Technical Assessment

OFFICE OF THE INSPECTOR GENERAL

Nonconformances of Resistors, Semiconductors, and Connectors Managed by the Defense Logistics Agency

Report No. 95-161 March 31, 1995

DEPARTMENT OF DEFENSE

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Acronyms

DESC	Defense Electronics Supply Command
DLA	Defense Logistics Agency
DORO	DLA Operations Research Office
NSN	National Stock Number

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
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ARLINGTON, VIRGINIA 22202-2884

March 31, 1995

MEMORANDUM FOR DIRECTOR, DEFENSE LOGISTICS AGENCY

SUBJECT: Technical Assessment on the Nonconformance of Resistors, Semiconductors, and Connectors Managed by the Defense Logistics Agency (Report No. 95-161)

We are providing this final report for your information and use. We conducted the technical assessment as a follow-on to the Inspector General's previous nonconforming product audits: No. 92-099, "Quality Assurance Actions Resulting From Electronic Component Screening," June 8, 1992; No. 90-113, "Nonconforming Products Procured by the Defense Industrial Supply Center," September 27, 1990; and No. 89-065, "Nonconforming Products in the Defense Supply System at Warner Robins Air Logistics Center," April 10, 1989. Management comments to a draft of this report were responsive and additional comments are not required.

Please contact Mr. Kenneth Stavenjord, Technical Director, at (703) 604-8952 or Mr. Gregory Donnellon, Project Manager, at (703) 604-8946 if you have any questions on this report. The courtesies extended to the Technical Assessment Division staff are appreciated. We also appreciated the support the Defense Logistics Agency provided in furnishing the material for testing. Appendix E lists the distribution of the report. The technical assessment team members are listed inside the back cover.

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Office of the Inspector General, DoD

Report No. 95-161 **March 31, 1995**
(Project No. 2PT-6018)

NONCONFORMANCES OF RESISTORS, SEMICONDUCTORS, AND CONNECTORS MANAGED BY THE DEFENSE LOGISTICS AGENCY

EXECUTIVE SUMMARY

Introduction. The Defense Electronics Supply Center (DESC) managed electronics inventory valued at $2.1 billion at the beginning of FY 1991. The inventory consisted of 980,000 National Stock Numbers (NSNs). The technical assessment tested nonconformances in three Federal supply classes (FSCs) of electronics parts (resistors, semiconductors, and connectors) drawn from DLA warehouses. In FY 1991, DESC spent $75 million to acquire 11.6 million items for 22,775 NSNs in the three FSCs.

Objectives. The primary objective of the assessment was to determine the percentage of nonconforming parts delivered in FY 1991 in each of the three electronics parts Federal supply classes. An additional objective was to assess differences in the percentage of nonconforming electronics parts between those items manufactured to military specifications and those items manufactured to commercial specifications.

Technical Assessment Results. The percentage of nonconforming material for the three FSCs in the inventory of the Defense Electronics Supply Center is higher than reported in the Center's Stock Quality Assurance statistics as shown below. We based the conclusion on a statistical sample with a projectible universe of 1,119 NSNs valued at $3.1 million.

Comparison of Stock Quality Assurance Test Nonconformance Results

	IG			
Group	Major Minimum Estimate (percent)	Minor Minimum Estimate (percent)	Major or Minor Minimum Estimate (percent)	DESC Reported Mean (percent)
Resistors	3.1	+0.0*	3.3	0.91
Semiconductors	8.6	23.8	31.0	3.03
Connectors	0	20.4	20.4	0

*0.017 percent.

In FY 1991 DESC tested 28,377 individual parts in the three Federal supply classes in our technical assessment as part of its Stock Quality Assurance Program. DESC's testing identified 320 nonconforming parts from the three supply classes.

Our higher nonconformance rates were due to differences in test methodology. We relied on complete critical performance characteristics testing while DESC tested only selected electronic parameters when it tested material. Also, we tested statistical samples of Federal supply classes, while DESC emphasized critical, high dollar volume material in reporting Stock Quality Assurance. A third reason that our test nonconformance rates were higher was because we tested a sample of material built to commercial specifications. In FY 1991, DESC's Stock Quality Assurance program tests included only 1 percent of material built to commercial specifications in the three Federal supply classes we studied, while 99 percent of the material DESC tested had military specifications. The commercial specificationed material point estimates of major or minor nonconformances for the three classes we tested were 17.8 percent for resistors, 18.3 percent for semiconductors and 29.1 percent for connectors. Higher rates of commercial parts nonconformances are particularly significant due to direction by the Secretary of Defense to utilize commercial parts specifications whenever possible. Additional testing of commercial specificationed parts is warranted.

Analysis of the reasons for the nonconformances also showed a problem with technical data management. The problems included out-of-date, incomplete, and ambiguous specifications.

Based on a reasoned order-of-magnitude calculation, DESC may have added upwards of a quarter of a million nonconforming items to its inventory in FY 1991 in two Federal supply classes. Nonconformances can impact the reliability and maintainability of weapons systems. The sampled parts typically had applications in more expensive remove-and-replace assemblies with applications in missiles, torpedos, aircraft and test equipment.

DLA took corrective action in a timely fashion upon receipt of our test results. For example, one vendor was disqualified from further procurements. Also, another vendor agreed to perform a testing program on its components.

Summary of Recommendations. We recommend that the Director, DLA, develop procedures for Stock Quality Assurance tests of complete critical performance characteristics; and that parts, to include commercial parts, be selected for testing with a process that will produce statistically significant results that can be extrapolated to projectable universes of parts. Also, we recommend that DLA review its technical data management program to determine whether the problems identified in this study were systemic for the FSCs examined.

Agency Comments. DLA concurred with all recommendations and requested that the projections in the report receive additional qualifications.

Technical Assessment Response. DLA's actions are responsive to the recommendations. Also, we added additional clarification to the final report on calculations made.

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This report was prepared by the Technical Assessment Division, Audit Planning and Technical Support Directorate, Office of the Assistant Inspector General for Auditing, DoD.

Part I - Introduction

Background

We initiated this technical assessment of electronics parts because of previous problems identified in audits of mechanical parts, problems found in investigations of electronics parts, and the size and criticality of electronic parts to the Defense mission. The previous audits identified nonconforming parts for hardware items such as nuts, bolts, and fasteners. The previous investigations found fraudulent product substitution and faked qualification test results.

Central management of electronic parts is the responsibility of the Defense Electronics Supply Center (DESC), Dayton, Ohio. DESC is responsible for purchasing electronic material for all Services. DESC also processes requisitions from Defense sources and sends the material to the requestor. At the time of our assessment, DESC managed 90 percent of the items classified as electronic parts. At the beginning of FY 1991, DESC managed approximately 980,000 National Stock Numbered (NSN) items. About 35 percent of the 980,000 NSNs belong to the three Federal supply classes studied in the assessment: resistors, semiconductors, and connectors. In FY 1991 DESC spent approximately $75 million to acquire resistors, semiconductors and connectors. The range in applications for these electronic parts vary from noncritical radios to critical applications in missiles and nuclear power plants. The definition of major and minor nonconformances were those used in the Defense Federal Acquisition Regulation Supplement 246.407:

> "Major nonconformance" means a nonconformance, other than critical, that is likely to result in failure, or to materially reduce the usability for the supplies or services for their intended purpose.
>
> "Minor nonconformance" means a nonconformance that is not likely to materially reduce the usability of the supplies and services for their intended purpose, or is a departure from established standards having little bearing on the effective use or operation of the supplies or services.

Objectives

The primary objective of the assessment was to determine the percentage of nonconforming parts delivered in FY 1991 in each of the three electronics parts Federal supply classes. A secondary objective was to determine whether significant differences existed between the nonconformance rates of parts manufactured to military specifications and parts manufactured to commercial specifications.

Scope and Methodology

The tested items came from three Federal supply classes; resistors (class number 5905); semiconductors (class number 5961); and connectors (class number 5935). The electrical parts tested came from 22,775 NSNs delivered to DLA warehouses during Fiscal Year 1991. The material was selected from stocks of ready-to-issue items with no shelf life restrictions. The sample included NSNs manufactured to commercial specifications as well as military specificationed NSNs.

Our assessment began with a research phase that included a feasibility study and development of the methodology used in the assessment phase. The resultant methodology was documented in the Sample Plan, the testing agreements, and support agreements. See Appendix A, "Statistical Methodology," and Appendix B, "Testing Memorandum of Agreement."

The assessment phase had four major stages:

- o NSNs were selected for test.
- o Test plans were written.
- o Material was tested.
- o Test results were analyzed.

A statistical sampling methodology was used to select the test items and project test results. Testing was based on the item specification. All critical performance characteristics were tested.

To perform the assessment, we interviewed officials of the Defense Logistics Agency (DLA) and the Defense Electronics Supply Center. We also visited DLA storage locations at Tracy, California; Ogden, Utah; Memphis, Tennessee; New Cumberland and Mechanicsburg, Pennsylvania; and Richmond, Virginia. DLA personnel at those locations assisted in selecting the sample material.

We discussed our statistical sampling methodology with officials of the DLA Operations Research Office in Richmond, Virginia. In selecting the test laboratories, we interviewed officials of Hill Air Force Base, Ogden, Utah, and officials of the Crane Naval Weapons Station, Crane, Indiana. We relied heavily on the expertise of the engineers at the Crane test laboratory in writing test plans and in conducting the electronics tests. The Crane engineers became a part of our assessment team, and their cooperation, effort, and guidance were essential in the successful completion of our assessment.

Following the completion of the test analysis by the Crane Laboratory, we discussed all major nonconformances with the manufacturers of the parts. In the majority of cases, we obtained agreement with the manufacturers about the causes of the nonconformances. Appendix D, "Organizations Visited or

Contacted," has a complete listing of all the commands and companies contacted in the assessment. The assessment methodology involved multiple steps and extensive coordination. However, the fact that the sample was drawn from items procured in FY 1991 does not, in our judgment, materially affect the validity of our conclusions.

The Inspector General's technical assessment team consisted of members with expertise in electronics engineering, general engineering, procurement, statistics, and logistics. The Technical Assessment was performed from March 1992 to October 1994.

Prior Audits and Other Reviews

Nonconforming parts have been the subject of three prior Inspector General audit reports since 1989.

Office of the Inspector General, DoD, Report No. 92-099, "Quality Assurance Actions Resulting From Electronic Component Screening," June 8, 1992. The report covered the Defense Electronics Supply Center processing of Product Quality Deficiency Reports. The report stated that the data in the Product Quality Deficiency Reports were incorrect and that the reports were not processed uniformly. Further, the Product Quality Deficiency Reports had no adequate follow-up. The report recommended enhancements to quality assurance testing programs, revisions to the Defense Federal Acquisition Regulation to provide remedies for obtaining reimbursements for critical and major nonconforming products, and procedural changes to improve the Product Quality Deficiency Report Program. DoD concurred with the recommendations to improve the Quality Deficiency Reporting Program. The DoD did not concur with the recommendations to revise the Defense Federal Acquisition Regulation because of the cost involved. However, definitions of patent and latent defects were to be added to the regulations, and a test was to be initiated to determine the costs and benefits of a standard contract clause that would require reimbursements for nonconforming items. The Army and Navy generally agreed with the need for expanded testing and making the revisions to acquisition regulations. The DLA agreed to use specific numbers of Product Quality Deficiency Reports to evaluate contractors for quality control problems, to improve automated edits of Product Quality Deficiency Reports, and to expand testing of electronic products.

Office of the Inspector General, DoD, Report No. 90-113, "Nonconforming Products Procured by the Defense Industrial Supply Center," September 27, 1990. The report stated that the estimated value of major nonconforming parts procured by the Defense Industrial Supply Center in 1986 and 1987 was $171.6 million and that the Product Quality Deficiency Reporting Program was ineffective and incomplete. Product Quality Deficiency Reports were not included in the Quality Evaluation Program, and Product Quality

Deficiency Reports were not prepared when nonconforming products were accepted at destination DLA stated that the implementation of the "DLA Action Plan for Continuously Improving the Quality of Spare and Repair Parts in the DoD Logistics System" would cover the intent of the recommendations.

Office of the Inspector General Report No. 89-065, "Nonconforming Products in the Defense Supply System at Warner-Robins Air Logistics Center," April 10, 1989. The report stated that $14.4 million of spare parts were unusable and that the Air Force Quality Deficiency Reporting System did not provide an adequate feedback system or a reflection of the quality of spare parts provided to the field. The report made two recommendations to testing spare parts and to improve the Quality Deficiency Reporting System. The Air Force concurred with both recommendations.

Part II - Finding and Recommendations

Rates of Nonconformance

The nonconformance rates in the resistors and semiconductors Federal supply classes are higher than the nonconformance rates the Defense Electronics Supply Center reported for its Stock Quality Assurance program in FY 1991. The rates are higher than DESC reported because DESC did not test the materials to complete critical performance characteristics. Another reason the true rates of nonconformance were higher is that DESC did not test statistically representative samples of electronics materials in the two Federal supply classes. DESC's test program primarily focused on military specification parts rather than on commercial parts. We calculated that DESC may have added upwards of a quarter of a million nonconforming parts to its inventory in the two classes in FY 1991. The higher rate of nonconformance than identified by DESC could effect readiness of weapons systems by degrading the reliability of higher assemblies such as circuit cards.

DESC Testing and Results

DESC oversees the quality of the material delivered by suppliers as part of its procurement responsibilities. The duty of oversight for quality assurance programs is in the Directorate of Quality Assurance. Within the Directorate of Quality Assurance, the Test Division has specific responsibility to conduct quality assessments of spare parts.

DESC's electronics testing used facilities and equipment available at the DLA warehouses and at DESC. DESC said that it used electronic test parameters contained in product specifications as "guides" for the tests. However, DESC only selected some tests to perform.

At the time our study was made, DESC did not perform statistical random sampling for test sample selections. The DLA Operations Research Office had made a series of recommendations regarding statistical sampling and quality assurance. However, those recommendations had been only partially implemented at the time of the assessment.

As a result, DESC did not report a combined major and minor stock quality assurance nonconformance rate across Federal supply classes. Instead, DESC reported nonconformance rates based on a combination of the following nonstatistical factors:

o DESC's Selective Management Category Codes. DESC assigned Selective Management Category Codes based on the item's requisition frequency and value of annual demand. DESC's strategy was to do more testing of the high dollar cost items with high requisition volume.

o Weapons System Program Coding Assignments. These criteria determined the criticality of the item and the effect of the item's nonconformance on the mission.

o Product Quality Deficiency history of the item.

o DESC's experience with the manufacturers or vendors.

Although DESC tested some material built to commercial specifications in FY 1991, most testing was of Military Specificationed (Mil-Spec) material. The DESC Test Division reported that 82 percent of the receiving inspection tests were for Mil-Spec material; 99 percent of the material in the stock quality assurance test program was Mil-Spec material. Since FY 1991, DESC has increased the amount of testing of commercial specificationed material.

Two of the test evaluation programs carried out by DESC in FY 1991 were receiving inspection and stock quality assurance. DESC described the purpose of its receiving inspection test program as:

> verifying the conformance of new DESC purchases to contractual requirements. Contracts awarded by DESC are selected for testing based on quality control considerations. A second consideration for testing was history, i.e., a suspect contractor or an NSN with a Product Quality Deficiency Report history. Test items are selected from a review of new contracts . . . Once at DESC, the material's test requirements were confirmed. Visual examination detected exterior defects. This examination consisted of checking packaging requirements, checking package/part marking, checking dimensional requirements, and checking mechanical damage/defects. Electrical tests were then performed according to the procurement specification or drawing.

The objective of DESC's Stock Quality Assurance Program is:

> to evaluate the quality of DESC managed stock that has been in supply depots for some time. All DESC managed supply classes are subject to testing in this program. Priority is placed on NSNs used in critical weapons systems, high cost and high usage items. . . . Standard military sampling plans are used to determine lot sizes. . . . The Stock Quality Assurance program differs from the Receiving Inspection Program in that the components tested include, but are not limited to, items from Condition Code A Stock [stock available for

> issue], and Diminishing Manufacturing Sources projects which are passed or failed are processed in the same manner as receiving inspection.

Results of DESC's FY 1991 receiving inspection and stock quality assurance test programs were reported in DESC's annual "Test and Evaluation Report." Reported nonconformance rates for the three Federal supply classes studied by our technical assessment are summarized in Table 1, DESC Nonconformance Rates. The rates presented are for Mil-Spec and commercial spec parts combined.

Table 1. DESC Nonconformance Rates
(Mil-Spec and commercial spec combined)

Group	Stock Receiving Inspection (percent)	Quality Assurance (percent)
Resistors	0.67	0.91
Semiconductors	0.99	3.03
Connectors	0.00	0.00

The above nonconformance rates are the result of 28,377 Stock Quality Assurance tests. In FY 1991, DESC identified significant quantities of nonconforming material, amounting to 320 items in the three Federal supply classes. For all Federal supply classes, DESC identified 643 nonconforming items.

Inspector General Testing and Results

Tests were conducted on three Federal supply classes of electronics parts delivered during FY 1991. Test plans were prepared and tests conducted based on complete critical performance characteristics. The tests included internal controls on what was tested and internal controls to ensure that every critical performance characteristic was tested. A statistical sampling plan was developed for selecting the parts for test so that the results of the tests could be extrapolated to each Federal supply class for FY 1991. We used multi-stage cluster sampling, selecting groups of candidate items using statistically random methods. Appendix A, "Statistical Methodology," contains details of the methodology employed.

The three Federal supply classes chosen for our tests were: resistors, class number 5905; semiconductors, class number 5961; and connectors, class number 5935. To qualify for selection, the material had to have been delivered into inventory between October 1, 1990, and September 30, 1991. The material was selected from ready-to-issue stocks with no shelf-life restrictions. We based our tests on a statistically random sample of NSNs in each Federal supply class, for both military and commercial specificationed material. Table 2 shows the size of our selection universe.

Table 2. Amount of DESC Inventory Delivered in FY 1991 Three Federal Supply Classes

Group	Number of Parts	Number of NSNs	Dollar Value of Material
Resistors	2,483,329	5,221	$ 8,496,097
Semiconductors	1,950,613	2,839	11,355,910
Connectors	7,215,793	14,715	54,885,742
Total	**11,649,735**	**22,775**	**$74,737,749**

We used a universe of all material delivered from October 1, 1990, through September 30, 1991. NSNs were selected using a random number program developed by the DLA Operations Research Office. The projectable universe was statistically determined by the percentage of our raw sample that was available for testing. The percentage of our raw sample available for testing was determined through the availability of parts in the quantity we set for each NSN tested (80 resistors and semiconductors and 20 connectors). Further, the parts availability was determined by DESC's item managers who ensured that the sample material was not needed to fill incoming requisitions. In order to obtain our statistical sample of 72 NSNs, we had to randomly select 1,372 NSNs; 1,300 NSNs were eliminated[1]. Table 3 shows the resulting projectable universe. Additional details on the projectable universe are contained in Appendix A.

[1]Not all 1,372 items needed to be selected because of item manager needs for the items; several other reasons included the prior issuance of material on shelves, the nonavailability of contract or technical data, and the nonavailability of mating connector material.

Table 3. Number of NSNs and Amount of Material Available for Testing

Group	Initial Universe	Raw Sample	Tested Sample	Projectable Universe	Value of Universe
Resistors	5,221	262	26	543	$ 843,127
Semiconductors	2,839	367	26	396	804,509
Connectors	14,715	743	20	180	1,477,414
Total	**22,775**	**1,372**	**72**	**1119**	**$ 3,125,050**

The three Federal supply classes and the two categories of parts made six groups or strata for statistical purposes: Mil-Spec resistors, commercial resistors; Mil-Spec semiconductors, commercial semiconductors; Mil-Spec connectors, and commercial connectors.

During the analysis of the test results, the determination of whether nonconformances were major or minor was based on established criteria in the Federal Acquisition Regulation Supplement, Section 246.407. For a description of the criteria, see Part I.

