form-14	-	-	X	-		D, R	C	-	-	-	C	A
	Sub-supplier (appointment/change) Check Sheet	Form-25	-	-	X	-	Shall be attached to Process Change Report at appointment or change of sub-supplier [Electronic file]	D, R	C	C	-	-	-	A
	Production Discontinuation Notice	Form-36	X	-	-	-	Within 1 business day after obtaining change information [Electric file]	D, R	C	C	-	-	C-	A
	Process Change Annual Plan	Form-15	X	-	-	-	By the specified date [Electronic file]	-	-	-	D	C, R	-	-
13	Initial Production Control Plan	Form-29	-	-	-	X	By the specified date (if requested) [Electronic file]	-	-	-	D	-	C, R-	-

14	Countermeasure Request & Report (A4 and A3), 8D Report	Form-18,19,31 FM-MR-024	-	-	-	X	By the specified date (if requested) [Electronic file]	-	-	-	D, A, R (Market claim)	-	-	D, A, R (Delivery claim, 0 km claim)
15	TDA Application Form	Form-20	-	-	X	-	As needed [Electronic file]	D, R	C	-	-	-	A (when delivering to two or more plants)	A (when delivering to 1 plant only)
19	Proposal for Revision ofSupplier Quality Manual	Form-33	X	X	-	-	As needed [Electronic file]	D	-	-	-	R	-	-
20	Gauge Specification and Approval Sheet	FM-SQ-044	-	-	X	-	with PPAP before mass production	-	-	-	D, R	-	C, A	A

*5: A corresponding part refers to the part falling under the requirements provided in this document.
*6: A specified part refers to the part specified by TS Mitsuba.

19.4 Forms

The forms of the following documents to be submitted to TS Mitsuba are available as attachments. Pleasecopy the required form(s) for submission. Please obtain the special form from TS Mitsuba.

Document name	Form	Size	Attachment
QARP Registration Notice	Form-1	A4	Available
Supplier Drawing (Specifications)Transmission Sheet	Form-2	A4	Available
Production Preparation Plan	Form-3	A4	Available
Process FMEA	Form-4, 5	A3	Available
Process QA Matrix	Form-6	A4	Available
Control Plan	Form-7, 8	A3	Available
Packaging Specifications ApplicationForm	Form-9, FM-LP-015	A4	Available
Test Certificate	Form-10, 11	A4	Available
ID tag	Form-12	A5	Available
IPP tag	Form-13, FM-QC-013	Special	Not available(special form)
Process Change Report	Form-14	A4	Available
Process Change Annual Plan	**Form-15**	**Special**	**Available**
Countermeasure Request & Report (A4)	Form-18	A4	Available
Countermeasure Request & Report (A3)	Form-19	A3	Available
TDA Application Form	Form-20	A4	Available
TDA Result (Approved/Rejected) Report	Form-21	A4	Available (for use by Mitsuba)
Delivery Specifications (Raw Material)Transmission Sheet	Form-22	A4	Available
Process Capability Investigation Sheet	Form-23	A4	Available
Self -Process Audit Sheet, QAV 2	Form-24,FM-QC-024	A4	Available
Sub-supplier (Appointment/Change)Check Sheet	Form-25	A3	Available
Delivery Specifications (Indirect Material)Transmission Sheet	Form-26	A4	Available
Inspection Standard	Form-27	A4	Available
Initial Production Control Plan	Form-29	A4	Available
Design Change Request	Form-30	A4	Available
8D Report	Form-31, FM-MR-024	A4	Available
Proposal for Revision of Supplier QualityManual	Form-33	A4	Available
~~Change Risk Assessment Sheet~~	~~Form-34~~	~~A4~~	~~Available~~
Process Plan Sheet	Form-35	A3	Available
Production Discontinuation Notice	Form-36	A4	Available
Quenching and Tempering Process Check Sheet	**Form-37**	**Special**	**Available**
Soldering Process Check Sheet	**Form-38**	**Special**	**Available**
Resin Welding Process Check Sheet	**Form-39**	**Special**	**Available**
Adhesion Process Check Sheet	**Form-40**	**Special**	**Available**
Gauge Specification and Approval Sheet	FM-SQ-044	A4	Available

❖ Implementation Specific procedure B

0 Purpose

(1) This Implementation Procedure B is an appendix to TS MITSUBA Corporation Supplier Quality Manual and provides specific implement procedures for processes such as APQP and PPAP.

1 APQP

1.1 Overview of APQP

(1) APQP (Advanced Product Quality Planning and Control Plan) is a set of procedures from product development to its SOP.

(2) APQP consists of the 5 phases below. For suppliers not involved in part design, C and later phases are applicable.

A. Planning phase: Setting of goals for design, reliability and quality, preparation of preliminary part and material list, and planning of preliminary processes, etc.
B. Product design and development phase: Design FMEA, design verification/review, management plan, equipment requirements, specified quality characteristics, etc.
C. Process design and development phase: Process FMEA, Control Plan, process flow chart, plant layout, management plan, packaging standard, etc.
D. Product and process validation phase: 300 or more prototypes, evaluation of measuring system, process capability, tests, evaluation of packaging, etc.
E. Feedback, evaluation and corrective action phase: Reduction of variations, customer satisfaction, shipment

(3) Design and development of parts and processes shall be implemented with a team approach involving supplier's design, production engineering, quality and manufacturing departments, customer, sub-suppliers, etc. Cooperation from the related departments is essential.

(4) Trial Production Control Plan (plan for the verification of dimensions and performance) and Mass Production Control Plan (plan for manufacturing conditions and actions against problems in addition to dimensions and performance) shall be developed and put in place.

(5) Since Design FMEA, Process FMEA and Control Plan are living documents, they shall be updated upon change.

1.2 Basic flow of APQP

(1) Basic flow of APQP is as follows. (The following applies to suppliers not involved in part design.)

No.	Step	Description
1	Receipt of drawing ➔Team feasibility commitment	After receiving a drawing, the involved persons of the supplier shall assesse the feasibility of order acceptance.
2	Preparation of APQP report	The supplier shall prepare APQP report (Production Preparation Plan) and enter the progress in it. The development team of TS Mitsuba requests the supplier to report the progress. The supplier shall prepare the required documents based on the submission level indicated in the “PPAP request”.
3	Preparation of manufacturing process flow chart	Process Flow Chart is used to define part processing order based on the drawing. When setting up new equipment, the supplier shall review a floor layout plan before changing the arrangement of equipment and parts.
4	Preparation of Process FMEA	Process FMEA is conducted to organize potential problems (including past problems) of each process and define actions to be taken. Problems in receiving and shipping inspections and those during transportation shall be also considered.
5	Process QA Matrix	The supplier shall verify process function to detect the concerns from past problems and FMEA using a matrix. (See “4. Process QA Matrix” of Implementation Procedure A.)
6	Preparation of Trial Production Control Plan	Trial Production Control Plan is used to define quality check items of each process based on the Process QA Matrix, set out check items with respect to concerns based on Process FMEA, specify measuring instrument and the number of samples to be measured and determine quality verification method for trial parts. Manufacturing conditions are provisional. It shall include check items for receiving and shipping inspections and transportation.
7	Determination of the requirements for equipment, jigs and measuring instruments	The supplier shall define the functions and requirements of equipment, jigs and measuring instruments installed in each process based on the functions of each process in the Trial Production Control Plan.
8	Setting of manufacturing conditions of equipment, tools/jigs and testers	The supplier shall verify the manufacturing conditions of equipment before trial production.
9	Preparation of Work Standard Operator training	After process order is defined, the supplier shall prepare Work Standard based on the Trial Production Control Plan incorporating quality check items of each process. The operators shall be trained based on the (provisional) Work Standard
10	Measuring system analysis	For the measuring instruments to measure the importantcharacteristics specified in the Trial Production Control Plan, the supplier shall evaluate instrument-by-instrument and measurer-by-measurer variations in measurement results.

11	Trial production run	The trial production run must be 1-hour production run or produce 300 pieces or more using, in principle, mass production equipment, operators and tact time in order to verify the productivity and quality under mass production conditions. Proficiency of operators and appropriateness of process conditions shall be also evaluated in the course of the trial production run.
12	Investigation of preliminary process capability	The supplier shall verify the process capability indices for the special characteristics (importance class) such as S and AR based on the Trial Production Control Plan.
13	Preparation of Mass Production Control Plan	To develop Mass Production Control Plan, the manufacturing conditions in the Trial Production Control Plan are reviewed based on the results of trial production run. In addition, the confirmation method (sampling/100%) for the quality check items is decided based on the investigation results of preliminary process capability. Along with these, provisional Work Standard is updated to the official one.
14	Approval of Mass Production Control Plan by Mitsuba	The supplier shall submit a Mass Production Control Plan to the **Quality Management Division** of TS Mitsuba for the review and approval by the plant. In principle, it should be submitted before final submission of PPAP package.
15	Trial production sample test (PV testing)	PV testing is conducted upon request from TS Mitsuba.
16	Final submissionofPPAP package	The supplier shall prepare necessary PPAP documents according to the submission level (1 to 5) specified by “PPAP Request Form” of TS Mitsuba, put the PSW as a cover and submit them one month beforeshipment.
17	Approval of PSW (PPAP) by Mitsuba	For approval of PPAP documents, the manager of the Quality Control ection of TS Mitsuba receiving plant places a seal or signature on the cover sheet (PSW). Then, TS Mitsuba returns it to the supplier.
18	Delivery of trial production sample(s)	When delivering trial production samples, the supplier shall attach an IPP tag and a copy of PSW (the cover of PPAP) to them.

1.3 Program need date (PND)

(1) Refer to Program Need Dates (PND) Guide for the creation of part production preparation schedule.

1.4 APQP Report

(1)The supplier shall incorporate the production preparation schedule into APQP Report and submit it to TS Mitsuba.

(2) When requesting the supplier to prepare the APQP Report, TS Mitsuba specifies “Significant Characteristics Control” and “TS Mitsuba Schedule” of the APQP Report. The APQP report shall include the names of TS Mitsuba APQP team members.

2 PPAP

2.1 Overview

(1) Production Part Approval Process (PPAP) is a set of procedures to obtain approval for part production.

2.2 PPAP conditions

(1) PPAP documents (package) shall be prepared based on the production run using the same equipment, gauges, processes, material, operators and cycle time as those used in actual mass production.

(2) The minimum production volume shall be 300 pieces or equivalent to 1 hour production. For multi-cavity die, part from each cavity shall be evaluated.

2.3 PPAP requirements

(1) The PPAP package shall be submitted for the initial production parts corresponding to the following (Refer to Mitsuba Implementation Procedure A - IPP Control.)

A. New products

B. Design change, process change, transfer of location, organizational change, sub-supplier change, resumption of production after one year or longer production suspension, etc.

C. Others (e.g. if specially requested by Mitsuba.)

(2) TS Mitsuba may require annual or regular PPAP submission upon customer request, etc.

(3) TS Mitsuba designates the PPAP submission level and the required documents in the “PPAP Request Form”.

A. Submission level: Unless otherwise specified, level 3 applies.

B. Number of samples to be submitted: Unless otherwise specified, the sample size is 5.

C. Other requirements (e.g. submission of checking aids)

Requirement		Submission level				
		1	2	3	4	5
1.	Design documents of sales product	R	S	S	*	R
2.	Design change document (if any)	R	S	S	*	R
3.	Design approval from Mitsuba (if requested)	R	R	S	*	R
4.	Design FMEA	R	R	S	*	R
5.	Process Flow Chart	R	R	S	*	R
6.	Process FMEA	R	R	S	*	R
7.	Control Plan	R	R	S	*	R
8.	Measuring system analysis results	R	R	S	*	R
9.	Dimensional evaluation result	R	S	S	*	R
10.	Material certificate and performance test results	R	S	S	*	R
11.	Preliminary process capability investigation results	R	R	S	*	R
12.	Qualified laboratory documentation	R	S	S	*	R
13.	Appearance Approval Report (AAR) (if applicable)	S	S	S	*	R
14.	Product sample	R	S	S	*	R
15.	Master sample (if any)	R	R	R	*	R
16.	Checking aids (if requested)	R	R	R	*	R
17.	Record of compliance with Mitsuba-specific requirements	R	R	S	*	R
18.	Part Submission Warrant (PSW)	S	S	S	S	R
19.	IMDS ID No. Submission	S	S	S	S	R
20.	Non-inclusion evidence of Substances of Concern	S	S	S	S	R
21.	Bulk Material Requirement Checklist (for bulk material only)	S	S	S	S	R

S: The supplier shall submit it to TS Mitsuba and retain its copy at an appropriate location (including manufacturing floor).

