TOSHIBA

Semiconductor Quality Guidelines

Toshiba Electronic Devices & Storage Corporation

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Toshiba Electronic Devices & Storage Corporation
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TOSHIBA

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Chapter 1 Quality Policy and Activity

Quality Policy

In accordance with the basic commitment of Toshiba Group based on respect for people, Semiconductor Division strictly conforms to the relevant laws and regulations and strives towards the concept of "Customer First", providing high quality and safe products and services that perform as expected, and contributing to society.

To realize our Quality Policy, we put the following standards of conduct into practice.

1) We secure quality based on the customer standpoint.
2) We comply with related laws, regulations, and contracts and respect the rights of customers and third parties.
3) We continually improve the quality management system.
4) We strive for stronger technology to manufacture quality products through the participation of all departments and employees.
5) We aim for essential improvement by pursuing root causes and prevention by risk analysis.
6) We strive to provide information to customers for proper product use.

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Chapter 2 Quality Integration

2.1 Quality Assurance System (Quality Assurance Organization Overview)

2.1.1 Quality Assurance Organization

Figure 2.1.1 shows an overview of the quality assurance organization for semiconductor products to explain the quality assurance activities of those products.

In Figure 2.1.1, the General Managers of Semiconductor Div. and Technology Executives operates the Quality Assurance Meeting and strives to maintain and improve the quality and reliability of all semiconductors.

For early-stage quality and reliability assurance of developed products, the Reliability Engineering Department of the Divisions, in cooperation with engineering departments, plans the quality and reliability of semiconductor products, tests and evaluates developed products, and verifies the quality and reliability of newly distributed products. They also give early feedback on development and design. In addition, they compile documents relating to quality and reliability, conclude specification documents and quality assurance agreements with customers, provide quality services, and promote education and training on quality and reliability.

Each manufacturing department strives to improve the process quality of its manufacturing sections. The Operations Quality Assurance Department is responsible for products transferred from engineering departments, quality assurance of incoming parts and materials, quality assurance of the manufacturing process, quality and reliability assurance at the time of shipping, post-shipping quality services, and controlling measurement instruments used at the Operations. In addition, the department manages Operations Quality Assurance Meetings sponsored by the Operations General Manager and strives to improve the quality and reliability of products.

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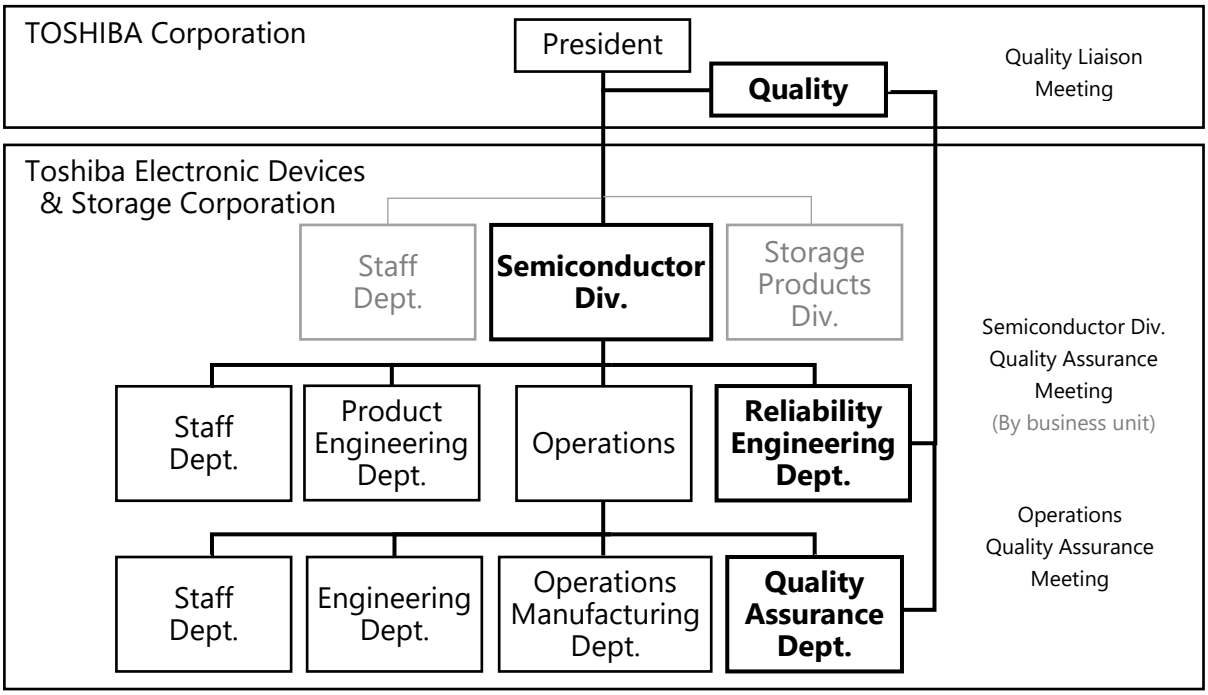

Figure 2.1.1 Quality Assurance Organization Overview for Semiconductor Products

2.1.2 Quality Assurance Procedure

Toshiba makes every effort to understand customer needs and incorporate into product design the quality and reliability required by the conditions under which the products will be used by customers. In the design review (DR) phase, the products are checked by each department, paying due attention to factors such as product safety and product liability.

For products under development, Toshiba conducts a quality and reliability evaluation based on Toshiba reliability test standards compliant with standards such as JIS, JEITA, IEC, ANSI and JEDEC, and conducts a Design Approval Test (DAT).

If a product passes the Design Approval Test (DAT), the Engineering Department standardizes the parts and materials as well as the process and inspection plans. In addition, detailed operations standards regarding the work to be performed are developed in the operations where the products are to be made in mass production. A Quality Approval Test (QAT) is then conducted to evaluate the quality and reliability of sample products manufactured based on

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these standards. If the product quality and reliability are approved, the operations will be put in charge of quality assurance for the actual production process.

During mass production, the Manufacturing Department carries out process, environment and facility management, and the Reliability Engineering Department carries out acceptance inspections, change control, measurement control, regular reliability confirmation and process audits. Departments such as the Manufacturing Engineering and Production Engineering Departments also join in problem solving and in improvement and automation of manufacturing processes.

If any modification is made on products after produced in volume, a Production Approval Test (PAT) is conducted, and the result is returned to the manufacturing process.

At the time of shipment, the Quality Assurance Department monitors product quality by initial quality inspection as well as reliability testing and monitoring. Furthermore, in customer related quality services such as specification development, quality and reliability meetings, and defect investigation and reporting, Toshiba continually strives to satisfy its customers with prompt action.

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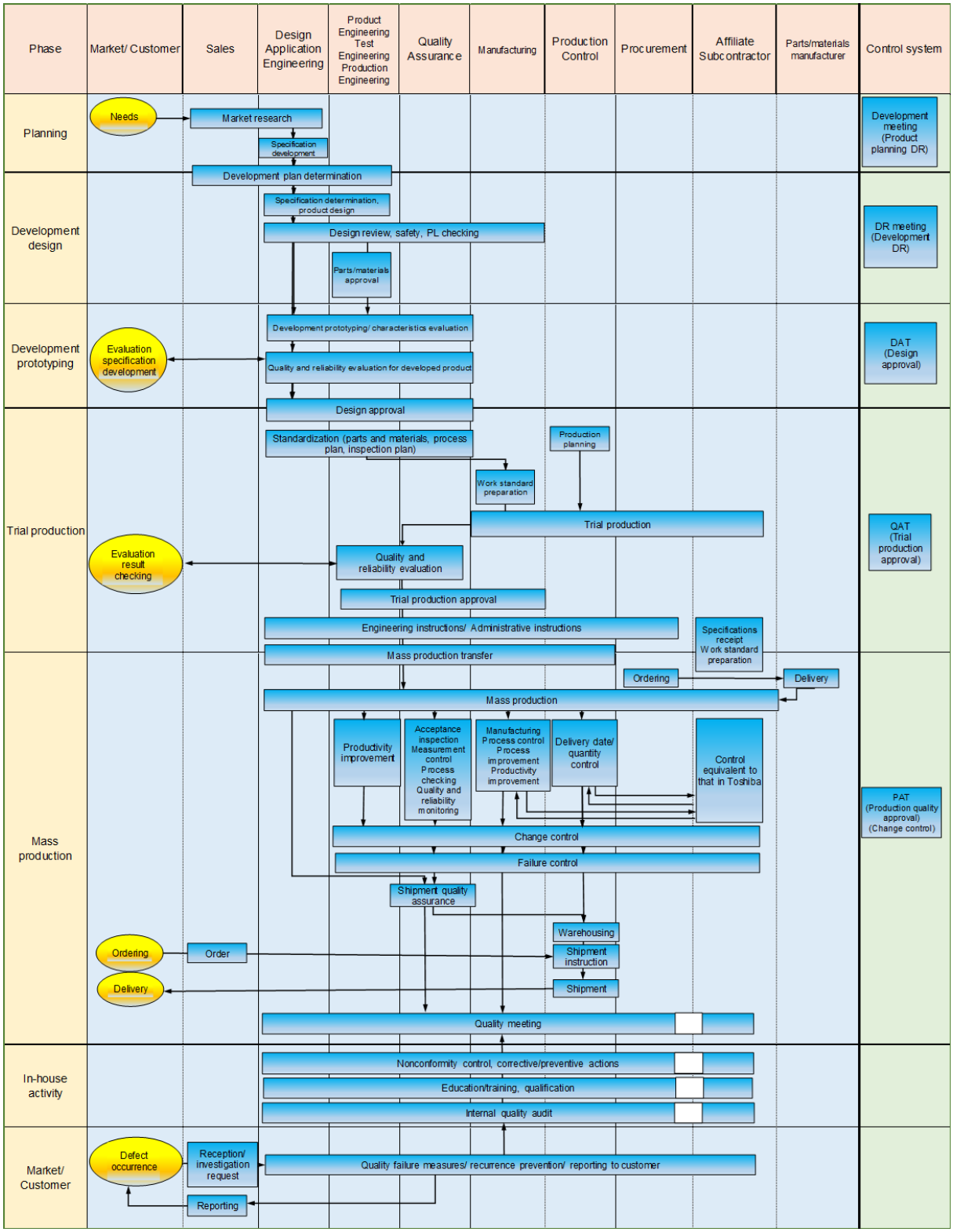

Figure 2.1.2 Quality Assurance Procedure for Semiconductor Products

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2.2 Quality and Reliability in Product Development and Design Changes

Overview

Toshiba semiconductor products are manufactured for a variety of applications, from consumer products to general industrial goods, automobiles. This section describes the system for developing products of high quality and reliability, from product planning to mass production.