As tests were completed, results were provided to DESC and DLA Headquarters. Corrective actions for specific selective parts nonconformances were initiated in a timely manner during the technical assessment. For example, a resistor supplier was disqualified from DESC contracts following DESC's receipt and analysis of our test results. Another resistor supplier agreed to conduct a testing program of its products. DESC also agreed to change a military specification because our assessment identified a lack of specificity of air exchange requirements that caused a resistor to overheat. The corrective actions resulted from discussions among DESC, the manufacturers, test laboratory personnel, and ourselves. Additional details of actions taken are included in Appendix C, "Engineering Analysis of Nonconformances."

The summary results of our tests in Table 4 show the statistical estimates of the mean value and the lower and upper confidence limits at 90 percent for all nonconformances, major or minor.

Table 4. Percentages of NSNs With Major or Minor Nonconformances

Group	Point Estimate (percent)	Lower Confidence Limit (percent)	Upper Confidence Limit (percent)	Minimum Estimate (percent)
Resistors	4.1	3.1	5.0	3.3
Semiconductors	33.1	30.3	35.9	31.0
Connectors	25.5	19.0	32.1	20.4

Values for major nonconformances are in Table 5.

Table 5. Percentages of NSNs With Major Nonconformances

Group	Point Estimate (percent)	Lower Confidence Limit (percent)	Upper Confidence Limit (percent)	Minimum Estimate (percent)
Resistors	3.7	2.9	4.6	3.1
Semiconductors	9.8	8.2	11.5	8.6
Connectors	0	0	0	0

Values for minor nonconformances are in Table 6.

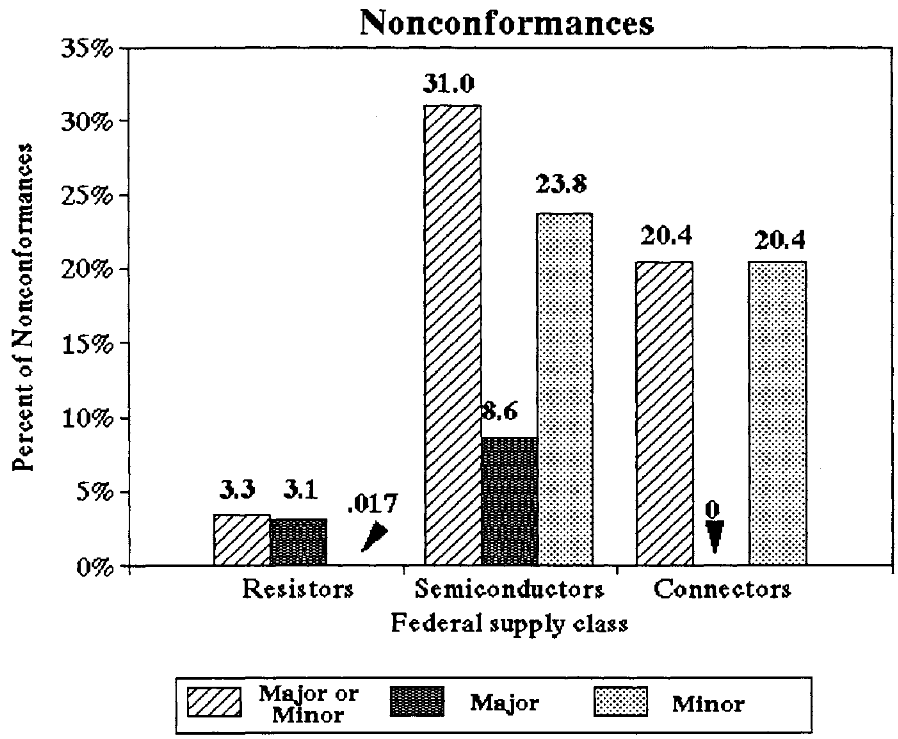
Table 6. Percentages of NSNs With Minor Nonconformances

Group	Point Estimate (percent)	Lower Confidence Limit (percent)	Upper Confidence Limit (percent)	Minimum Estimate (percent)
Resistors	0.3	0	0.7	+0.0*
Semiconductors	25.8	23.2	28.4	23.8
Connectors	25.5	19.0	32.1	20.4

*0.017 percent.

(The values and limits for minor nonconformances are presented for the sake of completeness; they are based on very sparse data.)

The following figure shows the nonconformances for each of the three Federal supply classes.



Summary of Test Results, Based on Minimum Estimates

The rates in the last columns of Tables 4, 5 and 6 are the "minimum estimate values," which were the conservative values we used to extrapolate the results from our testing of the projectable universe to estimate all nonconforming parts in the Federal supply classes. Minimum estimates are based on the application of a single-tailed normal probability distribution to the projected results.

Resistors. Resistors were the largest single group of electronics NSNs managed by DESC. DESC purchased 2.5 million resistors on 6,161 contracts delivered in FY 1991. The 6,161 contracts required 7,981 separate deliveries to DESC storage facilities. The value of the material was $8,496,097.

Tests of resistors showed the rate of nonconformance was at a "minimum estimate" of 3.3 percent for major or minor nonconformances. For major nonconformances the "minimum estimate" rate was 3.1 percent (both at 90 percent confidence). There was a higher major point estimate nonconformance rate, 17.8 percent, for the nonmilitary specificationed material. The difference between the two point estimate rates was statistically significant. See Appendix A for details.

Following our testing of resistors, a nonconformance analysis was completed for the material. Ten specific types of nonconformances were found, including direct current resistance, moisture resistance, and setting stability after thermal shock. Results of our technical assessment of the nonconformance's root causes are presented in Appendix C.

Semiconductors. During FY 1991, DESC purchased 2 million semiconductors on 3,771 contracts for delivery into DESC warehouses. The 3,771 contracts called for 5,907 separate deliveries. The value of the material delivered was $11,355,910.

Tests of semiconductors showed the rate of nonconformance was at a "minimum estimate" of 31 percent for major or minor nonconformances. For major nonconformances the "minimum estimate" rate was 8.6 percent (both at 90 percent confidence). The commercial specificationed material showed a higher point estimate rate, 18 percent, of major nonconformances than Mil-Spec material. The difference in point estimate rates was statistically significant. However, the point estimate major or minor nonconformance rates showed the opposite: the military-specificationed material showed a higher rate of nonconformances, 36.5 percent, and that rate difference was also statistically significant. See Appendix A for details.

After testing the semiconductors, we completed a nonconformance analysis for the nonconforming material. Results of the our technical assessment of the nonconformances' root causes are presented in Appendix C.

Connectors. Connectors represented a large group of items purchased by DESC. During FY 1991, DESC purchased 7.2 million connectors on 21,646 contracts for delivery into DESC warehouses. The 21,646 contracts called for 31,836 separate deliveries. The value of the material delivered was $54,885,742.

Tests of connectors showed the rate of nonconformances was at a "minimum estimate" of 20.4 percent for minor nonconformances (at 90 percent confidence). Since there were no major nonconformances, no conclusion could be drawn about differences in major failure rates between mil-spec and commercial material. For the minor nonconformances, commercial-specificationed material showed a higher point estimate rate of nonconformance, 29.1 percent, and the differences in the rates was statistically significant.

Although the connector nonconformances were not identified as major, we analyzed the material's specifications and drawings. We concluded that some nonconformances were due to problems with too stringent or ambiguous specifications. Details of our technical assessment are presented in Appendix C.

Comparison of Test Results

A summary comparison between our Federal supply class test results and DESC's Stock Quality Assurance test results for the three Federal supply classes showed greater nonconformances in our tests. Among the resistors available for test, the rate of major nonconformance we observed is higher than that DESC reported: 3.1 percent versus 0.91 percent. For semiconductors, we observed a rate of major nonconformance higher than DESC reported: 8.6 percent versus 3.03 percent. In both instances, the difference from DESC figures is substantial. Table 7 summarizes the differences for major, minor, and combined nonconformances. The chart compares our conservative minimum estimates, based on a single tailed normal probability distribution to the mean of DESC's test results. The nonconformance mean is the value shown in the Stock Quality Assurance tables in DESC's FY 1991 annual report.

Table 7. Comparison of Stock Quality Assurance Test Nonconformance Results

	IG			
Group	Major Minimum Estimate (percent)	Minor Minimum Estimate (percent)	Major or Minor Minimum Estimate (percent)	DESC Reported Mean (percent)
Resistors	3.1	+0.0*	3.3	0.91
Semiconductors	8.6	23.8	31.0	3.03
Connectors	0	20.4	20.4	0

*0.017 percent.

(The IG major and IG minor nonconformances do not equal the IG combined nonconformances because of rounding and also due to these being minimum estimates.)

While ideal projections can only be made on the percentage of the universe that was made available by DESC for testing, a simple calculation of nonconformance rates to the total universe of DESC material shows that of the calculated quarter of a million nonconforming items, about 30 percent were resistors and 70 percent were semiconductors (see Appendix A for the method of calculation). For FY 1991, our results showed a higher rate of nonconformances for connectors, but, as DESC reported, no major nonconformances.

Analysis of Test Methodology and Results

Complete Specification Testing. In contrast to the testing done by DESC, our tests captured all critical performance parameters of the material selected. Following the selection of the material, the test laboratory we employed wrote a test plan and cited the criteria used. We reviewed completed test plans. As the result of the review, some plans were corrected. In the few cases where the test laboratory lacked the in-house equipment, the laboratory obtained test stands and equipment through reciprocal arrangements with nearby commands.

One example of the kind of test failure that DESC could not have detected with its test approach was a group of 40 wirewound resistors. Three resistors (NSN 5905-01-190-5123) exceeded the allowed resistance change after 1,000 hour life tests at 25 degrees centigrade. Because of limitations of its test equipment and its test resources, DESC does not perform life testing. We concluded that this failure would not have been detected by DESC even if the item had been chosen for test.

Test results showed 24 different types of electronic and mechanical nonconformances. The nonconformances were so widespread that only four categories had more than a single failure each: incorrect dimensions; direct current resistance nonconformances; excessive reverse current leakage; and high/low resistance temperature characteristics. The other 20 categories of failure had just one example each. This data shows how widespread the nonconformances were and how impossible it is to concentrate on selected electronic characteristics, as DESC does, to determine electronic parts nonconformance.

A silicon bridge rectifier (NSN 5961-00-439-0871) was a good example of the large number of test parameters that a single item can fail. We tested 40 parts: 5 devices failed physical dimensions, 19 failed forward voltage drop, and 1 failed the leakage current reading test. In addition, 18 of the 40 parts failed a final electronic test: 13 shorted after the surge test; 1 device failed leakage current reading (11 of these nonconformances also failed initial forward voltage); and 4 additional parts failed forward voltage drop. While some of these nonconformances could have been detected by DESC, it is improbable that DESC could have found all of the nonconformances with its test approach.

DESC's reported Stock Quality Assurance program electronic parts nonconformance rates are not reflective of the Federal supply class, as demonstrated by our test results. DESC's reported nonconformance rates would be more reflective of the nonconformances in the Federal supply classes if DESC would perform its tests to complete critical performance characteristics.

Statistically Representative Samples. We tested a statistical sample of NSNs delivered into DESC inventory within the three chosen Federal supply classes for a single year. The purpose of the sample design was to calculate a joint major or minor percentage of nonconforming parts, rather than concentrate on high-volume critical items.

In contrast, DESC's stated intention was to concentrate on high requisition volume material, high dollar value material, and material with critical applications. In presenting its statistics on Stock Quality Assurance, DESC does not break down the amount of material tested by each of the above categories. Since the bulk of the material built to military specifications can be assumed to have critical applications, some inferences can be drawn from the breakdown between Mil-Spec and commercial specificationed material.

In combining DESC's reported tests for all three Federal supply classes, more than 89 percent of material tested was Mil-Spec resistors. For FY 1991, DESC tested 25,421 resistors. All were built to military specifications. For semiconductors, the class with the largest minimum percentage estimate of nonconformances, DESC tested 2,935 items during the year, and 95 percent were built to military specifications. DESC tested only 21 connectors during the year, 20 of which were built to commercial specifications.

The projected universe was greatly affected by the test quantity we selected for each NSN and by the release of material by the DESC item managers. DESC's statistical sampling would not have the same restrictions, since DESC controls the material and since statistical sampling plans can be developed for small test quantities of material from selected NSNs in different time periods.

DESC's reported Stock Quality Assurance program electronic parts nonconformance rates are not reflective of the Federal supply class, as demonstrated by our test results. In fact, without a statistically designed sample, DESC's test results cannot be extrapolated to parts other than those tested. DESC's reported nonconformance rates would be more reflective of nonconformances in the Federal supply classes if DESC would base its tests on a statistically representative sample of material from each Federal supply class.

Commercial Parts. The testing equally considered testing material built to Mil-Spec and commercial specifications. We planned to test 36 National Stock Numbered items with military specifications and 36 items with commercial specifications among the NSNs available for testing. Test results showed higher rates of nonconformance for materials built to commercial specifications. The point estimate major or minor nonconformances of commercial specificationed material for the three classes we tested were 17.8 percent for resistors, 18.3 percent for semiconductors and 29.1 percent for connectors. See Appendix A for details.

In FY 1991, DESC's Stock Quality Assurance testing was 99 percent Mil-Spec material in the three Federal supply classes we tested. We believe our test results show that this percentage is too high and more commercial parts should be tested.

For example, test results for semiconductors for major nonconformances showed that point estimate commercial nonconformance rates, 18 percent, are more than double the rate for Mil-Spec items, 8 percent. The difference between the two nonconformance rates was statistically significant. The point estimate nonconformance rate of 18 percent for commercial items shows a need for testing more than 164 items of 2,935 that DESC reported testing for stock quality assurance in FY 1991. The 164 items represent only 5.59 percent of the items tested for that Federal supply class, whereas commercial specification NSNs represent 78 percent of the NSNs, 33 percent of the items, and 61 percent of the value of the material.

DESC's approach is to test appropriately targeted high-risk material, but DESC's approach severely underrepresented other Mil-Spec NSNs and commercial specification NSNs. Our sample method provided a valid measure of conformance and nonconformance of each Federal supply class. If greater emphasis on high-risk Mil-Spec NSNs is required, that can be accomplished through the statistical technique of stratification, using the same number of sample NSNs.

Since FY 1991, DESC has increased the percentage of testing of commercial parts. For the most recent reported year, FY 1993, DESC's Stock Quality Assurance tests were 49.1 percent commercial parts, up from 1 percent. However, in the same period, the total number of parts tested declined from 28,377 to 5,972.

The Secretary of Defense sanctioned the use of commercial specifications to the greatest extent practical. In a June 29, 1994, memorandum, the Secretary endorsed a series of recommendations regarding greater use of commercial specifications. Those recommendations were to use commercial specifications and standards, except when no practical alternative exists. In the future, there will be less use of military specifications. As military specifications are increasingly eliminated or modified, the testing of commercial specificationed parts assumes greater significance.

In its FY 1991 Annual Test and Evaluation Report, DESC justified the lack of commercial specification testing by stating that commercial items are manufactured to less stringent requirements. However, the issue is not that critics are comparing "apples to oranges" as DESC asserted in its report. The issue is whether commercial items have high enough failure rates to justify testing. Our tests demonstrated that commercial parts' failure rates do justify additional testing.

Technical Data. Nonconformances classified as major nonconformances are significant for purposes of disqualifying vendors and rejecting lots of material. However, nonconformances classified as minor nonconformances can be significant because they can highlight additional problems. The number of minor nonconformances illustrated problems with technical data. Technical data are expensive to acquire and time consuming to manage. It is important because technical data are relied upon by equipment designs and ultimately determine whether an item is conforming or nonconforming. Testing to complete critical performance characteristics identified a whole series of problems with technical data.

Fourteen nonconformances were identified belonging to nine different categories due to problems with technical data and specifications. Among the problems discovered by our tests were incomplete specifications, ambiguous specifications, and items classified as interchangeable by the specifications that really could not be interchanged.

An example of an item with an ambiguous specification is a Silicon Bridge Rectifier (NSN 5961-01-188-6042). This rectifier nonconformed on a test of forward voltage. A drawing, #117606-TAB, contained the forward voltage requirement. The drawing referenced three sources of supply: Amperex, ST-Semicon, and TRW. A review of the Amperex technical specification showed different values for the forward voltage requirement, values that the tested item could pass. The root cause of the failure was that the specification drawing incorrectly showed that each of the three suppliers built items that could pass the same forward voltage requirement. By correcting the specification, the user of the part would know that items from different suppliers would pass different forward voltage specifications.

Another example of an item with an ambiguous specification is the group of 40 wirewound resistors (NSN 5905-01-190-5123), cited above. Three of these resistors exceeded the allowed resistance change after 1,000 hour life test at 25 degrees Centigrade. The Crane Laboratory report identified the cause of the failure as insufficient heat dissipation during testing or operation. In contrast, the manufacturer claimed the failure was due to an improper test setup. The Crane Laboratory and the manufacturer arranged the resistors differently. We concluded that both the manufacturer's interpretation of the proper setup and the test laboratory interpretation of the proper setup were within the parameters allowed by the specification. Accordingly, we recommended that an altered specification stress the need for heat dissipation when the resistor is in use.

An electronics part's quality was effected by technical data management. Further, electronic nonconformances were caused by differences in interpretation of specifications or drawings. These interpretations could be the determining factors in whether an electronic part was nonconforming and points to specification ambiguities. An essential part of inventory management is ensuring that specifications are up-to-date and free of flaws.

Weapon System Readiness

The higher rates of nonconformances than DESC reported and the addition of upwards of a quarter of a million nonconforming resistors and semiconductors to DESC stocks during FY 1991 could effect weapon systems readiness. The impact was identified in the sampled items having critical applications and with the sampled items having applications on critical weapons systems. Nearly all of the applications of the sampled parts were on higher assemblies designed to be removed and replaced when a single component fails. So the real cost of a single inexpensive electronic part failure is the much greater cost to purchase, warehouse, ship, and replace higher assemblies. DESC is taking action on the specific nonconforming parts identified in the assessment.

Conclusion

DESC has a test program in place that identified nonconforming material. However, the quality of electronics parts is lower than reported by the Test Division of DESC. Among the NSNs available for testing, at least 3.1 percent of the resistors and at least 8.6 percent of the semiconductors showed major nonconformances. In addition, minor nonconformances revealed problems with material specifications. Complete testing of all critical specifications would reveal nonconformances that current testing does not identify. Moreover, testing statistically designed samples of a more balanced grouping of Federal supply classes would provide a truer picture of the quality of all material added to inventory. Testing parts built to commercial specifications is necessary in order to portray the actual quality of the material. Commercial parts testing will be increasingly important as DoD converts from military specifications. DESC's past emphasis on selecting military-specificationed electronic parts almost to the exclusion of commercial parts diminished the accuracy of DESC's portrayal of electronics parts' quality. DESC's testing percentage of commercial parts has increased to 49.1 percent; however, the number of parts tested declined from 28,377 to 5,972 for the three Federal supply classes. Nonconformances of electronic parts adversely impacts the quality of higher assemblies in weapons systems that must be removed and replaced at additional expense.

Recommendations for Corrective Action

We recommend that the Director, Defense Logistics Agency:

1. Establish procedures ensuring that Stock Quality Assurance tests are conducted to complete critical performance characteristics. The procedures should include establishing controls over test plans and testing to verify that all critical performance characteristics are tested.

Agency Comments. DLA concurred with the recommendation. Under DLA's direction, DESC is preparing guidance on test plan preparation for its test center personnel. The guidance will include specifics on preparing test plans to include all critical performance specifications. The guidance will also provide for management review of the test plans. Furthermore, DESC will prepare an internal audit program to review the testing and ensure that test plans and procedures are followed. DLA estimates completion of the actions by March 30, 1995.

Technical Assessment Response. The DLA actions are considered responsive to the recommendation. Following the issuance of the draft report, DLA and the IG held working level meetings to discuss in detail the planned revisions to the testing methodology.

