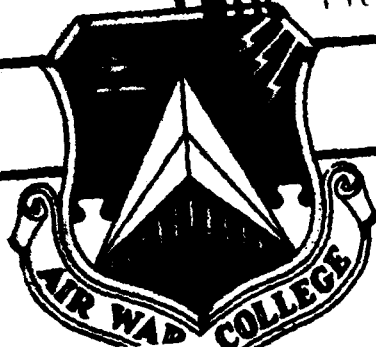


2

FILE COPY



AIR WAR COLLEGE

RESEARCH REPORT

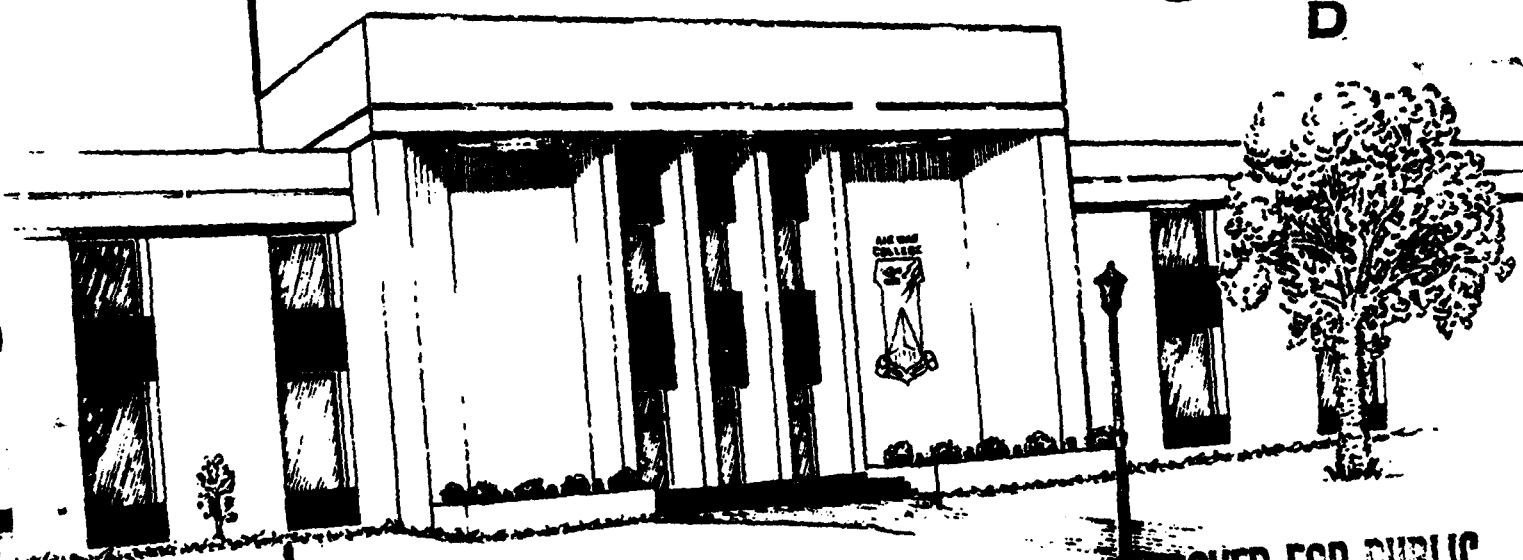
No. AU-AWC-88-069

AD-A202 731

AFLC NEEDS TO CONCENTRATE ON CUSTOMER ORIENTATION IN QUALITY ASSURANCE POLICIES

By LIEUTENANT COLONEL DONALD B. CAMPBELL

DTIC
ELECTE
JAN 12 1989
S D



89 1 11 038
AIR UNIVERSITY
UNITED STATES AIR FORCE
MAXWELL AIR FORCE BASE, ALABAMA

APPROVED FOR PUBLIC
RELEASE; DISTRIBUTION
UNLIMITED

AIR WAR COLLEGE
AIR UNIVERSITY

AFLC NEEDS TO CONCENTRATE ON CUSTOMER ORIENTATION IN
QUALITY ASSURANCE POLICIES

by
Donald B. Campbell
Lieutenant Colonel, USAF

A RESEARCH REPORT SUBMITTED TO THE FACULTY
IN
FULFILLMENT OF THE RESEARCH REQUIREMENT

Research Advisors: Colonel George W. Tiller
Colonel Paul T. Welch

MAXWELL AIR FORCE BASE, ALABAMA

May, 1988



Accession For	
NTIS CAA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution	
Availability Codes	
Dist	Avail and/or Special
A-1	

DISCLAIMER

This research report represents the views of the author and does not necessarily reflect the official opinion of the Air War College or the Department of the Air Force. In accordance with Air Force Regulation 110-8, it is not copyrighted but is the property of the United States government.

Loan copies of this document may be obtained through the interlibrary loan desk of Air University Library, Maxwell Air Force Base, Alabama 35112-5564 (telephone: [205] 293-7223 or AUTOVON 875-7223).

AIR WAR COLLEGE RESEARCH REPORT ABSTRACT

TITLE: AFLC needs to concentrate on customer orientation in Quality Assurance Policies.

AUTHOR: Donald B. Campbell, Lieutenant Colonel, USAF

The introduction briefly describes the importance of AFCL's Depot Maintenance program and details the author's road map in discussing the research topic. An analysis of Project Overlook, a 1982 AFCL directed review of the Quality Assurance program follows. Current quality assurance guidance for AFCL is reviewed from command level to the production planning level. A major portion of any quality assurance program, customer feedback, is then discussed. The Quality Deficiency Reporting System is used by AFCL for this purpose. The author then briefly discusses some quality assurance programs from the Army depots, Navy Aviation depots, and the status of quality assurance in civilian industries. A discussion of the statistical process control program as espoused by Dr. W. Edward Deming and some of his management principles that could be used by AFCL follows. Finally, the author provides three recommendations for improving the AFCL Quality Assurance program.

BIOGRAPHICAL SKETCH

Lieutenant Colonel Donald B. Campbell (M.S., Central Michigan in Industrial Management) is a career logistician. He has served in various maintenance positions in North Dakota, Vietnam, Florida, Okinawa, Georgia, and Michigan. He served three and a half years at the Robins Air Logistics Center as the Deputy Chief, Industrial Products Division and Chief, Product Quality and Reliability Division. He is a graduate of Squadron Officers School, The Air Command and Staff College (where he served on the faculty for two years), and the Air War College.