R: The supplier shall retain it at an appropriate location and make it available to TS Mitsuba upon request. *: The supplier shall retain it at an appropriate location and submit it to TS Mitsuba upon request.

(4) TS Mitsuba may request the submission of the PPAP documents from sub-supplier(s).

(5) In principle, the PPAP package shall be submitted one month before shipment.

(6) Before PPAP package submission, the supplier shall satisfy all the requirements of drawings and specifications.

If the requirements are not satisfied, the supplier cannot submit the PPAP package. In that case, the supplier shall define corrective actions after consultation with Mitsuba.

(7) The supplier shall start product shipment after obtaining PPAP approval from TS Mitsuba unless otherwise specified by TS Mitsuba.

2.4 Contents of PPAP

2.4.1 Prior confirmation

(1) Before PPAP package preparation, the supplier shall refer to the “Attachment-5 Supplier PPAP Submission
(2) Data List and Examples”. If there is anything unclear, the supplier shall contact the responsible person
(3) of the purchasing department or Quality Control Section of TS Mitsuba receiving plant described in the APQP report.

2.4.2 Preparation and data collection

(1) Design approval from TS Mitsuba: Approved drawing (if required)

(2) Process Flow Chart

(3) Process FMEA

(4) Dimensional evaluation results

The supplier shall define dimensional evaluation items based on design document(s) and Control Plan and evaluate them.

For new launch, all the dimensional items on drawing shall be evaluated.

In principle, the sampling size shall be five (n=5) or more, and, in case of multiple cavities, three per cavity (n=3/cavity) or more.

(5) Material certificate and performance test results

The supplier shall prepare the material performance test results if specified in the design document(s). Example) Material inspection certificate, corrosion resistance test results

(6) Preliminary process capability investigation results

A. If there are no special characteristics specified by TS Mitsuba or no instructions from
B. TS Mitsuba, process capability investigation shall be conducted on each item, which the
C. supplier sets in consideration of the internally-set importance, using at least 30 samples.
D. Ppk (process performance index) shall be used as the process capability index. It is calculated in the same way
E. as Cpk and used for unstable processes. Standard deviation (s) is calculated from the total variations.

Ppk	Minimum value of PPU and PPL	$PPU = \frac{USL - \bar{x}}{3s}$ $PPL = \frac{\bar{x} - LSL}{3s}$	$s = \sqrt{\frac{(x_i - \bar{x})^2}{n-1}}$

Another process capability index is Cpk which is used for stable processes. Standard deviation (σ) is calculated
from the variations within subgroups. Generally, Cpk is calculated based on the control chart

during mass production

Cpk	Minimum value of CPU and CPL	$CPU = \frac{USL - \bar{x}}{3\sigma}$ $CPL = \frac{\bar{x} - LSL}{3\sigma}$	$\sigma = \frac{\bar{R}}{d_2}$

Table of constants for control charts

n / Constants	2	3	4	5	6	7	8	9	10
A_2	1.880	1.023	0.729	0.577	0.483	0.419	0.373	0.337	0.308
D_3	-	-	-	-	-	0.076	0.136	0.184	0.223
D_4	3.267	2.575	2.282	2.115	2.004	1.924	1.864	1.816	1.777
d_2	1.128	1.693	2.059	2.326	2.534	2.704	2.847	2.970	3.078

A. Acceptance criteria for process capability are as follows:

Result	Explanation
Index value > 1.67	The process currently meets TS Mitsuba requirements.
1.33 ≤ Index value ≤ 1.67	Although the process is currently acceptable, there is a room for improvement. The supplier shall define improvement measures in consultation with TS Mitsuba. If the process cannot be improved before SOP, the supplier is required to review control methods such as inspection method.
Index value < 1.33	The process does not meet the acceptance criteria.

B. For items with process capability index of less than 1.33, the supplier shall submit a corrective action plan together with the PPAP package to TS Mitsuba for approval.

(2) Measuring system analysis results

The supplier shall conduct measuring system analysis based on a Measuring System Analysis Plan andcompile the results in a Measuring System Analysis Results Report.

(3) Qualified internal/external laboratory document

A laboratory is a facility that undertakes the inspection and testing of products and the calibration of measuring instruments.

The supplier shall document the scope and procedures of internal laboratory.

The scope of laboratory includes available test items (incl. inspection and calibration), test standards, testmethods, qualifications of staff members, equipment list, procedure to handle test samples and report formats. When using an external laboratory, the supplier shall submit a document evidencing that the laboratory satisfies either of the following:

(a) The scope of external laboratory is clarified and there is an evidence (record) of customer's approval.

(b) There is an evidence that the laboratory has obtained ISO/IEC 17025 or equivalent certification.

(4) Control Plan

Mass Production Control Plan.

(5) Part Submission Warrant (PSW)

A. PSW is attached to the PPAP package as the cover.

B. Part weight shall be the mean weight of randomly-selected 10 parts calculated down to 0.1 grams(0.0001kg) excluding the weight of packing materials.
If more than one production lines, dies or equipment are used, the above-mentioned 10 parts shall include at least one part from each line, die or equipment.

(6) Product sample

production. If otherwise specified by TS Mitsuba, pick up the requested number of samples.

(7) Master sample (if any)

The supplier shall make master sample(s) (e.g. boundary sample, color standard sample) and obtain approval from TS Mitsuba.

(8) Checking aids (if requested)

If requested by TS Mitsuba, the supplier shall submit measuring tool(s) used for part inspection (pass/fail) or thedrawing of such a measuring tool which shows its actual dimensions.

Besides, if a jig to secure a product for measurement is made, the supplier is required to submit the jig drawing.

(9) Others requested by TS Mitsuba

The supplier shall provide other specific records specified by TS Mitsuba.

2.1 Submission of PPAP package

2.5.1 Submission to Mitsuba

(1)In accordance with the instructions in the PPAP request, the supplier shall submit PPAP package (PSW,applicable documents, data, samples) to Quality Control Section of TS Mitsuba plant as in the case of IPP delivery in accordance with instruction from the responsible person of TS Mitsuba (designated in APQP Report). Thesupplier shall retain a copy of the PPAP package.

The supplier shall submit PPAP package to the Quality Control Section of TS Mitsuba receiving plant.

(2)When exempted from the submission of PPAP package to TS Mitsuba, the supplier shall review all the items inthe PPAP package and retain one copy of it. In that case, the supplier shall write down the name of the responsible person of TS Mitsuba who granted the exemption and the date of exemption granted.

2.2 PPAP approval status

(1) TS Mitsuba notifies the supplier of PPAP approval status. The approval status is classified as shown below:

A. Full approval

Full approval means that the part meets all of TS Mitsuba requirements. Therefore, the supplier is authorized to ship the part.

B. Provisional approval

Provisional approval permits shipment for a limited period or in limited quantity for the sake of production. The supplier shall resubmit the required PPAP document(s) to obtain full approval. Provisional approval is given only in the following case:

- The root causes of nonconformity which prevent full approval have been clearly identified, and furthermore, appropriate action plan has been prepared and approved by TS Mitsuba

C. Rejection

Rejection means that the submitted samples and production lot from which the samples are taken andPPAP package do not meet the requirements. The supplier shall submit corrected product samples andPPAP package and obtain approval before shipping production parts.

3 FMEA

The supplier shall establish a Process FMEA procedure based on process design (process flow chart) and the Control Plan of a base part (if any) and conduct Process FMEA according to it in order to clarify potential failure modes in the process, eliminate possible causes of failures and prevent outflow of defectives.

3.1 Overview

(1) Potential Failure Mode and Effects Analysis (FMEA) is a method to clarify potential issues in parts and processes, recognize and evaluate the effects of such issues and eliminate or reduce the occurrence of failures.

(2) An FMEA focusing on part design is called Design FMEA and one focusing on process design is called Process FMEA.

(3) Severity, Occurrence and Detection are rated on a scale of one to ten.

(4) Since FMEA becomes more accurate when developed in cooperation among various departments, it is preferable to hold a meeting for FMEA development.

(5) In clarifying failure modes, it is important to see them from the following viewpoints in addition to "potential issues":

A. Accumulation and transfer of knowledge learned from the analysis of complaint information and reliability testing results

B. Understanding of part function and operating condition, and organization and in-house communication of information about, for example, load applied to the part

3.2 Management

(1) Since Process FMEA is a living document, it shall reflect the latest design level and associated actions including changes made after SOP. When revising the Process FMEA, the supplier shall check the latest version of the Supplier Quality Manual and revise it in the latest format or add any missing items.

(2) The supplier shall revise Process FMEA along with the revision of Control Plan.
The supplier shall confirm that the revised contents of Control Plan and Work Standards are incorporated in the Process FMEA.

(3) When delivering multiple similar parts, the supplier shall not create a Process FMEA for each part, but a collective (family) Process FMEA attaching a list of representative part number and a specifications.

3.3 Submission timing

3.3.1 For new launch

(1) The supplier shall start preparing a Process FMEA upon receiving prototype drawing from TS Mitsuba. Necessary information can be obtained from the contact person of the section in charge of design or process quality.

(2) The supplier shall submit the Process FMEA to the **Quality Management Division** of TS Mitsuba within 45 days after TS Mitsuba sends a production drawing.

(3) Catalog products are not subject to submission of the Process FMEA. However, the supplier shall submit it upon TS Mitsuba request.
Catalog products are not the products designed by TS Mitsuba, but the products that have already been distributed in the market.
However, regarding electronic parts for the first transaction with TS Mitsuba, even if they are catalog products, the supplier shall submit their Process FMEAs.

3.3.2 Approval

(1) TS Mitsuba approves the Process FMEA and then returns it from **Quality Management Division** to the supplier.

(2) If there is any objection to the contents, Mitsuba issues “Document modification request” (Attachment 6)”and sends it from **Quality Management Division** to the supplier.

(3) The supplier shall modify the Process FMEA based on the request, fill out an answer in the “Document modification request”, and submit the modified document together with the “Document modification request”.

3.4 Procedure for developing Process FMEA

3.4.1 Process Name, Process Function and Requirement

(1) The top process in the Process FMEA shall be “receiving inspection” process so that the risk of purchased materials can be also considered. **Risk analysis shall be implemented up to the final process: shipping process.**

(2) Enter a brief description of each process or operation subject to analysis. FMEA development team is required to confirm the applicable regulations regarding performance, material, process, environment and safety in advance if needed.

(3) Clarify the “purpose” of and “what & how to do” in the process associated with quality characteristics.
(Good example) Insert armature assy to the specified position and ensure electrical conduction between commutator and brushes by removing pigtails.
(Bad example) Insert armature assy and remove pigtails (= work instruction)

(4) Every process and part has its own function (role). Processes and parts without functions are unnecessary. In O-ring insertion process, O-ring has a function to seal the inserted area.

(5) If a process contains many operations and the failure mode is different between operations, it is preferable to list each operation as a separate element.

3.4.2 Potential Failure Mode

(1) Potential failure mode refers to the possibility of a failure to meet process requirements and design intent and it is defined as how the failure occurs

(2) The more failure modes the supplier clarifies, the more effective the FMEA becomes.

(3) Consider failure modes from the viewpoints below:
(i) By what failure modes does the process or part becomes incapable of meeting the requirements?
(ii) Regardless of engineering specifications, what can be problems to customers (end users, operations or services in later processes)?

(4) Clarify issues which result from process functions and impair product functions and design quality as many as possible. Irregular operations shall be also considered.

(5) Irregular operations refer to those mainly performed by operators including quality check, rework, actions against temporary equipment stop, setup change and part handling, i.e. operations which may cause secondary harmful effects (for example, when already-processed parts are fed to the same process).

(6) Consider failure modes between a process and the following process, and handling of workpieces after processing. Incorporate them into either process.

Example: Consider ejection behavior, stagnation and storage between processes, feeding of materials and parts to the line, transportation between plant and site and transportation to customer. Decide whether transportation test is needed.

(7) Also take into account vibration, water exposure, temperature and sound.