2. Establish procedures for selecting parts for testing that will produce statistically significant results that can be extrapolated to projectable universes of items. We also recommend that documented internal controls be established over the statistical sampling process.

Agency Comments. DLA concurred with the recommendation. The DLA Defense Operations Research Office (DORO) will develop a sampling assistance model on which to base testing. DESC will write internal procedures to utilize the DORO sampling model. Action is to be completed on this recommendation by June 30, 1995.

Technical Assessment Response. The DLA actions are considered responsive to the recommendation.

3. Establish procedures to include commercial parts in statistically significant test samples.

Agency Comments. DLA concurred with the recommendation, and stated that DESC had expanded its testing of commercial parts to 40 percent of overall testing in FY 1994. The sampling assistance model developed in response to recommendation 2 will include the provisions to select statistically significant numbers of commercial parts. Action is due to be completed by June 30, 1995.

Technical Assessment Response. DLA's action is considered responsive.

4. Review the technical data management program for the three Federal supply classes reviewed in this assessment to determine whether the deficiencies identified are systemic.

Agency Comments. DLA concurred with the recommendation. DLA stated that our evidence was based on minor nonconformances which did not affect the usability of the material. DESC has formed a review team to look at technical data management practices to determine the scope of the problem. The estimated completion date for the review is June 30, 1995.

Technical Assessment Response. The DLA action is responsive to the intent of our recommendation. Our recommendation, however, was based on both major and minor nonconformances.

Additional Agency Comments. DLA concurred with our sampling methodology used to determine the percentage of nonconforming material. However, DLA questioned the reliability of the estimate of 244,000 nonconforming items being added to its inventory during FY 1991, and requested that the final report include additional qualifications.

Technical Assessment Response. During the course of the technical assessment, we held numerous meetings with DLA management to ensure complete understanding of the methodology used and the results achieved. We agree that the calculated value of 244,000 items cited in the draft report is not a statistical projection, due to limitations in drawing the random sample. Those limitations primarily included selecting items that were out of stock at the time of sample selection and were not released to us for destructive testing by DLA stock managers for the stated reasons that the items were either in limited supply or were required to fill urgent requisitions. As a result, hundreds of items were excluded from the sample and replacement items had to be selected (see Appendix A for details). While operational necessity may have precluded the random selection of certain items from destructive testing, it is not possible, from a purely statistical standpoint, to determine or quantify any bias (s) that may or may not have been interjected into the sampling process. On the other hand, given what we learned about the quality on stocks reviewed during the technical assessment and our conservative projections of nonconformance rates, we believe it is logical to expect that upwards of about a quarter of a million nonconforming items may have been added to the DLA inventory in FY 1991. The quarter of a million estimate is not an absolute, nor is it a statistical projection; but rather a reasoned order-of-magnitude calculation.

Part III - Additional Information

Appendix A. Statistical Methodology

The statistical methodology used in the Technical Assessment involved a sampling design based on the general principles of Multi-Stage Cluster Sampling as discussed in Cochran and more recently in Scheaffer, Mendenhall and Ott[1]. We employed multistage cluster sampling within six groups of NSNs, which represent the members three Federal supply classes stratified into Mil-Spec or commercial specification NSNs. The object of the design in this project was to estimate the amount of material that is nonconforming in three Federal supply classes managed by DESC. Note that we make no claim that we can project the number and value of all nonconformances across all Federal supply classes. We have specifically selected the three Federal supply classes based on the number of NSNs managed by DESC and also based on the desire to test both low technology items such as connectors and higher technology items such as semiconductors.

The multistage cluster sampling methodology involved selecting groups of sample items in a statistically random fashion--NSNs in this instance--and then selecting items for testing within these clusters, again using statistically random procedures. In practice, this selection involved one or more groups of items for a given NSN, these groups being delivered under one or more contracts from one or more contractors. In the first stage, we selected NSNs (which represent the clusters for each Federal supply class) and, in the second stage, we selected the units from qualifying deliveries of each NSN selected in the first stage.

We broke each Federal supply class into two strata for sampling purposes. In one stratum are items in one Federal supply class built to Mil-Specs, carrying an Acquisition Method Code of "1T" in the supply records. In the other stratum are all other items, including those with complete data packages built to commercial standards as well as those items with incomplete data packages. Three Federal supply classes and two subclassifications for each yielded six groups in all.

We received a listing from DLA of all items delivered into DLA warehouses belonging to the three Federal supply classes during a 1-year period beginning October 1, 1990, and ending September 30, 1991. To qualify for sample selection, at least one item had to be delivered into stock (as opposed to being sent directly to an end user or requisitioner). We based the original sampling plan on these data, as summarized in Table A.1.

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[1]Cochran, William, Sampling Techniques, 3rd Edition, John Wiley, New York, 1977; Scheaffer, Richard L., William Mendenhall and Lyman Ott, Elementary Survey Sampling, 4th Edition, Boston, PWS Kent Publishing, 1990.

Table A.1. Planned Statistical Sample Strata Details

Stratum Number	Supply Class	Mil-Spec Items	Amount of Material	No. NSNs	Batch Size	Items Tested
i	5905	YES	2,110,377	13	10	130
ii	5905	NO	372,952	13	10	130
iii	5961	YES	1,289,234	13	10	130
iv	5961	NO	661,379	13	10	130
v	5935	YES	3,362,938	13	10	130
vi	5935	NO	3,852,855	13	10	130
Total			**11,649,735**	**78**	**60**	**780**

The original plan allowed for sampling multiple contracts delivering materials for the same NSN.

The executed plan yielded the following:

Table A.2. Executed Statistical Sample Strata Details

Stratum Number	Supply Class	Mil-Spec Items	No. NSNs	Batch Size	Items Tested
i	5905	YES	13	40	520
ii	5905	NO	13	40	520
iii	5961	YES	14	40	560
iv	5961	NO	12	40	480
v	5935	YES	9	10	90
vi	5935	NO	11	10	110
Total			**72**	**180**	**2,280**

The size of the sample batches from each NSN was 40 items for each batch. This size sample allowed splitting the material into smaller groups for reliability testing and environmental tests once the initial inspection and electronic conformance screens had been completed. The connectors were an exception to this; their sample batch size remained 10.

While test batches came from one NSN, they do not always represent all deliveries for that NSN. As foreseen, at times more than one delivery of a given stock number went to DESC stock from a single vendor. In this case, the statistical sample was selected from the largest available batch of material from that single vendor. In some instances, more than one vendor shipped eligible material into DESC for a given stock number. Among the deliveries for the sample NSNs, which involved more than one vendor, DLA had sufficient shelf stock to sample from only one vendor's deliveries per NSN.

Several factors influenced the execution of the sample, including that of multiple deliveries for a sample NSN. They can be generally called issues of availability. All items were subject to the requirement of having enough shelf stock to draw 40 items for testing (10 for connectors). This factor also meant having a shelf quantity sufficient for testing after operational requirements were considered; many NSNs were screened out while selecting those qualified for testing. The attrition rate ranged from about 80 percent for semiconductors, about 88 percent for resistors, to about 97 percent for conductors. For connectors, we needed not only a given NSN to be available, but also its male or female counterpart.

Another availability issue concerned multiple vendors and multiple deliveries. We sampled items for testing from one delivery per contractor for a given sample NSN. This selection effected the sample design and its evaluation. We have NSNs that are statistically representative for each of the six strata (Federal supply classes of a given specification type) after screening. We also have items representative of a given delivery and vendor for those NSNs; this sample can be all or any part of the total deliveries for an NSN. These items and their associated delivery quantities comprise only part of the deliveries for an NSN. Our "projectable universe" is based on the largest delivery under an NSN from which the test items were drawn. The calculated number of major and minor nonconforming items related to the number in the projectable universe for each group.

The first screening deliveries affected NSNs. It meant that the initial sample of NSNs for each strata grew to be much larger than the targeted amount for each sample of 13 NSNs in order to yield 13 NSNs for a group with deliveries available for testing. At the NSN level, we had the results shown in Table A.3.

Table A.3. Number of NSNs Available for Testing

Category	Initial Universe	Raw Sample	Tested Sample	Projectable Universe
Mil-Spec:				
Resistors	2,799	107	13	340
Semiconductors	614	150	14	57
Connectors	6,046	373	9	162
Non-Mil-Spec:				
Resistors	2,422	155	13	203
Semiconductors	2,225	217	12	123
Connectors	8,669	370	11	234

The second type of attrition took place among deliveries for a given sample NSN. We applied the sample results to the largest delivery, rather than to all deliveries under the NSN. The net effect is to narrow the "universe" to which we made projections on a statistical basis with confidence and precision. The attrition from the total screening process left us with about 10 percent of the resistor and semiconductor items delivered and about 1.3 percent of the connectors.

While we cannot determine how precisely representative the sample is, we found no evidence overall of systematic differences between the sample items and the groups from which they were drawn. The results should give a good indication of the degree of nonconformance in the three Federal supply classes and a good comparison of nonconformance rates between Mil-Spec and non-Mil-Spec items within given Federal supply classes. It is not appropriate, however, to make a statistical projection to the Federal supply classes as wholes based on the sample data.

The details of the screening methodology follow.

NSN Screening Track Methodology

Each of the 234 NSNs selected for initial sample screening had a manila folder with a sheet of paper stapled inside listing the steps to be followed during screening. As the NSN progressed through the screening process, the screen step date was noted in the folder. Should the NSN be disqualified from consideration, the disqualifying step was noted in the folder and the folder was placed with other NSNs that had been screened out. The screening process was as follows:

1. Select 234 candidate NSNs in six groups of 13 NSNs (234 arbitrarily chosen as being triple the number of required NSNs prior to screen) for test screening. Remember that each NSN was associated with a single contract, which made the NSN eligible for the sample selection. Also, remember that each NSN was to consist of two batches of 40 items each for resistors and semiconductors and two batches of 10 items each for connectors. The second batch was to be used as a reserve for testing.

a. When the NSN had more than one contract delivery batch from one vendor, still select two batches of ten items for testing. In deciding which of the delivery batches to chose, select the largest. If the largest delivery batch was less than 20 (enough to make two batches of 40 or 10 items for testing), reject the NSN for sampling.

b. When the NSN had more than one delivery from more than one contractor, select two batches of 40 or 10 items from each contractor. For each contract, check to ensure that the delivery batch has at least 80 or 20 items, enough to make two batches. If one of the contracts does not contain a batch of 80 or 20 items and the others do, do further processing only on the contract with more than 80 or 20 items.

c. If both conditions described in a. and b. above are true, select the largest batch of material delivered by each contractor for screening. In each case, there must be 80 or 20 items in the largest delivery batch from each contractor. If 80 or 20 items are not present for at least one batch of items, reject the NSN for sampling.

2. The 234 NSNs came out of the computer sorted into six groups of 39 NSNs in order from lowest numbered NSN to the highest numbered NSN. In order not to bias the statistical sample in favor of lower numbered NSNs, randomize the order of the 39 NSNs in the six batches.

3. Check with the item manager. Was the quantity on hand (as shown in the current inventory records) sufficient for sampling? If not, reject the NSN.

4. Check with the item manager. Had the condition code of the NSN changed since the inventory record information was received? If so and if the new code was an unacceptable one (something other than A, B, or C), reject the NSN.

5. Check with the item manager. Did the material have any upcoming demand (such as a Planned Program Request or the DLA equivalent) that would preclude its issue for testing? If so, reject the NSN.

6. Research the technical data package. Did the NSN have a Mil-Spec available?

a. If the NSN has a Mil-Spec, was the Mil-Spec sufficient to write a test plan (determination by our engineer)?

(1). If the Mil-Spec is sufficient, accept the NSN and go to step 7.

(2). If no Mil-Spec, reject the NSN.

b. If there is a commercial specification, was that standard sufficient to write a test plan (as determined by our engineer)?

(1). If the commercial specification was available and acceptable, accept the NSN and go to step 7.

(2). If there was no commercial specification, could a specification be obtained within a reasonable amount of time?

(a). If a specification could be obtained within a reasonable time, place the NSN in "hold status" until the information was obtained. When the information was delivered, re-evaluate according to b.

(b). If a specification cannot be obtained, go to step c.

c. Were there commercial descriptions of the NSN that would be sufficient to write a test plan (as determined by our engineer)?

(1). If there were commercial descriptions, go to step 7.

(2). If there were not descriptions, could they be obtained within a reasonable amount of time?

(a). If they could be obtained within a reasonable amount of time, place the NSN in a "hold" status, and when the material was delivered, go back to step c.

(b). If the commercial descriptions could not be obtained within a reasonable amount of time, reject the NSN.

7. Sort the remaining NSNs by storage location.

8. Determine which storage locations would be visited in order to physically pull the material from storage bins. For material that was in storage at more than one location, select the storage location with the greatest overall quantity of material in that NSN.

9. The organization of the process of the selection of material from storage locations was to be as follows:

a. There was to be a central coordinator who had the master list of NSNs to be selected and would also keep a listing of NSNs that have successfully passed the selection screening process.

b. There would be a group of field personnel each of whom would visit one storage location. The field personnel would be supplied with a listing of potential sample NSNs that had passed the previous technical screens and that were ready to be selected for sampling.

10. Visit each storage location. For each NSN to be selected, have a listing which included the:

a. NSN;

b. contract quantity delivered to that location;

c. number of the contract that made the material eligible for inclusion in the sample;

d. total quantity of material on hand at that location; and

e. name, code, and phone number of the item manager responsible for the management of that NSN.

11. At each storage location, check the inventory records at the warehouse to determine whether there had been any last-minute changes in

material status from the time that steps 3. through 5. were performed. If there were any changes, check with the item manager by telephone for any issue restrictions. If there were issue restrictions, reject the NSN.

12. Prior to NSN selection, check the storage location records to see if the unit of issue has been changed. A change in the unit of issue means that the NSN had been repackaged when placed into storage. Repackaging would obscure the contract number on the material in the storage bins and make it difficult if not impossible to determine which material was delivered on which contract. Unit-of-issue-change-NSNs should be rejected for sampling purposes.

13. Select the material from the storage bins. If the quantity of material in the storage bin for the contract was less than the quantity to be sampled, reject the NSN.

14. For each NSN that had been successfully selected, telephone the central coordinator.

a. The central coordinator could direct the storage location person to cease processing the sample selection list if the required number of 13 NSNs in each of the six sample strata has been obtained.

b. The material would be handled in accordance with DESC Regulation 4140.7, "Selection of Items and Test Sites for the Verification Test Program," and DESC Regulation 4140.12, "Issue and Control of Items Selected for Testing by Commercial/Government Sources."

c. If the test sites were known prior to physical selection of the material, forward the material to the predetermined test site.

d. If the test sites were not known prior to physical selection, phone the central coordinator for instructions.

15. For each NSN that had been rejected, phone the central coordinator.

a. The central coordinator could add additional NSNs to be pulled from storage, should the required number of 13 NSNs in each sample strata not be filled.

Following the pulling of the sample material from the storage bins, the material would be forwarded to the test sites in the proper shipment packing material and forwarded in the order agreed to in the electronics test Memorandum of Understanding (MOU) between the Technical Assessment Division and the Test Facility. The MOU would contain the details of the establishment of the test schedule (See Appendix B).

Projection of the Results

The objective of the project was to estimate the amount of nonconforming material belonging to three Federal supply classes through the means of a statistical sample. The sample as executed can be used to make estimates about a "projectable universe:" those NSNs available for testing. That is, the estimates apply statistically to a constructive universe that considers losses due to the various screening criteria. This "projectable universe," for which we can make a statistical estimate, was considerably smaller than the initial universe.

The results of the projections provided the best available data about the three Federal supply classes in general. Technically, their results cannot be applied to the three Federal supply classes as wholes for the year beginning October 1, 1990, and ending September 30, 1991. However, the data did not indicate a systematic bias in the sample items; the results should provide a good indication of the proportion of items in a given Federal supply class that would be nonconforming--either major or minor nonconformances or at least major nonconformances.

The results are shown in Tables A.4., A.5., and A.6.

Table A.4. Projections for Major or Minor Nonconformances
(calculated for each Federal supply class as a whole)

Group	Point Count	At Least	Projectable Universe	Original Universe
Resistors	9,900	8,200	245,300	2,483,300
(percent)			(3.3)	(0.33)
Semiconductors	61,900	57,900	187,000	1,870,600
(percent)			(31.0)	(3.0)
Connectors	23,400	18,700	91,800	7,215,600
(percent)			(20.4)	(0.26)

Table A.5. Projections for Major Nonconformances
(calculated for each Federal supply class as a whole)

Group	Point Count	At Least	Projectable Universe	Original Universe
Resistors	9,200	7,500	245,300	2,483,300
(percent)			(3.1)	(0.30)
Semiconductors	18,400	16,000	187,000	1,870,600
(percent)			(8.6)	(0.82)
Connectors	0	0	91,800	7,215,600
(percent)			(0)	(0)

Table A.6. Projections for Minor Nonconformances
(calculated for each Federal supply class as a whole)

Group	Point Count	At Least	Projectable Universe	Original Universe
Resistors	750	43	245,300	2,483,300
(percent)			(.017)	(0.0017)
Semiconductors	48,200	44,400	187,000	1,870,600
(percent)			(24.0)	(2.2)
Connectors	23,400	18,700	91,800	7,215,600
(percent)			(20.4)	(0.26)

(The percentages under the projectable universe and original universe are based on minimum estimates.)

The sample was designed for a projection across all three FSCs, not within them. Furthermore, the minor nonconformance data is very sparse: among the six sub-groups, one has no minor nonconformances observed, four have only one minor nonconformance, and one has three. This is not sufficient data to make a projection with reasonable confidence and precision.

Table A.7. Comparison of Mil-Spec and Commercial Results, Major or Minor Nonconformances

Group	Mil-Spec (percent)	Commercial (percent)	Statistically Different?
Resistors	1.9	17.8	yes
Semiconductors	36.5	18.3	yes
Connectors	0	29.0	yes

Major Nonconformances

Group	Mil-Spec (percent)	Commercial (percent)	Statistically Different?
Resistors	1.6	17.8	yes
Semiconductors	8.0	18.0	yes
Connectors	0	0	no

Minor Nonconformances

Group	Mil-Spec (percent)	Commercial (percent)	Statistically Different?
Resistors	.4	0	no
Semiconductors	31.7	0.4	yes
Connectors	0	29.1	yes

(All percentages are based on point estimates.)

The same caveats apply here as in Table A.6.: there is not enough data on minor nonconformances to make sound projections. We computed the precision of the estimates using a 90 percent confidence level. These statistics are based on FY 1991 NSNs available for testing (about 10 percent of resistors and semiconductors and about 1.3 percent of the connectors). Although they are not a statistical estimate of the three Federal supply classes, these numbers are the best available indicators for the Federal supply classes as a whole, so are used in the comparisons.

The calculation of the approximate amount of nonconforming material that may have been delivered in FY 1991 was done by multiplying the amount of material delivered during the year times the minimum estimate of major nonconforming material. This should not be construed as a statistical projection, but rather a reasonable order-of-magnitude calculation. This leads to a total across both groups of about a quarter of a million nonconforming items which are split with approximately 30 percent resistors and 70 percent semiconductors.

Table A.8. Calculation of the Amount of Nonconforming Material

Group	Amount of Material Delivered	Minimum Estimate Percentage
Resistors	about 2.5 million	3.076
Semiconductors	about 2 million	8.574

Appendix B. Testing Memorandum of Agreement

1.0 Introduction

Subject. Testing and re-testing of resistors, semiconductors and connectors for nonconformance to designated contract, drawings, specifications, or other approved product description.

Purpose. Identify nonconforming electronics parts for the Inspector General, Department of Defense, Technical Assessment Division, on the resistors, semiconductors, and connectors project.

Scope. This agreement is applicable to the Naval Surface Warfare Center, Electronics Development Department, Components Division, Code 602, Crane, Indiana.