TABLE OF CONTENTS

CHAPTER.....	PAGE
DISCLAIMER.....	ii
ABSTRACT.....	iii
BIOGRAPHICAL SKETCH.....	iv
I INTRODUCTION	1
II PROJECT OVERLOOK	4
III REGULATORY GUIDANCE FOR AFLC'S QUALITY ASSURANCE PROGRAM	10
IV THE QUALITY DEFICIENCY REPORTING SYSTEM	15
V DR DEMING'S STATISTICAL PROCESS CONTROL	21
VI WHAT'S GOING ON IN THE ARMY, NAVY, AND CIVILIAN INDUSTRY?	27
VII SUGGESTED IMPROVEMENTS	32
APPENDIX A-EXCERPTS FROM AFLCR 74-1.....	37
APPENDIX B-EXCERPTS FROM AFLCR 74-12.....	39
APPENDIX C-EXCERPTS FROM AFLCR 74-2.....	41
APPENDIX D-EXCERPTS FROM AFLCR 66-60.....	43
APPENDIX E-EXCERPTS FROM AFLCR 65-22.....	44
APPENDIX F-EXCERPTS FROM AFLCR 66-4.....	45
APPENDIX G-EXCERPTS FROM AFLCR 66-51.....	46
BIBLIOGRAPHY.....	48

CHAPTER I

INTRODUCTION

The Air Force Logistics Command is a large organization consuming approximately 40% of the Air Force budget. However, AFLCs budget for FY 1989 is certainly smaller any previous budget submitted by the Reagan administration. The Reagan administration's defense buildup has been broad in scope and has previously provided adequate funding for spare parts and the repair of those spare parts. However, this is no longer the case. The logistics portion of any defense budget is always a tempting target and today's austere budgeting environment will cause logistics to take at least a share of whatever reductions are imposed. As always, there will be no reductions in the scope of responsibilities of the Air Force. And, as always, that imposes a pressure to do more with less. Every logistician is familiar with that pressure and is accustomed to trying to do just that. Based on this pressure, I will explore any possible ideas or thoughts which might enable AFLC to be either more productive or more efficient. My overall goal is to perhaps contribute to an increase in

productivity or efficiency by trying to formulate an improved quality assurance program. In an attempt to narrow the scope of this paper to a manageable level, I will restrict my discussion to the repair environment within AFLC. I am not trying to downplay the importance of the manufacturing effort within AFLC. However, I do feel that there are some potentially larger improvements to be made within the repair program.

Chapter II discusses where the repair quality assurance program is now and how it got there. Project Overlook is the road map for this program. Project Overlook was an in-depth industrial maintenance study conducted by a group under the direction of AFLC's Directors of Maintenance. The final report, on 15 February 1982, made 11 recommendations. These recommendations form the basis of the current AFLC Quality Assurance program. I feel that a thorough evaluation should be made of this program and Chapter II is the place.

One of the ways that you get a good quality assurance program is to provide clear quality standards throughout the repair process. In Chapter III, I explore how work is assigned to the Directorates of Maintenance and evaluate whether or not clear quality standards are provided. Then I review the engineered labor standard program for the same information. I also do the same for the work order

planning process. By reviewing these areas, I feel that I can determine whether or not quality standards are provided and whether or not they are conveyed throughout the system.

Another of the ways that you get a good quality assurance program is to have an effective feedback system in place to tell you when something is not working properly. In Chapter IV, I review the feedback system currently used by AFLC. The Quality Deficiency Reporting (QDR) program as governed by T.O. 00-35D-54 is that program. I feel that a good look at this program might be fruitful.

Currently, AFLC is investigating the use of statistical process control as espoused by Dr. W. Edward Deming. In Chapter V, I review that program. I feel that an analysis of this program might have some benefits.

In Chapter VI, I look at similar types of repair operations within the Department of Defense and some civilian companies. However, I do not compare any or all. I'm merely looking for good ideas that might make a positive contribution to AFLC's Quality Assurance program.

Finally, I propose ideas or solutions to problems that my research uncovered and assess possible ramifications for AFLC. Remember my original premise was to make suggestions that would either increase productivity or efficiency. If my suggestions don't do that, what good are they?

CHAPTER II

PROJECT OVERLOOK

Prior to the formation of the Industrial Maintenance Study Group in 1981, the Industrial Maintenance Quality Management System in AFLC was oriented toward product inspections. These inspections identified problems when those problems manifested themselves in some fashion after the repair operation was completed. In most cases, the manpower available to the quality function precluded a truly successful program based entirely on this concept. Approximately one inspector for each twenty production workers was available instead of the estimated one inspector per ten production workers needed to perform this "hands on" inspection for all products. This necessitated the use of a sampling technique as in most cases no inspector was available because of a lack of resources. (8:27) Although this program was called Quality Assurance, it was really a quality control oriented approach. There was a heavy dependence on separating good items from bad by a non-production organization (Quality). (8:23) This approach was hampered by a lack of

resources, even in 1981. The Industrial Maintenance Study group provided the framework for the changes that have resulted in the current Quality Assurance program within AFLC.

The Project Overlook study group visited 32 organizations and facilities to include all of the Air Logistics Centers, other Department of Defense organizations, and selected civilian industries in an attempt to identify any possible approaches to improvement. Quoting directly from the final report, the group made the following recommendations:

(1) The basic organizational structure of Quality within AFLC should be maintained.

(2) The Industrial Maintenance Quality Program should be quality assurance oriented to aid in the prevention of defects before they can impact on the product. A worker certification program with quality verification is recommended to motivate the work force to build in quality. Quality resources would then concentrate on the preventative aspects of a true quality assurance program such as process and procedures inspections, auditing, and trend analysis.

(3) To support the certification/verification quality assurance approach, it is recommended that an all professional GS 1910 Quality Assurance work force be established within the MAQs* at each center.

(4) To complement the quality assurance approach and to aid in problem solving, it is recommended that professional technical expertise be developed in the Quality Organization. A Quality Engineering Organization is required to perform such functions as the identification of critical inspection

*Office symbol for the Product Reliability and Quality Assurance Division in the Directorate of Maintenance at each Air Logistics Center

characteristics, investigation of customer complaints, and chair the Material Review Boards.

(5) Process control is one of the most important areas in defect prevention. It is recommended that MAQ be the single focal point for all process control planning.

(6) It is essential that a viable quality assurance program be implemented at each center for software and related items.

(7) The industry system of separating technical data into design and process is recommended for adoption in AFLC.

(8) Quality should participate in the development and identification of inspection techniques and equipment to keep pace with product technology advancements.

(9) A comprehensive data system is critical to any quality program to aid in analysis, feedback, and defect prevention. The Study Group recommends improvement of the current systems through data input simplification and improved access to data.

(10) A comprehensive cost of Quality is required to complement the quality data system. This should include the collection and tracking of rework costs.

(11) Quality indicators should be developed to emphasize the positive aspects of Quality in addition to identifying problem areas. (8:2-4)

Those were the recommendations of the Study Group as presented on 15 February 1982. Let's take a quick look at the status of those recommendations today.

The Study Group resisted the temptation to solve problems by reorganizing. The basic structure for Quality has been maintained in accordance with recommendation 1.

