National Voluntary Laboratory Accreditation Program

WORKSHOP ON FASTENER TEST METHODS

PART II - APPENDICES

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NISTIR 4818

U.S. Department of Commerce
Technology Administration
National Institute of Standards and Technology

NIST

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April 1992

U.S. Department of Commerce
Barbara Hackman Franklin, Secretary

Technology Administration
Robert M. White, Under Secretary for Technology

National Institute of Standards and Technology
John W. Lyons, Director

FOREWARD

Public Law 101-592, "The Fastener Quality Act," requires the establishment of an accreditation program for laboratories that test certain fasteners. The Act provides for the use of National Institute of Standards and Technology (NIST) procedures followed by the National Voluntary Laboratory Accreditation Program (NVLAP). In accordance with procedures a notice was published in the *Federal Register* inviting interested parties to provide a list of test methods to be included in the accreditation program. A public workshop was held at NIST in Gaithersburg, MD on April 22, 1991, to discuss the test method list.

Part I of this report (NISTIR 4817) summarizes the workshop presentations and the test method categories submitted in response to the notice published in the *Federal Register*. Part II of this report (NISTIR 4818) contains the appendices: (1) the notice published in the *Federal Register*; (2) detailed presentations by NIST and response to audience questions; (3) detailed presentations by public participants and response to audience questions; (4) the text of an open discussion session which followed the formal presentations; (5) a compilation of the test method lists; and (6) a list of the workshop presenters and attendees.

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PART II

EXECUTIVE SUMMARY

The Fastener Quality Act

The President signed the Fastener Quality Act (FQA), Public Law 101-592, on November 16, 1990. The intent of the Act is to increase fastener quality and reduce the danger of fastener failure. It requires that certain fasteners sold in commerce conform to the specifications to which they are represented to be manufactured, provides for accreditation of laboratories engaged in fastener testing, and requires inspection, testing and certification in accordance with standardized methods.

The Act requires the Secretary of Commerce, acting through the Director of the National Institute of Standards and Technology (NIST), to establish a laboratory accreditation program for fastener testing laboratories under the procedures of the National Voluntary Laboratory Accreditation Program (NVLAP). Qualifying laboratories will be granted accreditation which attests to their competence to perform tests on fasteners according to designated standard test methods. Laboratories will be able to seek accreditation, based on their unique capabilities, by selecting from a predetermined and diverse list of test methods. The list of test methods will be classified by technical category. Potential categories include, but are not limited to: chemical, dimensional, mechanical, metallurgical and nondestructive testing. Specific requirements and criteria are being established for determining laboratory qualifications for accreditation following prescribed NVLAP procedures. Criteria address quality systems, staff, facilities and equipment, calibrations, test methods and procedures, manuals, records, and test reports.

The Workshop

A notice was published in the *Federal Register* (Appendix A) March 22, 1991, announcing an April 22, 1991 workshop at NIST to provide interested parties an opportunity to discuss fastener specifications and to participate in the selection of test methods to be included in the accreditation program. Presentations at the workshop and test method lists submitted in response to the *Federal Register* notice contributed to a successful workshop. Many interested groups (both public and private) were involved, including manufacturers, standards organizations, instrument manufacturers, distributors and importers. The presentations and summary statistics for the lists are included in this report. The workshop presentations and lists of test methods will be used in determining an initial list of test methods that will be offered for accreditation. The NVLAP procedures provide for adding test methods to the list as may be found necessary.

In addition to the NIST representatives, ten speakers made presentations to the workshop attendees. A list of the registered attendees is provided as Appendix F.

Conclusions

1. The workshop presentations, discussion and test method lists submitted provided a valuable source of information to accomplish the purpose of the workshop - establishing a list of test

methods to be offered for accreditation. This information will be used to develop the accreditation program for each category of fastener testing. The categories of fastener testing will include mechanical and physical, chemical analysis, dimensional inspection, metallographic analysis, and nondestructive inspection.

2. Other topics, not related to the development of a test method list, were addressed by the participants to the workshop. This information will be taken into account as the laboratory accreditation program is developed and as the implementing regulations go through the shaping process.

Future Actions

1. Critical elements, which will be used to evaluate the competency of fastener testing laboratories, will be developed by NVLAP in each category of testing or inspection. Critical elements will be derived through a detailed evaluation of the needs prescribed by a test method.

2. Proficiency testing in each category of inspection or testing will also be addressed by NVLAP. Proficiency testing will provide a mechanism for comparison of interlaboratory test data.

3. Proficiency testing requirements and critical elements will be incorporated with other accreditation requirements into the NVLAP Fastener Handbook and assessor checklists.