Reference Documents.

MIL-STD-105E, Sampling Procedures & Tables for Inspection by Attributes.

MIL-STD-202, Test Methods for Electronics Components parts.

MIL-STD-750, Test Methods for Semiconductors Devices.

MIL-STD-1344, Test Methods for Connectors.

MIL-S-19500H, General Spec for Semiconductor devices.

MIL-STD-690, Failure Rate Sampling Plans.

MIL-STD-790E, Reliability Assurance for Electrical Parts.

MIL-STD-810, Environmental Test Methods.

MIL-S-901, Shock Test (Hi Impact).

MIL-STD-1678, Fiber Optic Test Methods.

MIL-STD-109B, Quality Assurance Terms and Definitions.

DLA Regulation 8200.10, Control of Nonconforming Material

DLAM 4155.2, Quality Assurance Program Manual.

DESCR 4140.7, Selection of Items and Test Site for the Verification Test Program.

DESCR 4140.12, Issue and Control of Items Selected for Testing by Commercial/Government Sources.

2.0 Authority

Inspector General, Department of Defense/Technical Assessment Division. Testing of Resistors, Semiconductors, and Connectors (RSC) Project 2PT-6018.

3.0 Responsibilities

The DoD IG Office/Technical Assessment Division has overall responsibility and authority for management of the RSC project.

The objective of the Technical Assessment Division is to determine: the extent of nonconformance parts, the effect, impact, and the technical cause of the defect/ failure.

The Naval Surface Warfare Center, Electronics Development Department, Components Division, Code 602 has the responsibility and authority to provide engineering special projects support regarding military standard electronics components.

3.1 DoD IG/Technical Assessment Division will:

3.1.1 Provide a Project Manager with authority to plan, coordinate, and implement actions for the RSC project.

3.1.2 Provide statistically selected sampled items from DLA storage locations.

3.1.3 Provide technical data packages to include: applicable contract(s), Mil-Specs, drawings and supporting documentation, as applicable. The Technical Assessment Division will assure all technical references for laboratory testing are complete and accurate for the NSNs parts.

3.1.4 Provide Engineering personnel with authority to approve the test plans, monitor the testing of electronics parts to include: materials, electronic, environmental, mechanical, and metallurgical tests.

3.1.5 Provide disposition or retest instructions within 30 calendar days of initial testing.

3.1.6 Obtain and provide necessary funding and negotiate a firm fixed-price contract with direction to NSWC, Crane, Indiana.

3.2 NSWC - Crane, Indiana will:

3.2.1 Develop and provide test plans criteria, testing requirements, scheduling/availability, final disposition instructions and reporting. Plans will be submitted to the Technical Assessment Division for review and approval.

3.2.2 Provide a Project Officer with authority to plan, coordinate and implement special testing support actions for NSWC-Crane, Indiana.

3.2.3 Provide the Technical Assessment Division with an estimated cost per NSN tested. Estimated cost shall be provided in conjunction with the Test Plans.

3.2.4 Provide the test facilities and tabulate a list of equipment to be used for nonconformance testing of electronics parts. Each instrument used to measure conformance specifications shall be calibrated and traceable to the National Bureau of Standards.

3.2.5 Work with the Technical Assessment Division to resolve technical questions arising from test results.

3.2.6 Upon completion of tests on each NSN, notify the Technical Assessment Division of the test results. Return the tested samples to the storage point with instructions to place the samples with the remainder of the NSN quantity and identify the material to the appropriate condition code as applicable.

3.2.7 When test results indicate possible counterfeit material, notify the Technical Assessment Division to have material from the suspected line item shipped to the Technical Assessment Division to maintain the chain of evidence. Store all suspect material in an approved area pending results of the investigation. Process suspected counterfeit and unauthorized substitutions in accordance with pertinent regulations.

3.2.8 Provide failure and defect analysis capabilities and facilities. The following list is furnished to indicate the degree of capability of analysis:

a. Radiographic techniques with adequate photo or electronic magnification.

b. Equipment for dissecting the failed parts without damaging or destroying the internal details or introducing contaminants when opening hermetically sealed electronic parts.

c. Detailed chemical analysis.

d. Microscopic inspection and measuring techniques, including the full range of magnification powers required to satisfactorily evaluate the product.

e. Mass spectrometer, radioactive tracer gas equipment, or similar sensitive leak detection apparatus for performing fine seal-leak test on those parts which are hermetically sealed.

f. Bubble chamber or similar facilities for performing gross seal-leak tests on those parts which are hermetically sealed.

g. Fluorescent-dye penetrant inspection and detection techniques for gross seal-leak testing of hermetically sealed parts.

h. Polarized-light inspection techniques to detect and analyze strains and incipient failure in glass, glazed surfaces, and similar possible seal defects.

i. Adequate mechanical inspection and measuring equipment to check tolerances and other possible dimensional discrepancies with sufficient precision to prove the assembly of the parts.

j. Electrical measuring or optical instrumentation necessary to analyze failure characteristics such as electronic leakage.

k. The necessary chemical-extraction or optical equipment to detect foreign ions or other internal contaminants which may cause degradation of the parts and materials used in the parts.

l. Facilities for metallographic examination, including mounting, grinding, polishing and etching equipment for sample preparation.

3.2.9 Test Plans.

3.2.9.1 Provide Test Plans for each NSN with the following information:

a. Part Identification. List Item identification, sample quantity, NSN and contract number and applicable specification.

b. Reference Documents. List all applicable reference documents.

c. Test Requirements and Procedures. Description of all parts specifications, detailed test procedures to be performed. Identify any planned variance from referenced test instructions. Data collection and certification procedures. Number of parts to be tested.

d. Test Schedule. Test length. Estimated time from test start to test report issue.

e. Cost Estimates. Estimated cost per NSN tested based on the approved test plan.

f. Authority. Test Plan review, approval and date.

3.2.9.2 The following are examples of tests anticipated to be included in the Test Plans:

Resistors/Connectors

Visual & mechanical examination per MIL-STD Qualification Inspection.

DC resistance per MIL-STD.

Thermal Shock per MIL-STD Quality Conformance Inspection.

Overload per MIL-STD Quality Conformance Inspection.

Life test per MIL-STD.

Dielectric withstanding voltage.

Resistance to soldering heat per MIL-STD.

For connectors use: method 2005.1 (vibration), 2007.1 (contact retention), 2016 (durability) and 1005.1 (temperature life).

Hermetic seal (pressurized connectors) Leakage (pressurized connectors) Moisture resistance.

Resistance-temperature characteristic.

Semiconductors

Visual, hermetic seal.

Physical dimensions.

Group "A" complete electronic test.

Minimum of 96 hour operating life (burn-in) and selected electronic end points.

Construction analysis.

Test condition B, 168 hr hi-temp bake Thermal shock and selected electronic end points.

Minimum of 168 hr operating life and selected electronic end points.

3.2.10 Testing. Tests shall be conducted in accordance with the Technical Assessment Division approved test plans. The Technical Assessment Division shall be notified immediately of any deletions or modifications to the approved test plan, including deletions or modifications to detailed test plans and procedures incorporated into the test plan by reference.

Test data shall be recorded for each test including: all test measurements (materials, electronic, environmental, mechanical, and metallurgical), dates, set up, equipment identification and calibration, and technician identification.

Failure analysis testing shall be considered when three or more samples fail or when the tested reliability is less than half of specification. Crane shall provide cost estimates and obtain the Technical Assessment Division approval prior to initiating failure analysis. Failure analysis should cover such issues as over stress condition, manufacturing defect, adverse environmental condition, maintenance induced or wear out failure mode.

3.2.11 Reporting.

Test Reports. Test reports shall be provided to the Technical Assessment Division for each NSN tested within 10 working days after completion of the tests. The test reports shall include a summary of the tests conducted and the test results. The test reports shall also include details of each test including:

- detailed test plans (by reference if appropriate)
- deletions or modifications to test plans and procedures
- number of samples tested per test
- all test measurements (test logs)
- failure data
- failure analysis (when approved by the Technical Assessment Division)
- test set ups
- test durations

- technician identification

- test equipment identification and calibration data

Monthly Progress Reports. Progress reports shall be provided to the Technical Assessment Division monthly. The reports shall include the progress of testing on each NSN and the financial status. The financial status shall include total funds expended to date, funds expended during reporting month, and estimated funds to complete the testing for the IG project.

3.2.12 Handling procedures shall be established to provide physical protection of material during testing. Handling and packaging procedures shall be prepared to cover storage of parts in a controlled storage area.

3.2.13 Nonconforming materials shall be controlled by a positive system of identification to prevent their inadvertent use or intermingling with conforming materials.

4.0 Terms and Provisions

This agreement will be reviewed at least every three months by a representative of each party and at such other times as circumstances dictate to determine whether it should be continued, modified or terminated. Changes to this agreement must be made by negotiation of a formal modification. Should any terms or provisions of this agreement become in conflict with the Navy regulations or directives of higher headquarters, the cognizant party shall initiate action to negotiate appropriate changes.

5.0 Project Officers

OIG. Names and Phone Numbers Removed.

NSWC Crane. Names and Phone Numbers Removed.

6.0 Billing Information

6.1 Funding in the amount of $(removed) is available for this project.

6.2 The following accounting information will be included in all billings.

(fund citation removed)

6.3 All invoices should be mailed to:

(address removed)

7.0 Approval

Approval list removed.

Appendix C. Engineering Analyses of Nonconformances

Table C.1. Index of Engineering Analyses of Nonconformances

Resistors

NSN	Nomenclature	Manufacturer	Specification	Unit Value	Page No.
5905-01-334-4620	Resistor, Fixed, Film	Dale Electronics	Commercial	$0.32	49
5905-01-190-5123	Resistor, Fixed	Dale Electronics	MIL-R-39017/2H	$0.50	49
5905-01-261-3378	Resistor, Fixed, Wire	Shallcross	MIL-R-39007	$1.38	54
5905-00-946-3525	Resistor, Variable	Spectrol Div	Commercial	$17.35	57
5905-01-225-3392	Resistor, Variable	Bourns	Commercial	$5.15	60
5905-01-012-9760	Resistor, Variable	Bourns	Commercial	$2.25	60

Semiconductors

NSN	Nomenclature	Manufacturer	Specification	Unit Value	Page No.
5961-00-439-0871	Diode, Bridge Rectifier	ST-Semiconductor	Commercial	$2.96	65
5961-00-235-8678	Diode, Silicon	General Instruments	MIL-S-19500/18D	40.37	68

Semiconductors (contd.)

NSN	Nomenclature	Manufacture	Specification	Unit Value	Page No.
5961-01-213-7878	Diode	American Power	MIL-S-19500/159E	$1.90	72
5961-00-850-7646	Transistor, NPN	Germanium Power Devices	MIL-S-19500/126	$5.15	75
5961-00-892-3473	Transistor, PNP	Germanium Power Devices	MIL-S-19500/60	$6.08	75
5961-01-188-6042	Diode, Rectifier	Amperex	Commercial	$0.95	80
5961-01-096-9924	Rectifier	Semitronics	Commercial	$6.75	83

Connectors

NSN	Nomenclature	Manufacture	Specification	Unit Value	Page No.
5935-01-101-7787	Connector, plug elec.	Hughes Aircraft	Commercial	$4.85	85
5935-01-247-6503	Connector, backshell	Amp	Commercial	$1.67	87
5935-00-167-7809	Polarizing key, electronic	Amp	Commercial	$31.91	89

Table C.2. Weapons Systems Program Coding Assignment Criteria

Groups	Mission Essential	Mission Degrading	Non Mission Essential
Most Critical Group A	F	H	P
Critical Group B	G	J	R
Least Critical Group C	K	M	S

Engineering Analyses of Nonconformances NSN 5905-01-334-4620, Chip Resistor NSN 5905-01-190-5123, Wirewound Resistor Vendor: Dale Electronics Incorporated

Nature of Nonconformances. The Crane Laboratory tested 40 commercial chip wraparound resistors (NSN 5905-01-334-4620). All nonconformances were major. Twenty-three exhibited Direct Current Resistance nonconformances. All chips had foreign substance on the terminations, which made resistance measurements very difficult. All resistors tested nonconformed on the low temperature excursion of resistance temperature characteristic. One chip nonconformed on the high temperature portion of the test. Nine resistors exceeded the allowed resistance change after moisture-resistance testing. Figure C.1. provides a summary of the nonconformances.

Forty MIL-R-39007 wirewound resistors (NSN 5905-01-190-5123) were tested. Three resistors exceeded the allowed resistance change after the 1,000 hour life test (a major nonconformance). Figure C.2. provides a summary of the nonconformances.

Application of the Electronic Parts. According to DESC, the fixed film chip wraparound resistor (NSN 5905-01-334-4620) has a Weapon System Group Code of "C," which is least critical (see Table C.2.). The DESC file indicated that the part was being used on General Purpose Electronic Test Equipment such as the Spectrum Analyzer.

For NSN 5905-01-190-5123, DESC files indicated the part has been used in systems such as AMRAAM, AIM120A, LANTIRN, ACM-129, LCSS, NUCLEAR POWER PLANT, HORNET F/A-18, PROWLER EA-6B, B-1B, and AN/UGC-129(V)-1.

Technical Assessment. For the commercial chip wraparound resistor (NSN 5905-01-334-4620), Dale agreed with the Crane Laboratory's results on Direct Current resistance and resistance temperature characteristic. The samples received from Dale showed many units were out-of-tolerance and that the units exceeded the expected 100 parts per million limit for resistance temperature characteristic. Dale's Material Analysis Report identified the foreign substance to be lead oxide. However, other lots in Dale's stock of the same vintage and value do not exhibit the same condition. Lead oxide can develop when the chip wraparound resistors are exposed to an environment of high temperature and excessive humidity over an extended period. Dale's engineers believe that the conditions that caused the lead oxide to develop could also cause the unit to shift out of tolerance and have excessive resistance temperature characteristics measurements by attacking the dielectric coating. The moisture resistance test (Dale Commercial Resistor Chip Wraparound Moisture Test Results NSN 5905-01-334-4620, Dale Report #048385) reported five nonconformances after nine units were tested.

For the wirewound resistors (NSN 5905-01-190-5123), Dale engineers indicated that the RWR80 resistor is the most critically rated resistor for its size in the MIL-R-39007 series. Heat removal is a critical parameter in the operation of the resistor. Correctly moving heat away from the part is a critical parameter of the test set up. The test specification allows as much as 500 feet per minute of air velocity but does not specify the air's direction or any impingement requirements. Dale's experience shows that if the impinging air velocity drops below 100 feet per minute, the parts will overheat. During our visit to the Dale Electronics Laboratory, we noticed that the test beds were arranged in parallel rows and the cold air blew from the bottom rack upward and directed at the devices under test. The air velocity is controlled. During our visit to the Crane Laboratory, we noticed that the testing beds were arranged in vertical rows and the air blew between the racks instead of at the devices. The air velocity is not controlled as Dale does. A Crane engineer explained to us that this arrangement is its interpretation of the test specification. Both the Dale test arrangement and the Crane test arrangement are correct in terms of the military specification; however, the part will fail if the air direction is the same as the Crane laboratory used.

The wirewound resistors under test are low value (0.681 ohms). The voltage to produce rated wattage (2 watts) is 1.16 volts. The Crane Laboratory used a 40 volt power supply for the test. The units should be arranged in series (as opposed to parallel) for the test to make voltage fluctuation less critical. However, Crane engineers arranged the resistors in parallel for the test and agreed that, with this kind of arrangement, it is somewhat difficult to control the voltage.

Dale reported that the load life testing at 2,000 hours, all RWR80 0.681 ohms (NSN 5905-01-190-5123) resistors were performing well within the limits of the specification at the Dale Laboratory. The same units nonconformed on load life testing at the Crane Laboratory at 1,000 hours. Dale believes that the original life testing had some anomaly that caused the life testing at Crane to appear so erratic.

Samples sent back to Dale for failure analysis showed the most significant results reported to be the discoloration of the molding compound. This result indicated excessive heat by overpowering or an insufficient air flow over the units. No specific defects were noted during the analysis that would account for the shifts. Dale's experiment showed that the resistance value does shift during load life test. This indicates that the unit has received excessive heat. Dale's internal analysis was performed after depotting the units. A photo in Dale's test report shows a solder ring around one lead. Dale's history has shown this ring to form on other units that have nonconformed due to overheating. The resistance element is composed of cupron wire; when exposed to higher temperatures, cupron wire resistance characteristically shifts negatively.

The difference in interpretation of the specification also accounted for the difference in test results between Crane's and Dale's Laboratories. The Crane Laboratory is working with the proper authorities to rewrite the specification to eliminate the ambiguity about method of mounting for heat dissipation.

Dale has requested Government assistance to trace from Dale to Government stock in order to determine where those abnormal conditions occur that could contribute to the failure of the resistors.

Conclusion. For the chip wraparound resistors (NSN 5905-01-334-4620):

The cause of failure was that the devices had been exposed to high temperature and excessive humidity for an extended period, which caused the lead oxide to develop and could also cause the unit to shift out of RTC tolerance.

For the wirewound resistors (RWR80S, NSN 5905-01-190-5123):

The cause of failure was the excessive heat that caused the negative shift recorded on the unit. The excessive heat was due to insufficient heat dissipation during testing or operation. The specification is also flawed since considerable variations in means of heat dissipation are allowed, which resulted in the test being passed at Dale Laboratory but failing at the Crane Laboratory.

Since our visit, DESC recognized the problem with the specification and requested comments from the Crane Laboratory and the manufacturer to investigate the possibility to eliminate the ambiguity in the specification.

Since our visit, Dale has requested Government assistance to trace the failure.

