

JEDEC STANDARD

Device Quality Problem Analysis and Corrective Action Resolution Methodology

JESD671D

(Revision of JESD671C, July 2018)

OCTOBER 2018

JEDEC SOLID STATE TECHNOLOGY ASSOCIATION



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DEVICE QUALITY PROBLEM ANALYSIS AND CORRECTIVE ACTION RESOLUTION METHODOLOGY

Introduction

Suppliers and Authorized Distributors of electronic devices strive to ship devices with zero defects. Despite their best efforts, problems may occur from time to time. When that happens, timely and accurate root cause failure analysis and the establishment and maintenance of an effective corrective action system are of critical importance to an electronic device supplier's ability to successfully resolve such customer-reported failures. The initial response, failure analysis, and corrective action turnaround time requirements for customer-initiated problem analysis or corrective action requests, vary widely. This document is a compilation of the most common requirements involving problem analysis and corrective action associated with customer-reported problems and provides guidelines for the establishment of common expectations for both the Supplier and the Customer.

DEVICE QUALITY PROBLEM ANALYSIS AND CORRECTIVE ACTION RESOLUTION METHODOLOGY

(From JEDEC Board Ballot JCB-18-39, formulated under the cognizance of the JC-14.4 Subcommittee on Quality Processes and Methods.)

1 Scope

The scope of this standard includes any Customer-initiated device problem analysis/corrective action request and Supplier/Authorized Distributor-identified device nonconformance to specification which may impact the Customer.

This standard establishes a common set of Customer, Authorized Distributor and Supplier expectations and requirements that will help to facilitate successful problem analysis and corrective action of device problems, including administrative quality problems, which may affect the Customer.

2 Applicable documents

ANS ISO9001:2000, *Quality Management System* (Quality systems for organization which design, develop, manufacture, install and/or service any product or provide any service.)

EIA-599, *National Electronic Process Certification Standard*

JESD625, *Requirements for Handling Electrostatic-Discharge Sensitive (ESDS) Devices*

JESD22-B101, *External Visual*

3 Terms and definitions

authorized distributor: A distributor with a written contract with a manufacturer that authorizes the distributor to stock, resell, and provide warranty support for specified device lines.

NOTE This standard gives instructions, guidance, and procedures and assigns responsibilities for Authorized Distributors only as unauthorized distributors or independent distributors may not be capable of providing manufacturer failure analysis support. When it was felt no confusion is likely, the term is frequently abbreviated to simply "Distributor".

device problem: Any problem related to the Supplier's device that causes failure during, or interruption to, the Customer's production flow or failures of their devices in the final application.

- a) administrative problems (wrong device, wrong quantity, packing/materials, orientation, date code, paperwork, shipping damage, shipping error, labeling, etc.),
- b) electrical problems (functional, parametric, timing, continuity, programming, etc.), and
- c) visual/mechanical problems (marking, leads, package body, solderability, contamination, etc.).

3 Terms and definitions (cont'd)

containment: Interim action(s) taken to minimize the effects of device problems on customers until corrective actions are implemented.

corrective action: Actions taken to eliminate the root cause(s) of an existing nonconformity, or other undesirable situation.

customer: The purchaser of a finished device

device: an individual device (e.g., integrated circuit, transistor, diode, capacitor, resistor, etc.)

NOTE A device may include a die or multiple die. Further, the die or dice in the device may be acquired by the device supplier from 3rd party subsuppliers. Such subsuppliers may be integral to the problem analysis and corrective action.

disposition: The act of determining the future course of action for nonconforming material, e.g., scrap, use-as-is, retest, rework, and other.

failure analysis: Investigation to determine the failure mechanism associated with a nonconforming device.

failure mechanism: The physical, chemical, electrical, or other process defect that has led to a nonconformance.

failure mode: The way in which a failure mechanism manifests itself in a failing device (electrical signature or workmanship standard).

preventive action: Action taken to modify the management systems, practices, or procedures to prevent recurrence of the current problem and similar problems where applicable.

problem analysis: Investigation to determine the root cause of a reported device problem.

root cause: The source of the failure mechanism or cause of an administrative problem.

subsupplier: A separate financial entity from the supplier that provides materials, components, assembly, and/or test services for the finished device.

supplier: The entity that guarantees the quality and specifications of the finished device.

