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*Martin Company*

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## "AUDIT - THE MEASURING TOOL OF QUALITY"

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### ABSTRACT

This article describes a Quality audit operation that has been tested and proven to be an accurate barometer of quality effectiveness. The paper explains the organization of the audit unit as an integral part of the overall quality concept. The details of how a properly implemented audit is a reliable management tool for measuring quality competency are explained.

The paper specifies why there is a need for an independent unit to continuously evaluate the total Quality system. Methods, that may be used to assure that problem areas are detected before they become significant failures, are explained. The qualifications for competent auditors, as well as the four types of audits are defined. In addition, the various techniques for reporting the audit findings, evaluating the overall quality image, and assuring that adequate corrective action has been taken, are discussed.

The paper also briefly outlines the need for auditing certain operations outside the normal sphere of Quality but nonetheless pertinent to quality requirements. This aspect of the paper deals with audits conducted to test the degree of compliance with established quality procedure, policies, and practices of the technical operations departments (i.e., engineering, procurement, logistic support).

### INTRODUCTION

Today, as never before, the aerospace industry and its customers must have absolute confidence that the products can meet their specific objectives. Confidence in a product has always played an essential role in any industry. However, in recent years, two new factors have increased the need for assurance that a specific objective can be met.

The first factor is simply that there is no second chance. Once the countdown has been completed, the entire image (if not the future) of the company is at stake. The second factor is one of fiscal prudence. Recent emphasis by the Defense Department on cost plus incentive fee and fixed price contracts has made it clear that only those companies with the highest standards of performance can be expected to survive the fierce competition for today's contracts. Profits will rise or fall on the basis of the ability to produce quality products on time.

In order to develop confidence in our products, we must provide assurance that we have the type of programs essential to achieve our objectives. Once we have set our objectives and developed the necessary programs, we then must constantly monitor and evaluate these programs. As part of the system for evaluating and monitoring our Quality program at the Denver Division of the Martin Company, we have organized an audit operation. This operation has been tested and proved to be an accurate barometer of Quality effectiveness. Lets begin our analysis of this function by answering a few basic questions relative to the audit operation.

## WHAT IS AUDIT?

Audit is a tool we can use to give us the most assurance that our overall system is operating properly and to point up the areas where we must take action. Audit is therefore a basic part of the Quality system; a fundamental in the concept of assurance and an aid to reliability.

## WHAT IS THE PURPOSE OF AUDIT?

The purpose of audit is to test the quality performance and adherence to the basic Quality policies of the company. Specifically, it is Audit's responsibility to ensure that existing acceptance criteria and inspection performance are adequate to assure the integral quality of each accepted product.

## MISCONCEPTION

I would like to clarify one misconception that many people apparently have about an audit operation. Audit has been developed as a program of preventive action to identify and eliminate potential problems. An audit operation can never be truly effective if it is run as a fire drill on known problems. If a problem has been identified, the necessary action is in all probability already being taken by the appropriate line organization or by a Corrective Action Unit. I would like to distinguish here between known problems and suspect areas. If there is a suspicion that something might be wrong, or could go wrong, an audit is advisable. As a matter of fact, we have made provision for this type of audit in our system.

## INDOCTRINATION

It is essential in organizing an audit program that management be thoroughly oriented to the audit philosophy. The philosophy that must be expounded is simply that the audit operation is intended to serve as a tool by which they (the managers) can evaluate their areas of responsibility. The audit operation is not intended to be a check on the manager, but rather an aid to assist him in carrying out his responsibilities. The audit operation is not intended to be punitive in any sense.

Today's Quality manager has many demands on his time. Consequently, the manager cannot spend his time evaluating every detail of the functions placed under his jurisdiction. On the other hand, today's manager must have some method by which he can effectively analyze how well his organization is performing. It is in this area that an audit can best serve management's needs.

In many cases, a fresh objective evaluation by a completely unbiased Audit Unit can point out deficiencies or discrepancies that would otherwise continue unnoticed until they become significant problems.

## ORGANIZATION

Prior to forming any audit operation, it is necessary to evaluate the company's organizational structure and determine just what needs to be accomplished. Figure 1 shows the organizational structure we were faced with when we developed our audit program.