4. A second workshop will be held to discuss the contents of the Fastener Handbook. The Handbook will describe all the laboratory accreditation requirements.

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Laboratories which apply for accreditation must pay all necessary fees and meet all program requirements prior to initial accreditation. The accreditation will be issued for a one year period, renewable annually. The on-site assessment will be performed biennially. Proficiency testing will be conducted annually.

Dated: March 19, 1991.

John W. Lyons,

Director.

[FR Doc. 91-6902 Filed 3-21-91; 8:45 am]

BILLING CODE 3510-13-M

National Institute of Standards and Technology

National Voluntary Laboratory Accreditation Program (NVLAP)

AGENCY: National Institute of Standards and Technology, Department of Commerce.

ACTION: Notice of public workshop.

SUMMARY: The National Institute of Standards and Technology (NIST) will host a public workshop on April 22, 1991, to provide interested parties with the opportunity to participate in a discussion of test methods and related specifications (consensus standards) to be used in an accreditation program for laboratories engaged in the testing of fasteners covered by the Fastener Quality Act of 1990 (Public Law 101-592).

DATES: The workshop will be held on April 22, 1991 from 9 a.m. to 4 p.m. Those who wish to contribute lists of specific test methods and related technical information for discussion at the meeting are asked to submit their material in writing on or before April 15, 1991 to Nancy M. Trahey, Chief, Laboratory Accreditation Program, National Institute of Standards and Technology, Building 411, room A124, Gaithersburg, MD 20899, (301) 975-4016, FX (301) 975-3839.

PLACE: The workshop will be held at the National Institute of Standards and Technology, Green Auditorium (seating capacity—300 persons), Gaithersburg, Maryland.

SUPPLEMENTARY INFORMATION: The Fastener Quality Act of 1990 (Pub. L. 101-592) requires that certain fasteners sold in commerce conform to the specifications to which they are represented to be manufactured, to provide for accreditation of laboratories engaged in fastener testing, to require inspection, testing and certification, in accordance with standardized methods, of fasteners used in critical applications to increase fastener quality and reduce the danger of fastener failure, and other purposes. In the Act, a fasteners is defined in section 3(5) as: (A) A—(i) Screw, nut, bolt or stud having internal or external threads, or (ii) a load indicating washer, with a nominal diameter of 5 millimeters or greater, in the case of such items described in metric terms, or ¼ inch or greater, in the case of such items described in terms of the English system of measurement, which contains any quantity of metal and is held out as meeting a standard or specification which requires through-hardening, (B) a screw, nut, bolt or stud having internal or external threads which bears a grade identification marking required by a standard or specification, (C) a washer to the extent that it is subject to a standard or specification applicable to a screw, nut, bolt, or stud described in subparagraph (B), or (D) any item within a category added by the Secretary (of Commerce) in accordance with section 4(b), except that such item does not include any screw, nut, bolt or stud that is produced and marked as ASTM A 307 Grade A.

Section 6 of the Act requires the Secretary of Commerce acting through the Director of NIST to establish a laboratory accreditation program for fastener testing laboratories under the procedures of the National Voluntary Laboratory Accreditation Program (NVLAP) (15 CFR part 7). To become accredited, a laboratory must submit an application, pay the required fees (to be determined) and demonstrate competence to perform specific tests in accordance with NVLAP criteria. Determination of competence includes review of quality systems, onsite laboratory assessments, and proficiency testing.

Scope of fastener testing—The accreditation program will include test methods which are required by fastener specifications or standards covered by the Act. Since fastener testing involves a wide range of expertise, several subfields of accreditation will be offered. Potential subfields include but are not limited to: chemical, dimensional, mechanical and metallurgical testing.

The following plans for the worship have been established:

1. *Purpose.* The workshop will provide all interested persons with the opportunity to discuss fastener specification and to participate in the development of a test method list for use in establishing some of the technical criteria for evaluation and accreditation of laboratories. Persons wishing to provide lists of test methods and related specifications they currently use, are asked to submit them to NVLAP in writing by the date indicated. All respondents to this notice will be placed on a mailing list.

2. *Procedure.* The workship will be an informal meeting. The presiding NIST chairperson will allocate time for persons wishing to make presentations and for discussion of each issue to be addressed, and exercise such authority as may be necessary to insure the equitable and efficient conduct of the workshop and to proceed in an orderly manner.

3. *Provisions.* This workshp will be open to the public. However, to guarantee space at the workshop and to make arrangements for entrance into the NIST facility, persons making presentations or observing the proceedings, should write to the above address. Please include name, address, telephone and FAX numbers, organizational affiliation(s) and intent to make a presentation. Requests involving a presentation, should be received by NVLAP no later than April 8, 1991; requests to observe should be received no later than April 15.