4 Requirements

In conjunction with this requirements section, Annex A (informative) provides a typical flowchart and Annex B (informative) provides a typical tracking and report form.

A favored structured process for identifying, containing, analyzing, correcting and preventing device failures is the Eight Discipline (8D) process.

The 8D disciplines of problem solving describe a method, a process, and a reporting format used in responding to customer returns or issues. Its effectiveness stems from the fact that it incorporates all the important aspects of problem management, i.e., containment of the problem, root cause analysis, problem correction, and problem prevention. The output of an 8D method is action that eliminates the root cause and an 8D report. The format of the 8D report follows the steps of the 8D method. The parts of this standard that correspond to 8D steps are described and otherwise labeled as 1D, 2D, etc.

4.1 General requirements

4.1.1 Supplier

The Supplier is expected to perform failure analysis upon request, and is therefore required to maintain failure analysis expertise and equipment within the company, or have such expertise and equipment available through subcontracted services in order to provide effective and timely analysis and conclusions.

If the risk of a verified device problem is determined to be significant and may affect other Customers, the Supplier shall attempt to notify all potentially affected customers of record in a timely manner of the problem and provide a status report of failure or problem, containment and corrective action. This requirement applies to both Customer-identified and Supplier-identified noncompliance.

4.1.2 Authorized Distributor

Authorized Distributors are expected to provide support to the Customer and the Supplier for a failure analysis request when the Customer purchased the device directly from the Distributor. This support should be in the form of the facilitation of communication between the Customer and the Supplier, request for and collection of information for the Supplier from the Customer, transportation of device to the Supplier and, if required, back to the Customer. This support should be effective and provide timely support to the Supplier's Failure analysis process and the Customer's request for a Failure analysis.

The Distributor is expected to maintain point of contacts for their Suppliers who are to be contacted for failure analysis requests. The Distributor is expected to understand any Failure analysis request requirements and processes for their Suppliers. They are to effectively communicate these requirements to the Customer.

4.2 Device Problem Description and Submission (1D)

The first step in beginning the device or device quality problem analysis is Discipline 1: Form the Team.

This is the first step of the 8D process and the first part of the 8D report. This step defines the composition of the 8D team. The team should be cross-functional and should include as members the process owner, a member from quality, and others who will be involved in the containment, analysis, correction, and prevention of the problem. The names of the members as well as their positions in the company organization are enumerated in this part of the report.

Problems identified by the Customer shall be communicated to the Supplier in a timely period to minimize further manufacture and distribution of problem devices.

The Customer shall segregate and control problem devices to minimize or eliminate the possibility of subsequent device damage including damage caused by the handling and shipping / media prior to Supplier's analysis.

Any device deemed by the Supplier to be in a condition that is not suitable for analysis will be placed on hold, and the Customer notified. In such a case, the analysis request may be rejected by the Supplier.

NOTE Supplier may also reject any analysis or implementation of this standard if it is determined that a returned device has been physically modified, reworked, refurbished, reconfigured or rebranded without authorization or knowledge from the supplier.

The Customer verification data, testing conditions and analysis shall be shared with the Supplier or Distributor to the extent the information and conclusions apply to that Supplier and device. Customer shall communicate any data and/or information with the defective device to the supplier along with the conditions by which the device fails in the Customer application and any explanation for how the failure can be reproduced. Customer shall interpret any data and / or information submitted with the defective device for the Supplier. The customer shall fault-isolate to the least element possible; in cases with multiple dice, isolation to at least an individual die is the ideal.