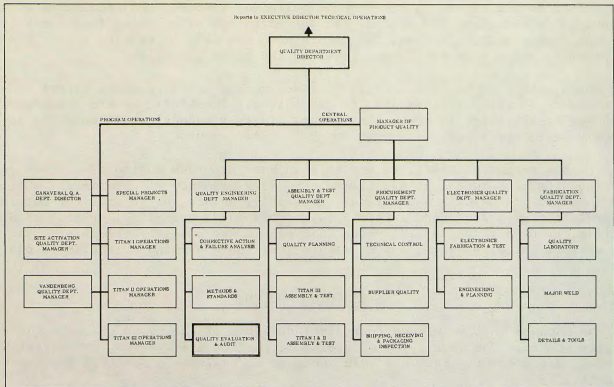


Fig. 1 Martin-Denver Quality Organization

#### GROUND RULES

We recognize that to be effective, some basic rules would have to be observed. The following guide lines were decided upon:

1. The system should be as simple as possible, with the least amount of paperwork;
2. The use of names in the audit reports serves no useful purpose;
3. The individuals in the areas being audited should not be criticized as long as immediate and effective corrective action is taken at the time of the audit;
4. No report of an unsatisfactory nature should be published until the individual involved has a reasonable chance to correct the deficiency;
5. There must be a permanent staff of auditors who are knowledgeable, honest, and impartial;
6. The audit reports must be confidential, submitted only to those members of management actually concerned with the problem.

#### BENEFITS DERIVED FROM THE PERMANENT STAFF

In the development of a permanent staff, we were able to choose our auditors in a manner that provided specialists in certain fields; and, at the same time, provided broad knowledge of the quality field. The permanent staff permits each

auditor to become expert in the various policies, systems, and procedures of the company. In addition, the auditor has the advantage of becoming familiar with the various supervisors. In time, the supervisors are able to develop a spirit of cooperation and a high confidence level in the audit operation.

Each member of the audit staff receives a copy of every audit report so that he is aware of every problem and its resolution. Therefore, we are transferring each man's experience to the entire group. In this manner, audit maturity is constantly being developed.

With a permanent staff, we are able to have numerous audits of various quality functions in process at all times. The very presence of a permanent audit staff has an effect on overall operations. Frequently we are called upon for our interpretation of a governing criteria (e.g.; standard, operating, or project directive, process plans, etc.). When this occurs, we not only obtain and pass on the correct interpretation, but we assure that the governing criterion is clarified.

### TYPES OF AUDITS

We decided that we needed four distinct types of audits to evaluate the total Quality system. The four types of audits we conduct are systems, procedural, special, and product. Each has been designed to evaluate a specific Quality responsibility.

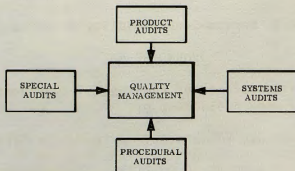


Fig. 2 Types of Audits

The systems audit is conducted by a review of the Quality performance and adherence to standard procedures, quality manual, manufacturing procedures, etc., as they apply to a specific Quality section. While performing this type audit, a complete analysis is made of all types of records, as well as the inspection methods currently in use. The auditor in this manner tests the degree of compliance with the appropriate governing criteria.

Four Quality departments, plus the Quality project groups, are audited by this method. Generally, each section of the Quality department is audited semi-annually.

Before conducting this type of audit, a meeting is held with the chief of the section to be audited. At this meeting, the purpose of the audit is explained and objections eliminated. The systems audit generally takes from two days to a week to complete, depending on the complexity of the section being audited. At the conclusion of the audit, a meeting is held with the chief of the audited section, and the auditor outlines the deficiencies found during the audit. Following the meeting, a corrective action requirement is issued to the responsible supervisor. When the corrective action has been implemented, the auditor then issues a management report to the director of Quality and the responsible Quality manager.

The status of each area is controlled by charts that indicate the day the audit started, when corrective action requirements were issued, when corrective action was obtained, and when the final audit report was issued.

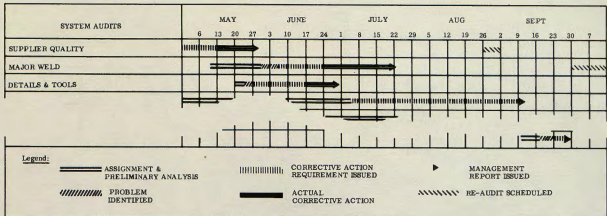


Fig. 3 Systems Audit Status Chart

The second type of audit conducted is a special audit. This audit is conducted when nonconformance is suspected. For example, if it is suspected that failure analyses are not being properly documented, or that corrective actions specified on material review records are not being properly implemented, a random review of a number of these documents is made to determine that the required action has been correctly implemented.

