STANDARD OF CHINA SPACE

System number: CNSA-QA000001

Originated from: GB/T 29076-2012

Execution requirements for quality problem close loop of space products

CHINA NATIONAL SPACE ADMINISTRATION

2015

ICS 03.120.10

National Standard of the People's Republic of China

Translation of GB/T 29076-2012

Execution requirements for quality problem close loop of space products

Issue date: 2012-12-31
Implementation date: 2013-07-01
Translation issue date: 2015-09-29

English version of this standard is issued by SAC

FOREWORD

The standard is translated from the Chinese version of Standard on GB/T 29076-2012 released by Standardization Administration of China (SAC) under the management of State General Administration of Quality Supervision and Inspection and Quarantine. TC 425 is responsible for the translation. In case of any doubt about the contents of English version, the Chinese original shall be considered authoritative.

This standard is drafted in accordance with rules given in GB/T 1.1-2009.

This standard is proposed by China Aerospace Science and Technology Corporation.

This standard is under the jurisdiction of National Technical Committee on Space Technology and Operation of Standardization Administration of China (SAC/TC 425).

INTRODUCTION

This standard belongs to the National Standard System of China Space. The National Standard System of China Space is applicable to the formulation, revision, and management of national standards in the field of space, covering three sectors of space management, space technology, and space application and services and serving as the basis for guiding spacecraft and launch vehicle project management, engineering, space launch services, and in-orbit satellite applications.

The close loop quality problem solving management scheme is developed during aerospace engineering practices. The scheme provides a systematic and scientific procedure to eliminate potential quality hazards, solve quality problems and avoid their recurrence. It has been successfully applied in the aerospace industry. The implementation of the scheme will help locate problems, analyze root causes, and identify weaknesses in the quality system, which will result in better management, processes, rules, and capacity. The standard is hereby formulated to summarize and disseminate good practices so that all enterprises engaged in aerospace product development and production can implement such quality improvement procedures, optimize management and constantly improve their management capacity.

Execution requirements for quality problem close loop of space products

1 Scope

This standard specifies the execution requirements for quality problem close loop of space products. The close loop quality problem includes closing problems technologically and managerially.

This standard is applicable to close loop solving of technological problems and management problems for space products from program implementation phase.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 19000 Quality management systems - Fundamentals and vocabulary

3 Terms and definitions

For the purposes of this document, the terms and definitions given in GB/T 19000 and the following apply.

3.1

quality problem close loop

quality problem close loop activities that include technological and management analysis of causes and mechanism for the faults, accidents, defects, non-conformity and other problems identified in product design, production, test and services, and corresponding corrective actions and preventive actions adopted in order to eliminate problems and avoid reoccurrence.

3.2

technology close loop

activities that include implementation of five requirements "*exact location, clear mechanism, problem repetition, effective action, learning by analogy*" from technology aspect, as well as the compiling problem close-loop reports, technical documents and relevant proof materials regarding the quality problem that occurred.

3.3

exact location

determining the exact part where the quality problem occurred.

Note: *Exact location* requires finding out where the problem occurred e.g. the process, product, component, part, or electronic part and component, and determining the abnormal conditions of the lowest-level faulty part and root causes of fault to solve the quality problem.

3.4

clear mechanism

indentifying the root causes of quality problem through analysis, calculation, test and other methods.

Note: *Clear mechanism* is the key to ensuring thorough quality problem close loop as it sorts out the causal relationship of the problem and its causes, supports and proves the correctness of causes of the problem, so as to provide a solid basis to take corrective actions.

3.5

problem repetition

conducting problem recurrence experiment through test and other verification methods, in an attempt to demonstrate the accuracy of location and correctness of mechanism analysis.

Note: No recurrence experiment is needed for quality problem caused by obvious mistakes; analysis and simulation may be adopted to demonstrate the fault phenomena for the fault mode that can not realize problem recurrence (or destructive fault mode).

3.6

effective action

for the quality problem that occurred, formulate and take effective actions to ensure the quality problem is solved.

3.7

learn by analogy

the information on quality problem is fed back to the organization and the program. Other organizationsand relevent programs should be informed about the problem to check for similar failure mode and take preventive actions.

Note: Through *learn by analogy*, the corrective actions taken to solve quality problem of the product are applied to other products designed and produced in the same batch or with the same design mechanism, so that occurrences of similar problems can be prevented. For the products that have not faced with the problem, it is a preventive action.

3.8

management close loop

activities that include the implementation of five management requirements of “clear process, distinct responsibility, action fulfillment, responsibility implementation, consummate rules” and formulation of management close loop reports, relevant documents and proof documents of quality problem that occurred.

3.9

clear process

finding out processes of the problem occurrence, analyzing causes of the problem and identifying management weaknesses or vulnerabilities.