4.2 Device Problem Description and Submission (1D) (cont'd)

The customer's request for problem analysis and/or corrective action to the supplier shall include, but not be limited to the following:

- a) Priority level (Standard or Urgent)
- b) Date the device failed in test or system
- c) Sample(s) of the reported problem, in testable condition.
- d) Customer request/tracking number.
- e) Manufacturer's part number.
- f) Supplier part number.
- g) Top and bottom, if applicable, part marking.
- h) Location of problem detection (receiving inspection, manufacturing process, life testing, field, system, etc.).
- i) Identification of the failure mode, terminal, etc.
- j) Operating conditions and environment (voltage, current, temperature, timing, pattern, vectors, application, etc.).
- k) Problem category and detailed description of the observed problem. The standard set of problem categories to be used is:

<u>Electrical</u>	<u>Visual/Mech.</u>	<u>Administrative</u>
Functional	Marking	Wrong device
Parametric	Leads	Wrong quantity
Timing	Package body	Packing/materials
Continuity	Solderability	Orientation
Programming	Contamination	Date code
Other	Other	Paperwork
		Shipping damage
		Shipping error
		Labeling
		Other
System / Application		

NOTE For the purpose of obtaining a cooperative and proactive analysis methodology that best suits the device and failure mode, the Customer is advised to contact the Supplier prior to the initiation of any destructive physical analysis.

The Customer shall segregate and control problem devices to minimize or eliminate the possibility of subsequent device damage including damage caused by the handling and shipping / media prior to Supplier's analysis.

4.2 Device Problem Description and Submission (1D) (cont'd)

When the Customer purchased the device directly from a Distributor, the Distributor shall communicate the Supplier's Failure Analysis process requirements to the Customer.

The Distributor shall collect all information about the problem from the Customer per the Supplier's requirements and any additional information provided by the Customer. Any information required by the Supplier shall be collected from the Customer by the Distributor and shared with the Supplier.

The Distributor shall facilitate the transportation of problem samples to the Supplier's location. The transportation may be via the Distributor's location or directly to the Supplier's location.

The Distributor should evaluate the Customer Failure Analysis request to ensure this, to the greatest extent possible, is a valid request prior to sending it to the Supplier.

4.3 Problem verification and identification (2D) - Supplier

Upon receipt of the reported problem samples from the Customer or Authorized Distributor, the Supplier shall verify the stated problem/failure mode with respect to the device specification or the agreed upon purchase specification, including visual, mechanical inspection and / or electrical test, where applicable. If the Customer has not submitted any technical information with the defective device, the Supplier may

- a) reject the analysis request,
- b) perform their standard electrical test or
- c) place the analysis on hold and contact the Customer for additional information.

Verification may be done on a representative sample of each failure mode or problem observed by the Customer. It is not required that the Supplier verify every device that exhibits the same failure symptom.

If the problem is verified by the Supplier, then all known elements of the problem, if any, shall be identified. This includes, but is not limited to, failure mode, location of the problem, effect/impact of problem, date/lot codes, other part numbers shipped to that customer that could be affected by the issue (e.g., is the issue limited to one device or all devices made on that process, in that package, on a specific tool) etc.. A clear statement of the problem and known impact shall be generated and submitted to the Customer. It should be understood that full knowledge of the problem may not be available prior to a more detailed problem analysis.

If the problem is not verified by the Supplier, the Customer has the responsibility to identify all failing conditions and upon request from the Customer the Supplier is expected to assist the Customer in identifying the source of the problem. The problem may be a test or application issue, handling, customer error, design, etc.

If the Customer fails to provide the requested support or information the Supplier may choose to close out the analysis request with a conclusion of "problem not verified".

This clause can be used to fulfill Discipline 2 (2D) of an 8D approach, "Describing the Problem". If employing the 8D approach, commonly included elements to record are a) the identity of the customer, b) a description of the customer application, c) device information (device, package, lot #, date code, etc., d) when the problem was encountered, e) where the problem was encountered, f) a specific description of the failure mode, and g) failure rate (if known).

4.4 Containment strategy (3D) - Customer/Supplier/Authorized Distributor

As soon as possible after verification of a device problem that may impact the Customer, a containment strategy shall be defined and implemented by the Supplier. The extent and urgency of any containment actions taken shall be appropriate to the risks and magnitude of the identified problem. Action can range all the way to recall from the field in the most critical situations.