Recommendation 2 resulted in the Production Acceptance Certification (PAC) program throughout AFLC. This innovative

program requires the technicians to certify that the work they have performed meets all specifications or operating parameters. This contrasts markedly from the previous system that required the quality assurance specialist to make that final determination. Although the program is not completely implemented across the command and still meets with some resistance, it is arguably the most drastic divergence from previous policy. The PAC program required a complete reversal of roles within the production areas. No longer was the Quality function responsible for the final condition of the repaired item. Now the production area is. PAC is a tremendous step forward that promises even greater gains for the future.

Recommendation 3 has been implemented across the command. It has arguably provided a more professional quality work force, but has resulted in significant career stagnation as the management of this job series has resulted in little cross movement.

The Air Logistic Centers (ALCs) were restructured in 1986 to provide increased technical and scientific expertise by creating a Quality Engineering function at each Air Logistics Center. This has provided an vastly improved capability to oversee and improve in-house depot maintenance processes by applying scientific and technical skills. The new quality verification centers provide sophisticated measurement and

examination for critical components. The methods laboratories are providing much needed help in the development of new procedures, tools, and equipment. The physical science branches have been augmented to provide a wide range of scientific functions to support the quality function. (15:1-2)

Process review responsibility has been assigned to Quality in accordance with recommendation 5. Each industrial process such as painting, plating, and heat treating of metals is reviewed periodically. This review is conducted by a special process task group assembled specifically for the particular process under review. Representatives on this panel might include experts from the physical sciences laboratories, safety, engineering, and quality assurance as well as the applicable production function.

A viable quality assurance program is in place in accordance with recommendation 6. (15:3)

The recommendation of separating technical data as per recommendation 7 has been tested and has been found to be unfeasible at this time. The cost was determined to be simply prohibitive.

All ALC Quality organizations are participating in the development and identification of new techniques and equipment as suggested by recommendation 8.

The development of a comprehensive data system has been

severely hampered by the implementation of the Depot Maintenance Management Information System (DMMIS). The current system is indeed unwieldy and difficult to access. However, it is not wise to invest in any program to improve the old system when the proposed system will be light years ahead in capability and ease of use. The Quality Information System (QIS) portion of the DMMIS is years away at the present rate of implementation.

The development of a comprehensive cost of quality system is also being impacted by the slow progress of the DMMIS program. The current system is almost completely unusable and it simply makes no sense to make further investment in such a limited system.

The same situation is occurring with the development of new quality indicators. Even though there are a large number of quality indicators being used throughout the ALCs, they are not tied to dollar costs.

So, that's a quick summary of where the command started from and a review of how they're doing in regards to Project Overlook. They've made giant strides forward in converting from an "inspect in" quality concept to a "build it in" concept. They've also made great strides in providing the needed scientific and technical expertise to the production areas. However, the slow progress of DMMIS is retarding the progress of other Project Overlook initiatives.

CHAPTER III

REGULATORY GUIDANCE FOR AFLC' QUALITY ASSURANCE PROGRAM

In order to be able to provide any meaningful suggestions concerning AFLC's Quality Assurance program, I feel that the regulatory guidance should be reviewed. In this chapter, I trace the guidance as it is provided from command level down to the production planning level. My review shows that there is no definition of an expected level of quality. The only quality assurance requirement is that any repaired item meet contract specifications, project directives, or other technical requirements. I feel that it is extremely important for a good quality assurance program to clearly spell out the level of quality that one expects. Then items should be repaired to that level of quality. Finally, to provide a true customer orientation, AFLC should provide a product warranty on every repaired item.

Even though the old Quality Assurance office has been abolished and the responsibility assigned to the Air Logistics Single Point of Contact Office (SPOCO) office, the basic responsibilities have not changed.

AFLCR 74-1 is titled AFLC Quality Program and

describes the quality assurance program desired from the command level. Excerpts from this regulation may be seen in appendix A. This regulation specifies that the program should be implemented to assure adequate quality. However, the regulation spells out the requirement to assure conformance to project directives, contract specifications, or other technical requirements.

AFLCR 74-12 is titled Quality Assurance Program and describes the quality assurance program desired from the ALC level. Excerpts from this regulation may be seen at appendix B. Again, there is no guidance in reaching a desired level of quality, although there is a requirement that there be realistic quality standards specified.

AFLCR 74-2 is titled Quality Assurance Program and describes the quality assurance program desired at the Directorate of Maintenance level. Excerpts from this regulation may be seen at appendix C. This regulation also spells out the requirement that all products and services performed by the Directorate of Maintenance conform to specifications. (6:3) The Product Quality and Reliability Division (MAQ) is specifically assigned the task of ensuring that products conform to standards.

AFLCR 66-60 is titled Policy and Control of Workload and provides guidance to the Directorate of Maintenance in the control of workload assigned to the directorate.

Excerpts from this regulation may be seen at appendix D. This regulation also spells out the requirement for rigidly observing the negotiated job specifications as established by the customer. (4:1-1)

AFLCR 65-22 is titled Depot Maintenance Work Specifications and provides guidance in the use and preparation of work specifications. This regulation refers to work specifications as the most critical item in maintenance negotiations and the most frequent source of disputes if not specific and encompassing agreed-to maintenance requirements. However, this regulation directs that a standard of quality be provided to contractors so that they may produce a quality product. (1:1-4)

AFLCR 66-4 titled Production Engineering Planning and provides guidance to the appropriate product division within the Directorate of Maintenance. Excerpts from this regulation may be seen in appendix E. This regulation requires that quality standards be established, maintained, and integrated into the production plan by the Product Quality and Reliability Division. (2:3-1) It is important to note that the level of quality did not come from the customer, but rather from the quality assurance organization.

AFLCR 66-51 is titled Use of Technical Data Within Depot Maintenance. Excerpts from this regulation may be seen in appendix F. This regulation specifies that technical data

to include specifications, standards, and blue prints are the source of information used to perform work or develop local step by step instructions to accomplish technical requirements. The regulation also describes the use and control of the work control document(WCD). The WCD is an expendable document used for work description and control identification of movement, and routing of items and normally covers the complete processing of an item. This is the place in the process that I feel that a level of quality should be verified. In other words, some description of the verification required to ensure that the desired level of quality by the customer is realized.

As I have selectively reviewed the regulatory guidance for the command, it is by now apparent that all repair work performed under the auspices of the command is done to a specification. If one would like the system to be more customer oriented, then one needs to perform this work to a desired level of quality. By this I mean that our intermediate customer, the D/MM, should spell out exactly the level of quality that they expect. All repair work should be performed to that level and delivered to our final customer with a promise of that level of quality. Just to show that we are truly customer-oriented, we should deliver every repaired item with a warranty that the item will last for a specified length or it will be replaced. This approach will

provide a true customer-oriented repair program. Our customer will receive repaired items with an expected level of quality and a warranty from the command that we stand behind what we have provided.