We issue no prior warning of the audit until we arrive in the area to check on specific details. At the conclusion of the audit, a management report is issued describing the complete findings and corrective action resulting from the audit.

The third type of audit that is conducted is the procedural audit. This audit examines adherence to specific procedures of the Quality or Standard Manuals. The audit generally extends across various Quality department functions. For example, if an audit is being conducted of the historical log, the auditor will ascertain whether Quality Planning has specifically outlined the data requirements. Next, the auditor determines whether Supplier Quality is assuring that the various vendors are submitting the data. From here the auditor checks whether Receiving Inspection is properly processing the data and adding any additional data that may be required. The next step is to monitor the data requirements as they are processed through the factory, vertical test facility, or test stands where the final functional tests are conducted. The audit is completed by a check of the historical log just before shipment. If there is a breakdown in the system anywhere along the line, we assure that immediate corrective action is implemented by the responsible supervisor to correct the condition before it becomes a problem.

This type of audit does not require a prior meeting with the responsible supervisors. Each supervisor is notified of the specific audit purpose when the auditor starts to work in his area.

The fourth type of audit conducted is called a product audit. Most audits are product audits, conducted to determine whether existing acceptance criteria and inspection performance are adequate to ensure the quality level of details, subassemblies, assemblies, etc. Thirteen basic Quality functions are continually

monitored by the product audit method. These functions embrace all Quality activities in the areas of receiving, planning, manufacturing, overhaul and repair, and shipping.

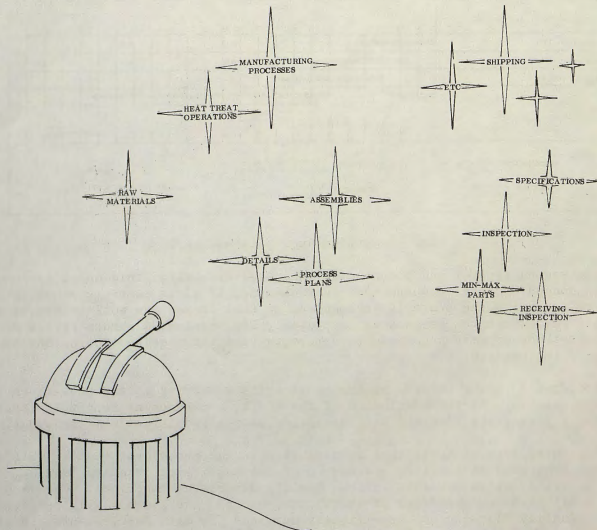


Fig. 4 Product Audit Points of Interest

When conducting a product audit, the auditor randomly selects the parts, materials, or governing criteria for audit without knowing if a problem exists. When deficiencies are discovered, the problem is immediately discussed with the responsible supervisor. After the supervisor is verbally informed of the deficiency, a corrective action requirement is issued. This requires a reply by the supervisor stating what corrective action will be taken. When the stated action is effected to the satisfaction of the auditor, a management report is issued to the Director of Quality and the responsible Quality manager.

#### PRODUCT AUDIT CHARTS

When the audit fails to reveal a deficiency, a formal report is not issued. However, weekly tab runs are issued to each of the Quality managers for each of the audit areas under his jurisdiction. These tab runs depict the cumulative number of audits conducted and the percent defective in each specific area. This report gives

the manager a clear indication of how well each of his areas is adhering to Quality standards. Figure 5 is an illustration of a typical product audit chart.

DATE 29 Sept 1964			DEPT QUALITY AUDIT UNIT				MAIL X-18							
REQ BY J. JONES			DEPT SYSTEMS AND AUDIT SECTION				MAIL X-18							
SUPTV M. F. SMITH			AVERAGE 2.45											
DATE	CUM	CUM %	0	1	2	3	4							
DA MO YR	AUDITS	DEFECT												
21	APR 64	10	16.9											
25	↓	16	5.1											
1	MAY	17	5.9											
13	↓	22	4.5											
19	↓	29	4.9											
26	↓	35	5.7											
2	JUN	43	4.7											
7	↓	44	4.2											
15	↓	54	5.4											
23	↓	65	5.2											
30	↓	64	4.7											
7	JUL	69	4.2											
14	↓	75	3.9											
21	↓	82	4.5											
28	↓	93	4.4											
4	AUG	95	4.2											
11	↓	101	4.0											
18	↓	109	2.9											
25	↓	115	3.6											
1	SEP	122	3.3											
7	↓	127	3.1											
13	↓	132	3.0											
20	↓	141	2.8											
27	↓	148	2.9											