2.2.1 Planning

When developing a new semiconductor product, first and foremost sufficient market research must be performed to ensure that the product satisfies customer objectives and the required quality and reliability, and to ensure the product's general marketability. Toshiba classifies its products, according to customer applications, into two groups: general-product and high-reliable product which are graded on quality.

The Sales Department, Application Engineering Department and Quality Assurance Department thoroughly survey the type and actual operating environment of the device in which the product will be used. Circuit conditions, target reliability, design derating, operation conditions and maintenance control are also investigated, in addition to initial functionality and component failure rates. They then determine the specifications for development that incorporate the target reliability and subsequently formulate the development plans.

2.2.2 Development Design

The quality of semiconductor products depends largely on the design. Product design is based on development specifications carefully studied during the planning phase. Circuit, layout, process and structural designs of sufficient design tolerances are comprehensively considered so as to allow variance in processes and to achieve a design with integrated reliability.

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To ensure design quality, a design review is held to deliberate the design from every perspective, confirming factors such as design standards, rules and safety. Design review participants include departments such as Engineering and Quality and Reliability. When a problem arises, a design review is conducted.

After the design review, a characteristics evaluation mainly designed to verify target characteristics and functions is performed using trial products, and a design approval test (DAT) is conducted with an emphasis on accelerated testing to verify target quality and reliability under actual use conditions.

DAT results are used to identify design margins and limits. If a defect is discovered, the defect conditions are surveyed and analyzed from every point of view of failure physics to determine the cause, and the results are fed back to the design and manufacturing departments so as to improve quality and reliability.

After completion of the above evaluations, a DAT review meeting is held and, once approval is obtained, the trial production phase is entered.

2.2.3 Trial Production

During the trial production phase, quality and reliability evaluations are conducted to maintain the designed quality and reliability and ensure continued stable production, and a quality approval test (QAT) is conducted to identify process capability, i.e., variations and yields, from the viewpoint of initial flow control.

Based on the evaluation results, the standards used are assessed with respect to appropriateness and information feedback is improved.

Product instructions, QC process charts and other work standards required for production are then prepared, and measurement instruments for manufacturing equipment, jigs and tools are adjusted.

Lastly, a QAT review meeting is held to review the above items and, once approval is obtained, a production transfer meeting is held and the mass production phase is entered.

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2.2.4 DR/AT System

Toshiba develops products using the Design Review/Approval Test (DR/AT) system.

Design Review (DR) System

At the end of the design phase, a design review is held with the participation of the Engineering and Quality and Reliability departments. During the meeting, design standards, design rules (including studies of past incidents), and Contractual Liability/Product Liability (CL/PL) items are confirmed and the evaluation standards that take into consideration the various elements that affect the application, quality and reliability of the trial product are deliberated from various angles, based on departmental knowledge collected using independently developed design review check sheets. In particular, due attention is paid to the confirmation of safety, taking into consideration international safety standards (UL, VDE and others) as well.

The design review results are used as a basis for redesign and for measures such as the addition of AT test items.

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Approval Test (AT) System

The approval test (AT) is performed after completion of the design review. First, the engineering grade of the product is assessed and then various evaluations and tests are conducted according to the grade. Table 2.2.1 lists the engineering grades and corresponding AT classifications.

Table 2.2.1 Engineering Grade Classifications

Engineering Grade	Technological Novelty	AT Class
I	(1) New technology never before developed domestically or overseas (2) Technology new to Toshiba but already developed by other companies	DAT and QAT
II	(1) Improved conventional technology (2) Existing technology applied to other products	DAT and QAT
	(3) Change in manufacturing location in the standard product manufacturing phase (4) Change in current manufacturing location during standard product manufacturing phase (5) Subcontracting of a part of the internal process during standard product manufacturing phase	QAT
III	Change made in the standard product manufacturing phase that does not greatly affect the quality and reliability of parts, materials or processes, or the resuming of production after being halted for 12 months or longer	PAT

DAT: Design Approval Test
QAT: Quality Approval Test
PAT: Production Approval Test

As shown to the right, the AT system flows, participating departments and evaluation contents are determined according to the AT class.
Reliability testing is also conducted in product family units, such as the design/process family or package family, in order to execute AT effectively.
For details, see the chapter of Reliability Testing in the Reliability Handbook.

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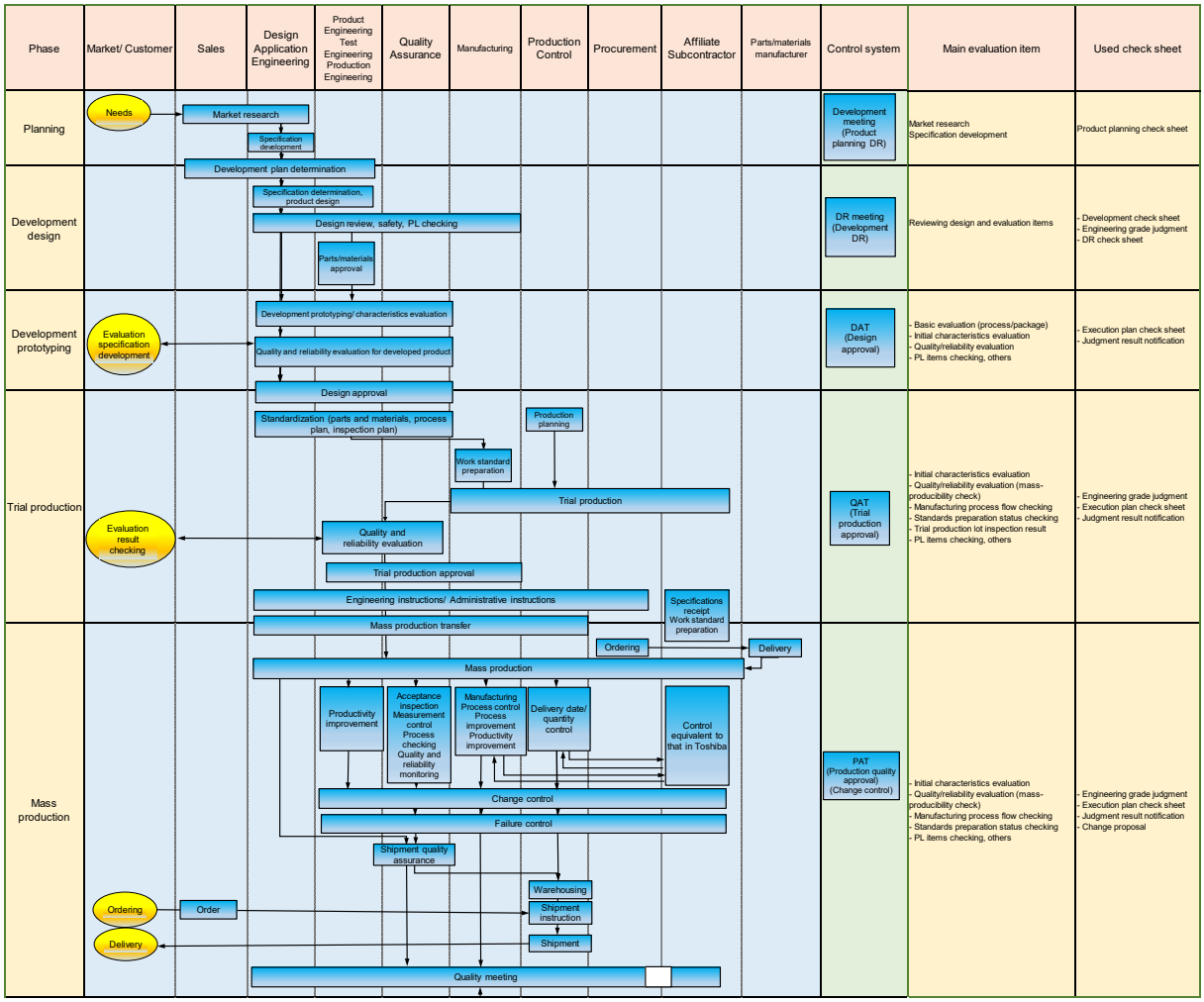

Figure 2.2.1 Approval Test (AT) System

2.2.5 Change Control

Semiconductor products are continually improved so as to enhance performance, decrease size, reduce cost, and improve manufacturability (such as better stability and efficiency). Changes for such improvements require detailed product evaluation and process control so as to maintain and improve quality and reliability.

The previously described evaluation and design review/approval test (DR/AT) system checks and evaluates improvements and changes, preventing quality problems which may arise in association with such improvements and changes.

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If a change or improvement requires modification to product structure, functionality or characteristics, or will have a significant effect on reliability, customer approval is obtained in advance. Toshiba has established the change control system as shown to the right for this purpose.