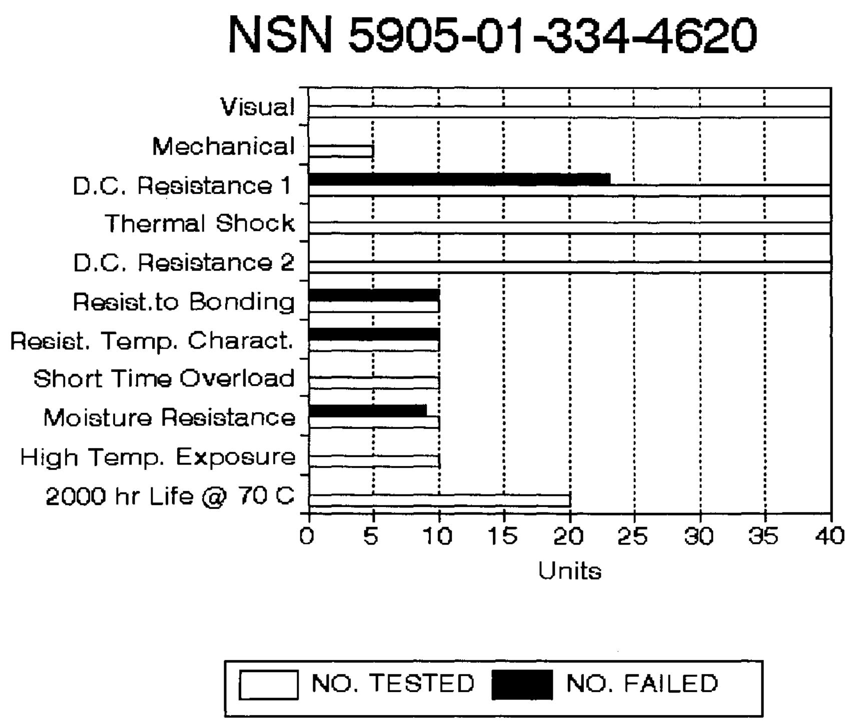

Figure C.1. Test Nonconformances

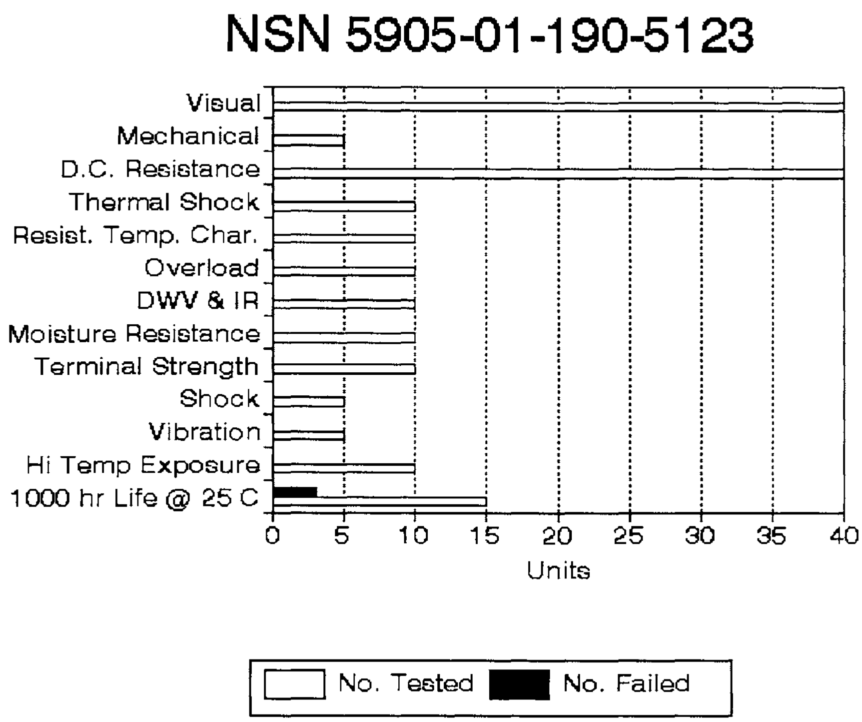

Figure C.2. Test Nonconformances

DWV = Dielectric withstanding voltage
IR = Reverse current leakage

Engineering Analyses of Nonconformances
NSN 5905-01-261-3378, Wirewound Resistor
Vendor: IRC Shallcross

Nature of Nonconformances. Crane engineers tested 40 wirewound resistors (NSN 5905-01-261-3378). Ten resistors exhibited Direct Current resistance major nonconformances. One resistor exhibited parametric failure (also a major nonconformance). The other nine exhibited catastrophic open resistance wire (major nonconformances). Crane engineers' failure analysis revealed an electronic overstress as the possible cause of nonconformance. Figure C.3. provides a summary of the nonconformances.

Application of the Electronic Part. According to DESC, the resistor is not a critical item and weapon system application is not available.

According to Shallcross personnel, its products can be found in the Minuteman, Apollo, Trident, Voyager, and the Space Shuttle Programs.

Technical Assessment. These resistors were manufactured in 1989 using a standard manufacturing process and materials. At the time of our study, Shallcross manufactured 400,000 resistors per month. DESC ordered 100 NSN 5905-01-261-3378 resistors from TTI, Dayton, in 1989. The parts were repackaged by Baker Associates and went to a military storage depot in Richmond, Virginia.

Upon hearing of the problem at the Crane Laboratory, DESC pulled the remaining 16 resistors from the depot and returned them to Shallcross for testing.

Shallcross requested assistance from the New Hampshire Materials Laboratory, Incorporated, and Harrison Alloy, Incorporated Both laboratories confirmed that the cause of the nonconformances was chlorine contamination.

In all cases, the resistance wire was severed in the center of the resistor. The opening could have been caused either by over-voltage or by corrosion. Over-voltage, however, leaves a telltale sign. A sphere or ball is formed at the end of each piece of the remaining severed wire. The resistors sent back to Shallcross had no such formations at the severed wire ends. A picture enlarged 970 times by the New Hampshire Materials Laboratory showed fractured resistance wire, most likely caused by corrosion. The resistor wire was made from a nickel, chromium, aluminum, and copper alloy known commercially as Evanohm. The wire was coated with an enamel insulation layer.

According to Shallcross engineers, corrosion was the most likely cause. This conclusion was also backed by two independent laboratories' reports. Both laboratories analyzed the opened resistors by using energy dispersive spectroscopy and scanning electro microscopy. Significant levels of chlorine were detected on the fractured surfaces that probably contributed to the failure of these resistors. Chlorides are known to cause corrosion in alloys of this type, particularly if some residual stress is present, as there is for any wire wound on a mandrel. Similar good resistors analyzed by energy dispersive spectroscopy showed no chlorine present.

A follow-up analysis report from the Crane Laboratory revealed significant levels of chlorine on both failing and non-failing resistors. In each case, the chlorine was detected on the winding in the center portion of the resistors but was not detected on the outer epoxy coating. This result indicated that the chlorine was most likely introduced during manufacturing. We sent the analysis report to Shallcross for comments. Shallcross indicated no challenge to the Crane's follow-up report. Shallcross believed this case is an isolated one.

Following the completion of our tests, DESC disqualified Shallcross from further contracts. DESC's files showed a number of Quality Deficiency Reports about the company. We were told that our test results had contributed to the command's decision to disqualify the vendor.

Conclusion. For the wirewound resistors (NSN 5905-01-261-3378), the cause of failure was corrosion that resulted from chlorine contamination. The chlorine contamination most likely occurred at the manufacturing plant during the production and cleaning process.

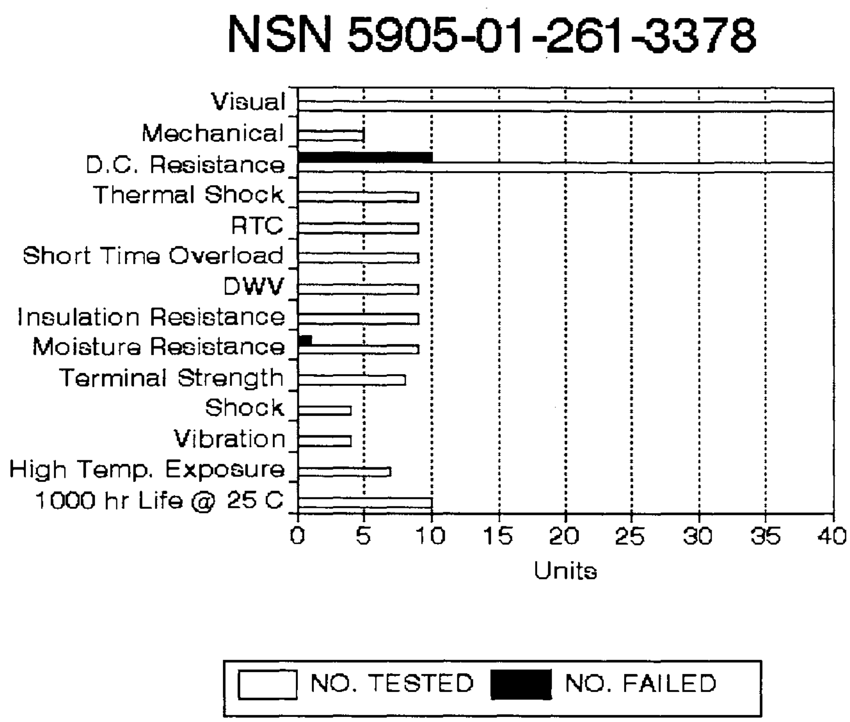

Figure C.3. Test Nonconformances

RTC = Resistance temperature characteristic
DWV = Dielectric withstanding voltage

Engineering Analyses of Nonconformances
NSN 5905-00-946-3525, Potentiometer
Vendor: Spectrol Electronics Corporation

Nature of Nonconformances. Forty model 80-9-176 Trimming Potentiometers (NSN 5905-00-946-3525) were tested; 26 nonconformed to the visual inspection (minor nonconformances). Of the 26 devices, 17 had shallow gouges in the side of the device; seven had small patches of rust near the lid seal; one had poor, illegible marking; one had a deep cut in one lead. Five devices had major nonconformances by not meeting the minimum starting torque requirements. Figure C.4. provides a summary of the nonconformances.

Application of the Electronic Part. According to DESC, the item is classified as least critical. Applications are found in the C-2A aircraft, the T-2 aircraft, and the A-4 Skyhawk aircraft.

According to DESC, the nonconforming device (NSN 5905-00-946-3525) has a weapon system group Code of "C," which is least critical (see Table C.2.). DESC Supply Operations does not have specific end item application data for this NSN.

Technical Assessment. Spectrol Electronics Corporation completed an investigation of the nonconforming devices and agreed with the technical findings of the Crane Laboratory's report on units that showed file cuts and did not meet minimum torque requirements. Spectrol sent to us a Correction Action Response (CAR #9307-011) describing technical findings and response. Spectrol could not verify the marking and corrosion discrepancies because Spectrol had no units in stock. Spectrol believed all marking was done according to the approved engineering specification. The following is a summary of Spectrol report on investigation:

Torque issue: The minimum torque requirement was not called out on Spectrol's internal drawing, which resulted in shipping the units without verifying the starting torque requirement.

Corrective action: Spectrol issued an Internal Quality Concern (IQC#9307-01) to incorporate the 0.5 ounce-inch minimum starting torque on engineering drawings.

Cut issue: The cut on the terminal was due to an operator error during the Tap Trimming off the base operations. This discrepancy was not caught during final inspection due to an oversight.

Corrective action: Spectrol issued a Quality Bulletin (QB#128) to alert both the assembly operators and final inspectors to the cut condition, which could occur during the trimming operation. Spectrol did not anticipate a re-occurrence of the discrepancies in the future shipments.

Corrosion issue: Some corrosion started on units with deep scratches in the surface finish. Some corrosion may have started when units were exposed to high humidity. The source of the corrosion needs further investigation.

Marking issue: According to Spectrol, all markings were done according to approved engineering specification. The poor marking could be caused by poor handling.

Conclusion. For resistor devices, Trimming Potentiometers (NSN 5905-00-946-3525):

Torque issue: The cause of failure was the manufacturer's poor Quality Assurance process. Spectrol initiated a corrective action after our visit.

Cut issue: The cause of failure was the manufacturer's poor Quality Assurance process. Spectrol initiated a corrective action after our visit.

Corrosion issue: The cause of failure was poor handling such that the devices were being scratched and exposed to a high humidity environment.

Marking issue: The cause of failure was poor handling.

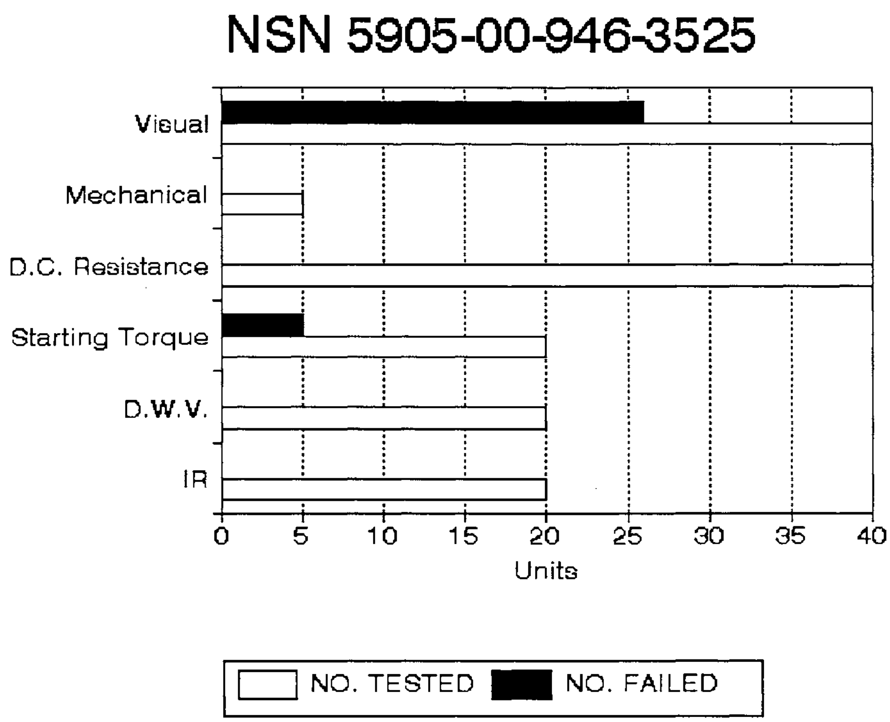

Figure C.4. Test Nonconformances

D.W.V. = Dielectric withstanding voltage
IR = Reverse current leakage

Engineering Analyses of Nonconformances
NSN 5905-01-225-3392, Variable Resistor
NSN 5905-01-012-9760, Variable Resistor
Vendor: Bourns Incorporated

Nature of Nonconformances. The Crane engineers tested 40 resistors (NSN 5905-01-225-3392, Part No. A3012868-8). Seven resistors nonconformed to Setting Stability after Thermal Shock testing (a major nonconformance). Figure C.5. provides a summary of the nonconformances.

Twenty variable resistors (NSN 5905-01-012-9760, Part No. 40-001029-15) were tested. All nonconformances were major. Four resistors nonconformed on resistance temperature characteristics at the low temperature extreme. One of the four resistors also nonconformed at the high temperature extreme. Another one nonconformed on the life test. Figure C.6. provides a summary of the nonconformances.

Application of the Electronic Part. According to DESC, item NSN 5905-01-225-3392 is least critical. The next higher assembly is a Radio System, Single Channel.

The Weapons System Indicator Code "S" for this NSN 5905-01-012-9760 indicates that a weapons system and item (Harpoon Missile, AGM-84) is considered critical by the Navy, but failure of the particular NSN in question will not render the end item inoperable. The item also has Army applications.

Technical Assessment. The Crane Laboratory engineers sent the nonconforming devices to Bourns for further analysis. Bourns internal laboratory presented the following explanations for the two main nonconformances:

Voltage Ratio Shift (Setting Stability) Failure (5905-01-225-3392). Bourns research scientists examined and analyzed the devices via scanning electron microscopy, energy dispersive X-ray spectroscopy, and wavelength dispersive X-ray spectroscopy, and found no physical or chemical evidence for the cause of failure in the units' component parts.

The trimpot devices consist of alumina substrate, thick film resistor, wiper, rotor, "O" ring, copper leads, and cap. The wiper is held under compression to ensure adequate wiper-to-resistor contact force. The components are made of materials with different temperature coefficients. When devices went through thermal shock, the various components expanded and contracted by different amounts, allowing the wiper to "creep" slightly under the influence of the lateral or shear stress, resulting in a shift in voltage ratio. Bourns' Material Research Department refers to this theory as "creep phenomenon" and is conducting a research effort into this phenomenon.

Temperature Coefficient (resistance temperature characteristics) Nonconformances (5905-01-012-9760). Bourns scientists reported no physical or chemical evidence when the devices were being examined and analyzed via scanning electron microscopy, energy dispersive x-ray spectroscopy, and wavelength dispersive x-ray spectroscopy. However, recent experiments with simulated electro static discharges made to thick film resistors have demonstrated that such events can cause a negative shift in temperature coefficient. Bourns scientists are currently conducting a research effort to clarify the "electro static discharge phenomenon."

In addition to the "electro static discharge phenomenon," we believe another possible cause of nonconformances was not mentioned in the Bourns point paper. The "resistive ink formulation" as a likely cause of failure was mentioned by a Bourns expert. A Crane Laboratory engineer said that the most significant factor effecting resistance temperature characteristic for this part type is the alloying of the materials used to comprise the resistor element. The resistive ink formulation requires a balance that produces the sheet resistivity required for the resistance value in order to maintain temperature stability.

The resistive ink formulation problem is not isolated to this device. We found from the Government and Industry Data Exchange Program data base information about an inadequate conductor ink printing process in similar Bourns devices. However, this cause had not been officially recognized by the manufacturer.

We concluded that both "Creep Phenomenon" and "electro static discharge phenomenon" were considered law of physics phenomena. Basic research was needed to improve the quality of the devices, since, these were not manufacturing problems.

Conclusion. We were unable to reach a conclusion as to the causes of the nonconformances from the evidence obtained during the tests by the Crane Laboratory. We gained some additional insight into the causes of nonconformances from evidence presented by Bourns. However, we were still left with only theories regarding the cause of failure of one of the two tested NSNs.

For the variable resistor devices (Trimpot trimming potentiometer, NSN 5905-01-225-3392), the manufacturer's explanation of the cause of the failure for setting stability was "creep phenomenon" of the devices after thermal shock.

We accepted this explanation and considered this a "law of physics" phenomenon requiring further research. The manufacturer is currently conducting research in this area.

Bourns also contends that the thermal shock test requirement was not included in the Bourns commercial catalog. We disagree, because the marking on Bourns devices referenced a drawing that had the thermal shock test requirement.

For the variable resistor devices (Trimpot trimming potentiometer, NSN 5905-01-012-9760), we were unable to determine the root cause of the failure. The manufacturer believed that the possible cause of failure for resistance temperature characteristics was "electro static discharge phenomenon." Bourns is currently conducting further research on electro static discharge. However, in our opinion, the cause of failure could also be in the resistive element, due to an ink formulation, and an inadequate conductor ink printing process. We believe that either the electro static discharge or the ink formulation process is equally likely to have caused the failure.

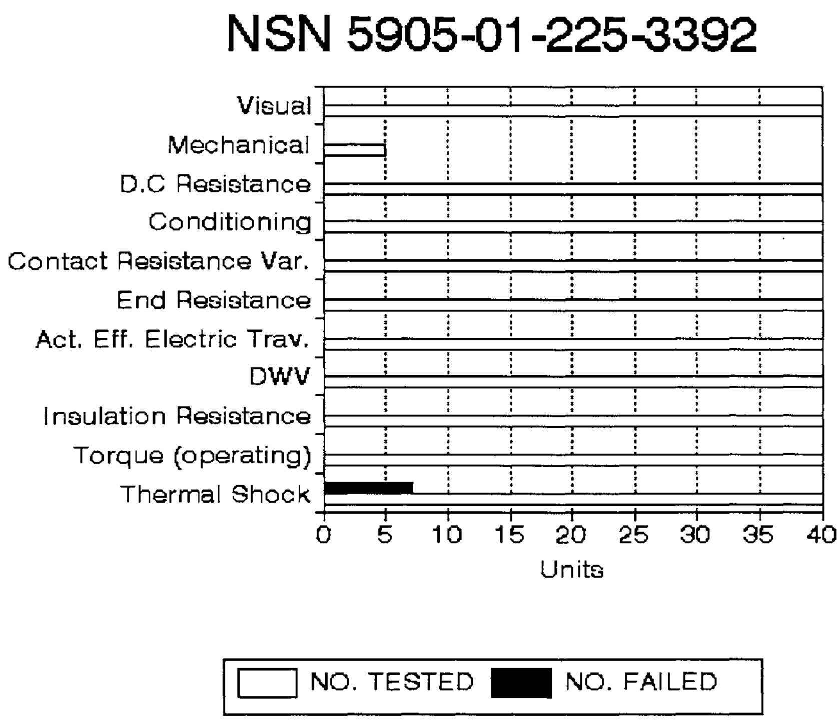

Figure C.5. Test Nonconformances

Act. Eff. Electric Trav.	=	Actual effective electrical travel, according to the appropriate drawing
DWV	=	Dielectric withstanding voltage

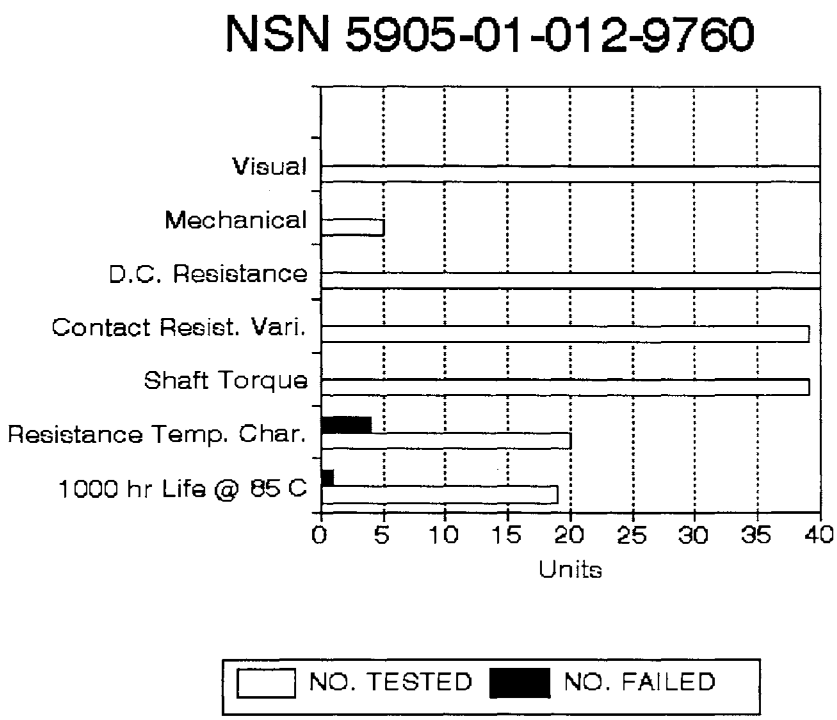

Figure C.6. Test Nonconformances

Engineering Analyses of Nonconformances
NSN 5961-00-439-0871, Silicon Bridge Rectifier
Vendor: ST-Semicon Corporation

Nature of Nonconformances. The Crane Laboratory tested 40 commercial grade Silicon Bridge Rectifiers (S7007-6, NSN 5961-00-439-0871). The following nonconformances have been reported, all major:

o Five devices were identified to be out of physical dimensional tolerances; the lead diameter measurement is significantly different from what is specified on the drawing.

o Nineteen devices nonconformed on the forward voltage drop test; one nonconformed the leakage current reading test.

o Thirteen devices shorted after surge testing. One device had a leakage current reading exceeding the maximum allowed. Eleven of these nonconformances were also initial forward voltage nonconformances. Four additional devices nonconformed on the forward voltage drop after surge test.