CHAPTER IV

THE QUALITY DEFICIENCY REPORTING SYSTEM

As I have done the research for this project, I have been impressed by the consistent reference in the literature to a positive customer-supplier relationship as the single most important factor in any good quality assurance program. I think that Mr. John Hagan said it best in his book, A Management Role for Quality Control.

Quality Control must enjoy a close relationship with the customer. This is true regardless of whether the customer is the general public or a specific agency of a large organization. Knowledge of the customer's problems with the product is necessary, not only for their immediate correction, but also for their future prevention and for the maintenance of customer goodwill. The company's response to customer problems is, in fact, an integral part of the image that must be continually promoted to all concerned. As the voice of company performance, Quality Control must communicate directly with the customer. There can be no substitute for first-hand information in the identification and resolution of product-quality problems: passage through many hands only dilutes the authority and effectiveness of the communication. The promotion of customer satisfaction should never be relegated to a system in which the involvement of too many company groups permits misinterpretation of responsibility and the mishandling of problems. (16:131)

In this chapter, I review the regulatory guidance for the Quality Deficiency reporting system. In doing so, I show that the Quality Deficiency reporting system is so structured to only process reports as identified as unsatisfactory by

the customer. While this is an excellent beginning for a strong customer relations program, it's not the whole answer. Some agency should be identified as being responsible for customer satisfaction. Customer relations is too important an area to be restricted to only answering specific problems as identified by the customer. Every ALC's maintenance activity has a strong system of unofficial customer relationships to fill this void. While this unofficial system is much more responsive and timely, it bypasses the agency which should be responsible. AFLC is at a particular disadvantage in utilizing a strong customer relationship as a major portion of a strong quality assurance program. Let's take a look at the reason why.

The majority of the organic and contractual repair work is performed for an intermediate customer, the Directorate of Material Management. The work is managed by either the System Program Manager (SPM) or an Item Manager (IM). Neither one of which are the final customer. The ultimate customer does not establish the specifications or the desired quality of the end product. That job is performed for him by either the SPM or the IM. However, he is expected to provide feedback on the quality of the items that he uses through the Quality Deficiency Reporting (QDR) System. This extra layer of administration between the customer and the repair activity makes a responsive and

timely customer relations program even more important.

Let's review the AFLC guidance for the QDR system. Again, I realize that this office has been abolished, but the responsibility is still within the ALC as directed by this regulation. AFLCR 74-12, Staff Quality Assurance Program, dated 28 July 1980 provides this guidance as follows:

2-1. Purpose. This chapter gives guidance for assessing the ALC quality assurance program by the Office of Assistant to the Commander for Quality Assurance (QE) and reporting results to management.

2-3. Responsibilities. The Office of Assistant to the Commander for Quality Assurance:

b. Directs special audits, reviews, and product assessments to ensure quality products to the ALC customers.

c. Analyzes all material deficiency reports from user activities.

f. Identifies to the organic Technical Repair Centers (TRC) or principal contracting officer (PCO) features which require mandatory inspection, and recommends other actions, when needed, to prevent or resolve quality control problems.

g. Evaluates the effectiveness of the ALC quality program.

h. Apprises the ALC commander and other levels of management of the QA Program status.

i. Analyzes discrepancy data and makes recommendations, when required, for program improvement or corrective actions. When significant problems or noncompliance with directives are encountered, take followup action.

9-1. (DEFICIENCY REPORTS) Applicability:

These procedures apply to quality deficiencies submitted under the provisions of TO 00-35D-54. This chapter doesn't change designated action or

investigating agency responsibilities for quality deficiency reports. It provides uniform procedures for assuring that quality data generated by using activities are effective and that appropriate management levels are apprised of quality problems. The Office of the Assistant to the Commander for Quality Assurance(QA) at the ALC exercise direct control of quality deficiency reports received and replies made to the initiator. The continuous analysis of quality deficiency data is needed to determine the quality status for items managed and to identify and correct quality control problems and adverse quality trends.

9-3. Objectives of Deficiency Data Analysis:

- a. To establish quality trends for all material already in the inventory and for overhauled or new acquisitions.
- b. To give managers at all levels, information as a management tool to evaluate the quality of items or systems for which they are responsible.
- c. To identify quality problems by product and product source.
- d. To facilitate review of responses and corrective action initiated by responsible quality assurance activities.
- e. To make sure action is taken to preclude the issue of all suspected defective items from supply and to repair or replace any known defective items in stock or already in use.

9-4. Responsibilities.

a. The ALC Office of the Assistant to the Commander for Quality Assurance(QA) will:

(1) Receive all Category II Quality Material Deficiency Reports(QMDRs), screen for accuracy and applicability, input data to the Quality Assurance System(G021); and maintain control during the receipt through closing action cycle.

(2) Respond to initiators according to TO 00-35D-54 and AFLCR 66-15 requirements.

(3) Analyze and correlate all quality deficiency

reports and other customer complaints to identify unsatisfactory quality trends and quality problems.

(8) Analyze all replies and corrective actions to make sure adequate attention is given to investigation of specific complaints by the responsible organization. Initiate necessary followup when there is inadequate response to deficiency reports. When followup to other ALC activities doesn't get the desired results, request the aid of the other ALC (QA) activities to improve investigating agency responses and corrective actions.

(10) Take action through IM/SM to effect item inspection, repair, or replacement to preclude the issue of known or suspect material to using activities or to correct or replace items already in use when deficiency data analysis indicates a likelihood of defective items in stock or in the field. (7:2-1,9-1)

Well, there's a review of the Quality Deficiency Reporting System. The guidance provided is certainly adequate to insure the appropriate response to a customer complaint. However, there is no clear delegation of responsibility for this agency to be responsible for customer satisfaction. The unofficial customer relationships that are being maintained by the repair activities are a response by the repair activities to overcome the problems with the current system. I realize that the deletion of the QA office and a realignment of those responsibilities to the SPOCO might be seen as an attempt to address those problems, but I think not. There is no new guidance in the planning stage to address this problem. AFLC must provide a more responsive and customer oriented approach, and the way I recommend doing that is to make the SPOCO office responsible for customer

satisfaction. There are doing an acceptable job in answering specific customer complaints, but could make much more of a contribution by insuring the satisfaction of our customers.

Chapter V

Dr Deming's Statistical Process Control

The organic depot maintenance quality program has always relied upon the use of statistical methods to carry out their function. One of the recent methods to be evaluated for use in the repair environment are the statistical process controls (SPC) originally formulated for use in a manufacturing environment. The methods being evaluated for possible use within the command have been postulated by Dr. W. Edwards Deming. In this chapter, I briefly describe the statistical process controls and discuss the 14 management principles proposed by Dr. Deming to be used while employing his SPC program. I then discuss the applicability of selected principles to an ALC operation.