- a) The containment strategy shall include the method and results of verifying the containment actions and the disposition of nonconforming device at the Supplier's, Authorized Distributor's and Customer's locations. It is understood that the containment process and directions may be iterative as the Supplier investigation proceeds.
- b) The containment strategy shall be communicated to the Authorized Distributor and Customer.

This clause can be used to fulfill Discipline 3 (3D) of an 8D approach, "Contain the Problem". If employing the 8D format, commonly included for 3D is a list of affected lots numbers and/or date codes.

4.5 Root Cause analysis –Customer/Supplier/Authorized Distributor

Root cause analysis is the process of failure analyzing the suspect devices in order to determine the failure mechanism responsible for the defective operation and using that failure analysis to determine the management systems, operating systems, practices, or procedures responsible for the fundamental reason the issue exists.

If a plan of analysis is requested, the supplier shall document a failure or problem analysis plan and corresponding schedule for failure or problem analysis that will be to the customer and tracked to completion.

- a) The analysis may be done on a representative sample of each observed failure mode or problem. It is not required that the supplier analyze every device that exhibits the same failure symptom.
- b) Signature analysis is acceptable in lieu of performing analysis on devices when failure symptoms and their corrective actions are directly related.
- c) Customer, upon request from the Supplier, shall assist in the understanding of how the defect occurred in the customer's application.
- d) The supplier shall generate a formal report upon completion of failure or problem analysis and provide a copy to the customer and Distributor, as applicable. The report may be in the form of Supplier specific failure analysis reports, embedded in a wider SCAR response or 8D reports, or other formats as agreed upon by the Supplier and Customer. Reports may include references to Process Change Notifications, Application Notes, and formal recalls, as appropriate.

This clause when coupled with tracking through to the fundamental reason can be used to fulfill Discipline 4 (4D) of an 8D approach, "Identify the Root Cause". If employing the 8D format, needed elements to include for 4D fulfillment are a description of the failure mechanism, the correctively actionable root cause, and the chain of events emanating from the root cause that explain the failure mechanism occurrence.

Some tools that can assist in driving toward and communicating the root cause include Naze-Naze (3x5 Why analysis), Ishikawa (fishbone or cause-and-effect) and Is-Is Not diagrams.

4.6 Corrective actions (5D and 6D) Customer/Supplier/Authorized Distributor

When the results of problem verification, failure or problem analysis indicate a need for corrective action by the responsible party (Customer, Supplier or Authorized Distributor), they shall document a corrective action plan and schedule, which shall be communicated to the Customer, Supplier and/or Authorized Distributor as needed and tracked to conclusion.

The corrective action plan shall include, as a minimum:

- a) Investigation of root cause of the failure mechanism or administrative problem (if not already known).
- b) Investigation of why the quality system did not detect and contain the problem.
- c) Identification of corrective actions to eliminate the root cause.
- d) Verification of the root cause and effectiveness of the corrective actions.
- e) Implementation schedule for corrective actions.
- f) Communication of the corrective actions to all of the supplier's areas and alternate facilities that could be affected by the same issue.

This clause can be used to fulfill Discipline 5 and 6 (5D and 6D) and of an 8D approach. 5D is "Formulate Corrective Action Plan". 6D is "Verify Corrective Action". If employing the 8D format, elements to include for 5D fulfillment are the corrective actions with the associated owners, target completion dates, and (preferably) rationales. 5D may also involve preliminary studies to determine the best corrective action before deployment. If employing the 8D format, elements to include for 6D fulfillment are corrective actions, respective owners and actual completion dates, data supporting the effectiveness of the corrective actions, and supplementation of the corrective actions where needed to address deficiencies in effectiveness.

Some tools that can be used to drive to and communicate corrective actions include Poka-Yoke (human error prevention), 6S (sort, set in order, shine, standardize, sustain, safety), PDCA (plan-do-check-act) and lessons learned sharing.