(8) The basic design of product should be assumed to be correct. But, if there is a design issue which may cause a problem in the process, the design team shall be notified accordingly to resolve the issue.

(9) Parts and materials fed to the process should be assumed to be correct. However, if there are past problems related to them or in the case where they are procured from overseas, the risk that they may not be correct shall be considered.

(10) Do not consider failures caused in the subsequent processes as the failure modes in the preceding processes.

(They are the failure modes in the subsequent processes of FMEA.)

(11)For safety concerns, estimate danger sources, endangered situations and dangerous events associated with processes and regard them as potential failure modes.

Shown below are the major examples of danger sources:

(a) Mechanical danger source (squash, shear, cut/cutoff, caught, clash, etc.)

(b) Electrical danger source (contact to charged area, electrostatic phenomenon, heat radiation, etc.)

(c) Thermal danger source (high/low temperature, flame, explosion, etc.)

(12) Describe potential failure modes specifically (avoid using abstract wording).

3.4.3 Potential Effects of Failure

(1) Potential effects of failure are defined as the effects of failure modes which can be recognized by customers. Consider the following to determine the potential effects:

-1. Will it be physical obstruction to the later processes? Or, will it cause potential harm to equipment or operations?

(i) Unable to install or connect parts, or endanger operators at customer's facility.
(ii) Unable to assemble or process parts, or cause damage to equipment or excessive wear of jig in the process.

-2. What are the effects on end users?

-Noise, heavy operation force, bad smell, intermittent operation, water leakage, irregular idling, adjustment impossible, difficulty in control, unsatisfactory appearance

-3. What happens if a failure is found before products are handed over to end users?

-Line stop, shipment suspension, storage at plant, scrap of all products, line speed reduction, increased operators for the maintenance of line efficiency

(2) For safety concerns, specifically describe the effects of incidents due to danger sources.

3.4.4 Severity (S)

(1) Severity is the degree of seriousness of the effects which potential failure modes have on customers and ranked on a scale of one to ten.

(2) Ranking is based on the effects of each potential failure mode on end users and/or on manufacturing and assembling plant. End users should be given the highest priority. If both effects are envisioned, the higher rank shall apply.

(3) Severity rank can be lowered by design change or process redesign. It is undesirable to modify the rank arbitrarily.

<Recommended Severity (S) assessment criteria>

Effect	Criteria: Severity of Effect on product (Customer Effect)	Rank	Effect	Criteria: Severity of Effect on process (Manufacturing/Assembly Effect)
Unable to meet safety and/or regulatory requirements	A potential failure mode affects safe vehicle operation and/or involves noncompliance with government regulation without warning	10	Unable to meet safety and/or regulatory requirements	May endanger operator (machine or assembly) without warning.
	A potential failure mode affects safe vehicle operation and/or involves noncompliance with government regulation with warning	9		May endanger operator (machine or assembly) with warning.
Loss or degradation of primary function	Loss of primary function (Vehicle inoperable, but safety vehicle operation is not affected)	8	Serious problem	100% of product may have to be scrapped. Line shutdown or stop ship.
	Decline of primary function (Vehicle operable, but at a reduced level of performance.)	7	Major problem	A portion of the production run may have to be scrapped. Deviation from primary process including decreased line speed or added manpower.
Loss or degradation of secondary function	Loss of secondary function (Vehicle operable, but Comfort/Convenience item(s) inoperable.)	6	Moderate problem	100% of production run may have to be reworked off line and accepted.
	Loss of secondary function (Vehicle operable, but Comfort/Convenience item(s) operable at a reduced level of performance.)	5		A portion of the production run may have to be reworked off line and accepted
Uncomfortable	Vehicle operable, but Fit & Finish/Squeak & Rattle item does not conform. Defect noticed by most customers (greater than 75%).	4	Moderate problem	100% of production run may have to be reworked in station before it is processed.
	Vehicle operable, but Fit & Finish/Squeak & Rattle item does not conform. Defect noticed by 50% of customers.	3		A portion of the production run may have to be reworked in-station before it is processed.
	Vehicle operable, but Fit & Finish/Squeak & Rattle item does not conform. Defect noticed by discriminating customers (less than 25%).	2	Minor problem	Slight inconvenience to process, operation, or operator.
No effect	No discernable effect.	1	No effect	No discernable effect.

3.4.5 Class

In order to classify special characteristics of the process, the characteristics to which the supplier should give priority in extracting failure modes shall be marked with the appropriate importance class of S, AR, A or B, FS (Functional Safety characteristics), or FIT (Fitting characteristics).

(1) Customer special characteristics: As specified by TS Mitsuba

-If special characteristics are specified in a drawing (specifications) or Importance Determination Notice by TS Mitsuba, the supplier shall enter the corresponding importance codes/symbols designated by TS Mitsuba without any change.

(2) Supplier special characteristics: Shall be selected by the development team of the supplier

(3) For special processes, enter “Special process”

3.4.6 Potential Cause(s) / Mechanism(s) of Failure

(1) Potential Cause or Mechanism of Failure is defined as an indicator of how a failure mode occurs and shall be extracted with a focus on the potential failure(s) of a process only, i.e. negative factors of parts and preceding processes shall not be considered. However, past problems, if any, shall be taken into account.

(2) If there are two or more causes, they shall be itemized in this field as in detail as possible.

(3) Do not use ambiguous wording to represent failure causes.
Good example) Missing seal. Reverse fitting of seal.
Bad example) Operator’s error. Seal fitting error.

3.4.7 Occurrence (O)

(1) “Occurrence” indicates the likelihood of occurrence of a certain cause or mechanism. The rank of occurrence refers not to the value, but to the degree of likelihood.

(2) For the purpose of prevention or control of failure causes and mechanisms, the rank of occurrence can be reduced by design or process change only

(3) If statistical data of a similar process is available, it should be used to determine the rank.

(4) The occurrence of potential cause(s) / Mechanism(s) shall be estimated on a scale of one to ten.

<Recommended Occurrence (O) assessment criteria>

Likelihood of failure	Criteria: Occurrence of Cause—PFMEA (Incidents per item / vehicle)	Rank
Very High	*100* or more / *1,000* *1* or more / *10*	10
High	*50* / *1,000* *1* / *20*	9
	20 / *1,000* *1* / *50*	8
	10 / *1,000* *1* / *100*	7
Moderate	*2* / *1,000* *1* / *500*	6
	0.5 / *1,000* *1* / *2,000*	5
	0.1 / *1,000* *1* / *10,000*	4
Low	*0.01* / *1,000* *1* / *100,000*	3
	0.001 or less / *1,000* *1* / *1,000,000*	2
Very Low	Failure is eliminated through preventative control	1

3.4.8 Current Process Control (Preventive)

In the field of “Current Process Control”, the following shall be entered:

(1) Control methods to prevent the occurrence of failure modes as far as possible, or

(2) Those which can detect failure modes in the case of occurrence. These control methods includes Poka-yoke, statistical process control and evaluation in later processes.

In the case that an unprecedented new line for the development theme of Rank S or A, the supplier may enter this field in consideration of its own past process control level.

(3) The following two types of current process control shall be considered and entered. Preferably, the supplier should apply (i) Preventive (P) as much as possible.

(i) Preventive (P)	Prevents or reduces the occurrence of causes, mechanisms or effects of failure modes.
(ii) Detective (D)	Detects causes, mechanisms or failure modes and leads to corrective actions.

3.4.9 Detection (D)

(1) “Detection” indicates the likelihood of opportunity of detecting potential failure causes or mechanisms (process weakness) before going out of parts and components from production or assembly site and ranked on a scale of one to ten.

(2) In order to reduce the rank, the supplier is required to improve the planned Process Control.

<Recommended Detection (D) assessment criteria>

Opportunity for Detection	Criteria: Likelihood of Detection by Process Control	Rank	Likelihood of Detection
No opportunity	No current process control; Cannot detect or is not analyzed.	10	Almost Impossible
Not likely to detect at any stage	Failure Mode and/or Error (Cause) is not easily detected (e.g., random audits)	9	Very Remote
Problem Detection Post Processing	Failure Mode detection post-processing by operator through visual/tactile/audible means	8	Remote
Problem Detection at Source	Failure Mode detection in-station by operator through visual/tactile/audible means or post-processing through use of attribute gauging (go/no-go, manual torque check/clicker wrench, etc.	7	Very Low
Problem Detection Post Processing	Failure Mode detection post-processing by operator through use of variable gauging or in-station by operator through the use of attribute gauging (go/no-go, manual torque check/clicker wrench, etc.)	6	Low
Problem Detection at Source	Failure Mode or Error (Cause) detection in-station by operator through use of variable gauging or by automated controls in-station that will detectdiscrepant part and notify operator (light, buzzer, etc.). Gauging performed on setup and first-piece check (forset-up causes only)	5	Moderate
Problem Detection Post Processing	Failure Mode detection post-processing by automated controls that will detect discrepant part and lock part to prevent further processing.	4	Moderately High
Problem Detection at Source	Failure Mode detection in-station by automated controls that will detect discrepant part and automatically lock part in station to prevent further processing	3	High
Error Detection and/or Problem Prevention	Error (Cause) detection in-station by automated controls that will detect error and prevent discrepant part from being made	2	Very high
Detection not applicable; Error Prevention	Error (Cause) prevention as a result of fixture design, machine design or part design or part design. Discrepant parts cannot be made because item has been error-proofed by process/product design	1	Almost Certain

3.4.10 Risk Priority Number

(1) Risk Priority Number (RPN) is the product of the ranks of Severity (S), Occurrence (O) and Detection (D). RPN = (S) x (O) x (D)

(2) Possible issues in a process shall be ranked based on RPN values.

(3) RPN ranges from 1 to 1,000. The team must make efforts to reduce the calculated risk of each issue with corrective actions giving priority to issues with higher RPN.

3.4.11 Recommended Action(s)

(1) The first to be subject to engineering evaluation of preventive or corrective actions should be the issues with high Severity and high RPN and other items specified by the team.

(2) The purpose of Recommended Action(s) is to reduce the ranks of Severity, Occurrence and Detection in this order.

(3) In general, for items with Severity rank of 9 or 10, action(s) must be considered regardless of their RPNs.

(4) Special care must be taken so that risks are addressed by the current design activity/control or preventive/corrective actions for processes.

(5) If clarified potential failure modes are likely to cause harm to manufacturing and assembling operators, all possible preventive/corrective actions must be taken to eliminate or control failure causes for operator protection.

(6) After considering actions against items with Severity rank of 9 or 10, the team shall make efforts to reduce Severity rank of other failure modes and then to reduce Occurrence rank and Detection rank in this order.

(7) Every recommended action shall be intended to reduce the rank of Severity, Occurrence and Detection.

(8) If there are no recommended actions against clarified failure modes, causes or current process control, enter “None” in these fields and regard them as the subject of future examination for the next model or the theme of continuous improvement.

(9) Recommended actions shall be focused on reducing the rank of Severity, Occurrence and Detection (in this order) of all failure modes regardless of RPN values.

(10) Since failure modes resulted from irregular operations (e.g., feeding of already-reworked parts to the same process) are likely to cause secondary harmful effects, special care must be taken for them.

(11) Increasing inspection frequency is not an effective action. This shall be used as a temporary measure.

(12) Do not set the thresholds (e.g. 100, 30…) for RPN.

In the example below, the RPN of the characteristics B is higher than that of the characteristics A. However, the higher priority should be given to the characteristics A because the Severity of A (=9) is higher than that of B.

Item	Severity	Occurrence	Detection	RPN
Characteristics A	*9*	*2*	*5*	*90*
Characteristics B	*7*	*4*	*4*	*112*

For critical safety and critical regulatory AR products, if the Severity of a process relating to the critical safety or critical regulatory characteristics is 10 or 9, its Detection (D) rank must be reduced to 4 or lower by employing Poka-yoke (or similar assurance method).

Even in the case of a process not relating to critical safety or critical regulatory characteristics, if its Severity is ranked as 10 or 9, the supplier should consider using Poka-yoke (or similar assurance method) as far as possible.

(13) In terms of safety, actions such as the following shall be considered:

A. Intrinsic safety - Risks or risk factors are eliminated.
B. Fail safe – Occurrence of incidents is prevented by safety reactions (e.g. operation stop) to failures.
C. Fool proof – Occurrence of incidents due to operator’s carelessness or error is prevented.
D. Redundant design – Serious incidents are prevented by designing with extra strength and capacity.
E. Tamper resistant – Dangers arising from curiosity and tampering are prevented.
F. Notification and warning of remaining risks – Operators are notified and warned of remaining risks.