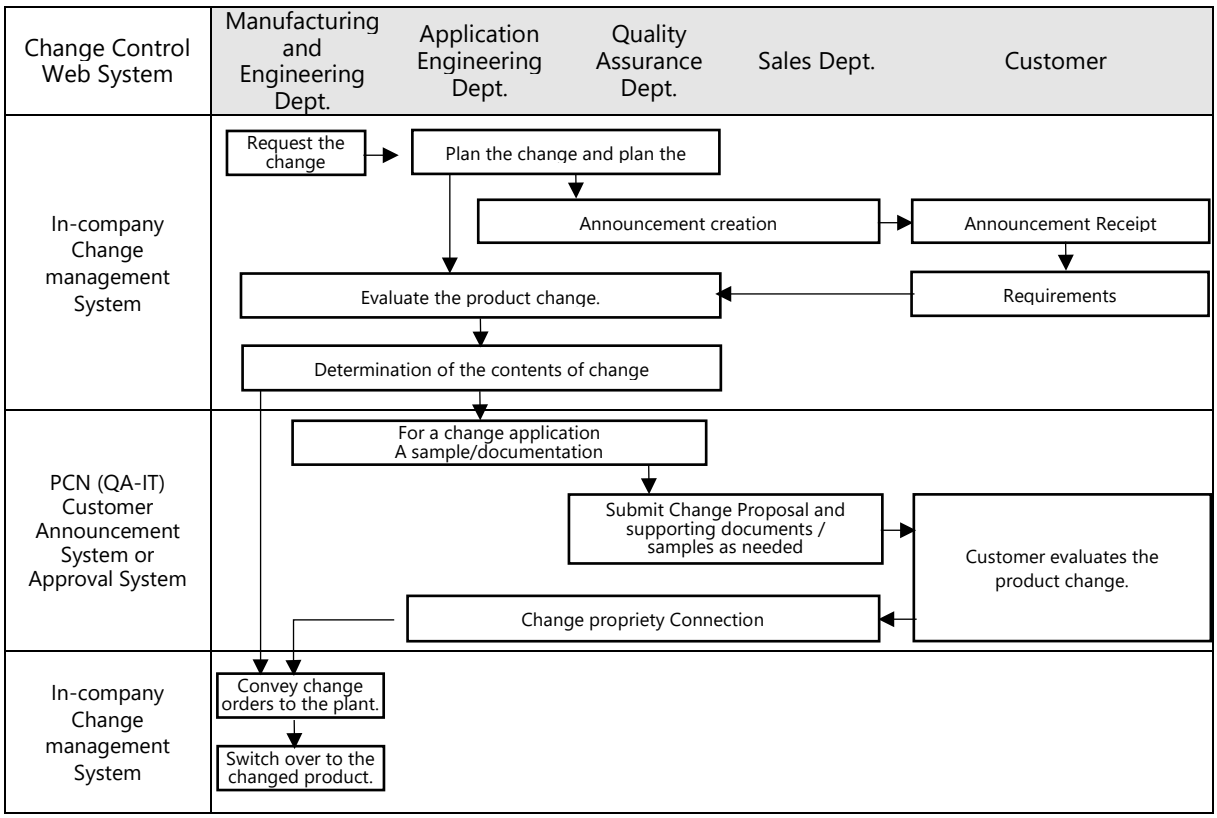

Figure 2.2.2 Change Control Procedure

2.3 Control of Parts, Materials and Subcontracting

2.3.1 Parts and Materials

The assurance of high-quality parts and materials for the manufacturing process is essential to continued stable production at the designed levels of quality and reliability. Therefore, the specifications and required quality standards for parts and materials are clearly defined in the manufacturing design phase. This information is used in the incoming parts and materials inspection and approval process (in the case of chemicals, periodic analysis).

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We carry out a number of different measures to ensure thorough management of parts and materials procured from outside vendors. We achieve this through a quality assurance agreement with outside vendors, systemization of the quality assurance implementation plan, guidance and education for quality control (SPC management, etc.), management guidance based on the ISO 9001, and periodic process auditing.

Regarding the environment, we are promoting green procurement. For details on green procurement, please refer to the chapter on Environmental Activities.

In addition, parts and materials are stored in an appropriate environment in accordance with established rules to prevent deterioration over time and assure quality.

Table 2.3.1 Procedure for Authorizing New Suppliers

Items	Descriptions	Main Responsible Department
(1) New Suppliers Specifications Meeting	We meet with new suppliers based on the purchase specification prepared by Toshiba regarding the parts and materials concerned.	Engineering Department
(2) Selection of Suppliers	We take quotations, technology, quality level, specifications, etc. into consideration when selecting suppliers.	Engineering Dept. Procurement Dept.
(3) Prototypes, Contracts	We order the prototype, confirm the technology and quality levels, and conclude the “basic contract.”	Engineering Dept. Procurement Dept.
(4) Primary Approval	We confirm that the parts and materials concerned satisfy the required functions.	Engineering Dept.
(5) AT Implementation	We make sure that the parts and materials concerned possess sufficient quality and reliability when used in products.	Engineering Dept.
(6) Executing the “Quality Assurance Agreement”	As a rule, suppliers are to sign the “Quality Assurance Agreement.”	Quality Assurance Dept. Procurement Dept.
(7) Supplier Certification (Thereafter, official orders can be made.)	We audit the manufacturer's quality assurance system and production line and confirm that products of sufficient quality are ready for mass production.	Quality Assurance Dept.
(8) Secondary Approval	We confirm that the quality level of the parts and materials concerned is at the same level as the primary approval result, including variations.	Quality Assurance Dept.

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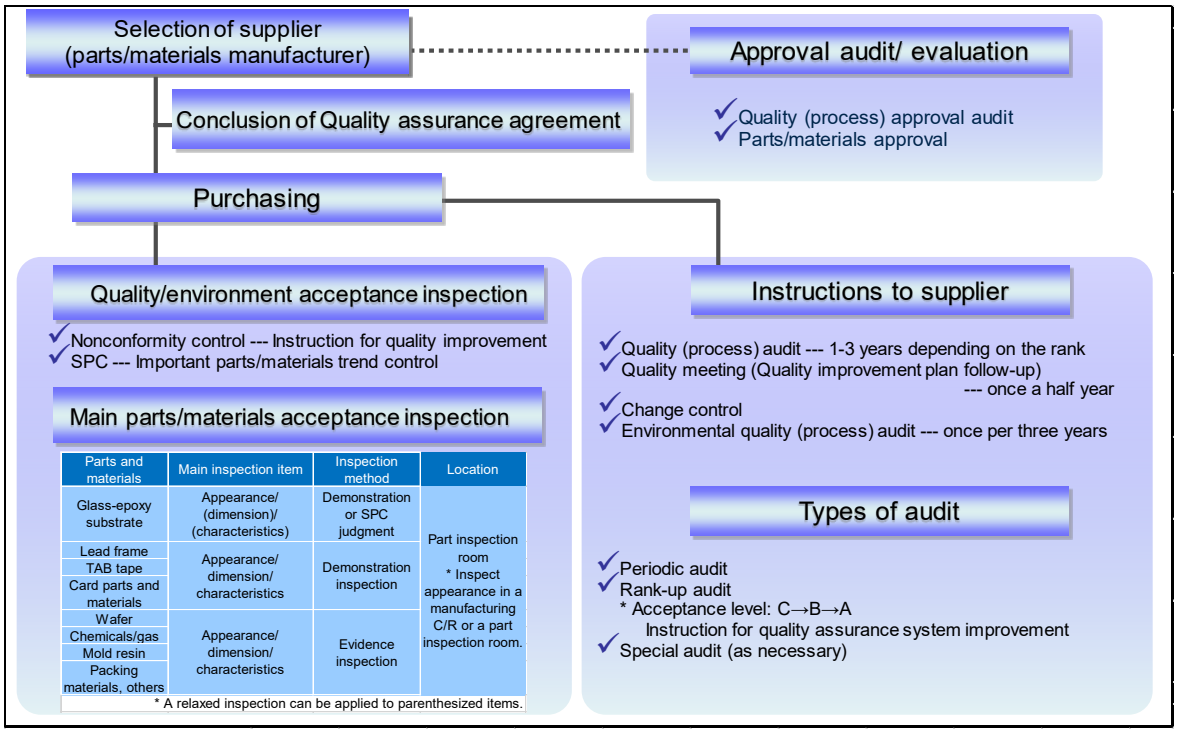

Figure 2.3.1 Example of Supplier Management

2.3.2 Subcontracting

When selecting an outsourcee to do part of the semiconductor product manufacturing process, items such as QC, management, technology and facilities are investigated and confirmed.

After production starts, support is provided to aid outsourcees in quality and engineering training and guidance and in facility planning. In addition, periodic quality audits are performed to check the process control and environment status. Furthermore, outsourcee quality meetings are held periodically to obtain action plans for items reported during quality audits, to verify the status of other quality items, and to provide guidance in quality improvement. Such continual improvement activities maintain and improve quality. Table 2.3.2 shows an example of an outsourcee control plan and its implementation.

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Table 2.3.2 Outsourcee Control Plan and Implementation Example

Classification	Planning			Implementation		
	Overview	**Dept. in Charge**	**Related Depts.**	**Overview**	**Dept. in Charge**	**Cooperating Depts.**
Outsourcee control	(1) Outsourcee selection (a) Management survey (b) Engineering status survey (c) QC status survey (d) Facility and other surveys	Production	Engineering Manufacturing QA	Business activity survey Engineering level survey Specialty experience and development capability survey QC system, and job instruction availability survey Material control status survey Contractual arrangements	Production	Engineering QA Manufacturing
	(2) Outsourcee quality control	QA	Engineering Manufacturing Production	Process control survey and guidance	QA	Manufacturing Engineering
	(3) Outsourcee technology guidance	Manufacturing	Engineering Production	Dispatch of engineer upon request Communication meetings as needed Technical guidance	Manufacturing	Engineering

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2.4 Manufacturing Process Control

2.4.1 Facilities

Toshiba establishes facility control regulations to guide the improvement and expansion of production facilities and the implementation of facility safety control. To maintain functionality, facility control incorporates the concept of total productive maintenance (TPM) whereby specific methods, such as facility inspections at the beginning of work, are defined and self-imposed/planned safety measures and inspections are implemented with the aim of identifying quality problems before they occur and stabilizing quality.