4.7 Preventive action (7D) -Customer/Supplier/Authorized Distributor

The Customer, when the corrective action has been completed, shall modify the management systems, operating systems, practices, or procedures to prevent recurrence of this and similar problems, where applicable.

The preventive actions shall be documented and communicated. This shall include communication of preventative actions to all of the supplier's internal and subsupplier areas and alternate facilities that could be affected by the same issue for similarly vulnerable devices or packages.

This clause can be used to fulfill Discipline 7 (7D) of an 8D approach, "Prevent the Problem". If employing the 8D format, elements to include for 8D fulfillment are the preventative actions, respective owners, and target dates for completion of the actions.

4.8 Congratulate the Team – Customer/Supplier/Authorized Distributor

The last step of the 8D process and the last portion of the 8D report consists of an acknowledgement from management of the good work done by 8D team. Approvals for the 8D report are also shown in this last discipline.

4.9 Time frames

Unless otherwise agreed to in a customer quality requirements agreement with the supplier, analysis of customer-reported problems should be completed in accordance with the task duration guidelines given in Table 1. It is recommended that the Supplier track and report actual performance in comparison to the suggested time limits in Table 1 to understand if improvements are necessary. This metric shall be available for review during regular Supplier/Customer reviews meetings.

The Supplier is required to notify the Customer in the event they are unable to meet previously agreed upon schedules as soon as is practicable.

A minimum set of cycle time guidelines are listed Table 1. In addition to providing general turnaround time guidelines to be used when responding to customer-reported problems, these guidelines can also be used in resource and capital planning. Specific timeline goals for the events described in Table 1 that differ from these guidelines may be determined and agreed to between the Customer and Supplier via a customer quality requirements agreement.

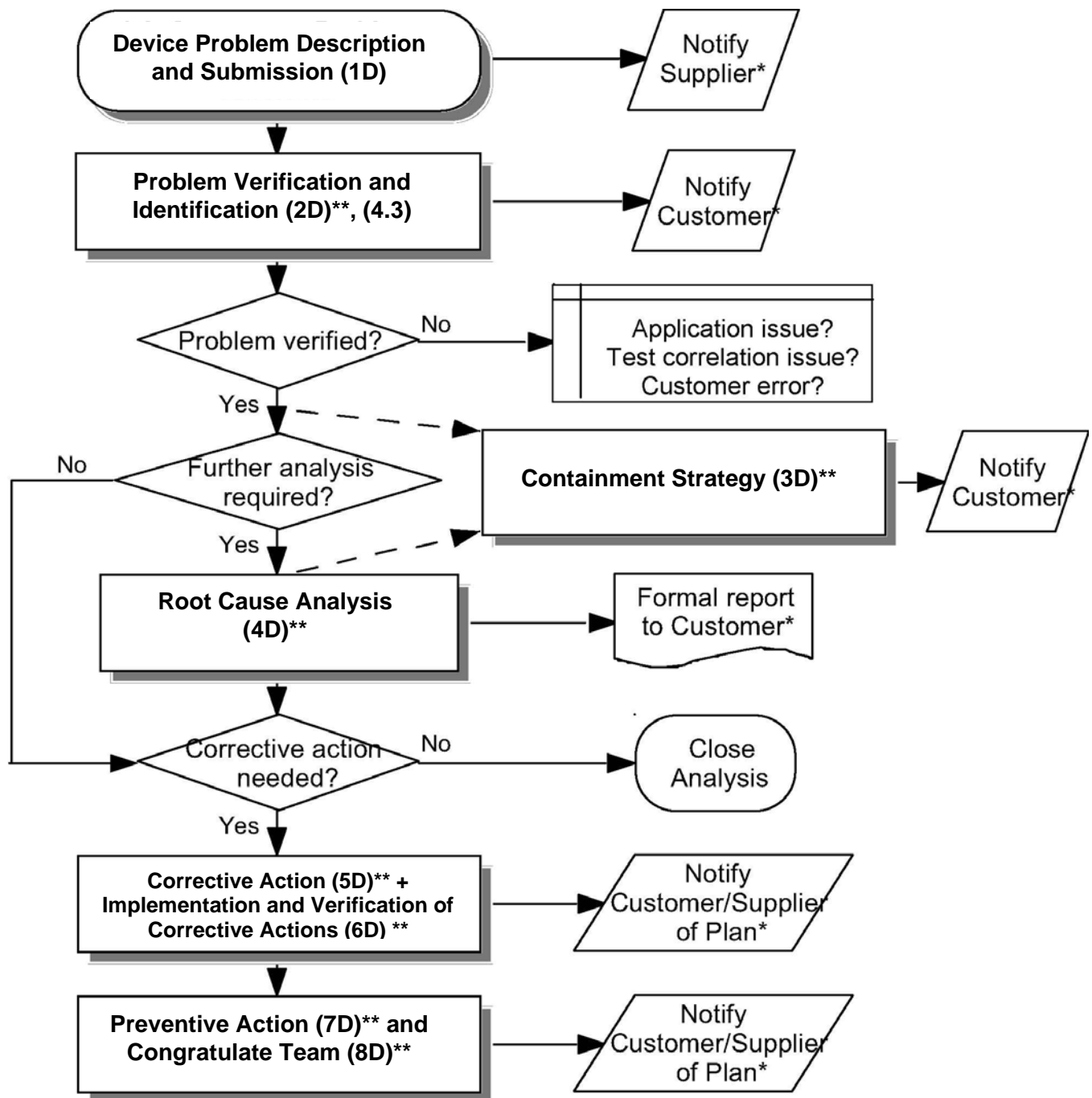
For some offerings, a primary supplier may acquire semiconductor content fabbed by a subsupplier. (This could apply for a supplier of multi-chip modules (MCMs), 2.5D and 3D chip stacked offerings, foundry-fabricated semiconductors, and even 2D packaged devices with other support semiconductor passives.) The customer and primary supplier shall agree on the specific timings that include dependencies on and involvement by sub-suppliers to secure verification, analysis, containment, and possibly even 8D response actions. In these cases, tracking and reporting actual performance should be against the procurement agreement.