*If no effective safety action can be taken against an issue, it shall be considered as a remaining issue and the action F above shall be taken.

(Example) Put the remaining issue in Control Plan or Instruction Manual, or display it at the corresponding process.

3.4.12 Responsibility and Target Completion Date

(1) Enter the name of person and department responsible for the recommended action and its target completion date.

3.4.13 Action(s) Taken and completion date

(1) After taking the action, enter a brief description of the actual action and its completion date.

3.4.14 Action Results

(1) Enter the names of documents (drawing, Control Plan, Work Instruction, check sheet, etc.) that are revised in connection with the actions taken in “Documents revised” field.

(2) Estimate the rank of Severity, Occurrence and Detection after the actions taken and enter them in the respective fields. Then, calculate RPN based on these rank values and enter the calculation result in “RPN” field.

(3) If no actions are taken, leave the corresponding ranking fields blank.

(4) It is desirable to keep reducing RPNs as part of continuous improvement activities.

3.4.15 Process FMEA Check List

(1) Prior to the submission, the supplier shall check the process FMEA with “Form-4 Appendix P-FMEA check sheet” to prevent incomplete and inadequate description.

4. MSA

4.1 Overview

(1) Measurement Systems Analysis (MSA) is a method to examine measurement variation attributable to operator or number of measurements, and different from measuring equipment calibration.

(2) Usually, Gauge R&R (repeatability & reproducibility) is used. In Gauge R&R, 3 appraisers measure 10 production parts 3 times, and their measurement error is evaluated.

(3) Although the scope of MSA can be reduced, special characteristics (S, AR, etc.) cannot be excluded.

4.2 Purpose

(1) One purpose is to assess the degree of measurement system variation beforehand because too wide variation impairs the reliability of measured values.

(2) Another purpose is to facilitate process control by improving measurement system accuracy through minimization of system variations and by knowing part-to-part variation correctly.

4.3 Scope of application

(1) MSA applies to the measurement systems capable of measuring objects repeatedly. Therefore, measurement values must not be affected and measurement objects must not be destructed by the act of measurement.

(2) In other words, MSA is not applicable to unrepeatable measurement such as destruction test and electrical characteristics test.
(Example: Armature coil resistance: The 1st and the 2nd measurement results defer from each other because of heat generated by measurement.)

4.4 Terms and definitions

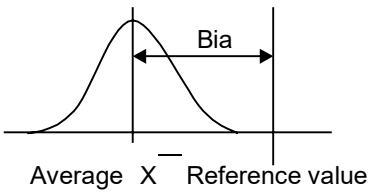
Term	Definition
Gauge	Measuring equipment
Measurement system	Whole process of measurement (mainly measuring equipment and appraiser)
Total Variation (TV)	Variation obtained by combining Part Variation (PV) and Gauge R&R
Tolerance range	Range between upper specification limit (USL) and lower specification limit (LSL). Tolerance range = USL - LSL
Gauge R&R	Variation obtained by combining repeatability and reproducibility variations
%GRR	Proportion of the combined variation of repeatability and reproducibility to the Tolerance range and to Process Variation (in %)

4.5 Types of measurement system variation

(1) Shown below are the types of measurement system variation.

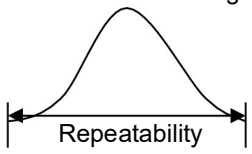
A. Bias:

Difference between the average of measured values and the reference value



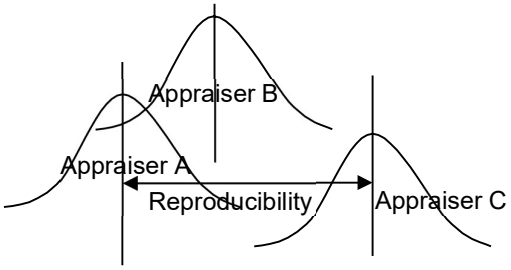
B. Repeatability:

Measurement variation observed when the **same appraiser** measures the same part several times with the same measuring equipment (Variation over the number of measurements).



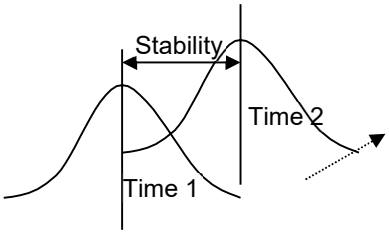
C. Reproducibility:

Measurement variation observed when **different appraisers** measure the same part several times with the same measuring equipment (Appraiser Variation)



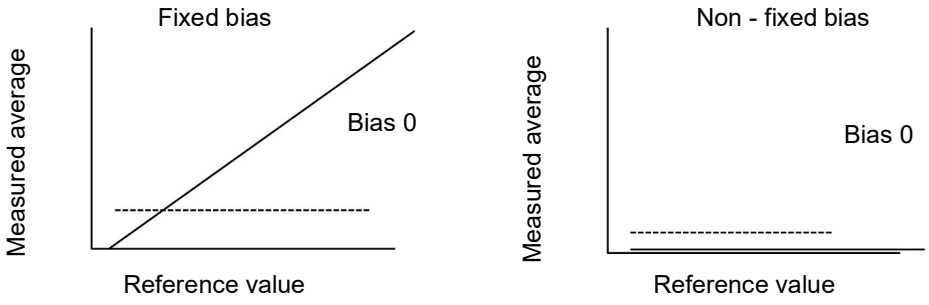
D. Stability:

Measurement variation observed



E. Linearity:

Difference in bias over whole measurement rangeFixed bias



4.6 Gauge Repeatability & Reproducibility (GR&R)

4.6.1 Measurement system variation evaluated with GR&R

(1) GR&R evaluates two types of measurement system variation, i.e. repeatability and reproducibility variations.

4.6.2 Types of GR&R methods

(1) There are two types of GR&R methods, i.e. Range method (Short method) and Average & Range method (Long method). Both methods are applicable to gauges to measure countable values.

Range method (Short method)	Average & Range method (Long method)
Not recommended	Recommended
- Provides easy calculation of the outline of measurement system variation - Since this method does not divide variation into repeatability and reproducibility, it is impossible to determine which is the cause of the variation, measuring equipment or appraiser.	- Since this method divides variation into repeatability and reproducibility, it is possible to determine which is the cause of the variation, measuring equipment or appraiser. Thus, this method can facilitate efficient improvement activity. - It takes long calculation time.

4.6.3 Range method (Short method)

(1) In this method, two appraisers measure five samples one time each.

Example) Standard deviation = 0.0777 (calculated in ordinary calculation method for σ beforehand), Tolerance = 0.60

Part	Measured value		Range (difference calculation) R = I A – B I
	Appraiser A	Appraiser B	
1	0.85	0.80	0.05
2	0.75	0.70	0.05
3	1.00	0.95	0.05
4	0.45	0.55	0.10
5	0.50	0.60	0.10
			∑R=0.35

Average of R ($\bar{R}$) = ∑R / 5 = 0.35 / 5 = 0.07

GR&R = 1σ= $\bar{R}$ / d2 = $\bar{R}$ / 1.19 = 0.07 / 1.19 = 0.0588

A. Analysis of measurement variation to Total Variation

%GRR (to Total Variation) = 100 X (GRR) / standard deviation

= 100 X 0.0588 / 0.0777

= 75.7%

B. Analysis of measurement variation to Tolerance

%GRR (to Tolerance) = 100 X (GRR) / Tolerance / 6

= 100 X 0.0588 / 0.60 / 6

= 58.8%

Because both %GRR values exceed 30%, the measurement system needs to be improved. Before improvement, it is necessary to determine which is the cause of variation, measuring equipment or appraiser, using Average & Range method.

4.6.1 Average & Range method (Long method)

(1) In this method, two or three appraisers measure 10 samples twice or three times each.

(2) Evaluation of Repeatability (Equipment Variation)

a. Equipment Variation **EV = 1σ = $\bar{R}$ × K**

$\bar{R}$ = ($\bar{R}$a + $\bar{R}$b + $\bar{R}$c) / (# of appraisers = 3): Average of each appraiser

# of repetitions (measurements)	2	3
K_1	**0.8862**	**0.5908**

b. Percent Equipment Variation (to Total Variation) **%EV = 100 (EV/TV)**

c. Percent Equipment Variation (to Tolerance) **%EV＝100 [EV/{(USL-LSL)/6}]**

(3) Evaluation of Reproducibility (Appraiser Variation)

a. Appraiser Variation $AV = \sqrt{[(X \quad \times K)^2 - (EV^2/nr)}$

X_{DIFF} = Max appraiser average – Min appraiser average
N = # of samples r = # of repetitions (measurements)

# of appraisers	2	3
K_2	0.7071	0.5231

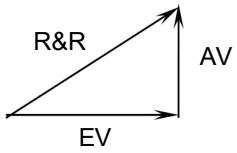
* If the value in the root sign is a negative value, the Appraiser Variation (AV) is zero (in the case of Ex. X_{DIFF} = 0, for example).

b. Percent Appraiser Variation (to Total Variation) **%AV = 100 (AV / TV)**

c. Percent Appraiser Variation (to Tolerance) **%AV = 100 (AV / {(USL-LSL) / 6})**

(4) Evaluation of measurement system (Gauge R&R)

a. Measurement system variation $R\&R = \sqrt{(EV^2 + AV^2)}$



(Combination of repeatability and reproducibility)

b. Measurement system variation (to Total Variation) **%GRR = 100 (R&R / TV)**

c. Measurement system variation (to Tolerance) **%GRR = 100 (R&R / {(USL-LSL)/6})**

(5) Evaluation of Part Variation

a. Part Variation PV = Rp × K3 Rp: Max part average – Min part average

# of samples	2	3	4	5	6	7	8	9	10
K_3	0.7071	0.5231	0.4467	0.4030	0.3742	0.3534	0.3375	0.3249	0.3146

b. %Part Variation %PV = 100 (PV / TV)

4.6.2 Average & Range method (Long method)

(1) In this method, two or three appraisers measure 10 samples twice or three times each.

(2) Evaluation of Repeatability (Equipment Variation)

d. Equipment Variation **EV = 1σ = R × K**

R = (Ra + Rb + Rc) / (# of appraisers = 3): Average of each appraiser

# of repetitions (measurements)	2	3
K_1	**0.8862**	**0.5908**

e. Percent Equipment Variation (to Total Variation) **%EV = 100 (EV/TV)**

f. Percent Equipment Variation (to Tolerance) **%EV=100 [EV/{(USL-LSL)/6}]**

(3) Evaluation of Reproducibility (Appraiser Variation)

d. Appraiser Variation $AV = \sqrt{[(X \quad \times K)^2 - (EV^2/nr)]}$

X_{DIFF} = Max appraiser average – Min appraiser average
N = # of samples r = # of repetitions (measurements)

# of appraisers	2	3
K_2	0.7071	0.5231

* If the value in the root sign is a negative value, the Appraiser Variation (AV) is zero (in the case of Ex. X_{DIFF} = 0, for example).

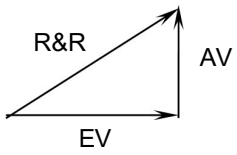
e. Percent Appraiser Variation (to Total Variation) **%AV = 100 (AV / TV)**

f. Percent Appraiser Variation (to Tolerance) **%AV = 100 (AV / {(USL-LSL) / 6})**

(4) Evaluation of measurement system (Gauge R&R)

d. Measurement system variation $R\&R = \sqrt{(EV^2 + AV^2)}$

(Combination of repeatability and reproducibility)



e. Measurement system variation (to Total Variation) **%GRR = 100 (R&R / TV)**

f. Measurement system variation (to Tolerance) **%GRR = 100 (R&R / {(USL-LSL)/6})**

(5) Evaluation of Part Variation

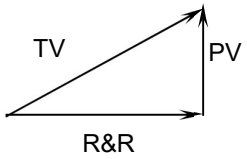
c. Part Variation PV = Rp × K3 Rp: Max part average – Min part average

# of samples	2	3	4	5	6	7	8	9	10
K_3	0.7071	0.5231	0.4467	0.4030	0.3742	0.3534	0.3375	0.3249	0.3146

d. %Part Variation %PV = 100 (PV / TV)

(6) Evaluation of Total Variation

$TV = \sqrt{R\&R^2 + PV^2}$



(7) ndc (number of distinct categories)

The number that can be reliably distinguished by the measurement system is called the number of distinct categories (ndc).