Figure C.7. provides a summary of the nonconformances.

Application of the Electronic Part. The vendor was out of business. No information on the application of this part was, therefore, available from the vendor.

According to DESC, the item is critical. Weapon system application is Coded R, required to prevent impairment of operational effectiveness of the end item (see Table C.2.). DESC's file listed weapon system application on OSPREY Class MHC, Stalwart Class TAGOS, USNS Henry J. Kaiser Class TAO, control assembly search light, and power Amp P/N 3636A.

Technical Assessment. The following summarizes the Crane Laboratory report:

Package construction evaluation showed the following:

Anode connection: A copper run is bonded to a silver-plated aluminum disc that is bonded to the anode of the chip.

Cathode connection: The chip substrate is bonded to a silver-plated aluminum disc that is bonded to a copper run.

Sealing method: The entire package consists of four diodes with connecting copper runs, encased in black epoxy with four protruding leads.

The overall device assembly was good. However, the external leads were 41 mils and the minimum allowed was 51 mils. The specified leads provide a 51 percent larger area for thermal heat sinking. This device did not appear to be acceptable for military use.

Curve tracer testing confirmed that device nonconformed on the initial forward voltage drop test, reading 961 millivolt and 920 millivolts, respectively. The maximum allowed is 900 millivolts. The average forward voltage drop for the good devices was 866 millivolts. The device also nonconformed on the leakage current after surge test. The reading was 60 microamps at 19.6 volts. The maximum limit is 60 microamps at 600 volts.

The diode was depotted and fell apart at diodes 1, 3, and 4. A good device was also depotted and remained intact at all diodes.

Low power microscopic analysis revealed very little or no die attach between the silicon chip and the silver barrier on the aluminum slugs.

The device was examined in the Scanning Electron Microscope where material analysis confirmed that there was minimal die attach materials between the silicon chip and the silver barrier on the aluminum slug.

Poor silicon and slug die attachment provided inadequate heat sinking for the device. The lead on these devices measured less than minimum required to provide more area for thermal heat sinking.

A former company engineer working with us confirmed this analysis report and stated that the flaw in rectifier design and the manufacturing process were the technical causes of nonconformances for this device.

Conclusion. For semiconductor devices, Silicon Bridge Rectifier (NSN 5961-00-439-0871), the causes of failure were the flaws in rectifier design and manufacturing process.

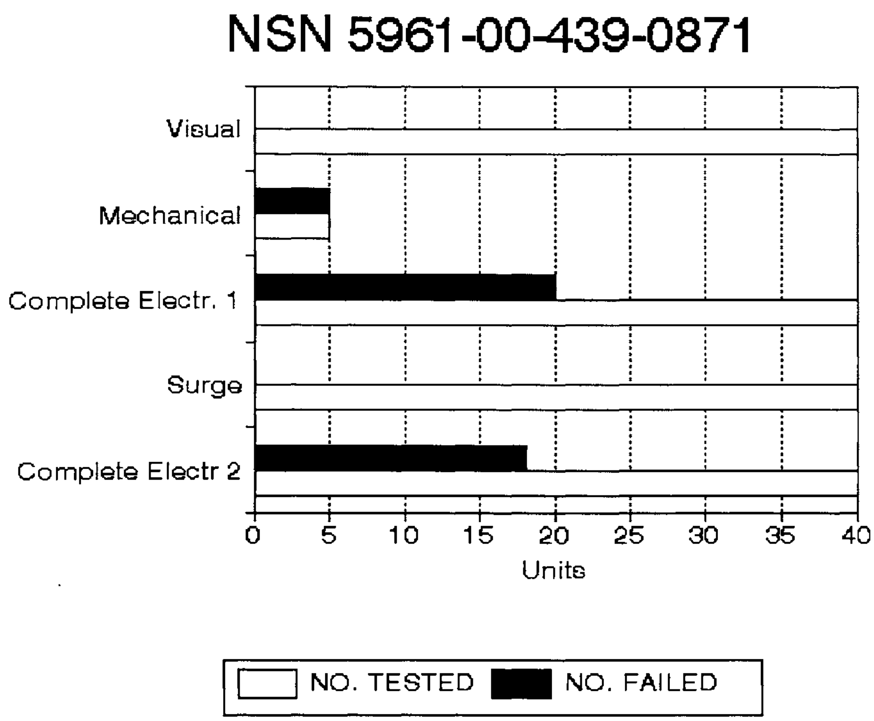

Figure C.7. Test Nonconformances

Engineering Analyses of Nonconformances
NSN 5961-00-235-8678, Diode
Vendor: General Instrument Corporation

Nature of Nonconformances. Forty Diode, Silicon, Chips (NSN 5961-00-35-8678) were tested. All nonconformances were major. Twenty-nine had electronic nonconformances such that one device nonconformed on the reverse current leakage values at ambient temperature during initial electronic test and 28 nonconformed on the reverse current at high temperature. Figure C.8. provides a summary of the nonconformances.

Application of the Electronic Part. According to DESC, the nonconforming devices (NSN 5961-00-235-8678) had a weapon system code "F." This code is most critical (see Table C.2.). Failure of the part will render the end item inoperable. The parts can be found in weapon systems such as Apache AH-64, B-52 Aircraft, boilers, communication equipments, compressors, and radar sets.

Technical Assessment. The test results and nonconforming devices were sent to General Instrument Corporation for analysis. The initial response from the General Instrument Corporation explained the cause of the nonconformance at ambient temperature. The General Instrument Corporation indicated that the examination found no external damage or defects. However, the sample tagged No. 33 failed reverse current leakage values at the rated breakdown voltage.

During physical analysis, the diode was chemically decapsulated, exposing the die attach braze joints and silicon die edge. Electronic microscopy of the die edge revealed evidence of an electronically induced phenomenon in the form of an arc-track traversing the junction region.

Arc-tracks occurred as the result of a high voltage, short duration spike. Typically, the voltage value of a transient spike is several orders of magnitude above the diode breakdown voltage rating limits. Due to short duration of this phenomenon, the overall energy impact is small. The result is highly localized damage to the die edge in the form of a small burn track. Arc-tracks allow current to bypass the junction at the die edge, resulting in increased leakage value. In this case, the reverse current leakage values were increased from 25 nanoamps to 476 nanoamps.

Sources of reverse voltage transients are typically from electronic equipment components (such as switch, relay, or test head) that may generate an electronic arc. External sources can be attributed to fluctuation in line voltage and Electro Magnetic Pulse phenomenon. The Arc-track of the high voltage, short duration spike could also be caused by electro static discharge.

We discussed the electro static discharge issue with the Crane Laboratory engineers. We also observed the performance of the laboratory's technician and found that it is a standard practice for the technicians to put on an electric discharge arm band before they touch any electronic test equipment. The electro static discharge is unlikely to happen at the Crane Laboratory. However, electro static discharge could happen at other locations. Crane engineers agreed with the General Instruments Corporation that the electric overstress caused this problem at ambient temperature. The Crane Laboratory engineers did not rule out the possibility that the electric spike could be generated by the test equipment. However, Crane does not know the source of the electric over-stress and could not duplicate it in its laboratory. Since only one out of 40 devices nonconformed on the ambient temperature test due to an electric spike and it is very difficult to duplicate the nonconformances, we considered this to be an isolated case.

The General Instrument Corporation follow-up report focused on the cause of failure of reverse current leakage at high temperatures. The examination of the exposed subassemblies revealed no evidence of structure damage or defect. The silicon die complies with intended design characteristics. No evidence of a leakage path or electronically induced damage has been found.

Test results showed the diodes to be functional and stable at ambient temperature but to exceed the specification at elevated temperatures. The physical analysis revealed no inherent defect or contamination problems.

In the specification, the reverse current leakage value at elevated temperature was very close to the upper limit. Based upon the data presented, the elevated leakage phenomenon was considered a parametric shift. The manufacturing date code of the returned samples dated to early 1989, making the samples more than four years old. The long shelf life may result in a slight upward drift in reverse current leakage value at high temperatures.

The General Instrument Corporation panel of experts explained the cause of high temperature nonconformances as detailed in the follow-up report and raised an issue about the specification. The panel's opinion was that the specification needs to be modified. The modification was to allow for slight parametric shifts in high temperature leakage value that occur over a long shelf life. The modification in leakage current value (say, 10 microamps) at high temperature will not effect the overall functionality or reliability of this product. We believe the specification is tight for this product at high temperature. However, we are not convinced about the parametric shifts due to shelf life. Neither DESC nor the Crane Laboratory personnel were aware of any shelf life requirement for this device.

Conclusion. For Diode, Silicon, Chip (NSN 5961-00-235-8678):

The cause of reverse current leakage failure at ambient temperature (25 degrees Centigrade) was electric over-stress.

Test equipment and test conditions could cause the electric overstress. The source of this condition was unknown.

The cause of reverse current leakage failure at high temperature (150 degrees Centigrade) was due to parametric shift of the devices. According to the manufacturer, the longer shelf life could contribute to the parametric shift of this device.

The General Instrument Corporation's panel of experts believed that the current leakage value at high temperature for this device was too close to the limit and recommended a change to a higher value.

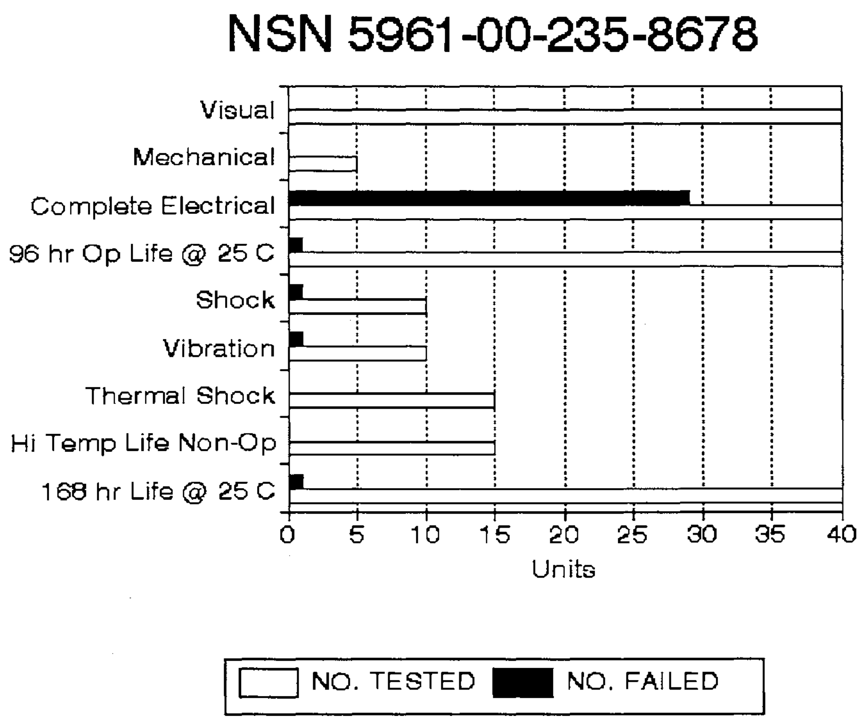

Figure C.8. Test Nonconformances

Hi Temp Life Non-Op = High temperature life non-operating test

Engineering Analyses of Nonconformances
NSN 5961-01-213-7878, Diode
Vendor: American Power Devices

Nature of Nonconformances. Forty temperature-compensated Zener Reference Diodes devices (NSN 5961-01-213-7878) were tested. All nonconformances were major. Twenty-two devices initially nonconformed on the Voltage Temperature Stability test. Two devices exhibited excessive reverse current leakage after burn-in. Figure C.9. provides a summary of the nonconformances.

Application of the Electronic Part. According to DESC, the proper Weapon System Code is "F," most critical; failure of this part will render the end item inoperable (see Table C.2.). Weapon Systems are Missile System - AEGIS Surface (SMS) MK7; Tactical Data System AN/UYA-4(V); Spruance Class DD(963); Belknap Class CG; Strategic weapon system (Poseidon and Trident); nuclear power plant.

Technical Assessment. The Crane Laboratory personnel sent the nonconforming devices to American Power Devices for evaluation. After further testing, the company agreed with Crane's test results.

The cause of the nonconformance for the initial voltage temperature stability test was American Power Devices' poor quality control, which resulted in poor calibration of test equipment during production.

American Power Devices personnel indicated that while they manufactured the 500 milliwatt temperature-compensated Zener reference diode (NSN 5961-01-213-7878) in accordance with MIL-S-19500/159E, the tests Crane conducted are in accordance with MIL-S-19500/159F. American Power Devices personnel pointed out specifically that in the MIL-S-19500/159F page 7, Table I, Subgroup 2, and page 11, table 4, the inspection to reverse current leakage was not in Revision E.

The device supplied to the Crane Laboratory for testing was manufactured, screened, and certified in accordance with MIL-S-19500/159 Revision E that did not have Reverse Current Leakage requirements. The devices were manufactured in 1988 when Revision E was in effect. Revision F was dated January 1991 and added a Reverse Current Leakage test requirement at several screening points.

The cause of failure of excessive reverse current leakage after burn-in was the difference in requirements in MIL-S-19500/159 Revision F and early Revision E.

Conclusion. For semiconductor, Zener Reference Diodes device (NSN 5961-01-213-7878)

The cause of failure for initial voltage temperature stability was the manufacturer's poor quality control on the production line.

The cause of failure for the reverse current leakage test was the difference in test requirements of the current specification revision and the former one. Product supplied to the Crane Laboratory was manufactured, screened, and certified in accordance with the former specification but tested under the new revision.

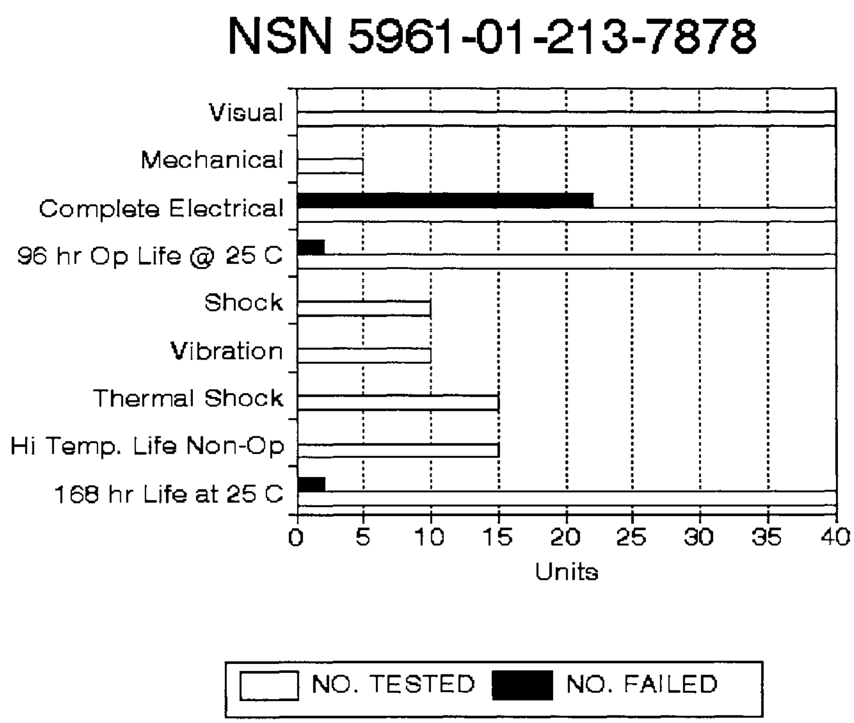

Figure C.9. Test Nonconformances

Hi Temp Life Non-Op = High temperature life non-operating test

Engineering Analyses of Nonconformances
NSN 5961-00-892-3473, PNP Transistor
NSN 5961-00-850-7646, NPN Transistor
Vendor: Germanium Power Devices Corporation

Nature of Nonconformances. The Crane Laboratory tested 40 Germanium PNP Small Signal Transistors (NSN 5961-00-892-3473) with the following results (all nonconformances were major):

o Three of the five measured devices nonconformed by failing to meet overall diameter specifications.

o One device nonconformed by failing the fine leak hermetic seal test. Visual examination of all units revealed a slight glass cracking problem with the lot.

o Three devices nonconformed on the Noise Figure measurement test.

Figure C.10. provides a summary of the nonconformances.

The Crane Laboratory tested 40 Germanium NPN transistors (NSN 5961-00-850-7646) with the following result:

o One device nonconformed on the initial Base to Emitter voltage measurement test, a major nonconformance.

Figure C.11. provides a summary of the nonconformances.

Application of the Electronic Parts. According to DESC, the item (NSN 5961-00-892-3473) is most critical. Weapon system application is coded "F." Failure of this part will render the end items inoperable (see Table C.2.). The item is used on 27 weapon systems (end items) such as Spurance Class DD (963), Patrol Hydrofoil Missile (PHM), Forrestal Class CV, Nimita Class CVN, general purpose electronic test equipment, and Sealift Support Facilities Program (SSFP).

According to DESC, the item (NSN 5961-00-850-7646) is coded "F," most critical; where the failure of this part will render the end item inoperable. The item is used on weapon systems such as AN/MSC-63, MK-48 torpedo, Spurance Class D (963), Patrol Hydrofoil Missile, AN/TYA-28, Forrestal Class CV, Laundry Equipment, Marine Hardware and Hull Doors, and 88 Windlass Equipment.

Technical Assessment. Germanium Power Devices Corporation did failure analyses and verified the nonconformances reported by Crane and initiated corrective actions.

For NSN 5961-00-892-3473 nonconformances:

Mechanical: Germanium inspected the finished goods inventory and found the diameter measurements exceeded the specified maximum limit. Germanium Quality Assurance personnel explained that the cap and header diameters were within the specification, but their process inspection procedures did not include physical dimensions at cap welding. If the cap and header are not aligned properly or spreading of the flange material occurs during cap welding, the diameter will exceed the limit. However, the manufacturer believed that the slight change in measurement will not effect the circuit performance or function of the devices.

Corrective action: To prevent reoccurrence of mechanical failure, the Integrated Circuit production line's operation and inspection procedures will be revised to include the measurement of the flange diameter at the cap welding operation.