Note: *Clear process* means to clearly know the time, place of the problem, work conditions, operating procedures, problem phenomena and results, the related management processes, causes of the problem, the weaknesses and vulnerabilities of the management.

3.10

distinct responsibility

determining the responsible organization and responsible person that lead up to the quality problem, and distinguish the primary and secondary responsibilities and responsibility level. Penalties should be imposed on responsible organization and person for repeated quality problems and problems due to poor duty sense.

Note: *Distinct responsibility* means to identify the responsible organization and responsible person and their responsibilities, and distinguish the direct responsibility and indirect responsibility, the primary responsibility and secondary responsibility, leadership responsibility and execution responsibility in accordance with the process and post responsibility of the problem.

3.11

action fulfillment

developing and implementing effective corrective and preventive actions for management weaknesses or vulnerabilities.

3.12

responsibility implementation

handling the quality problem prudently caused by management weaknesses and learning from lessons for the purpose of staff education and management improvement; the responsible organization and responsible person for the repeated quality problems and quality problems due to poor duty sense shall be given punishment in accordance with the circumstances and consequences.

Note: *Responsibility implementation* focuses on the serious treatment of the matter with the ultimate goal of staff education and management improvement; only the responsible organization and responsible person for the repeated quality problem and quality problem due to poor duty sense shall be given certain administrative punishment and economic punishment. The punishment aims to deepen the education and prevent the recurrence of quality problems.

3.13

consummate rules

consummating the rules and regulations on the management weaknesses or vulnerabilities in avoidance of the recurrence of quality problems from the perspective of system.

Note: *Consummate rules* means to include the related actions on quality problem close loop into the relevant rules and regulations, work guidance documents, standards or specifications.

3.14

repeated quality problem

as for quality problems that have occurred in the organization or on which the parent organization has circulated a notice of criticism, similar quality problems have happened in the organization once again.

3.15

quality problem due to poor duty sense

quality problems caused by failure to comply with rules and regulations, operation against rules, and other human factors.

4 General requirements

4.1 Quality problem close loop shall be carried out technologically and managerially. Quality problems covered by the scope specified in Annex A shall implement quality problem close loop in accordance with Article 5 or Article 6 before the report compiling. Quality problems covered by Annex A.1 and A.2 simultaneously shall conduct problem closing technologically and managerially.

4.2 Quality problem close loop should be conducted in accordance with the consequences of the quality problem, product level, and management level.

4.3 Top management of the organization shall take full responsiblility for the close loop work of the organization quality problem. Program manager is responsible for organizing and checking the close loop work of the program quality problem. The launch site director is responsible for the close loop work of launch missions quality problem.

4.4 The closing problems technologically shall meet the five requirements of "*exact location, clear mechanism, problem repetition, effective action, learning by analogy*"; while the closing problems managerially shall meet the five requirements of "*clear process, distinct responsibility, action fulfillment, responsibility implementation, consummate rules*".

4.5 Quality management department of the organization is the competent department of quality problem close loop and responsible for planing quality problem close loop, checking the conformity of quality problem close loop report, organizing the examination or review on quality problem close loop report, supervising and inspecting the implementation of the quality problem close loop work as well as related actions, and keeping relevant evidences of quality problem close loop.

4.6 Responsible organization of quality problem shall be responsible for implementing specific quality problem close loop work. The completion of preparation, sign, examination or review of the quality problem close loop report, and the implementation of improvement action close loop mark the end of the quality problem close loop.

5 Procedures of technology close loop of quality problems

5.1 Locate the problem

The main work of problem locating includes:

a) When a problem is detected, the organization shall protect the scene, make records and report timely without compromising safety and security;
b) Organize related technicians to confirm the phenomena and location of the quality problem, formulate troubleshooting plan and carry out the troubleshooting work in a timely manner;
c) Check whether the product, related equipment and working conditions are in compliance with requirements or not, and check out whether it is a product (device) problem or problems concerned with test experimental equipment and operation methods;
d) Replace suspected faulty item when it is possible and necessary, and prove as far as possible that the fault exists only in the replaced products upon the confirmation of the parties;
e) Test and inspect faulty items.

5.2 Fault mechanism analysis

Carry out a fault mechanism analysis program to find out the root cause and mechanism. The main work of fault mechanism analysis includes:

a) Sort out and identify all fault phenomena, and determine the main fault;
b) Set up a fault tree and conduct troubleshooting work based on the main fault;
c) Carry out mechanism analysis of the problem, adopting engineering analysis, failure analysis and statistical analysis etc. Analyze and expound the physical or chemical processes that the lowest level faulty item and abnormal factors causing the quality problem through the theoretical and technical analysis;
d) Cite identification conclusion by professional organizations as circumstantial evidence when necessary, and analyze and determine causes of the problem.