As an example, custom timings could be appropriate for an MCM containing an ASIC, plus 3D memory stacks where the primary supplier of the MCM depends on diagnosis of a 3D memory stack by an overseas 3rd party subsupplier who, in turn, may depend on another subsupplier for a logic chip within the 3D memory stack. Another example could be where root cause analysis by the primary supplier depends on one remote subsupplier for outsourced testing to run diagnostics then a fabless design house as a second subsupplier to provide fault locations then a foundry provider as a third subsupplier to execute physical failure analysis and identify a defect.

4.9 Time frames (cont'd)**Table 1 — Problem Analysis Timeline Guidelines**

Event	Standard	Urgent
Customer		
Problem notification and submission to supplier by customer shall be less than 3 months maximum.	ASAP	ASAP
Sample shipped from Customer to Supplier failure analysis facility. NOTE 1 Customer to Supplier shipping Transit Time within country borders. NOTE 2 Customer to Supplier Shipping Transit Time outside of the country borders.	2 Days 5 Days	1Days 3 Days
Supplier		
Sample shipped to Supplier failure analysis facility. NOTE 1 Supplier to analysis facility shipping Transit Time within country borders. NOTE 2 Supplier to analysis facility shipping Transit Time outside of the country borders.	2 Days 5 Days	1Days 3 Days
Analysis facility: receipt of samples and inspection.	1 Days	1 Days
Analysis facility: sample preparation for analysis.	2 Days	1 Days
Initial problem verification completed and report communicated to Customer.	4 Days	2 Days
Interim containment plan reported communicated to customer; If applicable.	5 Days	3 Days
Root cause analysis completed and results communicated to the Customer.	15 Days	5 Days
Corrective action plan reported and communicated customer.	23 Days	9 Days
Corrective and preventive action plan implemented and verified.	ASAP (per plan) As agreed between supplier & customer, Max of 90 days.	
NOTE 1 Days are defined independently for each event and are working days. Progress reporting within each event is recommended. NOTE 2 The driving factors that determine problem analysis and corrective action priorities and the resultant turnaround times are the impact on the customer, the impact on the supplier, and the complexity of the device problem. More complex circuits and packages (e.g., microprocessors, ASICs) and dependencies on subsuppliers of semiconductor content may have longer turnaround time expectations. NOTE 3 An additional delay may be present in timeline guidelines shown here if the communication between Customer and Supplier is arranged by distributors.		