Simply put, SPC is a statistical chart which detects the existence of a cause of variation that lies outside the system. It does not find the cause. (12:112) The type of variations to be kept on the chart are to be determined by the user. This simple but powerful tool is being widely employed throughout private industry. The statistical techniques are very basic. The difficulty lies in

determining which variables to track. An equally important part of Dr Deming's suggested program is 14 management principles which, if followed, will improve the quality of one's product.

Dr. Deming's 14 management points are as follows:

1. Create constancy of purpose toward improvement of product and service, with a plan to become competitive and to stay in business. Decide who top management is responsible to.
2. Adopt the new philosophy. We are in a new economic age. We can no longer live with commonly accepted levels of delays, mistakes, defective materials, and defective workmanship.
3. Cease dependence on mass inspection. Require, instead, statistical evidence that quality is built in, to eliminate need for inspection on a mass basis. Purchasing managers have a new job and must learn it.
4. End the practice of awarding business on the basis of price tag. Instead, depend on meaningful measures of quality, along with price. Eliminate suppliers that can not qualify with statistical methods of quality.
5. Find problems. It is management's job to work continually on the system (design, incoming materials, composition of material, maintenance, improvement of machine, training, supervision, retraining).
6. Institute modern methods of training on the job.
7. Institute modern methods of supervision of production workers. The responsibility of foremen must be changed from sheer numbers to quality. Improvement of quality will automatically improve productivity. Management must prepare to take immediate action on reports from foremen concerning barriers such as inherited defects, machines not maintained, poor tools, fuzzy operational definitions.
8. Drive out fear, so that everyone may work effectively for the company.
9. Break down barriers between departments. People in

research, design, sales, and production must work as a team, to foresee problems of production that may be encountered with various materials and specifications.

10. Eliminate numerical goals, posters, and slogans for the work force asking for new levels of productivity without improving methods.

11. Eliminate work standards that prescribe numerical quotas.

12. Remove barriers that stand between the hourly worker and his right to pride of workmanship.

13. Institute a vigorous program of education and retraining.

14. Create a structure in top management that will push every day on the above 13 points. (12:16-17)

Some of these points have particular significance for AFLC Quality Assurance functions and I will discuss selected points from Dr. Deming's list.

Point 3 refers to the concept of statistical process control as previously described in this chapter. The concept should also be applied to our suppliers. There is no current requirement for suppliers to employ a quality concept other than an "inspect quality in" concept. Our supply of raw materials or component parts has a great deal to do with the quality of the final product. It will do no good to have the finest in-house quality assurance program in the world if the materials supplied by a private firm do not meet the required standards. This concept ties in neatly with point 4. It simply is not in the best interests of the AFLC repair effort to award business to the lowest bidder. If statistical

process control can do positive things for the command, then require our suppliers to provide statistical evidence of quality. Then buy from them. Not the lowest bidder.

Dr. Deming's proposal number 10 to eliminate numerical goals, posters, or any other exhortations to improve productivity without providing methods would also be a drastic change in the operating procedures within the command. We are especially prone to attempts to raise productivity by appealing to our work force. If it were possible to significantly improve the productivity of our work force by posters or other programs, we would certainly have raised the levels of productivity through the roof by now. Exhorting our work force rather than doing the much more difficult tasks of replacing obsolete equipment or outdated repair procedures is certainly much easier. Dr. Deming would have us put that effort and money into improving methods to allow our work force to improve their productivity. We have already established a precedent by showing our work force that we feel they are responsible for the quality of the final product by implementing the PAC program.

Every repair action taken throughout AFLC is covered by a work standard which assigns a number of manhours that each repair action will consume. "As usually used, work standards are a guarantee of inefficiency and high cost. For example,

a work standard may contain an allowance of 10 per cent for defective items, and 20 per cent for scrap. Work standards guarantee that the company will get the specified amount of defective items, and the specified amount of scrap, and never improve." (12:40) Dr. Deming's point 11 of eliminating work standards and quotas would certainly be a radical change for the command. The command has certainly done an outstanding job of creating and managing work standards and quotas.

While I realize that the concept of work standards provides an outstanding tool for financial management, it is probably the worst way to produce a quality product. Again, I feel that it's time to show some more trust in our work force. Lets eliminate work standards and ask our work force to produce as much as they can of the highest possible quality.

Well, that's a brief synopsis of statistical process control as proposed by Dr. Deming. As you can see, the concept consists of much more than a new statistical concept which wasn't new anyway. As you will recall, Dr. Deming is the person who started the Japanese on their road to consistently producing the highest quality of manufactured goods in the world. His point of asking our suppliers to show evidence of statistical process control certainly fits in with my recommendation of implementing statistical process control in house. It makes no sense to update our quality assurance program and not require our suppliers to do

likewise. Ending the practice of exhorting our work force to do better via numerical goals and posters should be worthwhile. If this practice was of any value, we would have already raised the levels of quality and productivity to the highest possible level. Finally, eliminating work standards should shift the emphasis from a purely production emphasis to a quality production basis. His management principles constitute a marked departure from the operating procedures used by the command. However, the PAC program was an equally marked departure in its time.

CHAPTER VI

WHAT'S GOING ON IN THE ARMY, NAVY, AND CIVILIAN INDUSTRY?

In my research efforts, I was interested in seeing if there were any startling revelations or new concepts in quality assurance that AFLC could borrow. I reviewed the quality assurance programs for the Army Depot System, Navy Aviation Depots, and civilian industry in general. I was pleased to learn that the Army and the Navy are rapidly assimilating the statistical process control to quality assurance. In this chapter, I show the depth of the Army and Navy commitment to SPC and some overall impressions of quality assurance programs in civilian industry.

The Department of the Army has a draft regulation, DESCOM Regulation no. 702-1, titled Depot Quality System, in coordination at this time. The regulation spells out the requirement for SPC as follows:

1-4. POLICY.

c. To assure that established quality standards are achieved, processes, products, services, and procurements will be managed through statistical process and quality controls and through periodic audits during all phases of operations. (10:1-2)

There is also a section describing management responsibilities as follows:

1-4. POLICY.

e. Management at all levels will:

(1) Assure that employees are knowledgeable of the quality standards applicable to their output (hardware, software, service).

(2) Strive to create an attitudinal environment which places a high value on quality and makes it a personal responsibility of every employee to do the job "right the first time".

(3) Develop and sustain an atmosphere and environment where waste, delays, errors, and mediocrity are unacceptable. (10:1-2)

Although the Army Depot System support for SPC is very evident in its draft regulation, support for Dr Deming's 14 management principles is not nearly so straightforward.