Ndc = 1.41 (PV / R&R)

The ndc is truncated to the integer and ought to be 5 or greater. The ndc of 5 or greater shows sufficient resolution performance.

4.7 Preparation and implementation of Gauge R&R

4.7.1 Characteristics:

(1) Gauge R&R applies to the quality characteristics (principally mechanical characteristics) that are repeatable and specified in Control Plan, including special characteristics (important characteristics) and customer-required characteristics. They are specified in the Measurement System Analysis Plan.

(2) Gauge R&R doesn't apply to non-repeatable characteristics such as leak, electric property and destructive test.

4.7.2 Implementation timing:

(1) Before production trail under the mass-production-equivalent conditions, or at the customer-specified timing during mass production phase.

4.7.3 Appraiser:

(1) Appraisers shall be selected from the operators who use the measuring equipment on a regular basis, preferably those who will measure dimensions in mass production phase.

4.7.4 Measuring equipment:

(1) Use the identical measuring equipment to be used in mass production phase.

(2) In general, the supplier shall select the measuring equipment that is capable of measuring dimensions down to at least one tenth of the tolerance. The measuring equipment shall have appropriate resolution according to the object to be measured. When the supplier does not have the appropriate measuring instrument, please consult to the TS Mitsuba receiving plant.

4.7.5 Measurement sample:

(1) Actual production parts shall be used.

(2) Measurement samples should be the representative of the variation within a process. For example, take one piece per day, or take one piece at 8:00 am, 10:00 am, and 12:00 pm.

4.7.6 Measurement point:

(1) Measurement shall be implemented as usual.

(2) If necessary, variations other than those intended to be examined can be eliminated by putting marks on measurement points.

4.7.7 Measurement order

(1) For unbiased measurement, the following procedure shall be implemented so that the appraisers are unaware of which numbered sample is being checked:

A. Make the first appraiser measure all the samples once in any order.
B. Make the second appraiser measure all the samples once in any order.
C. Continue until every appraiser measures all the samples once.
D. Repeat A through C necessary number of times without informing the appraisers of the data.

4.8 Case example: Evaluation of Gauge R&R

# of samples = 10, # of appraisers = 3, # of repetitions (measurements) = 3 times, Method = Long method

4.8.1 Data sheet for Gauge R&R evaluation

Appraiser / # of repetitions		Sample 1	2	3	4	5	6	7	8	9	10	Average
Appraiser A	1st	0.29	-0.56	1.34	0.47	-0.80	0.02	0.59	-0.31	2.26	-1.36	0.194
	2nd	0.41	-0.68	1.17	0.50	-0.92	-0.11	0.75	-0.20	1.99	-1.25	0.166
	3rd	0.64	-0.58	1.27	0.64	-0.84	-0.21	0.66	-0.17	2.01	-1.31	0.211
	Average	0.447	-0.607	1.260	0.537	-0.853	-0.100	0.667	-0.227	2.087	-1.307	$\bar{X}a = 0.1903$
	Range	0.35	0.12	0.17	0.17	0.12	0.23	0.16	0.14	0.27	0.11	$\bar{R}a = 0.184$
Appraiser B	1st	0.08	-0.47	1.19	0.01	-0.56	-0.20	0.47	-0.63	1.80	-1.68	0.001
	2nd	0.25	-1.22	0.94	0.86	-1.20	0.22	0.55	0.08	2.12	-1.62	0.098
	3rd	0.07	-0.68	1.34	0.20	-1.28	0.06	0.83	-0.34	2.19	-1.50	0.089
	Average	0.133	-0.790	1.157	0.357	-1.013	0.027	0.617	-0.297	2.037	-1.600	$\bar{X}b = 0.0628$
	Range	0.18	0.75	0.40	0.85	0.72	0.42	0.36	0.71	0.39	0.18	$\bar{R}b = 0.496$
Appraiser C	1st	0.04	-1.38	0.88	0.14	-1.46	-0.29	0.02	-0.46	1.77	-1.49	-0.223
	2nd	-0.11	-1.13	1.09	0.20	-1.07	-0.67	0.01	-0.56	1.45	-1.77	-0.256
	3rd	-0.15	-0.96	0.67	0.11	-1.45	-0.49	0.21	-0.49	1.87	-2.16	-0.284
	Average	-0.073	-1.157	0.880	0.150	-1.327	-0.483	0.080	-0.503	1.697	-1.807	$\bar{X}c = -0.2543$
	Range	0.19	0.42	0.42	0.09	0.39	0.38	0.20	0.10	0.42	0.67	$\bar{R}c = 0.328$
Part (sample) average		0.169	-0.851	1.099	0.348	-1.064	-0.186	0.454	-0.342	1.940	-1.571	$\bar{\bar{X}} = -0.0004$ $Rp = 3.511$
$\bar{\bar{R}}$		$[\bar{R}a = 0.184] + [\bar{R}b = 0.496] + [\bar{R}c = 0.328] / [\#\text{ of appraisers} = 3]$										$\bar{\bar{R}} = 0.3360$
$\bar{X}_{DIFF}$		$[\text{Max } \bar{X} = 0.1903] - [\text{Min } \bar{X} = -0.2543] = \bar{X}_{DIFF}$										0.4446
UCL_R		$[\bar{\bar{R}} = 0.3360] \times [D_4^* = 2.58] = UCL_R$										0.8669
LCL_R		$[\bar{\bar{R}} = 0.3360] \times [D_3^* = 0.00] = LCL_R$										0.00

* If the range exceeds the upper control limit (UCL_R), measurement or calculation needs to be conducted again.

4.8.2 Table of control chart constants

# of repetitions (measurements)	D3	D4
2	0	3.27
3	0	2.58

4.8.3 Evaluation results

Part name:
Dimension: Thickness
Specification: ×××±3.00mm

Tolerance: 6.00

Measuring tool: Vernier caliperTool control No.:

Date: YYYY/MM/DD
Performed by:

From data sheet: $\bar{R}$ = 0.3360, $\bar{X}_{DIFF}$ = 0.4446, Rp = 3.511
# of samples = 10
# of repetitions = 3
# of appraisers = 3

Measurement unit	% variation: To Total Variation (TV)	% variation: To Tolerance (Tolerance = USL-LSL)
Repeatability – Equipment Variation (EV) $EV = \bar{R} \times K_1$ $= 0.3360 \times 0.5908$ $= 0.19851$ | # of repetitions | K_1 | | 2 | 0.8862 | | 3 | 0.5908 |	%EV = 100[EV/TV] = 100[0.19851/1.14553] = 17.33%	%EV=100 [EV / {(USL-LSL)/6}] =100 [0.19851/(6.00/6)] = 19.85%
Reproducibility – Appraiser Variation (AV) $AV = \sqrt{[(\bar{X}_{DIFF} \times K_2)^2 - (EV^2/nR)]}$ $= \sqrt{[(0.4446 \times 0.5231)^2 - (0.19851^2/(10\times3))]}$ = 0.22973 | Appraiser | 2 | 3 | | K_2 | 0.7071 | 0.5231 |	%AV = 100[AV/TV] = 100[0.22973/1.14553] = 20.05% n = # of samples R = # of repetitions	%AV=100 [AV / {(USL-LSL)/6}] = 100 [0.22973/(6.00/6)] = 22.97%
Repeatability and Reproducibility (R&R) $GRR = \sqrt{[(EV^2 + AV^2)]}$ $= \sqrt{[(0.19851^2 + 0.22973^2)]}$ = 0.30362	%GRR = 100[GRR/TV] = 100[0.30362/1.14553] = 26.50%	%GRR = 100 [GRR / {(USL-LSL)/6}] = 100 [0.30362/(6.00/6)] = 30.36%
Part Variation (PV) PV = Rp x K_3 = 3.511 x 0.3146 = 1.10456 | Part | K_3 | | 2 | 0.7071 | | 3 | 0.5231 | | 4 | 0.4467 | | 5 | 0.4030 | | 6 | 0.3742 |	%PV = 100[PV/TV] = 100[1.10456/1.14553] = 96.42%	-----
Total Variation (TV) $TV = \sqrt{[(GRR^2 + PV^2)]}$ $=\sqrt{[(0.30362^2 + 1.10456^2)]}$ = 1.14553 | 7 | 0.3534 | | 8 | 0.3375 | | 9 | 0.3249 | | 10 | 0.3146 |	ndc = 1.41[PV/GRR] = 1.41[1.10456/0.30362] =5.130 ～5	

4.2 Interpretation of %GRR (measurement system variation)

4.9.1 Interpretation

(1)First, compare the measurement system variation %GRR (to Tolerance) to the criteria.If it is less than 10%, the measurement system is acceptable.

(2)If %GRR (to Tolerance) exceed 10%, calculate %GRR (to Total Variation).If it is less than 10%, the measurement system is acceptable.

(3)If either %GRR to Total Variation or %GRR to Tolerance is 30% or less, the use of the measuring system is permitted. However, it is desirable to narrow the specification range. If the measuring tool is used without such specification range narrowing, justifiable reasons shall be explained (in consideration of importance of usage, purchasing and repair costs of the measuring tool).

(4)If both %GRR values exceed 30%, this measurement system is unacceptable and needs to be improved. Identify the issues and correct them.

(5) The ndc is truncated to the integer and ought to be 5 or greater. The ndc of 5 or greater shows sufficient

resolution performance.

4.9.2 Acceptance criteria

Criteria		Interpretation
%GRR	Less than 10%	The measurement system is acceptable and usable
	10 ~ 30%	The use of the measuring system is permitted. However, it is desirable to narrow the specification range. If the measuring tool is used without such specification range narrowing, justifiable reasons shall be explained (in consideration of importance of usage, purchasing and repair costs of the measuring tool).
	Over 30%	Measurement system needs to be improved. The issues shall be identified and corrected.
ndc	Less than 5	Measurement system needs to be improved (e.g. improvement of the resolution of the measuring tool).

4.3 Direction of improvement

(1) Reproducibility (Appraiser Variation) is larger than Repeatability (Equipment Variation): EV < AV

A. It is likely that the appraiser is undertrained in handling and reading of the measuring tool. In this case, the appraiser needs to be retrained.

B. Alternatively, a fixed stand can be used to allow the appraiser to handle the measuring equipment moreeasily.

(2) Repeatability (Equipment Variation) is larger than reproducibility (Appraiser Variation): EV > AV

A. The measuring equipment may need inspection or repair.

B. The fixing method or fixing position of the measuring tool may need to be improved.

4.4 Others

(1)There are two methods of calculating %GRR, i.e. %GRR to Total Variation and %GRR to Tolerance. The following is the fundamental policy for %GRR calculation:

When %GRR to Total Variation is used, the process capability is increased by continuous improvement ➔ the part variation decreases ➔ TV decreases ➔ %GRR increases, causing a contradiction that the measurement system variation (%GRR) increases as the part variation decreases.

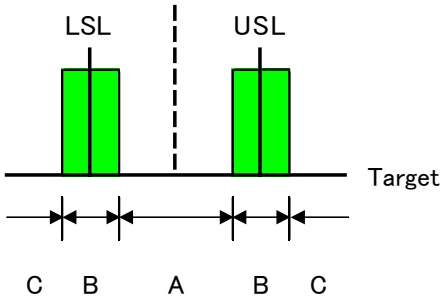
Therefore, %GRR to Tolerance is used as a value free of this contradiction.

4.5 Attribute Measurement System Analysis (Cross Tab Method)

(1) Evaluation by Cross Tab method

For a process that has insufficient capability and thus causes out-of-spec parts (defectives), it is necessary to conduct a screening inspection to remove such defectives.

In a screening inspection, attribute gaging (e.g., Go/No-go gauge) is often used to judge parts within specifications as acceptable and out-of-spec parts as unacceptable. Unlike variable gaging, attribute gaging cannot judge how good/bad a part is. It can judge only whether a part is acceptable or not. (See the figure below.)



・Area A: It is always judged as a good pro
・Area B: Misjudged good products as defective products, or defective products
There is a possibility of erroneously
Etermining that it is a good product.
・Area C: It is always judged as defective product.