2.4.2 Working Environment

The quality and reliability of semiconductor products depends largely on the work environment of manufacturing processes. Cleanliness, temperature, humidity, and static electricity, in particular, require strict control.

Toshiba clean rooms are controlled to the level required. To maintain and improve a clean room, dust is monitored and the source of the dust is periodically analyzed and controlled. In addition, temperature and humidity are monitored and controlled as specified.

The purity of the ultra pure water used in great amounts in the wafer process also greatly affects the quality and reliability of semiconductor products. Therefore, the water is purified using methods such as ion exchange and micron filtering, and the result is monitored and analyzed periodically.

Furthermore, the miniaturization and an increasing variety of packaging has led to a growing problem with device failure due to electrostatic discharge (ESD). Toshiba has therefore created guidelines for controlling ESD effectively, particularly during the assembly process.

2.4.3 Process Control

The wafer process for semiconductor products is a series of unit processing including oxidation, diffusion, deposition, pretreatment, etching, ion implantation and

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photolithography. In the assembly process, unit processes such as bonding and molding are continuous.

A QC process chart is used to clarify the control items, conditions, tools, individuals responsible, and actions at the time of failure for each process. Detailed process control is achieved by recording the data of each process and utilizing the data to check whether or not the product has been made under normal manufacturing conditions, and to trace failures to lots when failure occurs. The manufacturing history of lots in manufacturing process is clearly recorded on travel sheets and check sheets.

2.5 Identification and Traceability

2.5.1 Processes

To control materials in processes and clearly define manufacturing history, Toshiba employs the following identification control methods:

- Storage racks and containers for materials, semi-finished, finished, repaired and returned products are identified by shape, color and signage to ensure that the storage and processing status of each item is clearly understood.
- At manufacturing process inspections and final inspections, the inspection status (before inspection, inspection in progress, inspected) is marked so that it is clearly understood.
- The process history of lots located amidst manufacturing processes is clearly defined using travel sheets and check sheets.

2.5.2 Products

Product identification is controlled by marking production lot codes to products so that the manufacturing history of any product can be traced. Figure 2.5.1 shows the typical Toshiba production lot code assignment method.

If the production lot code is not possible to mark due to restrictions for package size, that is printed in the internal carton box label.

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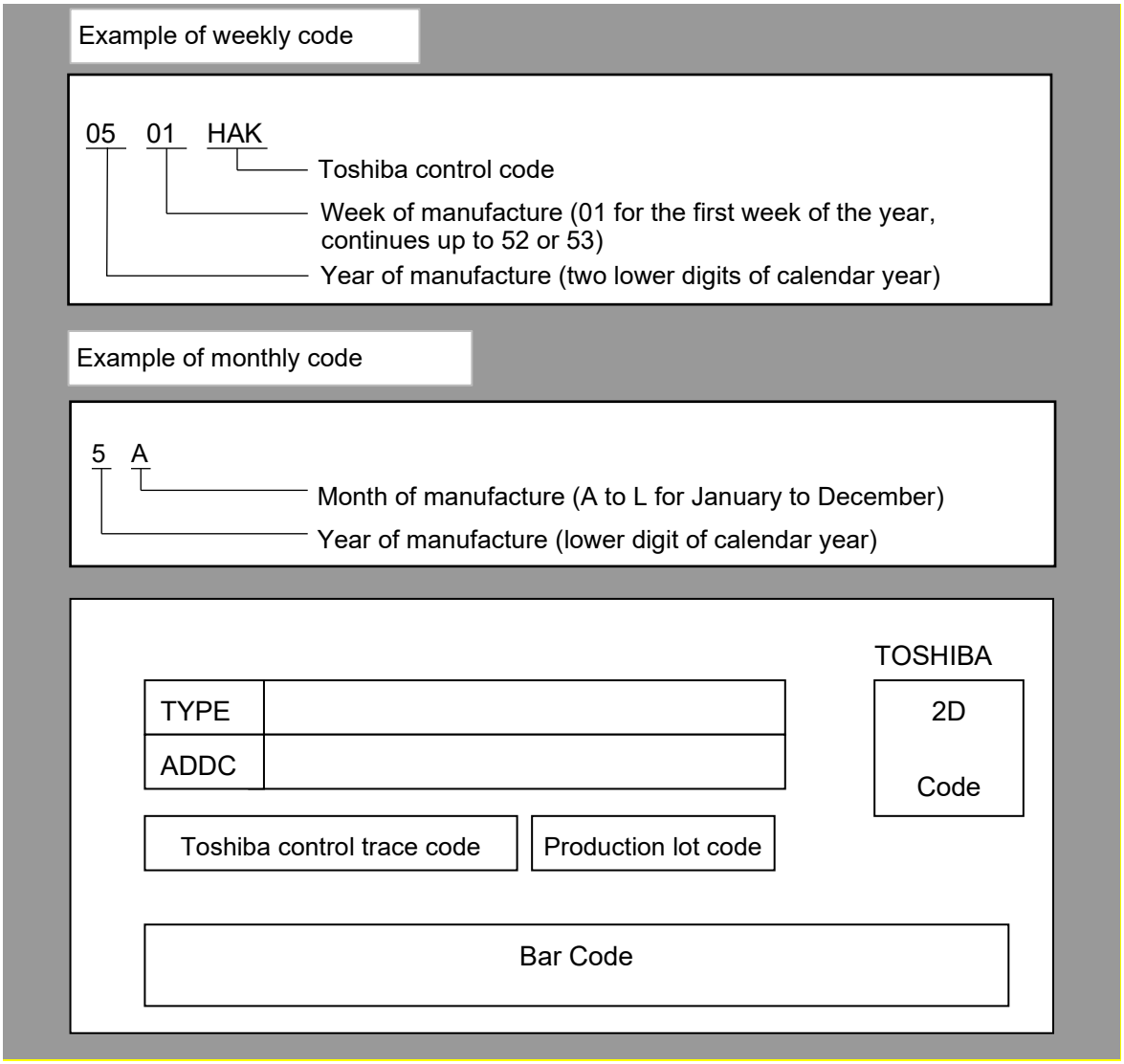

Figure 2.5.1 Production lot code Examples

2.6 Action at the Time of Failure

For defects in the manufacturing process, parts, or products, we investigate the cause and confirm the affecting range, and promptly treat the target products, parts, and processes using the path shown in Figure 2.6.1.

If the defects discovered during the process extend to products that have already been shipped, we will promptly contact the customer and take care of the product.

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In addition, we conduct a root cause investigation and carry out corrective actions and preventive actions, including quality system changes. Depending on the details, we perform corrective actions and preventive actions after obtaining prior approval from the customer. After corrective and preventive actions are taken, we confirm the effect and verify the details of their implementation. This series of details is reported to relevant departments and kept as quality records, and is deployed horizontally as necessary to prevent recurrence.

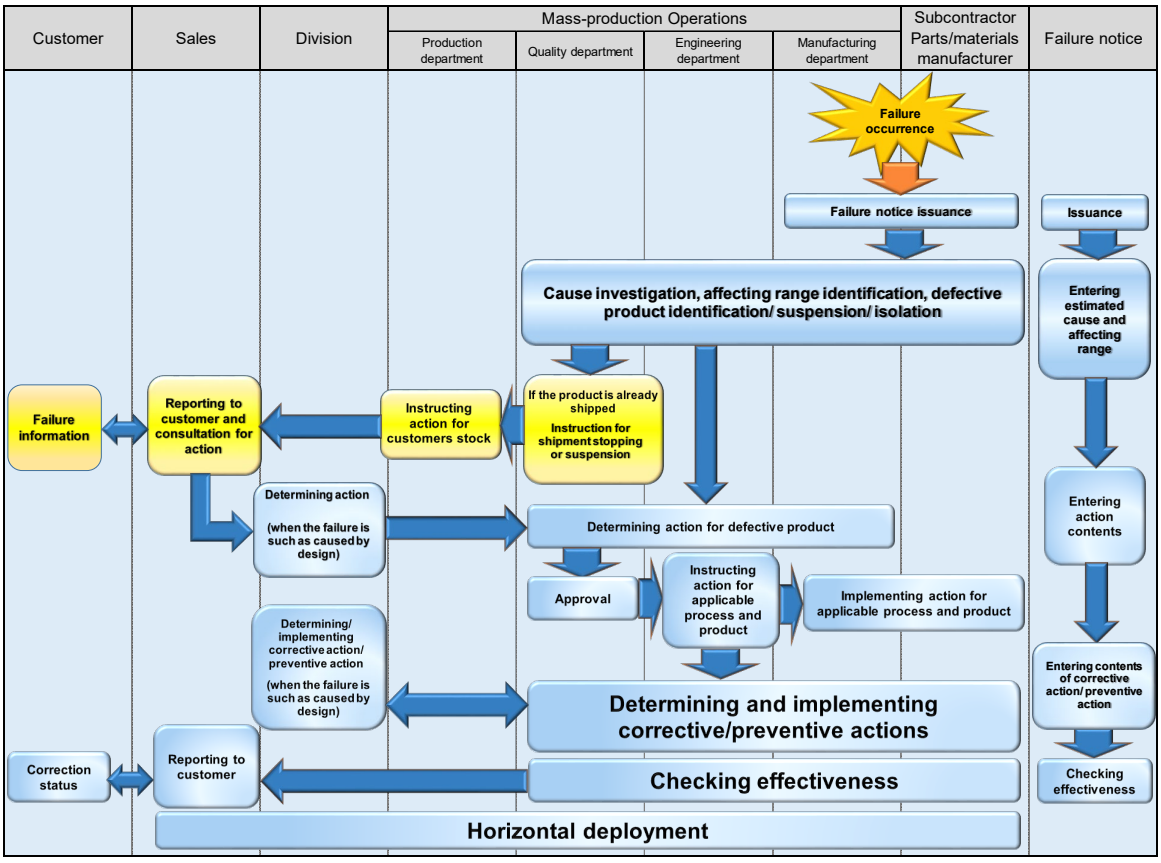

Figure 2.6.1 Flow of Action at the Time of Failure

2.7 Statistical Process Control

We use statistical methods for each process, quantitatively analyze the variation affecting quality, and use the results to improve quality.