Although it is fairly easy to pick out at least some of his ideas from the section on management responsibilities. The Army's management point number two of creating an attitudinal environment which places a high value on quality correlates with Dr Deming's first management principle of creating a constancy of purpose towards product and service. The Army's management point number three of developing and sustaining an atmosphere and environment where waste, delays, errors, and mediocrity are unacceptable correlates with Dr Deming's point number three. This management principle states that we are to adopt the new philosophy and we can no longer live with levels of delays, mistakes, defective materials, and defective workmanship.

The Naval Aviation Depots are implementing a Total

Quality Management system. Their stated management approach is a systematic approach to productivity improvement using statistical methods and all employees to continuously improve the quality of all products and services and meet the expectations of the customer.

(19:22) The Naval Aviation Depots are using a program they call Total Quality Management. Their approach also stresses the management principles of Dr. Deming as a major factor in this approach.

The latest American Society for Quality Control (ASQC) Gallup survey revealed some startling impressions of the need for quality assurance programs and the need for improving them. The third annual survey conducted as part of National Quality Month activities for ASQC drew responses from 615 top level executives. One of the responses was as follows:

Eighty percent of the respondents indicate that product/service quality plays a very important role in strengthening the ability of U.S. business to compete with foreign competition. And an overwhelming majority (85%) acknowledge that even if U.S. companies were to achieve a "level playing field" in international trade through the elimination of barriers to entry into foreign markets and elimination of dumping there would still be a need to improve quality in order to compete effectively. (22:14)

This response is very confusing when one considers the status of quality improvement programs as reflected in this same survey:

While nearly half (46%) of the nation's top business

executives report major results in profitability and market share through quality improvement efforts, some 30% either see no need to use quality improvement as a strategic activity or have only recently become aware of the possibility. (22:15)

Finally, as it relates to the responses given when executives were asked how often their companies use various technical and management programs that typically form the background of quality assurance efforts. Their responses were as follows:

While 38% report using total quality control very often, only 17% use statistical process control very often, and 29% use SPC rarely or never. (22:16)

So, our civilian industries recognize the need for quality assurance, but for significant numbers, don't see the need to work at it.

I see both the Army Depots and the Navy Aviation Depots as having stepped up to their quality assurance problems and are working hard to solve them. They have selected the use of SPC and Dr. Deming's 14 management principles as the method of solving those problems. Our civilian industries are not so deeply involved. While most recognize the need for a strong quality assurance program, most do not employ quality systems very often. When they do use quality control systems, they do not use SPC very often. It makes even more sense for AFLC to require the use of SPC by our suppliers. This will enable us to provide the highest level of repair support to our

customers by insuring that we use the highest possible
quality purchased items in our repair program.

CHAPTER VII

SUGGESTED IMPROVEMENTS

Now comes the difficult part of this project. I think that I've laid the basic groundwork for proposing some ideas to improve the repair quality assurance program for the command. I reviewed the roadmap for the command, Project Overlook, and taken a look at the status of the recommendations from that study group. Incidentally, I am even more impressed with the high quality of that effort. I have reviewed the Quality Assurance guidance from the AFLC level down to the production planning level. Then I took an in-depth look at the Quality Deficiency Reporting System as it is currently in the regulations. Even though the responsibility has shifted from the old QE office to the SPOCO, no changes in either guidance or operating procedures were apparent to me. I briefly reviewed the statistical process control as espoused by Dr. W. Edwards Deming. Finally, I reviewed the Army Depot Systems proposed regulation, the Naval Aviation Depots Total Quality Management, and a short review of the status of quality assurance on the civilian side. Now, let's see if

I can make something out of all of this.

CUSTOMER RELATIONS

The first area that I would like to address is our customer relations program. Like it or not, our customers will decide whether or not we have provided a quality product. (20:82) They, of course, do not have the option of showing their displeasure by going to another source for their repaired items. The American Society for Quality Control commissioned the Gallup Organization to survey executives' perceptions on a wide range of quality-related topics. Their comments concerning customer relations are as follows:

Customer satisfaction is clearly the driving force behind quality improvement efforts-a stronger motivator than concern over domestic or foreign competitors. Communications with the customer, including customer complaints, are dominant factors mentioned by respondents as indicators of the quality of their products. (22:16)

The problem has been recognized at least as far back as the Project Overlook study. Every ALC D/M has a strong program of customer relations apart from the formal customer relations program, the Quality Deficiency Reporting System. This unofficial program is strongest in the aircraft repair and overhaul area. The component repair area is much more

likely to use the formal reporting system rather than the informal system. The formal system as mentioned in Chapter IV is administratively complex and probably does not reflect customer satisfaction. With this situation in mind, let's make the SPOCO responsible for customer satisfaction rather than for just specific customer complaints. This would require a much more aggressive approach towards quality assurance by the SPOCO. By increasing the scope of the responsibilities of the SPOCO, a much more positive customer related program could be implemented.

EXPECTED LEVEL OF QUALITY vs SPECIFICATIONS

In Chapter IV, I showed that all repair work done by AFLC was done to a specification. The specifications that are used in repair work are spelled out in great detail. This approach assumes that a quality product may be produced by precisely meeting a specification. However, there was never a specified standard of quality. For example, an item should be repaired such that it will last for a specified number of operating cycles or operating hours. This changes the entire concept of our quality program from a meeting a specifications approach to a customer oriented approach. This will mean a radical change in how we do business. In order to provide a true customer-oriented approach to quality assurance, we must provide items that work the first time and last for a long item rather than meeting a specification or

series of specifications. How long a time should be specified by the tasking agency, the D/MM. We should then provide a product warranty backing up our desired level of quality. In this way, we can provide a truly customer oriented approach to our repair program. This warranty should specify for how long that item should work. If it doesn't meet this standard, then a replacement item will be provided at no charge to the customer. In this way, we are certain to have every failure promptly reported. This should improve the reliability of the Quality Deficiency Reporting System as every repaired item that did not meet the customer's expectations would be promptly reported. By providing our customers with a repaired product with a warranted length of service, AFLC would be providing a much more customer oriented approach to its Quality Assurance program.

IMPLEMENT STATISTICAL PROCESS CONTROL

I strongly recommend that the command use the statistical process control system as espoused by Dr Deming. It's one more statistical tool but it's a good one. I feel that the benefits of implementing this approach will allow AFLC to provide a higher quality repaired item. What will be more of a change for AFLC will be implementing some of Dr Deming's management principles. Certain of these are

extremely applicable to the ALC operation and are a logical extension of the PAC program.

Well, that's the crux of this report. I haven't recommended a new quality assurance program, but rather the old one restructured to pursue a customer orientation. Requiring the SPOCO to be responsible for customer satisfaction should help. Also, providing more of a customer orientation by providing a warranty for repaired items will require much greater effort in determining a required level of quality rather than a meeting a specification approach. Finally, implementing SPC and selected of Dr Demings management approach will allow AFLC to do a better job in the repair program.