5.3 Conduct recurrence experiments

In principle, recurrence experiments shall be conducted for all quality problems, so as to verify location and mechanism analysis of the quality problem. When it is difficult to make recurrence experiments, theoretical analysis shall be made, and simulation analysis or model analysis shall be adopted as far as possible for verification which shall be indicated in the close loop report. The main work of recurrence experiments includes:

a) Prepare an experiment scheme and send it to related parties for signature and approval;
b) Carry out experiments in line with the experiment scheme, and make records;
c) Prepare experiment result analysis report, and conduct a review on the report.

5.4 Define and implement corrective actions

Define and implement corrective actions based on the following requirements:

a) Take actions to make correction and eliminate the impact of occurred quality problems;
b) Define specific, quantitative, workable and verifiable corrective actions and work out a clear implementation plan regarding causes of the quality problem;

c) Conduct test verification on the validation of corrective actions, prepare a procedure document before the verification test, make original records during the test, and complete the test report;

d) Corrective actions that have been verified and approved shall be adopted to technical documents or related standards and regulations.

5.5 Implement lessons learning

Lessons learning by analogy shall be carried out based on the following requirements:

a) Lessons learning shall be implemented after the quality problem close loop, so as to summarize lessons on quality problems. Related recommendations on incomplete specific articles shall be proposed with reference to the technical standards;

b) According to the mechanism and lessons of quality problem, check the possibility that similar mechanism problems may happen to related products, take corrective actions and record relevant circumstances into the quality problem close loop report;

c) Report the quality problem close loop information to the superior quality management department. The superior quality management department shall define the requirements on learning by analogy and feed back the requirements to related organizations and programs.

5.6 Finish closing problem technologically report

The closing problem technologically report shall be prepared based on the following requirements:

a) The report shall be prepared by responsible organization of the quality problem. The contents of reports refer to Annex B;

b) The report shall be fully signed in accordance with requirements. The report after the delivery of end product or in the process of tests on missile, rocket, and satellite (spacecraft) systems shall be submitted to the superior designers for countersignature. The report on purchased and outsourced products shall be countersigned by the organization which ordered products or proposed the assignment;

c) For problems which cannot be solved thoroughly, the technical risk analysis shall be conducted. And a quality problem analysis report is required with reference to Annex B, explaining why the problem close loop work cannot proceed. The quality problem analysis report shall be signed.

6 Procedures of management close loop

6.1 Identify the development process of quality problem

When a problem is detected, the organization shall protect the scene, make records and report timely without compromising safety and security. Organize related personnel to inspect the process of quality problem occurrence timely from the perspective of management:

a) Find out the process of the faulty item formation and the process of problem identification, and check the document requirements on management and process control and execution records;

b) Analyze the causes on requirements and execution of process management and control documents that lead up to the abnormal factors, and identify the management weaknesses or vulnerabilities.

6.2 Determine the responsible organization and responsible person

Based on the identified process, and in accordance with the requirements and execution records in process management and control documents identify the responsibilities that the responsible organization and responsible person shall take, define the primary responsibilities.

6.3 Fulfill measures and perfect the rules

Implement measures and improve the rules based on the following requirements:

a) Take effective corrective and preventive actions for management weaknesses or vulnerabilities that result in quality problems;

b) The actions shall be specific, detailed, workable and verifiable. Each work in the actions shall be assigned to responsible department and responsible person. Plans and resource guarantee shall be made available for medium- and long-term actions;

c) Actions shall be consolidated by perfecting quality management system documents, rules and regulations, standards, etc.

d) For problems caused by incomplete rules and regulations, it is necessary to specify the revision time and modified contents of rules and regulations;

e) Lessons learning shall be implemented to summarize lessons on quality problems; meanwhile, relevant circumstances shall be included into the quality problem close loop report.

6.4 Implement the responsibilities

Implement the responsibilities shall meet the following requirements:

a) Quality problems caused by management defects shall be treated seriously in terms of attitude. Lesson learning shall be implemented to strengthen staff ideological education and training;

b) In case the organization and person find out defective or incomplete rules, regulations or process as well as other management weaknesses in advance, take the initiative to carry out quality problem close loop, propose operable, practicable, and checkable actions, the organization shall grant rewards;

c) In case the responsible organization and responsible person cause repeated quality problems and other quality problems due to poor duty sense, and the responsible person practices fraud and covers up the problems, punishment shall be given in accordance with related regulations and based on the responsibility degree and influence level.

6.5 Finish closing problem managerially report

Finish management problem close loop solving report based on the following requirements:

a) The management close loop report shall be prepared by the responsible organization with the contents in accordance with Annex B;

b) The management close loop report shall be countersigned by the quality management department of the organization and related departments, and approved by the top management of the organization;

c) For the same category of management problem, a management close loop report may be prepared, indicating the products with quality problems.