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Specifically, using risk analysis as shown in Figure 2.7.1, we determine the critical control items based on those that affect quality and reliability, had serious trouble in the past, correlate with defect mechanisms, etc.

Based on that, we investigate the capabilities of each process, carry out process improvement on items with a poor process capability index level, and perform continuous quality improvement activities. A computer integrated manufacturing (CIM) system is employed to improve data entry efficiency and enhance Statistical Process Control (SPC) effectiveness. Furthermore, educational curricula are incorporated in training to promote the use of statistical methods among operators and engineers, so as to broaden the use of SPC and further improve quality.

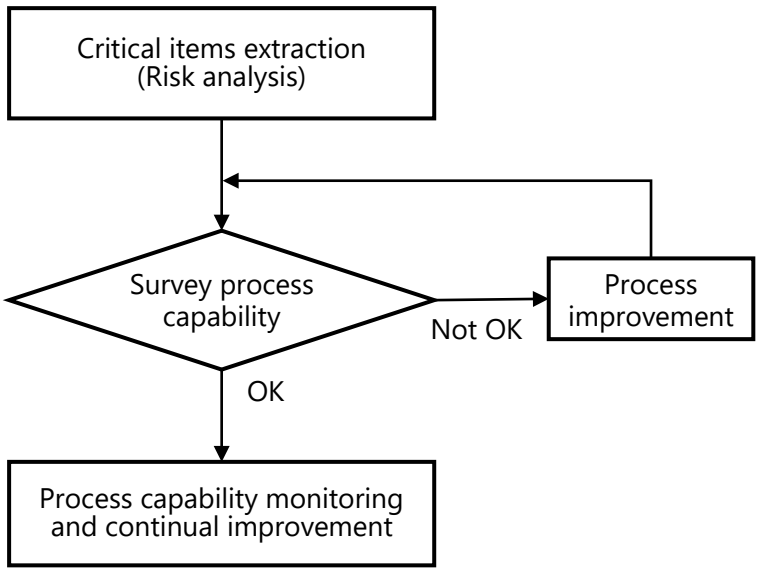

Figure 2.7.1 Example of Statistical Process Control Flow

2.8 Product Shipment Quality Assurance

To guarantee the quality and reliability of semiconductor products, it is important to incorporate quality and reliability in the products during the design and manufacturing stages. After confirming that there is no omission in quality control at each stage, and conducting all electrical characteristics inspections in the manufacturing process to ensure

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the quality and reliability of the final shipment, in principle, we conduct sampling inspections for lot acceptable quality level (AQL) based on the standard shown in Table 2.8.1 in the initial distribution phase.

We also monitor quality and reliability levels.

Quality monitoring is used to verify the initial electrical characteristics and appearance of randomly selected sample products. This process assures the quality and reliability of shipped products.

On the other hand, reliability monitoring is used to verify the reliability level based on the end product process or package family type. The required reliability tests are therefore conducted in units of process or package family. Changes in quality/reliability levels are reflected in the establishment of target failure rates, thereby aiding in level maintenance and improvement of the manufacturing process.

Furthermore, because recent customer requirements have been raised to a level that cannot be verified by normal random inspection, Toshiba further improves quality and reliability levels by utilizing a method that controls the defect rate at the PPM level.

Table 2.8.1 Acceptable Quality levels (AQLs) (AQL; ANSI Z1.4-1993 compliant) (normal inspection by single sampling)

Item	Product Type
	Discrete/IC/LSI
Electrical Characteristics	0.15%
Appearance	0.15%

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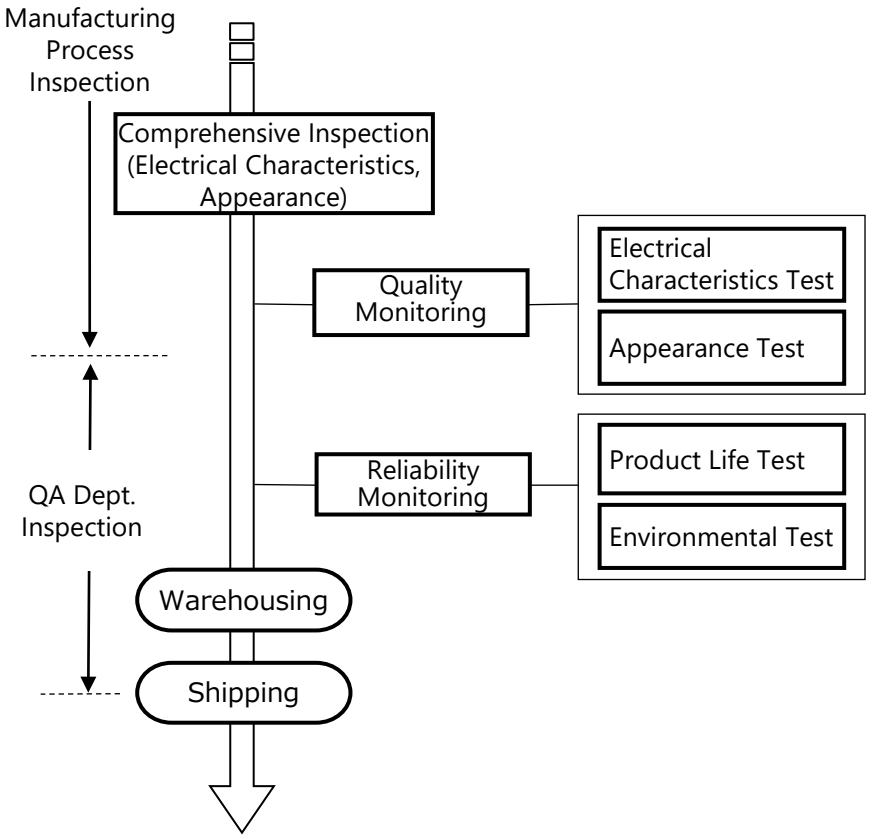

Figure 2.8.1 Inspection Procedure

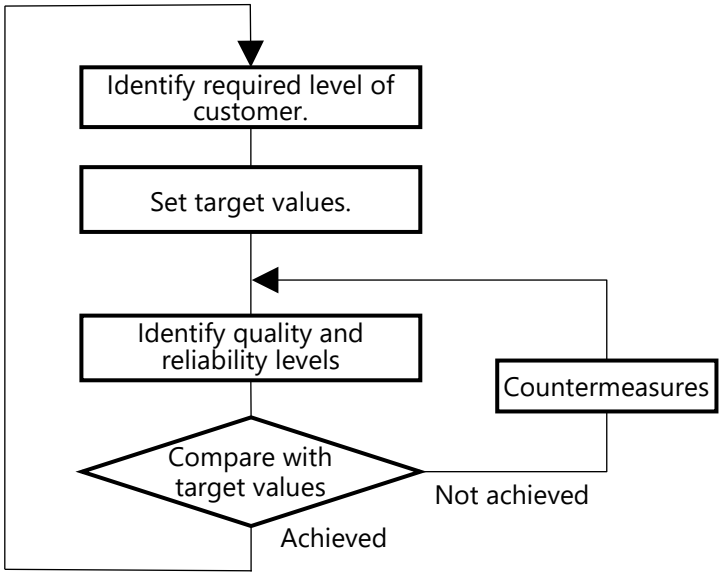

Figure 2.8.2 Quality and Reliability Level Confirmation Procedure

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2.9 Certificate of Inspection

Products that have passed prescribed inspections have a quality assurance tape so as to clearly show that the product is quality assured. The example of a quality assurance tape is shown in Figure 2.9.1, and the example of use is shown in Figures 2.9.2 and 2.9.3.

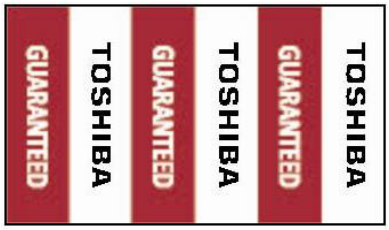

Figure 2.9.1 Quality Assurance Tape Example

Figure 2.9.2 Quality Assurance Tape Use Example

Figure 2.9.3 Quality Assurance Tape Use Example

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2.10 Certificate of Inspection

Toshiba has established an original logistic system, which offers just-in-time delivery to customers. Toshiba warehouses across the world comply with the common standards of quality control. Toshiba logistics with unified control offers transportation system that satisfies customers. The products manufactured in factories are distributed according to the Toshiba logistics and delivered to the right customers as per order. Furthermore, in order to enhance collective distribution quality, Toshiba has made an effort to improve package management and transportation management.

2.10.1 Package Management

From various viewpoints including consideration for global environment, protection of products in transits against various damages, and ensuring of product quality and reliability, management of package materials and specification is important. Thereby, Toshiba manages product packages based on the following two points:

Out of consideration to global environment, Toshiba promotes the use of package materials that are selected based on the Toshiba Green Procurement guideline and that satisfy the 3Rs (Reuse, Reduce, and Recycle).

Various characteristics evaluations including sizing and electrical characteristics are conducted to ensure a prevention of damage towards products in transits and product quality. Also, considering for customers' equipment that will incorporate Toshiba products, Toshiba has been promoting use of package materials complied with JEITA/IEC standards in order to share types of package materials in common with other semiconductor manufacturers.

2.10.2 Logistic Quality Improvement

Toshiba manages logistic quality in accordance with management points listed in Table 2.10.1. The management criteria are stipulated in order to avoid product degradation in quality. By automating logistic system, Toshiba makes an effort on upgrading detection

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capability of product mishandlings due to mistakes, like wrong labeling, that are made in logistic process.