APPENDIX A

AFLCR 74-1 dated 25 March 1976 and titled AFLC Quality Program implements the Quality and Reliability Assurance program for the command. The general requirements described in this regulation are as follows:

3. GENERAL REQUIREMENTS. Effective and economic Quality Systems, planned and developed in consonance with, other command management, administrative, and technical programs, are required to implement the requirements of this document. Design of the Quality Systems shall be based on the technical and mission aspects of Material Management, Maintenance, Distribution, and Procurement. The Quality Program shall be implemented by procedures, methods, etc. to assure that controls are applied to all products and services acquired from organic and contract sources. The program shall be implemented to assure adequate quality throughout all AFLC areas of command responsibility; for example, Material Management, Maintenance, Distribution, Procurement, and including support and technical activities such as engineering, design, development, test, fabrication and site installation.

a. All AFLC products and services whether subjected to acquisition, maintenance, (including repair and overhaul), manufacture, modification, or distribution, etc. shall be controlled by appropriate mechanical, statistical, or procedural means at all points necessary to assure conformance to project directives, contract specifications, or other technical requirements. The Quality System shall provide for means to assess the effectiveness of prevention and ready detection of deficiencies and defects and for verification of timely and positive corrective action. Objective evidence of quality conformance must be readily available to assure conformance of products and services to the required specifications and technical directives. Instructions and records related to quality assurance must be complete and auditable to provide documented proof of quality.

b. Within the areas of Material Management,

Procurement, Maintenance, and Distribution, the authority and responsibility of those in charge of testing shall be clearly stated. The Quality Systems shall facilitate determination of the effect of quality deficiencies and quality costs on command efficiency. All facilities, tools, equipment, and standards such as drawings, technical orders, engineering changes, laboratories, measuring and test equipment, and the like, which are necessary for the creation of the required quality shall be effectively managed. (5:1-2)

APPENDIX B

AFLCR 74-12 , titled Staff Quality Assurance Program and dated 28 July 1980 implements the Quality Assurance program at the ALC level. That guidance is as follows:

1-1. CONCEPT OF OPERATIONS. Each ALC directorate develops, implements, administers, and maintains, quality assurance programs for its area of operation to provide the best level of customer support. The ALC Office of the Assistant to the Commander for Quality Assurance(QE), is responsible for keeping the commander apprised of the status of the AFLC Quality Program. QE integrates existing operational procedures into a centrally monitored and coordinated ALC quality assurance program; and provides staff direction to make sure existing ALC Directorate programs are compatible and produce the best results. All ALC directorates are responsible for assuring the quality of their products and services.

1-2. OBJECTIVES.

a. Achieve effective and economic use of quality assurances through centralized coordination of the total quality assurance effort.

b. Ensure realistic quality standards are specified and effective controls set up to ensure compliance. This applies to material acquired, modified, maintained, repaired, serviced, stored, packaged, issued, and transported by the ALCs and to document and data related to these processes.

c. Evaluate the degree of compliance with established standards through the development and use of data feedback systems and other techniques such as surveys, studies, and audits.

d. Use coordinated and compatible data which accurately reflect all pertinent aspects of logistics, to assess the condition and conformance of material and documentation to technical requirements.

e. Promote mission effectiveness by providing quality material in a timely manner.

f. Proper use of resources for complete cost effective quality assurance coverage.

g. Provide records that are adaptable to mechanized processing and management usage at all organizational levels.

h. Provide an effective career management and training program for quality assurance personnel.

i. Attract, develop, and retain skilled people to perform quality assurance programs efficiently. (7:1-1)

APPENDIX C

AFLCR 74-2 titled Maintenance Quality Assurance Program and dated 11 January 1985 provides the Quality Assurance to the Directorates of Maintenance at the ALCs. Selected portions of that guidance are as follows:

1-1. INTRODUCTION. This program is used to ensure that products and services provided by maintenance conform to technical order (TO) requirements. The Quality Assurance Division (MAQ) assesses the quality of all production and service operations; helps the producing activity resolve production quality problems; and helps identify costly and ineffective processes. This directive is used along with AFLCR 74-1. Local operating instructions are needed.

1-3. ORGANIC DEPOT RESPONSIBILITY. The Directorate of Maintenance, Quality Assurance Division (MAQ) is responsible for developing and managing the Maintenance Quality Assurance Program according to this regulation.

1-4. OBJECTIVE. The primary objective of the AFLC Maintenance Quality Assurance Program is to make sure that products produced and services performed by the D.M conform to specifications. This program also provides the means necessary to measure the quality levels of maintenance processes.

1-6. BACKGROUND. Quality assurance involves a planned, systematic approach to provide confidence that products conform to established requirements. The maintenance quality assurance program adheres to three basic principles:

a. Responsibility for quality rests with the organization that produces the product. Quality assurance supports these activities by ensuring that adequate assurance provisions are planned, developed, and implemented.

b. Quality must be built into the product. Quality assurance focuses its activities on the identification, prevention, and correction of unsatisfactory conditions or elements which influence the quality and acceptability of the finished product.

c. Quality is defined in terms of specific

requirements to be met. Such requirements must be effectively communicated to and understood by those activities and their personnel whose operations influence the quality of the finished product.

1-8. GENERAL PRACTICES OF THE D/M:

- a. The product division will provide products and services that conform to TO requirements.
- b. MAQ personnel must be actively involved in preproduction or production planning to make sure quality issues, concerns, and problems are considered in quality planning.
- c. MAQ must make sure products conform to standards.
- d. MAQ determines and documents the characteristics to be verified, nature, and extent of verifications, and points where verifications are to be performed.
- e. Products and services won't proceed past designated product quality verification points until they have been verified by MAQ.
- f. Product divisions must correct product, process and procedure nonconformance and their causes.
- g. The result of all quality observations must be documented.
- h. MAQ will analyze results of verifications and audits to identify and help correct causes of defects.
- i. MAQ keeps management informed of significant aspects of maintenance quality problems and provides recommendations for their prevention.
- j. MAQ prepares directives as necessary to implement this regulation. (6:3-4)

APPENDIX D

AFLCR 66-60 titled Policy and Control of Workload dated 14 July 1983 is starting to provide more specific quality assurance guidance. A selected portion of this regulation is as follows:

1-1. GENERAL. The Air Logistics Center (ALC) Directorate of Maintenance (D/M) is basically a product oriented organization and is aligned for the most effective means of accomplishing the assigned D/M mission. Workload control is an integral part of that mission and starts from the point of building a plan and ends when the last item is completed for the last work order for a given fiscal period.