Hermetic Seal: Germanium Quality Control personnel subjected 125 pieces from Integrated Circuit product, date code 9126, to both fine and gross leak tests and found no nonconformances. Fine leak testing was also performed after initial setup of cap welder and before each shift and was sampled at final inspection. Gross leak testing samples were taken at cap welding twice each day. The hermetic seal failure was not detected by the statistical sampling process. However, Crane's examination revealed a slight glass cracking problem with the lot. The slight glass cracking could account for the fine leak hermetic seal problem. The glass cracking most likely occurred during shipping or handling and was considered an isolated case.

Corrective action: Germanium Power Device will improve quality control and use an accepted limit of 8 decibels to remove any borderline noise figure devices from future JAN2N526 lots.

For NSN 5961-00-850-7646 nonconformances:

Electrical: Germanium Power Devices Corporation sampled Voltage Based Emitter (Saturated) on two different lots from finished goods inventory and found no rejects from either lot. Since they were unable to duplicate the failure conditions, the firm did not perform further analysis.

Conclusion. For semiconductor devices NSN 5961-00-892-3473:

The cause for the device's overall diameter measurement to be incorrect was poor quality control. The manufacturer corrected the production line operation and inspection procedure after our visit.

The cause of failure for the Noise Figure measurement was poor quality control. The manufacturer corrected the problem by updating the acceptance criteria after our visit.

The cause of failure for the fine leak hermetic seal test was a slight glass cracking problem with the lot. This cracking most likely occurred during shipping or handling.

For semiconductor devices NSN 5961-00-850-7646:

No cause of failure had been identified. Since only one in a lot of 40 nonconformed, this was considered an isolated case.

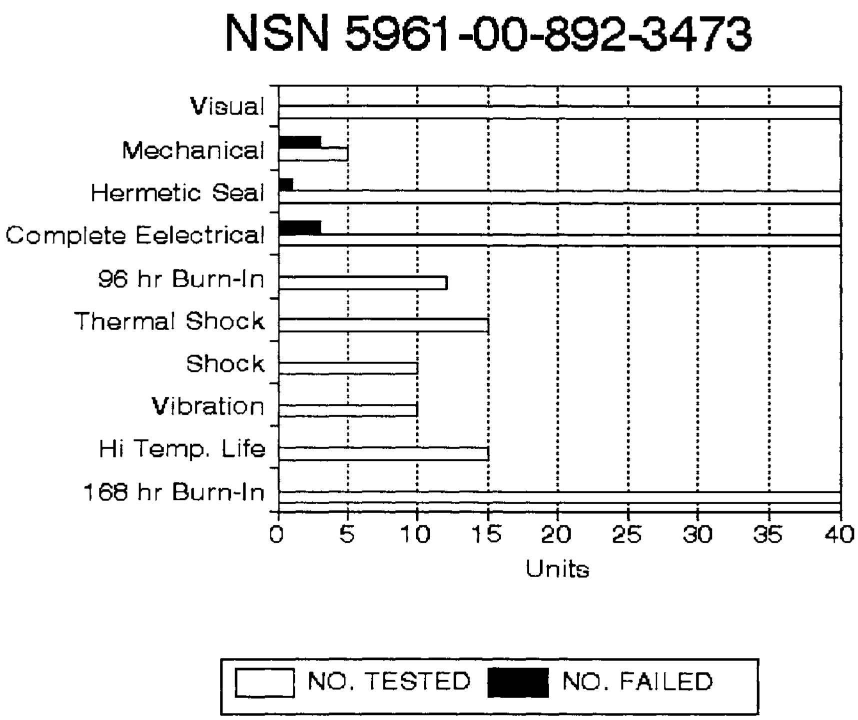

Figure C.10. Test Nonconformances

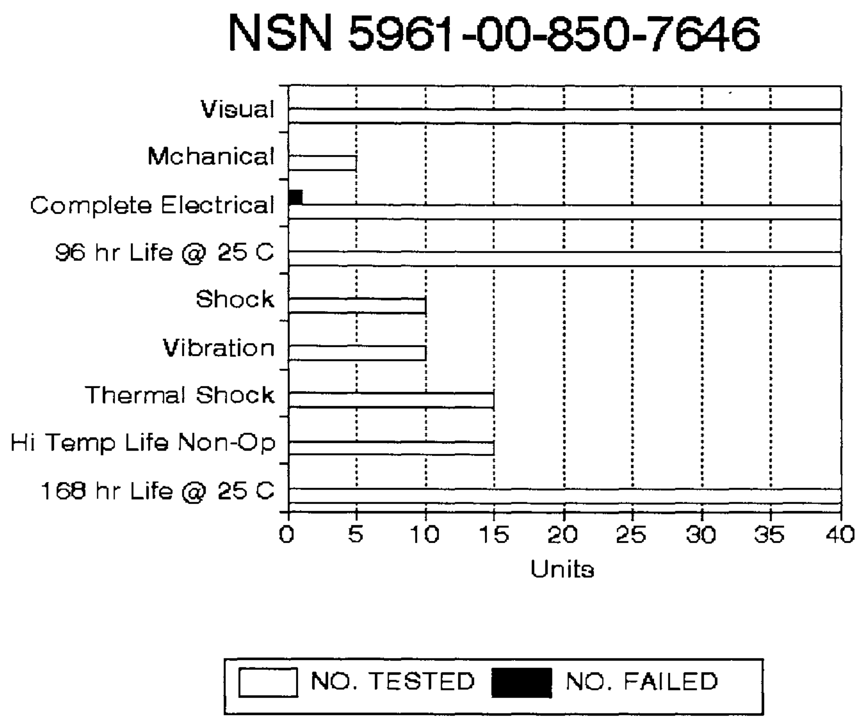

Figure C.11. Test Nonconformances

Hi Temp Life Non-Op	=	High temperature life non-operating test

Engineering Analyses of Nonconformances
NSN: 5961-01-188-6042, Diode
Vendor: Amperex (owned by North American Philips)

Nature of the Nonconformances. All nonconformances were major. All 40 diodes (NSN 5961-01-188-6042) nonconformed to the body diameter and body length physical dimensions parameters. All 40 devices nonconformed on the Forward Voltage test at one ampere peak (pulsed) where the maximum limit is 1.25 volts. Units read between 1.33 and 1.99 volts. Figure C.12. provides a summary of the nonconformances.

Application of the Electronic Part. DESC reported that the item was coded weapons system code "F," most critical (see Table C.2.). Weapon systems applications include Hercules KC-130, C-2A, Regency Net System, Starlifter C-141, Corsair A-70, F-16, and the Intruder EA-6A.

Technical Assessment. The diode manufactured by Amperex (part number BYV26B) did not meet the requirements of Drawing 117606-TAB that references three vendors: Amperex, Semicon, and TRW.

The Amperex engineering specification called for a maximum forward voltage of 2.5 volts. The specified test current is one ampere. However, the Semicon engineering specification called for maximum forward voltage of 1.25 volts at the specified current of one ampere. All nonconformances occurred between 1.33 and 1.99 volts.

The physical dimensions for the Amperex device were 0.15 inches for body diameter and 0.18 inches for length. In contrast, the semicon devices had 0.085 inches for body diameter and 0.085 for length.

Crane Laboratory results suggested that these devices were not interchangeable. The technical requirements listed on Drawing 117606-TAB (New Jersey Electronics Division) were not the same requirements as stated on the Amperex engineering specification.

DESC, Quality Assurance, said that the original manufacturer was the Singer Company, Kearfott Guidance and Navigation Division. The vendor supplier was the Electric Measurements Incorporated A Singer drawing and not an Amperex drawing was released by DESC to us for review and subsequently provided to the Crane Laboratory. DESC further suggested that the New Jersey Electronics Corporation, Singer Kearfott, and the Unitrode parts were interchangeable.

According to DESC Quality Assurance personnel, all three vendor's parts for this contact are interchangeable. In addition, a letter from the supplier Electronic Measurements Incorporated stated that "Engineering sheets for part number 117606-002 referencing Amperex P/N BYV26B is of the same form, fit, and function for both parts."

DESC indicated that the device was a commercial item coded with Acquisition Method code/Acquisition Method Suffix Code of "3Z." In addition, "All approved vendor part numbers are acceptable without reference to a controlling drawing or to other manufacturing data."

Conclusion. Amperex (owned by North American Philips) did not meet the engineering requirements of Drawing 117606-TAB.

Conflicting technical requirements caused the failure.

We found that diodes from Amperex, Semicon, and TRW were not of the same form, fit, and function.

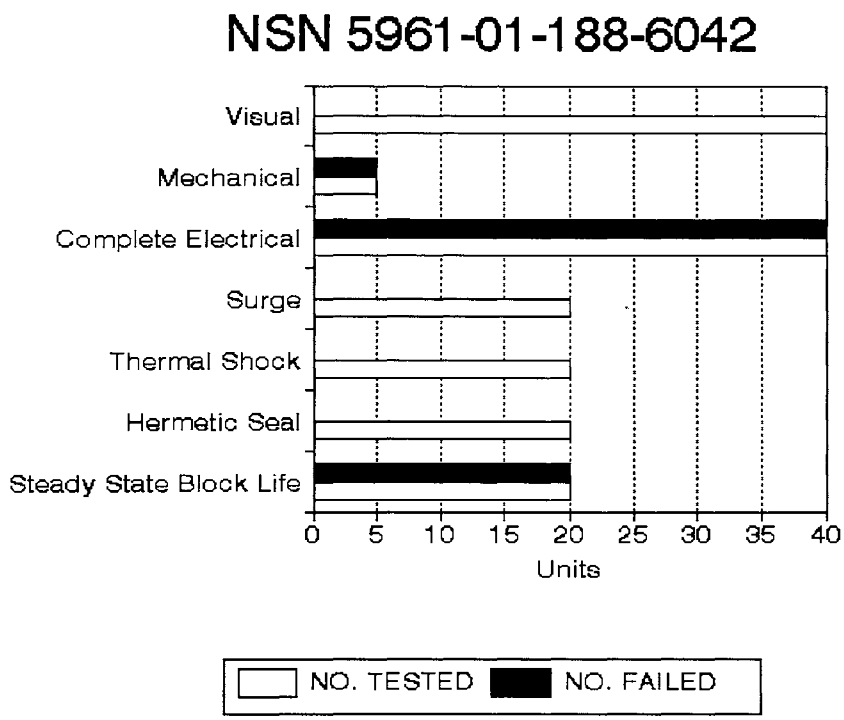

Figure C.12. Test Nonconformances

Engineering Analyses of Nonconformances
NSN: 5961-01-096-9924, Rectifier
Vendor: Semitronics Corporation

Nature of the Nonconformances. All nonconformances were major. Forty simple silicon controlled rectifiers (NSN 5961-01-096-9924) were tested and all 40 devices nonconformed on numerous physical dimension parameters, among them, overall length and mounting tab dimensions. The rectifiers did not nonconform on any stated electronic parameters in accordance with the Bendix drawing. However, the rectifier would only operate in one polarity. The specification stated that this device was supposed to be a "Triac" and therefore should be able to be operated in two directions. Figure C.13. provides a summary of the nonconformances.

Application of the Electronic Part. DESC reported that the item is least critical. Weapon System end items included: the Hercules aircraft, the KC-130 aircraft, and the Intruder 6A.

Technical Assessment. An incorrect device was provided to DESC. The appropriate specification was Bendix Drawing number 140006, which called for a Triac bipolar silicon-controlled rectifier.

Instead, the device received from Defense Logistics Agency Depot in Richmond, Virginia, was a Semitronics part number SES484, which is a simple silicon controlled rectifier and only operates in one polarity. The specification clearly states that the device is to be a "Triac." Triac rectifiers are bipolar and operate in more than one polarity.

A list of customer and depot complaints with contractor noncompliance for the Semitronics Corporation and the Semtex Industrial Corporation was submitted by DESC.

Conclusion. The manufacturer did not provide DESC with the correct device. The device provided was a simple silicon receiver as opposed to the required Triac bipolar rectifier. DLA will take corrective action when the Crane Laboratory returns the tested items. The material is being provided to DLA.

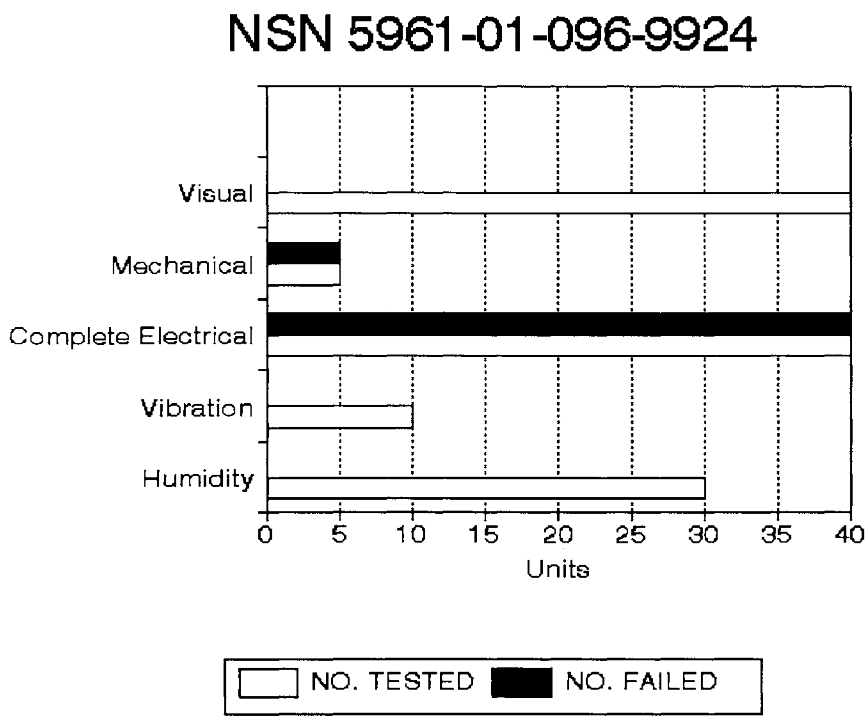

Figure C.13. Test Nonconformances

Engineering Analyses of Nonconformances
NSN 5935-01-101-7787, Connector Plastic Cover
Vendor: Hughes Aircraft Company

Nature of the Nonconformances. All nonconformances were minor. Ten plastic covers (NSN 5935-01-101-7787) were tested. One of the 10 tested samples visually inspected was chipped on one end of the plastic body. Six of the 10 tested samples nonconformed on the 0.050 inches maximum dimension end of the connector. Nonconforming measurements ranged from 0.0501 to 0.0615 inches on the left end and from 0.055 to 0.0592 inches on the right end. Figure C.14. provides a summary of the nonconformances.

Application of the Electronic Part. No criticality code was provided by DESC. However, DESC classified the item as Most Critical, where the failure of the part would render the end item inoperable. The weapon system application of this part is the A-10A weapon system. No reports of discrepancy or products quality deficiency reports were on DESC records for this contract.

Technical Assessment. The item was listed as noncritical by DESC Quality Assurance. Usage is on a circuit card assembly. Failure of this part will not render the end item inoperable.

We and the Crane Laboratory engineers determined that the dimensional nonconformances were so small that they were, therefore, noncritical. Engineers from the manufacturer Hughes Aircraft Company indicated that they had not received any complaints from customers.

Conclusion. All nonconformances were determined to be noncritical.

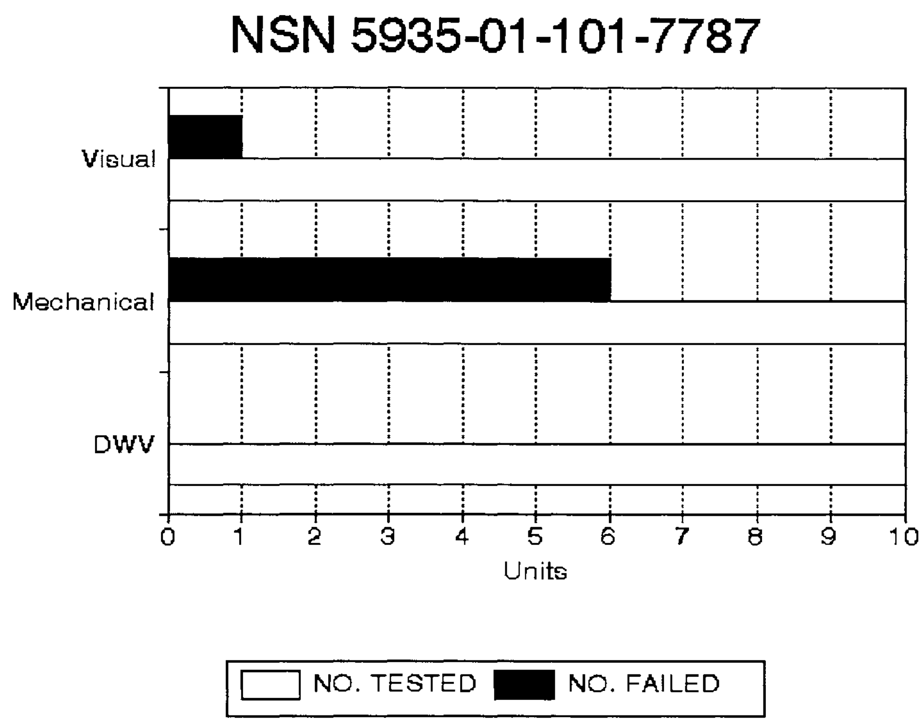

Figure C.14. Test Nonconformances

DWV = Dielectric withstanding voltage

Engineering Analyses of Failure
NSN 5935-01-247-6503, Connector Backshell
Vendor: AMP Incorporated

Nature of Nonconformance. All nonconformances were minor. Ten connector backshells (NSN 5935-01-247-6503) were tested. All 10 of the test samples nonconformed on the measurement requirement of 2.302 inches +/- 0.005 of the drawing. Nonconformances ranged from 2.287 inches to 2.283 inches. Figure C.15. provides a summary of the nonconformances.

Application of the Electronic Part. Applications include support equipment, and the MX Peacekeeper Missile. The quality history for this product (obtained from DESC) contained no complaints.

Technical Assessment. The 2.302 inches dimension was listed as a reference dimension which commonly does not carry a tolerance value. According to the Crane Laboratory, this appeared to be an over-specification problem.

Conclusion. A review with the Crane Laboratory engineers indicated that the 2.302 inches reference measurement was not a critical dimension. The Crane Laboratory engineers also stated that this dimensional failure did not constitute an unserviceable backshell.

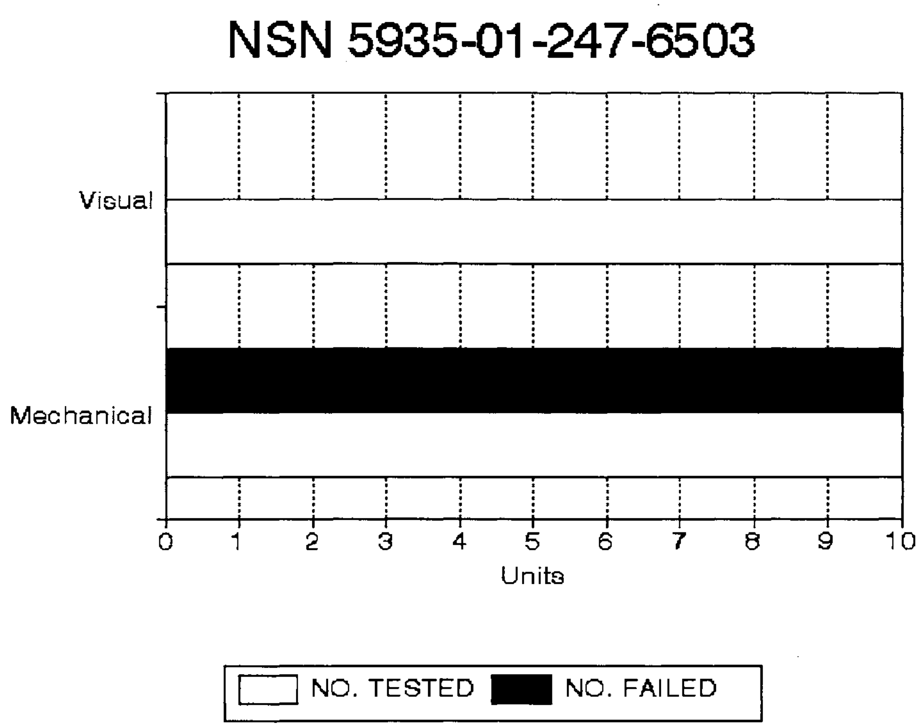

Figure C.15. Test Nonconformances

Engineering Analyses of Nonconformances
NSN 5935-00-167-7809, Key Pin
Vendor: AMP Incorporated

Nature of the Nonconformances. All nonconformances were minor. Ten connectors (NSN 5935-00-167-7809) were tested. Two out of the 10 units nonconformed on the dimensional requirements. Unit #1 measured 0.190 inches and unit #2 measured 0.196 inches. The requirement on the drawing was 0.199+/- 0.002 inches. Figure C.16. provides a summary of the nonconformances.