Fig. 5 Sample Quality Audit "Alarm" Report Issued Weekly to Each Quality Manager

Product audit charts are only distributed to the manager responsible for the function shown on the chart. In addition, the audit charts have the residual effect of recognizing those areas that are performing an outstanding job. In order to evaluate the total Quality picture, we maintain one composite chart of all product audits. The individual charts clearly indicate trends within a specific function, whereas the composite chart gives the total Quality analysis.

### TECHNICAL OPERATIONS

The audit operations at Martin-Denver have recently been expanded to include audits of certain operations outside the normal sphere of Quality, but closely integrated with the total Quality effort. Departments other than Quality presently being audited are:

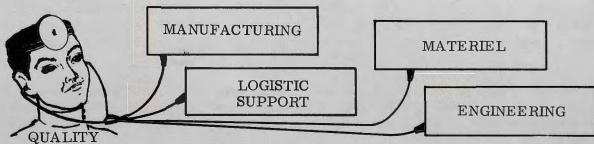


Fig. 6 Technical Operations Audit Areas

The cooperation from all departments in the implementation of this program has been excellent. We believe this attitude is indicative of the desire of all personnel to assure the highest standards of quality.

Audits are conducted of the technical operations departments for various items relating to the Quality effort:

Engineering

Timeliness and adequacy of replies to liaison calls, realistic tolerances on drawings, D.C.N.'s, standard repairs, etc.;



Manufacturing	Adherence to process plans and contamination control requirements, maintenance of tools and equipment, control of floor stock, accuracy of log books and other administrative documents relating to the product;
Logistic Support	Accuracy and completeness of Technical Orders and Technical Manuals with respect to military specifications and drawing requirements;
Materiel	Packaging, handling, storage, shelf life, and temperature control requirements.

When auditing the technical operations departments, we follow the same general ground rules as when auditing Quality functions. We hold a brief meeting with the responsible supervisor prior to conducting the audit. At the conclusion of our analysis, we discuss the findings with the responsible supervisor and arrive at a mutually acceptable solution. A final audit report is then issued to the director of the department audited and the Director of Quality.

#### CORRECTIVE ACTION

Regardless of the type of audit that reveals a deficiency or discrepancy, we are primarily interested in one thing--prevention of a similar occurrence in the future. A simple example of this would be an audit that revealed test instruments past their due date for calibration. While it is important that the specific instruments be removed from use until they are recertified, that is not our main objective. Our primary goal in this type of situation is to see that an inventory of the items requiring calibration is established, with a lead time from the date on which the items require calibration. This enables the responsible individuals to check their file daily, and make the necessary provisions to assure that all items are within the calibration cycle.

#### COST REDUCTIONS

During 1963, the Audit Unit at Denver submitted approximately one quarter million dollars in cost reductions, cost avoidance, and work improvements. The work improvements and cost reductions were concerned with consolidation of various forms into one single document, improved drawing system for repair of facility components, simplification of the method for recertification of shelf-life material, etc.

Actually, savings of this magnitude are no more than should be expected from an audit operation, since the nature of the auditors' assignments permit them to evaluate many facets of a job not available to employees with fixed work areas and assignments.

#### RESEARCH & DEVELOPMENT

The requirements of present Research & Development contracts for space stations, lunar vehicles, deep space probes, etc. make it more and more obvious that it is essential for every effort to be expended to assure the highest standards of performance. We anticipate that our audit operations will soon be extended to embrace R&D functions. In this area, we can be expected to determine such factors as adequate approvals by engineering, manufacturing and quality, availability and compatibility of special tools, equipment, materials, processes, etc. needed for this type of contract.

Based on past performance, we believe the audit operation can make significant contributions to the successful completion of these contracts.

WHAT IS THE FUTURE OF AUDIT?

We believe that the audit function is here to stay. The value of Audit has been conclusively established. This essential management tool will continue to grow in importance in the future.

The stature of the audit function in any company will reflect the ability of audit personnel to perform a competent professional job, and the desire of progressive management to make use of their evaluations.