1-3. OPERATING POLICIES. The emphasis on workload management includes control of all direct work from point of input through the resulting costs. This control over workload in no way affects the basic charter of the D/M, but actually enhances response by limiting support to valid mission requirements of a legitimate customer.

b. Required Correlation Between Negotiated Work Specifications and Quality Assurance Verification Requirements. Under the Depot Maintenance Service, Air Force Industrial Fund DMS/AFIF), the D/M must rigidly observe the negotiated job specifications as established by the customer (AFLCR 65-17 and AFLCR 65-22). Planned workbooks and quality verification requirements will be developed within these guidelines (4:1-1)

APPENDIX E

AFLCR 65-22 titled Depot Maintenance Work Specifications dated 17 October 1983 gives procedures for preparing maintenance work specifications. A portion of this regulation which refers to Quality Assurance is as follows:

3. General Instructions for Preparing Maintenance Work Specifications:

a. Role. These specifications are of prime importance in securing maintenance services under the Air Force depot maintenance concept. They govern the scope of maintenance, serve as a basis for competitive contracting, and are worded to help determine cost allocation. In dealing with ALC organic facility managers, using commands, or private industry, work specifications are the most critical item in maintenance negotiations and the most frequent source of disputes if not specific and encompassing agreed-to maintenance requirements.

4. Instructions for Preparing Standard Maintenance Work Specifications for Aircraft.

a. Section 1-General. General information is provided to the maintenance facility named in the specification. Maintenance on each element of work specified in the Appendix A must be thoroughly described to a standard of quality so that contractors unfamiliar with Air Force maintenance techniques may produce a quality product.

(11) Prepare quality requirements for contractual and organic work specifications as given in AFLCR 74-12. Coordinate work specifications with Quality Assurance (QA). (1:1-4)

APPENDIX F

We are continuing to develop more specific Quality Assurance guidelines. AFLCR 66-4 titled Production Engineering Planning dated 26 May 1981 is the next step. Selected portions of that guidance are as follows:

3-1. Introduction. The resources assigned to maintenance must be used in the most efficient and economical manner. Traditionally, the D/M engineering and planning personnel have been identified with improving use of government-owned and -operated facilities, as well as establishing labor and material standards to measure performance and distribute costs. Under the competitive influence of today's depot maintenance service AFIF which requires changes in organization and the means of collecting production feedback, basic resources are evaluated with respect to end item completions and their contributions to the overall maintenance effort.

b. Quality standards derived from the applicable technical data or management directives are also necessary and applicable to production and staff support. The quality standards are established, maintained, and integrated into the production plan by the appropriate quality assurance division. The resource standard developed to support a particular production requirement must take into account the quality standard and be constructed so that it provides the necessary resources to meet the desired quality.

(2:3-1)

APPENDIX G

AFLCR 66-51 titled Use of Technical Data Within Depot Maintenance dated 29 January 1985 is the final step in my investigation into the Quality Assurance guidance provided to the D/M. Selected portions of this regulation are as follows:

1-2. General Policy:

a. Technical data including specifications, standards, and blue prints is the source of information used to perform work or develop local step by step instructions to accomplish technical requirements. All work affecting the quality of products and services will be described by clear and complete instructions appropriate to the circumstances.

b. The method or format of providing technical information and instructions to the individual should be based on the type, complexity, and repetitiveness of work. The work control document (WCD) must be used in conjunction with the applicable technical data. The planning team makes the decision as to the method to be used for providing technical information and for preparing the necessary documentation.

2-1. General.

a. A WCD is an expendable document used for work description and control, identification of movement, and routing of items and normally covers the complete processing of an item. It specifies the sequential operations and inspection checkpoints to complete the work requirement when work control is the objective. Completion of the document provides an audit trail of specific control points certified by production and verified by quality assurance as well as an audit record for production count verification.

4-1. Production Planning Teams Responsibilities:

a. Preparing and coordinating WCDs and required workcards when all the work on an item is performed in the division.

4-4. Applicable Quality Function Responsibilities.

Provide quality planning team members whose duties will

include the following:

- a. Reviewing and coordinating on approved master copy of WCDs work cards and revisions thereto after all required steps or references are acceptable.
- b. Entering verification/certification identification code on the WCD as required.
- c. Adding or revising verification check points on WCDs when requested by the Quality function he or she is responsible for.
- d. Establishing verification requirements according to the Quality Assurance Plan and other guidance provided. (3:12)

BIBLIOGRAPHY

1. Air Force Logistics Command Regulation 65-22, Depot Maintenance Work Specifications, 17 October 1983.
2. Air Force Logistics Command Regulation 66-4, Production Engineering Planning, 26 May 1981.
3. Air Force Logistics Command Regulation 66-51, Use of Technical Data Within Depot Maintenance, 29 January 1985.
4. Air Force Logistics Command Regulation 66-60, Policy and Control of Workload, 14 July 1983.
5. Air Force Logistics Command Regulation 74-1, AFLC Quality Program, 25 March 1976.
6. Air Force Logistics Command Regulation 74-2, Quality Assurance Program, 11 January 1985.
7. Air Force Logistics Command Regulation 74-12, Staff Quality Assurance Program, 28 July 1980.
8. AFLC Project Overlook, Industrial Maintenance Quality Study Group, Final Report, 15 February 1982.
9. Air Force Technical Order, 00-35D-54, The Quality Deficiency Reporting System.
10. Army Headquarters, US Army Depot System Command (DESCOM) Draft Regulation 702-1, Product Assurance, Depot Quality System
11. Crosby, Phillips B., Quality Without Tears, The Art of Hassle-Free Management, USA: McGraw-Hill Book Company, 1984.
12. Deming, W. Edward, Dr., Quality, Productivity, and Competitive Position, USA: Massachusetts Institute Technology, Center for Advanced Study, 1982.
13. Feigenbaum, A. V., Total Quality Control, 3rd Edition, USA: McGraw-Hill Book Company, 1983.
14. Fuchs, Jerome H., CMC, Administering the Quality Control

Function, USA: Prentice-Hall Inc., 1979.

15. Glovka, Robert, Air Force Logistics Command Organic Depot Maintenance Quality Improvement Initiatives, 31 December 1986.
16. Hagan, John T., A Management Role for Quality Control, USA: American Management Association, Inc., 1968.
17. Juran, J. M., Management of Inspection and Quality Control. USA: Harpers & Brothers, 1946.
18. Mann, SMSgt, Making Quality Deficiency Reporting Work, TIG Brief, September-October 1987.
19. The Naval Aviation Maintenance Program (NAMP), Volume III, Intermediate Level Maintenance, 1 October 1986.
20. Peters, Tom, Thriving on Chaos, Handbook for a Management Revolution, New York: Alfred A. Knopf, Inc., 1987.
21. Peters, Thomas J. and Watermann, Robert H., Jr., In Search of Excellence, USA: Harper and Row Publishers, Inc., 1982.
22. Ryan, John, Quality and the Competitive Advantage, Quality Progress, December 1987.