Application of the Electronic Parts. The application information obtained from DESC showed that the connector was used on 45 different circuit card assembles for various end items. The quality history for this part showed no complaints on file.

Technical Assessment. We and the Crane Laboratory engineers concluded that since the keys are epoxied into position on the connector, this dimensional measurement was not considered critical.

Conclusion. All connectors' lot nonconformances were found to be noncritical nonconformances. We concurred with the Crane Laboratory engineers' failure analysis results.

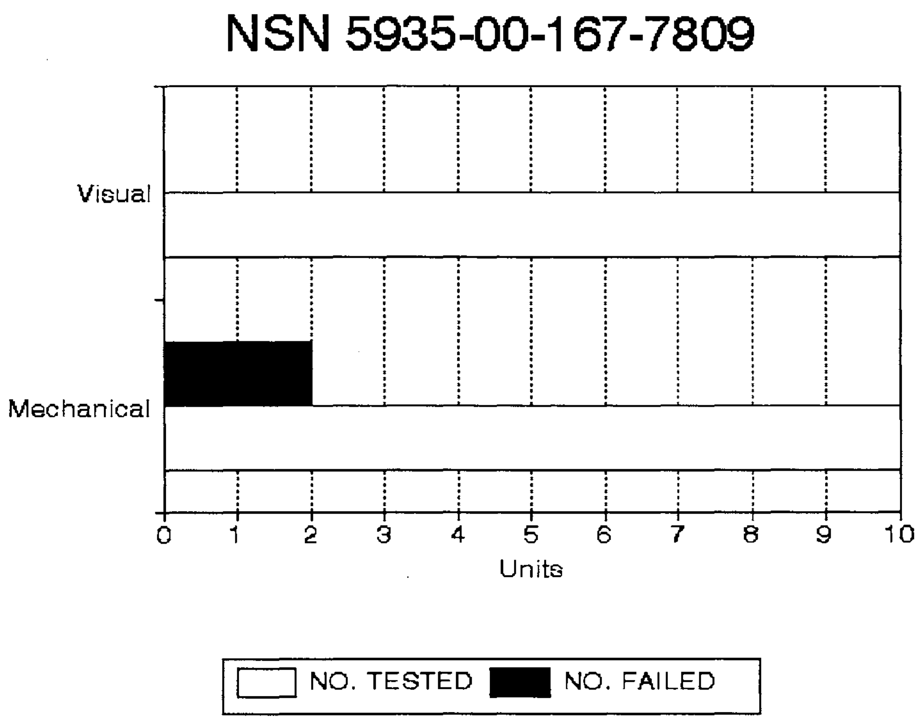

Figure C.16. Test Nonconformances

Appendix D. Organizations Visited or Contacted

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition and Technology

Department of the Army

Office of the Assistant Secretary of the Army (Financial Management)
Army Material Command, Arlington, VA

Department of the Navy

Office of the Assistant Secretary of the Navy (Financial Management)
Naval Supply Systems Command, Washington, DC
Naval Surface Warfare Center, Crane, IN
Fleet Material Support Office, Mechanicsburg, PA

Department of the Air Force

Office of the Assistant Secretary of the Air Force (Financial Management and Comptroller)
Air Force Materiel Command, Ogden Air Logistics Center, McClellan Air Force Base, CA
Ogden Air Logistics Center, Hill Air Force Base, Ogden, UT
Sacramento Air Logistics Center, McClellan Air Force Base, CA
San Antonio Air Logistics Center, Kelly Air Force Base, TX

Defense Agencies

Defense Logistics Agency, Alexandria, VA
Defense Electronics Supply Center, Dayton, OH
Defense Logistics Agency, Operations Research Office, Richmond, VA
Defense Logistics Agency, Central Region, Ogden, UT

Defense Agencies (cont'd)

Defense Logistics Agency, Eastern Region, New Cumberland, PA
Defense Logistics Agency, Eastern Region, Richmond, VA
Defense Logistics Agency, Southern Region, Memphis, TN
Defense Logistics Agency, Western Region, Tracy, CA

Non-Defense Federal Organizations

American Power Devices Incorporated, Lynn, MA
Amperex/Philips, Riviera Beach, FL
Bourns Instruments Incorporated, Riverside, CA
Dale Electronics, Columbus, NE
Germanium Power Devices Corp, Andover, MA
International Rectifier, El Segundo, CA
ST-Semicon Incorporated, Dallas, TX
Semitronics Corporation, Freeport, NY
Shallcross Incorporated, Smithfield, NC
Spectrol Electronics, Ontario, CA

Appendix E. Report Distribution List

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition and Technology
Deputy Under Secretary of Defense (Acquisition Reform)
Deputy Under Secretary of Defense (Logistics)
Assistant Secretary of Defense (Economic Security)
Director, Defense Procurement
Deputy Assistant Secretary of Defense (Industrial Affairs)

Department of the Army

Secretary of the Army
Assistant Secretary of the Army (Research, Development and Acquisition)
Commander, Army Material Command
Commander, Communications-Electronics Command
Commander, Sacramento Army Depot
Commander, Tobyhanna Army Depot
Auditor General, Department of the Army

Department of the Navy

Secretary of the Navy
Assistant Secretary of the Navy (Research, Development and Acquisition)
Commander, Naval Air Systems Command
Commander, Naval Sea Systems Command
Commander, Naval Supply Systems Command
Commander, Space and Naval Warfare Systems Command
Commander, Naval Avionics Center
Commander, Crane Naval Weapons Support Center
Commander, Ships Parts Control Center
Commander, Aviation Supply Office
Commander, Naval Material Quality Assessment Office
Commander, Washington Navy Yard
Commander, Naval Electronics Systems Engineering Activities
Program Manager, Government Industry Data Exchange Program
Auditor General, Department of the Navy

Department of the Air Force

Secretary of the Air Force
Assistant Secretary of the Air Force (Acquisition)
Commander, Air Force Logistics Command
Commander, Ogden Air Logistics Center
Commander, Sacramento Air Logistics Center
Commander, Warner Robins Air Logistics Center
Auditor General, Department of the Air Force

Defense Agencies

Defense Logistics Agency
Defense Electronics Supply Center

Non-Defense Federal Organizations

Office of Management and Budget, Office of Federal Procurement Policy
General Accounting Office, National Security and International Affairs Division,
Technical Information Center

Chairman and Ranking Minority Member of each of the following Congressional Committees and Subcommittees:

Senate Committee on Appropriations
Senate Subcommittee on Defense, Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Governmental Affairs
House Committee on Appropriations, Subcommittee on National Security
House Committee on Defense, Committee on Appropriations
House Committee on Government Reform and Oversight
House Subcommittee on National Security, International Affairs and Criminal Justice, Committee on Government Reform and Oversight
House Committee on National Security

Part IV - Management Comments

DEFENSE LOGISTICS AGENCY
HEADQUARTERS
CAMERON STATION
ALEXANDRIA, VIRGINIA 22304-6100

IN REPLY REFER TO DDAI

25 JAN 1995

MEMORANDUM FOR THE ASSISTANT INSPECTOR GENERAL FOR AUDITING, DEPARTMENT OF DEFENSE
(ATTN: Mr. Kenneth Stavenjord)

SUBJECT: DODIG Draft Audit Report on Nonconformance of Resistors, Semiconductors, and Connectors Managed by The Defense Logistics Agency (Project No. 2PT-6018)

This is in response to your 1 December 1994 request.

JACQUELINE G. BRYANT
Chief, Internal Review Office

cc:
MMA
DESC

TYPE OF REPORT: AUDIT DATE OF POSITION: 25 JAN 1995

PURPOSE OF INPUT: INITIAL POSITION

AUDIT TITLE AND NO: Nonconformances of Resistors, Semiconductors, and Connectors Managed by the Defense Logistics Agency, Project No. 2PT-6018

FINDING: **Rates of Nonconformance.** The nonconformance rates in the resistors and semiconductors Federal supply classes are higher than the nonconformance rates the Defense Electronics Supply Center reported for its Stock Quality Assurance program in FY 1991. The rates are higher than DESC reported because DESC did not test the materials to complete critical performance characteristics. Another reason the true rates of nonconformance were higher is that DESC did not test statistically representative samples of electronics materials in the two Federal supply classes. DESC's test program primarily focused on military specification parts rather than on commercial parts. DESC may have added at least 244,000 nonconforming parts to its inventory in the two classes in FY 1991. The higher rate of nonconformance than identified by DESC could effect readiness of weapons systems by degrading the reliability of higher assemblies such as circuit cards.

DLA COMMENTS: We concur with the sampling methodology used by the DoDIG. However, we do not concur with the projections extrapolated from this methodology, or the impact of these projections as portrayed in this report. The DoDIG projected percentage of defective parts in these three stock classes is not really indicative of the quality provided to our customers. The vast majority of nonconformances found were minor in nature and did not affect the useability of the materiel. In fact, 72% of the semiconductors, and all of the connectors, reported as nonconforming were fully usable and satisfied our customers' requirements.

The projections made based on the sampling results were for a majority of minor deficiencies. In addition, the scope of these projections was limited to 4.9% or 1,119 of the 22,775 NSNs managed by DESC within these three Federal supply classes. As the DoDIG states in Appendix A, Statistical Methodology, " It is not appropriate, however, to make statistical projections to the Federal supply classes as a whole based on the sample data".

The universe of items, from which the estimate of 244,000 nonconforming parts is derived, is the wrong universe. As shown on page 32 of this report, the original universe was reduced from 11 plus million items to about 1/2 million due to losses from the DoDIG's screening criteria. Yet despite statements indicating that statistical projections cannot be made in Appendix A (page 27, page 32), projections are reported in the Executive Summary and Part II using the original universe. Any projections should be made from the restricted "Projectable Universe". Projections made in Table A.8 should be revised to use the "Projectable Universe" values from Table A.4 resulting in a minimum projection of about 1/10th the number of nonconforming parts reported in the finding.

To clarify the results of the report, we request that the following statement be added in the Technical Assesment Results section of the Executive Summary in the final report:

" The level of nonconforming parts was estimated from tests conducted on a sample representing 10% of the materiel purchased and delivered in 1991 in 3 of the 92 Federal Supply Classes procured by DESC."

INTERNAL MANAGEMENT CONTROL WEAKNESSES:
( ) Nonconcur.
(x) Concur; however, weakness is not considered material.
( ) Concur; weakness is material and will be reported in the DLA Annual Statement of Assurance.

ACTION OFFICER: Michael E. Shields, Jr., DLA-MMSLP, DSN 617-0505, 19 Dec 94
REVIEW/APPROVAL: J. S. Rountree, CAPT, USN, Deputy Executive Director, Supply Management, MMS, x70510, 17 Jan 95
COORDINATION: Eileen Sanchez, FOE, 1/18/95
A. Broadnax, DDAI, 1/18/95
Bryant, DDAI, 23 Jan 95

DLA APPROVAL:

24 JAN 1995

LAWRENCE P. FARRELL, JR.
Major General, USAF
Principal Deputy Director

TYPE OF REPORT: AUDIT DATE OF POSITION: 25 JAN 1995

PURPOSE OF INPUT: INITIAL POSITION

AUDIT TITLE AND NO: Nonconformances of Resistors, Semiconductors, and Connectors Managed by the Defense Logistics Agency, Project No. 2PT-6018

RECOMMENDATION 1: We recommended that the Commander, Defense Logistics Agency establish procedures ensuring that Stock Quality Assurance tests are conducted to complete critical performance characteristics. The procedures should include establishing controls over test plans and testing to verify that all critical performance characteristics are tested.

DLA COMMENTS: We concur with the recommendation. DESC is currently preparing written internal procedures providing all test center personnel with guidance on preparing test plans to verify critical performance characteristics and sampling procedures and specifying required testing. An internal audit program will be initiated to review and assure that the performance of actual testing meets the requirements of the written procedure. A process requiring management review and approval of test plans developed will be initiated. Testing to life cycle/environmental requirements will be performed in accordance with the sampling methodology already submitted to and approved by the DoDIG Technical Assessment Team.

DISPOSITION:
(x) Action is ongoing. Estimated Completion Date: 30 Mar 95
( ) Action is considered complete.

INTERNAL MANAGEMENT CONTROL WEAKNESSES:
( ) Nonconcur.
(X) Concur; however, weakness is not considered material.
( ) Concur; weakness is material and will be reported in the DLA Annual Statement of Assurance.

MONETARY BENEFITS: N/A
DLA COMMENTS: N/A
ESTIMATED REALIZATION DATE: N/A
AMOUNT REALIZED: N/A
DATE BENEFITS REALIZED: N/A

ACTION OFFICER: Michael E. Shields, Jr., DLA-MMSLP, DSN 667-0505, 19 Dec 94
REVIEW/APPROVAL: J. S. Rountree, CAPT, USN, Deputy Executive Director, Supply Management, MMS, x70510, 17 Jan 95
COORDINATION: Eileen Sanchez, FOE, 1/18/95
A. Broadnax, DDAI, x49607, 1/18/95

DLA APPROVAL:

LAWRENCE P FARRELL, JR.
Major General USAF
Principal Deputy Director

TYPE OF REPORT: AUDIT DATE OF POSITION: 23 JAN 95

PURPOSE OF INPUT: INITIAL POSITION

AUDIT TITLE AND NO: Nonconformances of Resistors, Semiconductors, and Connectors Managed by the Defense Logistics Agency, Project No. 2PT-6018

RECOMMENDATION 2: We recommend that the Commander, Defense Logistics Agency establish procedures for selecting parts for testing that will produce statistically significant results that can be extrapolated to projectable universes of items. We also recommend that documented internal controls be established over the statistical sampling process.

DLA COMMENTS: We concur with the recommendation. A project has been intiated with the DLA Operations Reasearch Office (DORO) to develop a sampling assistance plan which meets the recommended criteria. A written internal procedure will be developed and implemented to assure the DORO developed sampling model is utilized in the development of DESC test plans.

DISPOSITION:
(x) Action is ongoing. Estimated Completion Date: 30 Jun 95
( ) Action is considered complete.

INTERNAL MANAGEMENT CONTROL WEAKNESSES:
( ) Nonconcur.
(X) Concur; however, weakness is not considered material.
( ) Concur; weakness is material and will be reported in the DLA Annual Statement of Assurance.

MONETARY BENEFITS: N/A
DLA COMMENTS: N/A
ESTIMATED REALIZATION DATE: N/A
AMOUNT REALIZED: N/A
DATE BENEFITS REALIZED: N/A

ACTION OFFICER: Michael E. Shields, Jr., DLA-MMSLP, DSN 667-0505, 19 Dec 94
REVIEW/APPROVAL: J. S. Rountree, CAPT, USN, Deputy Executive Director, Supply Management, MMS, x70510, 17 Jan 95
COORDINATION: Eileen Sanchez, FOE, 1/18/95
A. Broadnax, DDAI, x49607, 1/18/95

DLA APPROVAL:

23 JAN 1995

LAWRENCE P. FARRELL, JR.
Major General, USAF
Principal Deputy Director

TYPE OF REPORT: AUDIT DATE OF POSITION: [illegible]

PURPOSE OF INPUT: INITIAL POSITION

AUDIT TITLE AND NO: Nonconformances of Resistors, Semiconductors, and Connectors Managed by the Defense Logistics Agency, Project No. 2PT-6018

RECOMMENDATION 3: We recommend the Commander, Defense Logistics Agency establish procedures to include commercial parts in statistically significant test samples.

DLA COMMENTS: We concur with the recommendation. Independent of this report, DESC has already increased testing of commerical parts to 40% of overall testing in FY 94. The sampling assistance project currently being developed by DORO to satisfy recommendation 2 will include provisions to select and test statistically significant amounts of materiel procured to commerical standards/discriptions. A written procedure will be developed and implemented by DESC to assure the DORO sampling plan is utilized in the development of DESC test plans.

DISPOSITION:
(x) Action is ongoing. Estimated Completion Date: 30 Jun 95
( ) Action is considered complete.

INTERNAL MANAGEMENT CONTROL WEAKNESSES:
( ) Nonconcur.
(X) Concur; however, weakness is not considered material.
( ) Concur; weakness is material and will be reported in the DLA Annual Statement of Assurance.

MONETARY BENEFITS: N/A
DLA COMMENTS: N/A
ESTIMATED REALIZATION DATE: N/A
AMOUNT REALIZED: N/A
DATE BENEFITS REALIZED: N/A

ACTION OFFICER: Michael E. Shields, Jr., DLA-MMSLP, DSN 667-0505, 19 Dec 94
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COORDINATION: Eileen Sanchez, FOE, 1/18/95
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DLA APPROVAL:

24 JAN 1995

LAWRENCE P. FARRELL, JR.
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TYPE OF REPORT: AUDIT DATE OF POSITION: 25 JAN 1995

PURPOSE OF INPUT: INITIAL POSITION

AUDIT TITLE AND NO: Nonconformances of Resistors, Semiconductors, and Connectors Managed by the Defense Logistics Agency, Project No. 2PT-6018

RECOMMENDATION 4: We recommend the Commander, Defense Logistics Agency review the technical data management program for the three Federal supply classes reviewed in this assessment to determine whether the deficiencies identified are systemic.

DLA COMMENTS: The report cites (page 20), "The number of minor nonconformances illustrated problems with technical data." These minor nonconformances, by definition, did not affect the useablity of materiel which satisfied our customers requirements. However ,we do concur with the recommendation. An action team has been formed at DESC. The team is currently reviewing technical data management practices to determine the scope of the problem with minor specification ambiguities and will identify any systemic deficiencies. Any deficiencies identified will be the basis for corrective action to be developed and implemented to correct existing deficiencies and preclude recurrence.

DISPOSITION:
(x) Action is ongoing. Estimated Completion Date: 30 Jun 95
( ) Action is considered complete.

INTERNAL MANAGEMENT CONTROL WEAKNESSES: N/A
( ) Nonconcur.
(X) Concur; however, weakness is not considered material.
( ) Concur; weakness is material and will be reported in the DLA Annual Statement of Assurance.

MONETARY BENEFITS: N/A
DLA COMMENTS: N/A
ESTIMATED REALIZATION DATE: N/A
AMOUNT REALIZED: N/A
DATE BENEFITS REALIZED: N/A

ACTION OFFICER: Michael E. Shields, Jr., DLA-MMSLP, DSN 667-0505, 19 Dec 94
REVIEW/APPROVAL: J. S. Rountree, CAPT, USN, Deputy Executive Director, Supply Management, MMS, x70510, 17 Jan 95
COORDINATION: Eileen Sanchez, FOE, 1/18/95
A. Broadnax, DDAI, x49607, 1/18/95

DLA APPROVAL:

24 JAN 1995

LAWRENCE P. FARRELL, JR.
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