Just like Go/No-go gauge inspection, visual inspection is a kind of attribute measurement system and its results can be categorized, for example, as very good, good, ordinary, bad and very bad.

The following shows examples of an attribute measurement analysis data sheet and cross-tab tables. The Cross Tab method can be used for evaluation of attribute measurement systems such as Go/No-go gauge inspection and appearance inspection.

(2)Implementation procedure of Cross Tab method – [1]

The first step is to summarize the observed data.

Fifty samples (n = 50) are randomly chosen from a manufacturing process so that they can cover all range of process variations. The samples are appraised by three appraisers (Appraiser A, B and C) three times (r = 3). The appraisal results of three appraisers are recorded in the data sheet below by entering P for passed samples and N for no good samples.

Then, the data for pairs of appraisers are examined by counting the numbers of agreements and disagreements for each set of evaluations.

In “Reference” field, enter the appraisal results (P or N) for the fifty samples by an engineer or an skilled inspector.

Attribute measurement system analysis data sheet

Appraiser	A			B			C			Reference
	A-1	A-2	A-3	B-1	B-2	B-3	C-1	C-2	C-3	
№										
1	P	P	P	P	P	P	P	P	P	P
2	P	P	P	P	P	P	P	P	P	P
3	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N
6	P	P	N	P	P	N	P	N	N	P
7	P	P	P	P	P	P	P	N	P	P
8	P	P	P	P	P	P	P	P	P	P
9	N	N	N	N	N	N	N	N	N	N
10	P	P	P	P	P	P	P	P	P	P
11	P	P	P	P	P	P	P	P	P	P
12	N	N	N	N	N	N	N	P	N	N
13	P	P	P	P	P	P	P	P	P	P
14	P	P	N	P	P	P	P	N	N	P
15	P	P	P	P	P	P	P	P	P	P
16	P	P	P	P	P	P	P	P	P	P
17	P	P	P	P	P	P	P	P	P	P
18	P	P	P	P	P	P	P	P	P	P
19	P	P	P	P	P	P	P	P	P	P
20	P	P	P	P	P	P	P	P	P	P
21	P	P	N	P	N	P	N	P	N	P
22	N	N	P	N	P	N	P	P	N	N
23	P	P	P	P	P	P	P	P	P	P
24	P	P	P	P	P	P	P	P	P	P
25	N	N	N	N	N	N	N	N	N	N
26	N	P	N	N	N	N	N	N	P	N
27	P	P	P	P	P	P	P	P	P	P
28	P	P	P	P	P	P	P	P	P	P
29	P	P	P	P	P	P	P	P	P	P
30	N	N	N	N	N	P	N	N	N	N
31	P	P	P	P	P	P	P	P	P	P
32	P	P	P	P	P	P	P	P	P	P
33	P	P	P	P	P	P	P	P	P	P
34	N	N	P	N	N	P	N	P	P	N
35	P	P	P	P	P	P	P	P	P	P
36	P	P	N	P	P	P	P	N	P	P
37	N	N	N	N	N	N	N	N	N	N
38	P	P	P	P	P	P	P	P	P	P
39	N	N	N	N	N	N	N	N	N	N
40	P	P	P	P	P	P	P	P	P	P
41	P	P	P	P	P	P	P	P	P	P
42	N	N	N	N	N	N	N	N	N	N
43	P	N	P	P	P	P	P	P	N	P
44	P	P	P	P	P	P	P	P	P	P
45	N	N	N	N	N	N	N	N	N	N
46	P	P	P	P	P	P	P	P	P	P
47	P	P	P	P	P	P	P	P	P	P
48	N	N	N	N	N	N	N	N	N	N
49	P	P	P	P	P	P	P	P	P	P
50	N	N	N	N	N	N	N	N	N	N

The items below are automatically calculated based on the inputs in the data sheet above.

	A-1	A-2	A-3	B-1	B-2	B-3	C-1	C-2	C-3	Ref.
P(Passed)=	34	34	32	34	34	35	34	33	32	34
N(No good)=	16	16	18	16	16	15	16	17	18	16

K(*Kappa*) value between appraisers

				Total					Total	
A=N & B=P	0	2	4	6	A=N & B=N	16	14	14	44	33.33
A=P & B=N	0	2	1	3	A=P & B=P	34	32	31	97	66.67
B=N & C=P	1	3	1	5	B=N & C=N	15	13	14	42	31.33
B=P & C=N	1	4	4	9	B=P & C=P	33	30	31	94	68.67
A=N & C=P	1	4	2	7	A=N & C=N	15	12	16	43	33.33
A=P & C=N	1	5	2	8	A=P & C=P	33	29	30	92	66.67

K(*Kappa*) value between appraisers and standard

A=N & Ref.=P	5	B=N & Ref.=P	2	C=N & Ref.=P	9	Misjudgment that pass is failed.
A=N & Ref.=N	45	B=N & Ref.=N	45	C=N & Ref.=N	42	The rejection is judged as rejection.
A=P & Ref.=P	97	B=P & Ref.=P	100	C=P & Ref.=P	93	Pass is passed.
A=P & Ref.=N	3	B=P & Ref.=N	3	C=P & Ref.=N	6	The rejection is misjudged as passing.

Appraiser	3 times correct (Passed)	3 times incorrect	Mixed	Appraiser	3 times correct (No good)	Appraiser	3 times correct (Pass & No good)
A	29	0	8	A	13	A	42
B	32	0	5	B	13	B	45
C	28	0	10	C	12	C	40

(3)Implementation procedure of Cross Tab method – 2: Preparation of cross-tab table and calculation of K (Kappa) values

K (Kappa) values greater than 0.75 indicate good to excellent agreement (with a maximum kappa = 1), while those less than 0.40 indicate poor agreement.

1. K (Kappa) value between appra **Values of *kappa* greater then 0.75 indicate good to excellent agreement (with a maxinum *kappa* =1); values less then 0.40 indicate poor agreement.**

A* B Cros tabulation study results

			B		
			N	P	Total
A	N	Count	44	6	50
		Expected Count	15.7	34.3	50.0
	P	Count	3	97	100
		Expected Count	31.3	68.7	100.0
合計		Count	47	103	150
		Expected Count	47.0	103.0	150.0

K (Kappa) A - B

Po: 0.94 (the sum of the observed proportions in thediagonal cells.)

Pe: 0.56 (the sum of the expected proportion in the diagonal cells.)

0.38	0.44	0.86
(P0—Pe)	(1 — Pe)	K

B*C Cros tabulation study results

			C		
			N	P	Total
B	N	Count	42	5	47
		Expected Count	16.0	31.0	47.0
	P	Count	9	94	103
		Expected Count	35.0	68.0	103.0
Total		Count	51	99	150
		Expected Count	51.0	99.0	150.0

K (Kappa) B - C

Po : 0.91 (the sum of the observed proportions in thediagonal cells.)

Pe : 0.56 (the sum of the expected proportion in the diagonal cells.)

0.35	0.44	0.79
(P0—Pe)	(1 — Pe)	K

A*C Cros tabulation study results

			C		
			N	P	Total
A	N	Count	43	7	50
		Expected Count	17.0	33.0	50.0
	P	Count	8	92	100
		Expected Count	34.0	66.0	100.0
Total		Count	51	99	150
		Expected Count	51.0	99.0	150.0

K (Kappa) A - C

Po : 0.90 (the sum of the observed proportions in thediagonal cells.)

Pe : 0.55 (the sum of the expected proportion in the diagonal cells.)

0.35	0.45	0.78
(P0—Pe)	(1 — Pe)	K

2. K (Kappa) value between appra

Values of *kappa* greater then 0.75 indicate good to excellent agreement (with a maxinum *kappa* =1); values less then 0.40 indicate poor agreement.

A*Ref. Cross tabulation			Ref. N	Ref. P	Total
A	N	Count	45	5	50
		Expected Count	16.0	34.0	50.0
	P	Count	3	97	100
		Expected Count	32.0	68.0	100.0
Total		Count	48	102	150
		Expected Count	48.0	102.0	150.0

K (Kappa) A - Ref.

Po : 0.95 (the sum of the observed proportions in thediagonal cells.)

Pe : 0.56 (the sum of the expected proportion in the diagonal cells.)

0.39	0.44	0.88
(P0−Pe)	(1 − Pe)	K

B*Ref. Cross tabulation			Ref. N	Ref. P	Total
B	N	Count	45	2	47
		Expected Count	15.0	32.0	47.0
	P	Count	3	100	103
		Expected Count	33.0	70.0	103.0
Total		Count	48	102	150
		Expected Count	48.0	102.0	150.0

K (Kappa) B - Ref.

Po : 0.97 (the sum of the observed proportions in thediagonal cells.)

Pe : 0.57 (the sum of the expected proportion in the diagonal cells.)

0.40	0.43	0.92
(P0−Pe)	(1 − Pe)	K

C*Ref. Cross tabulation			Ref. N	Ref. P	Total
C	N	Count	42	9	51
		Expected Count	16.3	34.7	51.0
	P	Count	6	93	99
		Expected Count	31.7	67.3	99.0
Total		Count	48	102	150
		Expected Count	48.0	102.0	150.0

K (Kappa) C - Ref.

Po : 0.90 (the sum of the observed proportions in thediagonal cells.)

Pe : 0.56 (the sum of the expected proportion in the diagonal cells.)

0.34	0.44	0.77
(P0−Pe)	(1 − Pe)	K

(4) Implementation procedure – 3: Assessment of appraisers by Cross Tab method

The following shows the acceptance criteria for attribute measurement system by the Cross Tab method and the judgment result for three appraisers according to the acceptance criteria.

Acceptance criteria for attribute measurement system by Cross Tab method

	Acceptable for the appraiser	Marginally acceptable for the appraiser - may need improvement	Unacceptable for the appraiser - needs improvement	Remark
Effectiveness	≥90%	≥80%	<80%	Probability of judging correctly
Miss Rate	≤2%	≤5%	>5%	Probability of judging No good parts as OK parts
False Alarm Rate	≤5%	≤10%	>10%	Probability of judging OK parts as No good parts

Judgment result

	Appraiser A		Appraiser B		Appraiser C	
	Result	Judgement	Result	Judgement	Result	Judgement
Effectiveness	84.0%	Conditional acceptance	90.0%	Acceptable	80.0%	Conditional acceptance
Miss Rate	6.3%	Unacceptable	6.3%	Unacceptable	12.5%	Unacceptable
False Alarm Rate	4.9%	Acceptable	2.0%	Acceptable	8.8%	Conditional acceptance

These result shows that the measurement system has different levels of performance in Effectiveness, Miss Rate and False Alarm Rate depending on the appraiser. No single appraiser has acceptable results in all three categories. No single appraiser has unacceptable results in all three categories.

Since every appraiser has an unacceptable result in one category, it is not appropriate to certify them as inspectors.

The following items must be considered for certification:
- Do the acceptance guideline need to be changed for this process?
- Are these risks acceptable for suppliers?
- Do the appraisers need better training?
- Do the testing environment need to be improved?

Note:
The acceptance criteria above should not be taken as an absolute. IATF16949 stipulates that it is necessary to obtain customer's approval about the acceptance criteria for appearance inspectors with respect to appearance characteristics (appearance items) specified by the customer.

In other words, the supplier must obtain TS Mitsuba approval about the acceptance criteria for appearance inspectors.

5. SPC

5.1 Overview

(1)Statistical Process Control (SPC) is one of the process control methods using a statistical approach (mainly control charts).

5.2 Roles of SPC

(1) Control charts serve an important role in creating quality in the process and for continuous improvement.

(2)Control charts demonstrate that the controls are in place and the activities to maintain values within the range between control limits are effectively implemented.

(3)Continuous improvement is promoted by repeating the verification of the process stability and the improvement effectiveness after improvement actions are taken.

5.3 Benefits of SPC and control charts

(1)Detecting nonconforming products is not efficient, but wasteful, in exercising quality control. Controls to prevent nonconforming parts from being made are much more effective. Use of control charts is useful to prevent nonconforming products.

(2)Control charts are useful to take actions for the process rather than for the product itself. Process stability canbe maintained by control charts.

5.4 Theory of control chart

(1)Characteristics values include dispersion. This dispersion is attributable to common causes (inevitable causes) and special causes (avoidable causes or the cause that should not be overlooked).
The basic concept of control chart is to detect the dispersion attributable to special causes based on the dispersion attributable to common causes.