Toshiba has promoted improvement on processing of individual claims from customers. To satisfy customers' claims, the lot tracing system has been used two-dimensional code, which enhances inspection accuracy. Furthermore, Toshiba has promoted enhancement of logistic quality by establishing the check system in various ways like introduction of logistic management system that is compliant with ISO9001 and IATF16949 and supply chain management (SCM) system.

Table 2.10.1 Points in Logistic Quality Management

Characteristics	Cause of Quality Degradation	Possible Problem
Temperature	Temperature Humidity Dust	Discoloration, deformation of packages, contamination
Handling	Mishandling (Impacts like dropping products and mishandling of sheets and forms)	Deformation of packages, contamination Mislabeling
Delivery	Vibrations and impacts Transportation	Deformation of packages, contamination Destination errors, stowage control errors, delays in delivery

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Chapter 3 Common Support Systems

3.1 Education and Training

Toshiba provides education and training programs for each level and position, including programs for new employees, general employees, supervisory manager and corporate managers.

Constructive quality-related education and training is carried out based on curricula designed to maintain and improve product quality and proactively promote quality control. Table 3.1.1 shows a quality-related education system example. Two types of education and training courses are offered: those for engineers engaged in manufacturing, engineering or quality assurance and for onsite supervisors.

Courses for engineers cover a wide range of quality control education that takes into consideration the student's level of knowledge and experience.

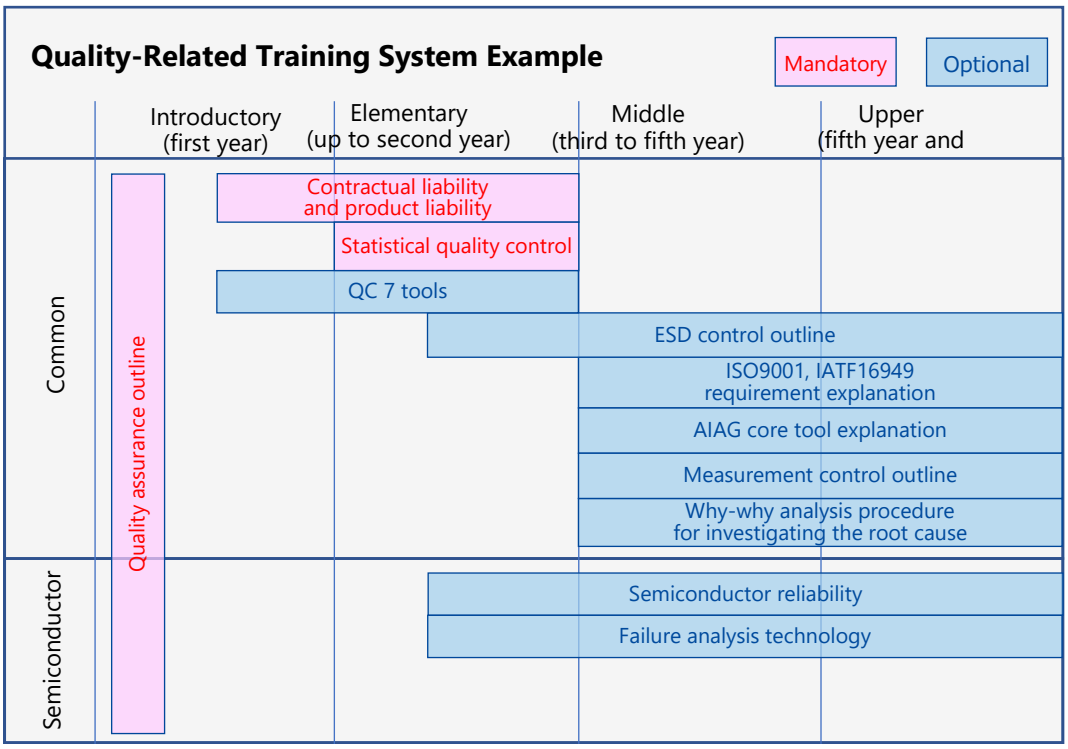

Figure 3.1.1 Quality-Related Education System Example

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To manufacture stably high-quality and reliable semiconductors, each manufacturing department provides basic and specialized education related to semiconductor manufacturing periodically and on an as-needed basis to operators, using the qualification system shown in Figure 3.1.2.

The process of qualifying personnel for particular tasks in this way raises and equalizes the skill levels of employees, helping to stabilize quality.

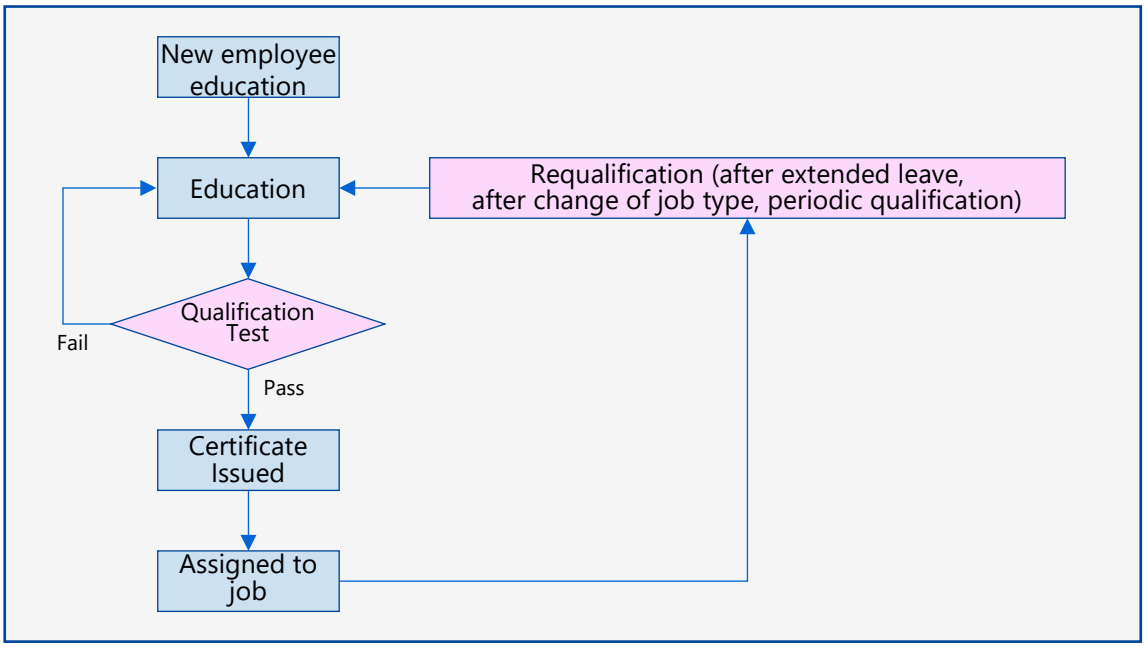

Figure 3.1.2 Operator Qualification System

3.2 Document Control

3.2.1 Standardization System

Toshiba standards are controlled at every phase, from design to manufacturing, using an internal network system. A procedural flow is established that ensures that these standards are issued efficiently and without fail.

In addition, rules for as-needed revision and abolishment have been set so that the standards prepared are effectively utilized at all times.

Figure 3.2.1 shows how Toshiba standards are organized.

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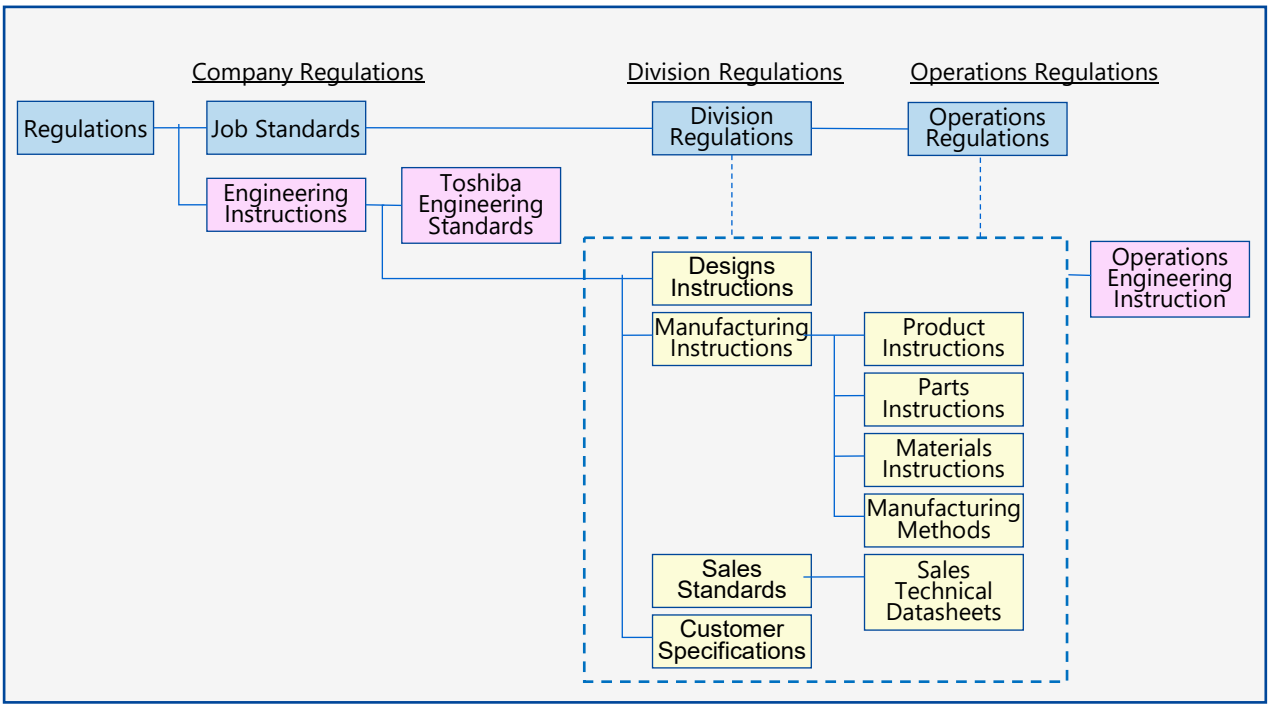

Figure 3.2.1 Standards Organization

3.2.2 Document Control System

Documents and data are controlled as follows:

Performance, quality and reliability standards required by the customer and items related to quality assurance that appear in customer specifications are integrated into the standardization system as custom specifications and made known to the departments concerned to ensure appropriate utilization and proper reflection in manufacturing. (See Figure 3.2.1)

In addition, this information is strictly controlled to ensure confidentiality.