7 Close loop procedures of quality problem in launch missions

In principle, the close loop of quality problem in launch missions shall be carried out in line with requirements in article 5 and article 6. In consideration of particularity of problems in launch missions, organizations shall formulate specific implementation requirements and rules based on the actual situation, including:

a) Responsibility assignment in launch missions close loop;

b) On-site close loop procedure;

c) Close loop procedure off the site (e.g., returning back to the organization or other outsourcing organizations);

d) Work requirements in case of incomplete close loop;

e) Subsequent work requirements of close loop after the mission.

Annex A

(Normative)

Scope of quality problem close loop

A.1 Quality problems that should be issued following close loop technologically

The scope of quality problems that should be issued following close loop technologically covers:

a) Problems in design which might delay development schedule, create interface design change with other business organizations, lower performance index and result in production rework;

b) Problems in design and production which might result in major economic losses;

c) Problems in production which might occur repeatedly and in batch due to technology causes;

d) Problems in EEE components and raw materials which might occur in batch due to technology causes;

e) Problems in test technology which might result in test failure or product damage;

f) Problems which might occur due to technology causes after the single equipment, system (subsystem) were delivered;

g) Problems which might occur due to technology causes in shooting range or external field;

h) Problems which might occur due to technology causes after the final product had been delivered for use;

i) Problems which might occur in orbit operation and return of satellite and spacecraft, due to failure or other technology causes which can affect mission completion;

j) Problems which might be solved through technology close loop after confirmation by model command system and designer system.

A.2 Quality problems that should be issued following close loop managerially

The scope of quality problems that should be issued following close loop managerially covers:

a) Repeated quality problem;

b) Quality problem caused by men;

c) Quality problem caused by no rules and regulations to follow or incomplete rules and regulations;

d) Management problem of technological state;

e) Quality problems that need undergo close loop confirmed by product command system.

Annex B

(Normative)

Contents of quality problem close loop report

B.1 Main contents of closing problem technologically report

B.1.1 Problem description

Description of time, place of quality problem, faulty items (e.g. Product name, batch and number, design production phase) and their work state, as well as design organization, production organization and phenomena of faulty items.

B.1.2 Problem location

Process, basis, and results of defining the problem (e.g., the problem of a certain operating state, a certain interface of single equipment, part, component, material, or software), causes of the problem and responsible organization.

B.1.3 Mechanism analysis

Describe process and method of mechanism analysis, analysis result (theoretical analysis result and test result). Based on mechanism analysis and (or) test process, find out causes of the problem and fault mode. Elaborate each of them in case of multiple causes. But main causes shall be detailed as far as possible. Such causes can be summarized as design, process, operation, management, equipment, software, device, environment, etc.

B.1.4 Conduct recurrence experiments

Confirm whether recurrence experiments conducted and experiment results verify the precision of location and correctness of mechanism analysis. When recurrence experiments are not to be conducted, the reason shall be described and theoretical analysis results shall be given.

B.1.5 Actions taken and verifications

Describe the corrective actions taken, their confirmation and implementation, results and effectiveness of verification test, incorporation of corrective actions into documents, etc.

B.1.6 Learn by analogy

The contents of learning by analogy as well as lessons learned within the organization and within the range of the model.

B.1.7 Conclusion

Introduce whether the quality problem close loop is completed, and state the leftover problems, recommendations, and conclusions.

B.1.8 Proof documents list of technology close loop

Generally, proof documents shall include:

a) Title and number of test report (including test data);

b) Title and number of circumstantial evidences for verification;

c) Title and number of executive documents (technical notice sheet, sheet of changes, sheets of questions, processing sheet of technical questions);

d) Title and number of other proof documents.

B.2 Main contents of closing problem managerially report

B.2.1 Process overview

Describe the time, place of quality problem, technical status of the product, problem phenomena, whole process of problem development.

B.2.2 Analysis of causes

Analyze causes from the perspective of management by management links and responsibilities; and define the responsibility of related personnel and departments.

B.2.3 Actions and their implementation

Corrective actions taken and their implementation.

B.2.4 Handling

Handling consequence of responsible organization and responsible person.

B.2.5 Rules Perfection

Introduce rules and regulations of the organization to be further improved or formulated, as well as definite requirements on rules and regulations that have not been implemented.

B.2.6 Conclusion

Conclusion review on whether quality problem close loop is completed.

B.2.7 Proof documents list of management close loop

Proof documents shall include:

a) Title and number of technology close loop report on quality problems of dual close loop;

b) Title and number of review conclusion report on technology close loop;

c) Title and number of executive documents (technical notice sheet, sheet of changes, sheets of questions, processing sheet of technical questions);

d) Title and number of revised rules and regulations;

e) Title and number of reward and punishment documents;

f) Title and number of other proof documents.