(2)If the process is well controlled, the data dispersion is resulted from common cause(s) only. At this time, measurable value data show the normal distribution. In the normal distribution with the population mean (μ) and the population standard deviation (σ), the probability is as follows:

The probability of the data falling within	μ±1σ is 0.68	and falling outside it is	0.32
	μ±2σ is 0.95		0.05
	μ±3σ is 0.997		0.003

More specifically, if you take 3 times as wide margin as the standard deviation (σ) in both upper (+) and lower (-) sides of the population mean (μ), the probability of the data falling within the margin is 99.7% and falling outside it is 0.3% (only 3 out of 1000 times).

(3)In the control chart, two limit lines are drawn in the positions corresponding to [(population mean μ) ±3 x (standard deviation)] and they are referred to as “3 sigma limit lines”. When points are within the range between the limit lines, they are in the same distribution as the conventional normal population, i.e. the process is under control.

In contrast, points outside the range mean that the distribution has changed, specifically “the process is abnormal”, rather than that an event whose probability is 3 out of 1000 times has occurred.

5.5 Types and usage of control charts

(1) The following table shows the types and descriptions of control charts:

Type	Target characteristics	Description
Xbar-R control chart	Measurable values such as quality and production conditions	Xbar-R control chart consists of the Xbar control chart that shows the changes in mean value of several data (sub-group) and the R control chart that shows the changes in range (R) and the difference between the maximum and minimum values in each sub-group. Each sub-group typically consists of 4 to 5 pieces. To increase the accuracy of detecting the changes in averages, it is more effective to focus on the changes in the averages of sub-groups rather than on the changes in the actual measurement value X. This is because the center of the distribution of the averages of the samples (sample size = n) taken from the population is equal to the average of the population while dispersion is $1/\sqrt{n}$ of the dispersion in the population.
p-n control chart	Countable values such as defect rate and number of defective parts	The p chart shows the proportion of defectives to the entire products, i.e. defect rate p. And the np chart shows the changes in the number of defectives. The defect rate (p) shows a binominal distribution. For the p chart, the range between 3 sigma limit lines varies as the sample size changes. In contract, when the sample size is constant, straight control limit lines are available and the use of the number of defectives instead of the defect rate makes no difference in the central line (CL). Therefore, it is recommended to use the np chart when sample size is constant and the p chart when non-constant.
Number-of-defects chart	Countable values such as number of defects	The number-of-defects chart is used to understand how many defects there are in a single product. Of course, no (zero) defect is the best. However, it is impossible to define the number of defects as defect rate.
X-Rs or X-MR control chart	Measurable values such as quality and production conditions	When data cannot be rationally divided into sub-groups or only one measurement can be obtained from the specified process, the X-Rs control chart is used. In the X-Rs control chart, measured value (X) is directly plotted and the moving range (Rs) is used instead of the range (R). For example, this type of control chart is used to ensure heat treatment quality in batch furnace.

(2) Measurable value and countable value

A. Measurable value: Length and weight, for example. They are consecutive values. Fine values can be taken by using high precision measuring instrument.

B. Countable value: Number of flaws and defective parts, for example. The number of defective parts for the day cannot be 10.5 pieces. The values are always integers.

5.6 How to read control charts

5.6.1 Introduction

(1)Control chart is a method to understand production process conditions based on the distribution of points and take proper actions, and it is used to determine whether a given dispersion is attributable to an accidental cause or an abnormal cause. It is a kind of line-graph with “Control Line” and provides an information such as “this slight dispersion is attributable to an accidental cause and the process is considered to be under control” or “this dispersion can be prevented and the process is considered to be out of control”

(2)Therefore, it is necessary to understand how to read control charts (i.e. distribution of points) in order to analyze and control the process using the control charts.

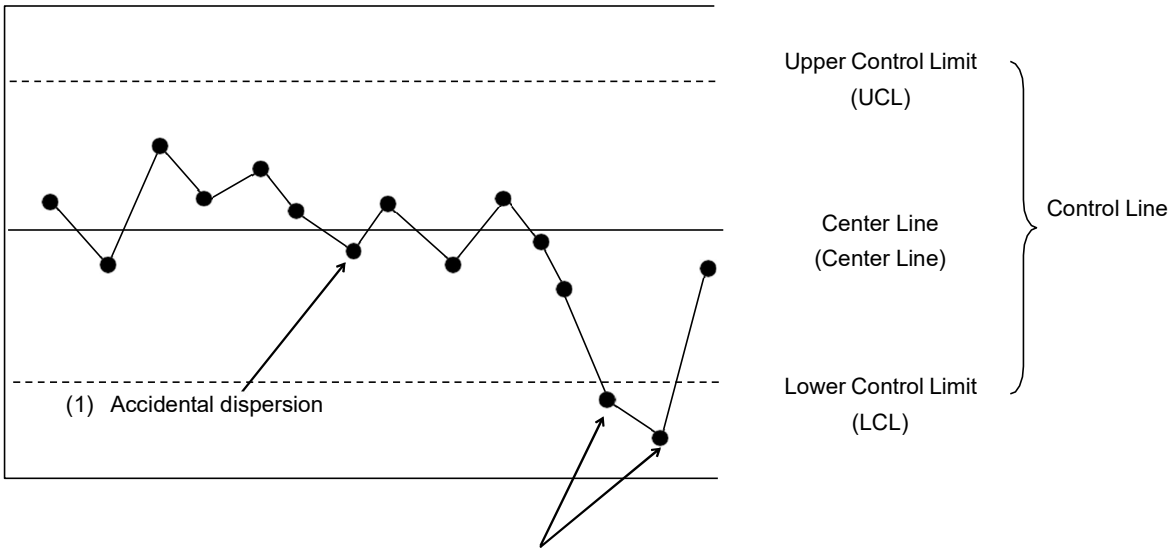
5.6.2 Criteria to judge that the process is under control

(1)If the following two conditions apply, the process is considered to be under control. If not, it is considered as abnormal:

A. There are no points on or outside the control limits.
B. There is no peculiarity in points arrangement.

5.6.3 Criteria to judge that the process is out of control

A. There is/are point(s) on or outside the control limits.
B. There is a peculiarity in points arrangement.



(2) Out of control (dispersion due to abnormal cause)

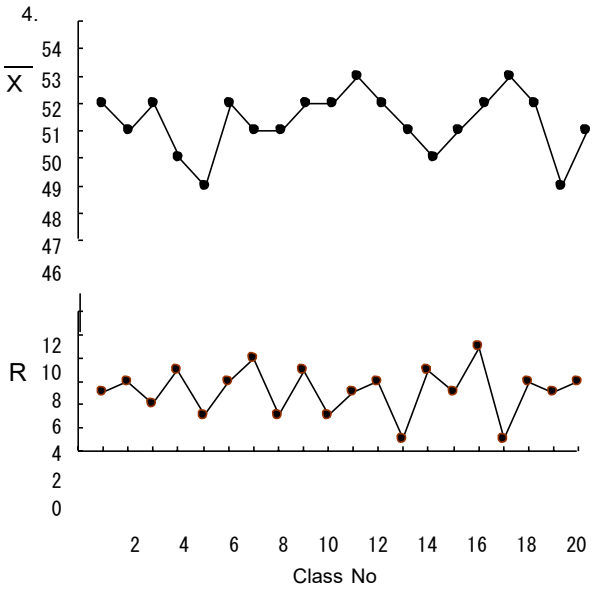
How to create Xbar-R control chart

Xbar-R Control Chart Data Sheet

Class No.	Measured Value X_1	X_2	X_3	X_4	X_5	Total Σ_X	Ave. value $\overline{X}$	Range R
1	51	48	53	51	51	254	50.8	5
2	53	47	48	50	52	250	50.0	6
3	51	49	50	53	50	253	50.6	4
4	50	52	50	48	45	245	49.0	7
5	48	48	50	49	47	242	48.4	3
6	47	53	51	51	52	254	50.8	6
7	50	53	45	49	52	249	49.8	8
8	49	52	51	49	51	252	50.4	3
9	50	4	55	53	48	254	50.8	7
10	49	52	50	52	50	253	50.6	3
11	50	52	52	53	55	262	52.4	5
12	50	53	47	51	51	252	50.4	6
13	50	50	51	50	50	251	50.2	1
14	52	50	52	50	45	249	49.8	7
15	49	51	48	52	51	251	50.2	4
16	55	46	50	52	49	252	50.4	9
17	52	52	51	51	51	257	51.4	1
18	50	49	52	54	48	253	50.6	6
19	46	51	48	49	48	242	48.4	5
20	48	54	51	49	48	250	50.0	6
						Total	1005.0	102
						Ave.	$\overline{\overline{X}} = 50.25$	$\overline{R} = 5.1$

Number of class

Size of group

Procedure	Example
Process1: Take approximately 100 data regarding each item that you are going to control. The data is collected by picking up 20 - 25 sets of 4 or 5 sorts of samples and is measured.	1. Check following before making a control chart ・Check whether each data is making regular distribution.(Histogram) if not, remove the characteristic cause and effect first, and make a control chart. ・A population is standardized as much as possible. (Do not mix with different type of data.) <Ex>In case that there are 2 kinds of screwed point which are limited model, data is plotted separately, etc.
Process2: Calculate the mean value (X/bar) of the sample in each set. $\bar{X} = \frac{\text{The amount of the data in each set}}{\text{The size of a set}} = \frac{\Sigma X}{n}$	2. $\bar{X} = \frac{51+48+53+51+51}{5} = \frac{254}{5} = 50.8$
Process3: Calculate the Range (R) of each set of the sample. Range ® shows the remainder between the maximum value and the minimum value of data X in a set. R = (The Max. value of X) - (The Min. value of X)	3. R = 53 - 48 = 5
Process4: Plot ● for X/bar and R on the graph paper in numerical order of the set number.	4. 
Process5: Calculate X/double bar (the average of X/bar) and R/bar (the average of R) based on the value of X/bar and R about 20 - 25 sets. $\bar{\bar{X}} = \frac{\text{The amount of } \bar{X}}{\text{The number of sets}} = \frac{\Sigma \bar{X}}{k}$ $\bar{R} = \frac{\text{The amount of R}}{\text{The number of sets}} = \frac{\Sigma R}{k}$	5. $\bar{\bar{X}} = \frac{50.8+50.0+\cdots+50.0}{20} = \frac{1005.0}{20} = 50.25$ $\bar{R} = \frac{5+6+\cdots\cdots+6}{20} = \frac{102}{20} = 5.1$

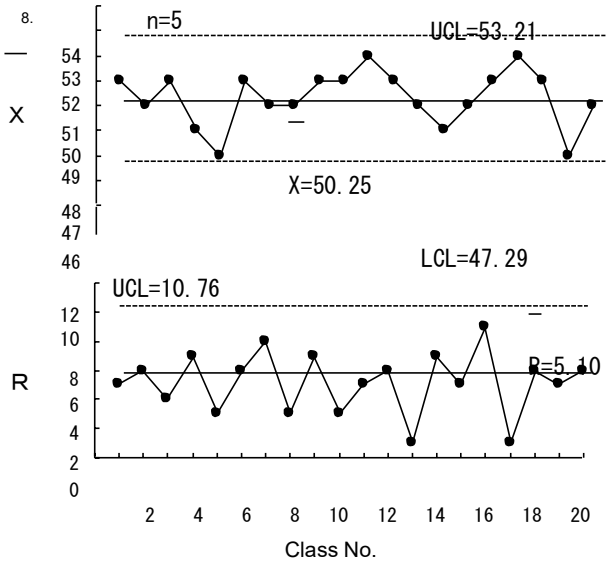
Procedure	Example
Process6: Calculate the control line on the X/bar Control Chart Central line (CL): $\overline{\overline{X}}$ Upper control limit (UCL) = $\overline{\overline{X}}+A_2\overline{R}$ Lower control limit (LCL) = $\overline{\overline{X}} - A_2\overline{R}$ A_2 is a coefficient decided by n (the size of a set)	6. Central line $\overline{\overline{X}}$ = 50.25, A_2 = 0.58 UCL = 50.25＋0.58×5.1 = 50.25＋2.96 = 53.21 LCL = 50.25－0.58×5.1 = 50.25－2.96 = 47.29 * See table 1 for coefficient
Process7: Calculate the control line on the R Control Chart Central line (CL): $\overline{R}$ Upper control line (UCL) = $D_4\overline{R}$ Lower control line (LCL) = $D_3\overline{R}$ D_3 and D_4 are coefficients decided by n (the size of a set) * See table 1	7. Central line $\overline{R}$ = 5.10, D_4 = 2.11, D_3 = UCL = 2.11×5.10 = 10.76 LCL =
Process8: Plot the control line on the graph - Draw sideways a red continuous line for $\overline{\overline{X}}$ and a red dotted line for UCL and LCL on the X control chart. - Draw sideways a red continuous line for $\overline{R}$ and a red dotted line for UCL and LCL on the R control chart. - Add the value of n, the central line and the value of UCL and LCL to the graph, if you need the graph more obviously. - Draw lines such as a control limit line, by ruler. ・Introduction of setting a vertical axis. $\overline{X}$ control chart -maximum width of $\overline{X}$ is set up 2 times greater than minimum of it. R control chart -minimum scale is 0.Muximum width of R is 2 times greater than minimum value. Graduation line -A graduation of $\overline{X}$ is 2 times greater than a graduation or R.	8. 