A controlling department for quality-related documents and data is clearly identified so that the information can be effectively utilized with applicable standards. Such information includes internal approval documents and data, reliability test data and process audit records.

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The retention period for these documents and data is prioritized according to the criticality of the contents and controlled in such a manner that ensures storage for the appropriate period of time.

3.3 Measurement Control

Measurement control regulations have been established to guide the control and use of measuring instruments.

Toshiba uses calibration instruments regulated by law that have been inspected and approved by authorized agencies. These instruments are periodically inspected and the results are filed and maintained. This type of control is performed by the Quality Assurance Department.

Semiconductor manufacturing is a field that involves very small dimensions for which there are no national standards. In such cases, Toshiba standards and Toshiba Electronic Devices & Storage Corporation standards are formulated in cooperation with measurement device manufacturers and overseas agencies, enabling tracing to the standard calibration instrument of each process.

Figure 3.3.1 shows the instrumentation accuracy traceability system.

Procurement inspections, periodic inspections and spot inspections are performed on instrumentation. The related log books and slips are filed with the Quality Assurance Department. Approved instruments are identified by a seal which indicates the effective period and the next inspection date.

In addition, the department that owns an instrument is responsible for daily management based on control standards.

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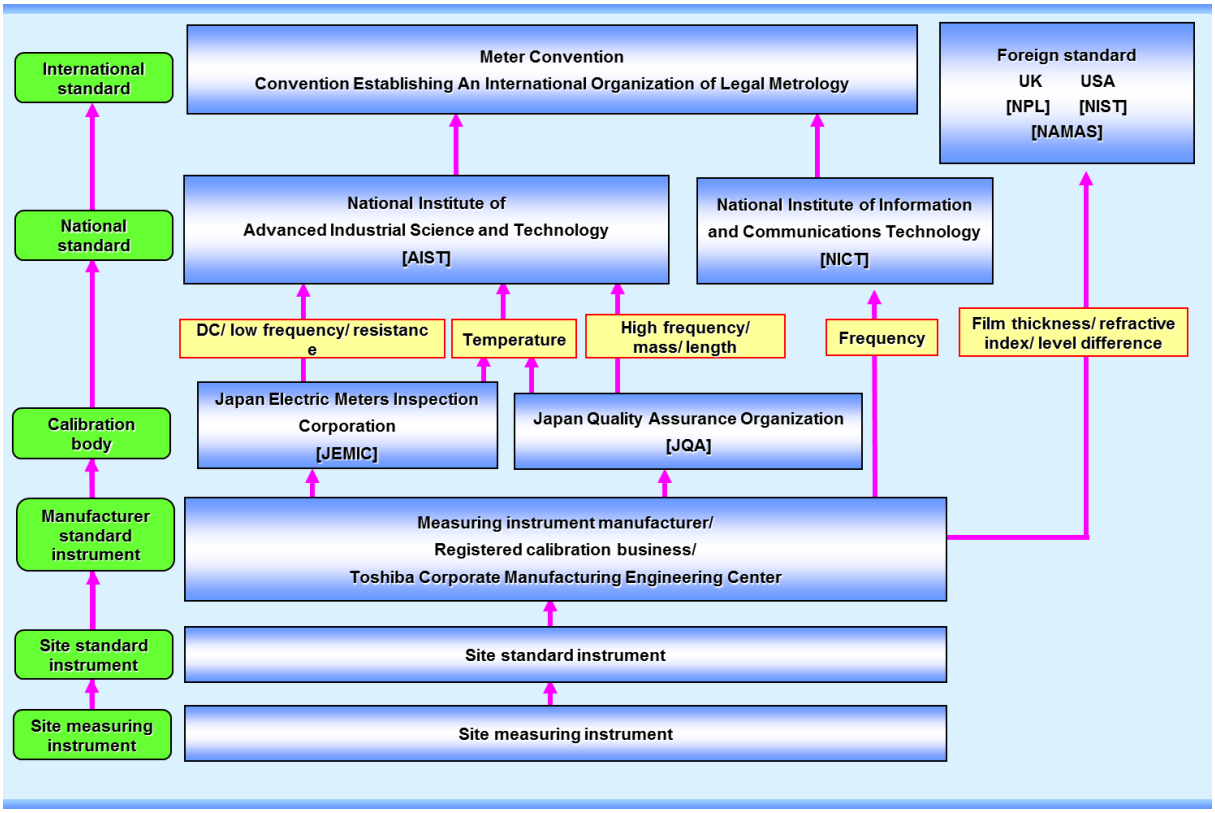

Figure 3.3.1 Traceability System Diagram for Measuring Instruments

3.4 Internal Audit

To ensure that quality assurance activities and related work is carried out as planned and to maintain and improve product quality and reliability, audits are periodically conducted in each phase of planning, development , design and manufacturing by an audit team. Table 3.4.1 describes the main internal quality audit types and content.

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Table 3.4.1 Main Internal Audit Types and Content

Type	Target	Auditor	Frequency	Items Checked
Comprehensive quality audit	Division	Quality department of Toshiba Corporation	Once a year	Quality assurance system Standardization Planning phase control Design phase control Manufacturing, inspection, packaging Other
Internal audit	Staff Sales Engineering Dept. Manufacturing Dept. Production Dept. QA Dept. Other	Audit team (Those who have completed the required training)	Once a year	ISO9001/IATF16949 applicable items (Regulations, records and implementation status)

3.5 Customer Support

3.5.1 Customer Quality Support

Overview

Toshiba has established a system whereby the increasingly diverse customer quality requirements and customer satisfaction levels after product shipment are clearly identified and fed back to processes and design departments so as to ensure continual response to market quality requirements.

Quality Information Services

Toshiba prepares the following information and materials to offer support in every phase, including the phases of product approval by customer, incoming inspection and assembly.

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This information can be provided promptly upon customer request.

1. Reliability data
2. Approval test data for product changes
3. Package Mounting Guidance

Quality Communication Meetings

Periodic quality communication meetings attended by customers and Quality Assurance Department members are held to maintain a relationship of trust with customers.
In the meetings, the customer is provided a high level of support through information exchange and reports on defects, preventive measures and plans for improvement.
To satisfy customer expectations concerning the quality level and to maintain and further improve product quality, Toshiba has adopted a proactive system of cooperation, ensuring that the detailed information that cannot be checked on a daily basis is checked and that mutual goals are achieved.

Customer Support on Failures

We support customers when a failure arises. We will explain further in the following section.

Collecting Information from Customers and Feedback

Toshiba utilizes the delivery specifications and quality contracts that state customer requirements, failure information from customers, customer testimonies obtained from various venues such as quality communication meetings as well as the results of customer satisfaction surveys conducted by a third party to further improve customer satisfaction and obtain customer trust.

3.5.2 Customer Support on Failures

Through the in-house electronic system from the Sales Department, failure information from customers is quickly conveyed to the Operations Quality Assurance Department in charge of

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manufacturing and the Quality and Reliability Engineering Department in the Division. Both departments in cooperation conduct tracing of product information, confirmation of the actual product, failure analysis, etc. They also examine investigations and countermeasures with manufacturing and engineering Departments, and submit deliveries of corrected products and failure information, etc.

In addition, failure information is fed back to relevant departments in charge of the manufacturing process, etc. to prevent recurrence and is used to improve quality and reliability.