Annex A (informative) Device problem analysis flowchart



* See clause 4.9 for suggested time frames.

** May involve 3rd party subsuppliers.

Annex B Device problem analysis tracking and report form (Page 1 of 3)

4.2 Device Problem Description and Submission – Customer

Date sent: _____ # of devices: _____ Customer request #: _____

Customer name: _____ Customer part #: _____

Customer address: _____

Customer contact: _____ Phone: _____ FAX: _____

Supplier Name: _____ Supplier part #: _____

Top Marking: _____ Bottom Marking: _____

Location of problem detection (e.g., receiving, manufacturing, life testing, field, etc.): _____

 Operating conditions and environment (e.g., voltage, current, temperature, etc.): _____

Problem category (circle one):

Electrical**Visual/Mech.****Administrative**

Functional

Marking

Wrong device

Parametric

Leads

Wrong quantity

Timing

Package body

Packing/materials

Continuity

Solderability

Orientation

Programming

Contamination

Datecode

Standard _____

Other

Other

Paperwork

Urgent _____

Shipping damage

Shipping error

Labeling

Other

Detailed Description: _____

Was the failure intermittent? _____ How often? _____

All affected Lot or P.O. Numbers: _____

 Estimate of problem severity (e.g., number of incidents, percent nonconformance, etc.):

 Device history, value-added processing, other information: _____

Once a problem is verified by the supplier, an 8D report such as the following is the preferred for documentation format for subsequent activity.

[illegible]

Annex B Device problem analysis tracking and report form (cont'd) (Page 3 of 3)

4D Problem Cause			
5D Corrective Actions			
Action	Date	Owner	Status
6D Verification of Corrective Actions			
Action	Date	Owner	Status
7D Preventive Actions			
Action	Date	Owner	Status
8D Closing			
Action	Date	Owner	Status

Annex C (informative) Differences between JESD671D and its predecessors

This annex briefly describes most of the changes made to entries that appear in this standard, JESD671D, compared to its predecessors, JESD671C (2018) and JESD671B (2012). If the change to a concept involves any words added or deleted (excluding deletion of accidentally repeated words), it is included. Some punctuation changes are not included.

C.1 Differences between JESD671D and JESD671C

Clause	Description of change
3	“device” definition drops “product” or “system” and adds NOTE
4.2	Customer responsibility added to isolate failure to least element possible.
4.9	Add last two paragraphs (preceding Table 1
4.9	Renumber Notes in Table 1; NOTE 2 augmented for subsupplier considerations.
Annex A	Notes added; labels for mapping to 8D steps modified.

C.2 Differences between JESD671C and JESD671B

Revision C includes many changes throughout the document. Principally, Rev C introduces a mapping of this process to elements of 8D problem solving for the convenience of those who choose to practice an 8D approach. Other changes include the replacement of “device” for “component” and the addition of the role that authorized distributors have in this process.

C.3 Differences between JESD671B and JESD671A

Clause	Description of change
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At time of publication this information was not provided.



Standard Improvement Form**JEDEC JESD671D**

The purpose of this form is to provide the Technical Committees of JEDEC with input from the industry regarding usage of the subject standard. Individuals or companies are invited to submit comments to JEDEC. All comments will be collected and dispersed to the appropriate committee(s).

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1. I recommend changes to the following:

☐ Requirement, clause number _____

☐ Test method number _____ Clause number _____

The referenced clause number has proven to be:

☐ Unclear ☐ Too Rigid ☐ In Error

☐ Other _____

2. Recommendations for correction:

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