Table 1. Coefficients for $\overline{X}$ - R control chart

n (Group size)	$\overline{X}$ control chart A_2	R control chart D_4	R control chart D_3
2	1.88	3.27	–
3	1.02	2.57	–
4	0.73	2.28	–
5	0.58	2.11	–
6	0.48	2.00	–
7	0.42	1.92	0.08

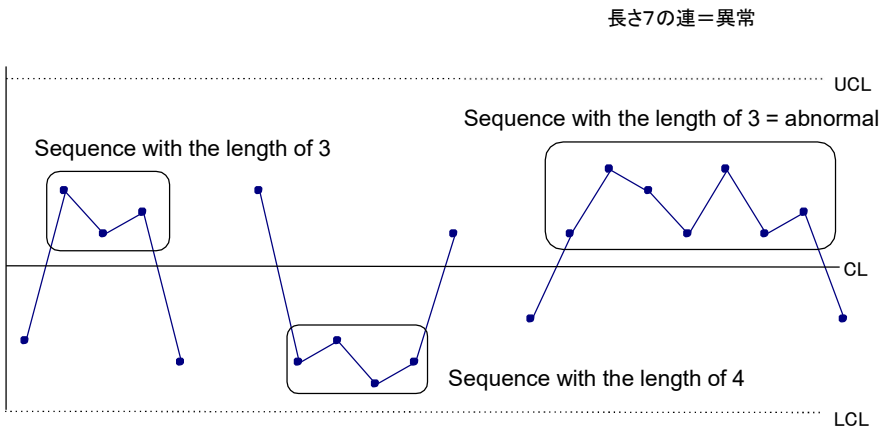
*The number of picking out from control plan.

5.6.4 How to read Xbar-R control chart

	Designation	What the chart shows	Action
Out of control	Point outside the limit line	Any point is on or outside of the limit line. X/bar control chart shows the changes in the mean value of the process. R control chart shows the changes in the dispersion of the process.	Since this point is associated with an unignorable abnormal cause, it is necessary to clarify the cause and take appropriate measures to prevent the recurrence.
	Sequence with the length of 7 or more	Seven or more points are consecutively arranged on the one side of the center line	These points mean that the average or dispersion of the process has been slightly changed. Valuable technological knowledge can be obtained through cause investigation.
	Points near the limit line	Although all points are inside the range between the limit lines, two out of three consecutive points are arranged in the area(s) furthest from the center line when the range between the center line and the limit line is equally divided into three areas. *See 2.4 Theory of control chart	These points mean that the dispersion of the process is increased. So, care must be taken.
	Peculiarity in points arrangement	Points are arranged upward or downward or they fluctuate periodically.	This tendency is attributable to a certain cause(s) in the process. Valuable knowledge for process control can be obtained through cause investigation.
	Points near the center line	Although the two third of the points should be distributed near the 1/3 below or above the center line, too many points locate too close to the center line, or points in 1/3 areas are too few. *See 2.4 Theory of control chart	The way of classification or stratification is improper.
Under control	Stable state (controlled state)	The points or tendency mentioned above are not observed over 25 or more consecutive points.	The process is stable. No actions are required.

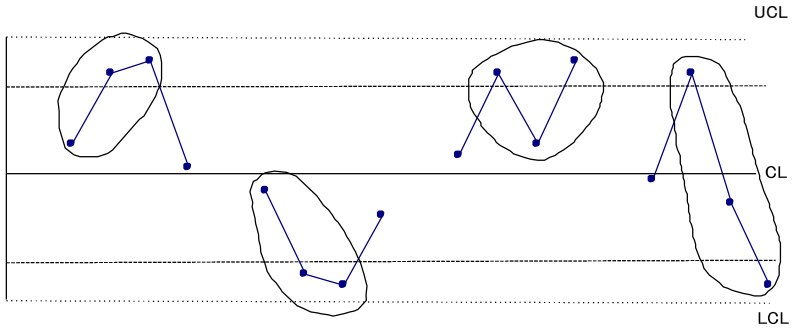
5.6.4.1 Sequence

(1) Sequence means the points consecutively arranged on the one side (upper or lower) of the center line, and the number of points in the sequence is called the length of the sequence.
If the sequence with the length of 7 or more is observed, the process is considered to be abnormal



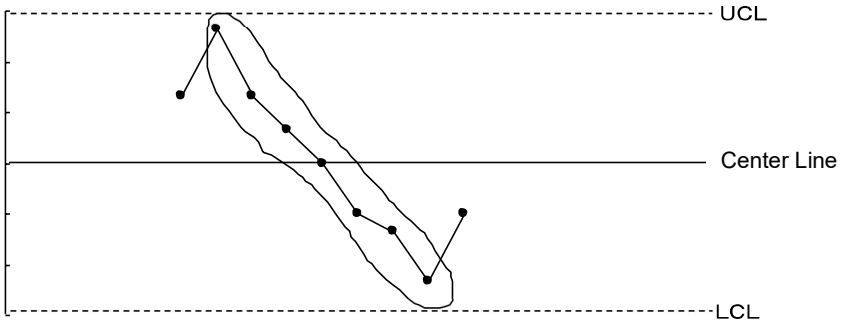
5.6.4.2 Points near the limit line

(1) When the range between the center line and the limit line is equally divided into three areas and two out of three consecutive points are arranged in the area(s) furthest from the center line, the process is considered to be abnormal.



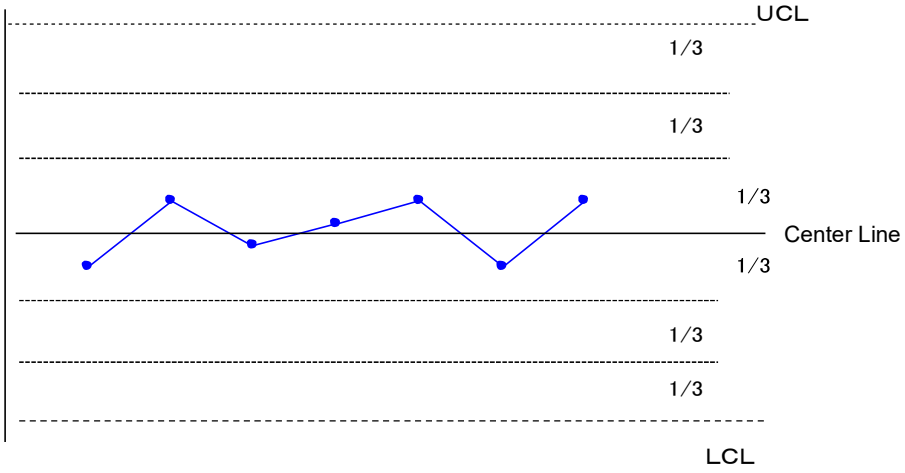
5.6.4.3 Tendency

(1) When six consecutive points are arranged upward or downward, the process is thought to have a tendency (peculiarity).



5.6.4.4 Points near the center line

(1) The points concentrated near the center line seem to be a good trend. Nevertheless, this constitutes one of abnormalities. Valuable know-how can be obtained through cause investigation.



5.6.5 Usage of X-bar-R control chart

(1) Purpose for using X-bar-R control chart:

A. To verify whether the process is under control (Control chart for process analysis)
The X-bar-R control chart is created based on data collected from the process over a certain period andused to verify whether the process is stable.

B. To keep the process in well-controlled state (Control chart for process control)
If the production process is stable and the product quality meets the requirements, it is permitted tocontinue production under ongoing conditions. Values of X-bar and Rare plotted on the X-bar-R controlchart to detect unignorable abnormal causes.

Glossary of Terms

Term	Expansion
AIAG	Automotive Industry Action Group
APQP	Acronym of “Advanced Product Quality Planning”,It provides general guidelines for preparing plans and checklists for supplier to carry out from the initial development stage to the initial production.

Term	Expansion
BOM	Bill Of Material

Term	Expansion
CAD	Computer-Assisted Design
CKD	Complete Knock Down
Control Plan	Control Plans are written descriptions of the systems for controlling parts and processes.
Countermeasure	Corrective action
Cpk	This means the variation index in the process quality, taking the variation in lots and materials and the deviation of the process average into consideration. It is used in production stage.
Cp/ Cpk	Process Capability Index

Term	Expansion
DCC	Design Change Control
DFMEA	Design Failure Mode and Effects Analysis - An analytical technique used by a design responsible engineer / team as a means to ensure, to the extent possible, that potential failure modes and their associated causes / mechanisms have been considered and addressed.

Term	Expansion
EO	Acronym of “Engineering Order”. This means the notification of design change issued by the design department of TS Mitsuba.
ECN.	Acronym of “Engineering Change Notice”.
ECR.	Acronym of “Engineering Change Request”.
ELV	End of life vehicles.

Term	Expansion
FMEA	Failure Mode and Effects Analysis
FTA	Fault Tree Analysis
FIFO.	First In First Out.

Term	Expansion
Gage R&R	Abbreviation of “Gage Repeatability & Reproducibility”. Three operators take measurements on 10 samples to confirm the repeatability and the reproducibility of the measuring system employed.
GD&T	Geometric Dimensioning & Tolerancing.

Glossary of Terms

Term	Expansion
RFQ	Request For Quotation
Reliability test	This means the confirmation test for the quality characteristics such as durability, strength, operation characteristics of part or system. The environmental and operation conditions of the test involve the time element.
Regulatory part	This means the part that must comply with government regulations.
R@R	Run at Rate.
RPN	Acronym of “Risk Priority Number”. This is calculated to determine the priority of the problem defined by the FMEA, with the function specified as follows; RPN = “Criticality” x “Frequency of occurrence” x “Detection rate”

Term	Expansion
Service Parts	Replacement parts required for after-sales support
SOP	Start Of Production
SHC	Supplier Health Check
SOC	Substance of Environmental Concern.
Safety part	Their functional failure could cause injury or fire. The part is identified with the words, "safety part" in the drawings.
Special process	This means the process in which the quality characteristics of the parts are likely influenced by the operator's skill and the control of the equipment conditions, and judging the conformance of the products is difficult by the inspection with general purpose inspection tools or with nondestructive test, such as welding, forging, casting, heat treatment, plating, painting, cleaning, press-fitting, and caulking.
SPC	Statistical Process Control
Special Characteristics	Important A or B or C part or a Regulatory part. It is important to note that these characteristics are specified by TS Mitsuba and the Supplier must ensure conformance to TS Mitsuba Special Characteristics requirements identified in the Special Characteristics Management (Control of Product and Process) Activity. Special characteristics are quite different from, and should not be confused with, Key Features

Term	Expansion
TPM	Total Preventative Maintenance
Traceability	This means the ability to trace the history of parts with records and identification.

Term	Expansion
OEE.	Overall Equipment Effectiveness.

Term	Expansion
QARP.	Quality Assurance Responsibility Person.
QAV.	Quality Audit Visiting.
QCD	Quality, Cost, Delivery
QRQC	Quick Response Quality Control

Term	Expansion
4M.	Man , Machine , Material , Method

Supplier Quality Manual

Issued by

Thai summit Mitsuba Electric Mfg. Co., Ltd.
Quality System Department