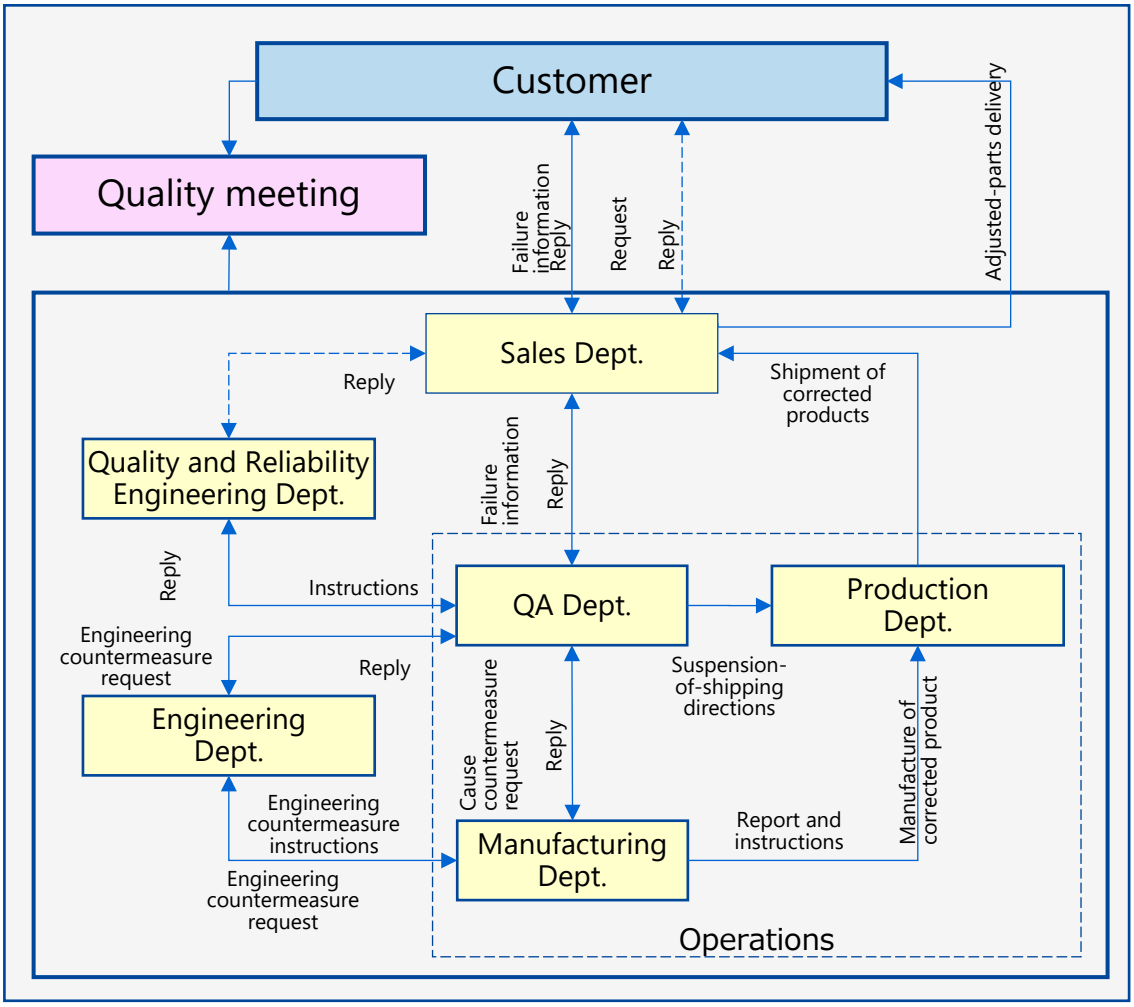

図 3.5.1 Customer Support Channel on Failures

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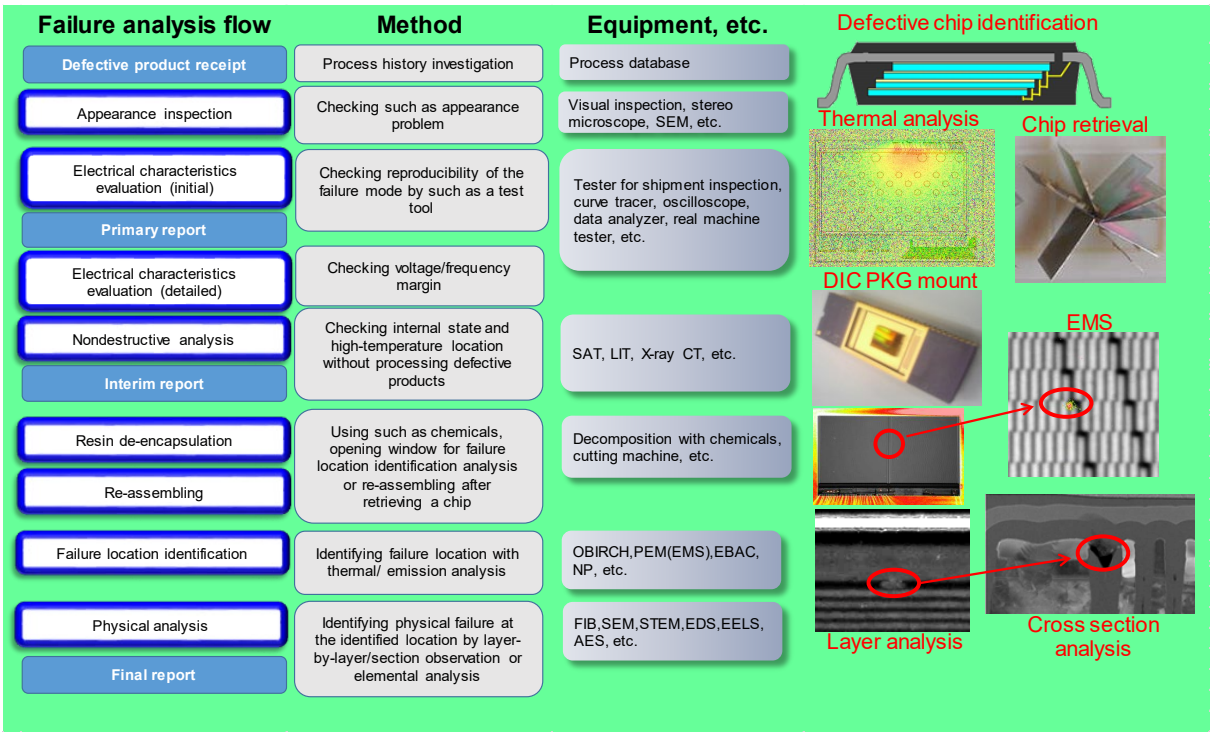
Figure 3.5.2 shows a general failure analysis flow chart.

Basically, after acquiring a defective semiconductor product, we perform an appearance inspection and initial electrical characteristic evaluation, and report on the results of the reproducibility check of the failure mode. We will perform a more detailed evaluation and present an interim report as necessary.

We then continue to identify the cause of the failure and make the final report, including countermeasure proposals, etc.

Refer to the "Reliability Handbook" for each analysis example.



SAT: Scanning Acoustic Tomograph
LIT(ELITE): Lock-In Thermograph
OBIRCH: Optical Beam Induced Resistance Change
PEM(EMS): Photo Emission Microscope
EBAC: Electron Beam Absorbed Current
NP: Nano Probe
FIB: Focused Ion Beam
SEM: Scanning Electron Microscope
STEM: Scanning Transmission Electron Microscope
EDS: Energy Dispersive X-ray Spectrometry
EELS: Electron Energy Loss Spectroscopy
AES: Auger Electron Spectroscopy

Figure 3.5.2 Failure Analysis Flow Chart

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Chapter 4 Environmental Activities

4.1 Environmental Quality of Products

Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive, the End of life Vehicles (ELV) Directive and other legislation in Europe restrict the use of environmentally hazardous materials in the various manufacturing types of electronic and electrical equipment. In response to the movement, China, Korea, Taiwan, Thailand, India, Vietnam, and others have also enacted their own laws and regulations similar to the EU/RoHS Directive.

Furthermore, the REACH (a European Community regulation which deals with the Registration, Evaluation, Authorization and Restriction of Chemicals) requires the regulations of chemical substances including carcinogens and other potentially hazardous substances to gene information. The objectives of these regulations and restrictions such as RoHS Directive and the REACH Regulation in use of such chemicals are: 1. to prevent environmental pollution such as soil, groundwater and atmospheric contaminations and 2. to protect the human health and environment, against chemical substances contained in electronic and electrical equipment (i.e., parts and materials that constitute them). For semiconductor devices that compose electronic and electrical equipment, better control and management of environmental pollutants and conversions to safer alternative substances are considered to be important quality factors.

With the goal of "contributing to the realization of a sustainable society through environmental management which aims to create enriched value and to ensure harmony with the earth," Toshiba reduce environmental burdens.

At Toshiba, quality management extends beyond the assurance of semiconductor devices' functions and reliability; the concept of quality encompasses controlling substances contained in the products. Toshiba defines procurement-prohibited substances and controls those contained in its products below a specified limit. As shown in Figure 4.1.1, the quality, procurement and environment divisions are concerned with environmental quality of

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products. These departments make combined efforts to assure environmental quality of products.

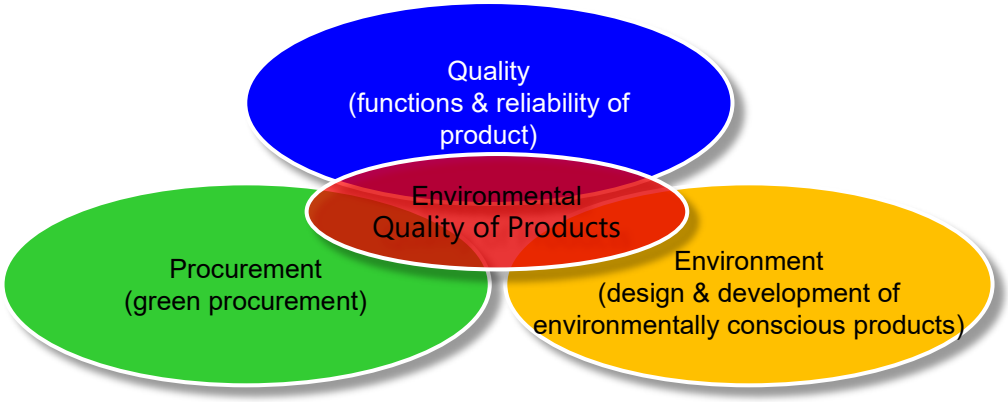

Figure 4.1.1 Environmental Quality of Products

4.2 Environmental Considerations for Design, Development and Process Changes

Environmental Considerations for Design, Development and Process Changes

At the design and development stages, semiconductor devices are based on the environmentally conscious product design. Thus, implementing the product environmental assessment enhances developing the environmentally conscious products (ECP)[*1]. A similar approach is also taken when changing materials and/or manufacturing processes.

*1: ECP・・・Environmentally Conscious Products

4.3 Green Procurement

To ensure compliance with environmental legislation such as the EU / RoHS directive and the REACH Regulation, Toshiba has created its own list of materials, considering the customer trends. Toshiba also has the green procurement guideline to obtain cooperation from each of its suppliers for the control of environmentally hazardous substances.

The guideline defines the voluntarily controlled substances and their controlled level, and the requirements for the environmental quality management system, including the banned and

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reportable substances. The guidelines also oblige suppliers to submit the evidences and so on that satisfy the Toshiba requirements. For green procurement, Toshiba endeavors to select environmentally-friendly parts and materials in a joint effort with its suppliers.

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Notes

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