Documents in the Public Record

A summary record of the meeting will be prepared and made available for inspection and copying in the NVLAP program office, Building 411, room A124, Gaithersburg, Maryland.

Dated: March 18, 1991.

John W. Lyons,

Director.

[FR Doc. 91-6877 Filed 3-21-91; 8:45 am]

BILLING CODE 3510-13-M

National Oceanic and Atmospheric Administration

Proposed Boundary Expansion for the Great Bay (New Hampshire) National Estuarine Research Reserve

AGENCY: Sanctuaries and Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

ACTION: Notice with request for comments.

SUMMARY: Notice is hereby given that the Sanctuaries and Reserves Division, Office of Ocean and Coastal Resource Management (OCRM), National Ocean Service (NOS), National Oceanic and Atmospheric Admiistration (NOAA), U.S. Department of Commerce is considering the State of New Hampshire's request to expand the

APPENDIX B - PRESENTATIONS (NIST)

B.1. Development of a Fastener Laboratory Accreditation Program - S. Wayne Stiefel, Program Manager, National Voluntary Laboratory Accreditation Program (NVLAP)

Mr. Stiefel explained that the purpose of the workshop was to provide an opportunity for public participation in the development of a fastener test method list. The test method list will: define the scope of accreditation for fastener testing laboratories and serve as the basis to develop the technical criteria for evaluation and accreditation of laboratories. The process of developing the Laboratory Accreditation Program involves seeking advice from knowledgeable sources through public workshops, and technical experts from industry, government, academia, professional/technical standards organizations and our NIST technical units.

The Fastener Quality Act requires that manufacturers of fasteners certify that their fasteners conform with the requirements of the fastener specifications and have undergone inspection and testing by accredited laboratories. Section Six of the Act requires the Secretary of Commerce, acting through the Director of NIST, to establish the fastener laboratory accreditation program using the procedures of the National Voluntary Laboratory Accreditation Program (NVLAP).

NVLAP, established in 1976, has a history of developing programs and accrediting laboratories. The program currently accredits laboratories in ten major areas of testing and has accredited approximately twelve-hundred laboratories; fastener testing will be added. NVLAP offers accreditation for specific test methods and develops the evaluation criteria for assessing the competency of a laboratory. In its application a laboratory selects its unique scope of accreditation. When accreditation is granted, the scope of accreditation lists the test methods that they have demonstrated competency to perform. The goal is to accredit all competent laboratories, capable of producing equivalent testing results. Given the importance of this program and the regulatory aspects, consistency of test results is a key measure of success.

Mr. Stiefel described the main steps involved in establishing a laboratory accreditation program. An initial step involves defining the test methods to be included. Additional steps include:

> <u>Determining the units of accreditation.</u> This organizational function helps us administer the program efficiently. Based on an analysis of the test methods on the list, we determine whether test methods should be offered individually, or whether similar methods should be grouped into units of accreditation. Conversely, should a specific standard that has many different test methods within it be offered as a single test method or should it be broken up?
>
> <u>Defining the critical elements that will be used to assess a laboratory's competency.</u> Critical elements are derived through a detailed evaluation of the demands of a test method. The critical elements together with the NVLAP accreditation criteria are used to evaluate a laboratory's system to determine if the necessary and appropriate: quality systems, documentation and record keeping, staff competence and training, facilities and equipment, calibration traceability, test method procedures, and test reports are in place for fastener testing. We focus on these areas in developing our program and a laboratory should review them in preparing for accreditation.

Developing assessment techniques for use during on-site assessments. Checklists are derived from analysis of the test methods to aid assessors and ensure uniformity amoung assessors. Assessors have to address themselves to the importance of the particular set of tests that are being conducted and set priorities. While an assessor may emphasize a particular area, the checklists ensure that the assessment does not neglect any important aspects of the laboratory's operations. Another important consideration is the approach used during demonstrations in the laboratory. Should fasteners be provided to assessors for on-site demonstrations?

Developing the proficiency testing scheme. A key element of the NVLAP accreditation program is proficiency testing, a means of inter-laboratory comparison. Each laboratory learns how well it is doing relative to the group of accredited laboratories testing fasteners. This also provides feedback concerning the test method itself. Essential information on test methods can be provided to the standard developers through the results produced by the population of laboratories testing with a well characterized object.

Seeking technical experts to be NVLAP assessors. NVLAP has a relatively small staff to manage its various programs. We contract for assessors to perform on-site assessments. Part of this process is establishing the credentials and the criteria used to evaluate the candidates. Our objective is to strengthen the measurement capabilities of laboratories. If deficiencies are found, assessors may make recommendations improvements needed to meet our criteria. So, the people involved are very important. They need a strong background in the technical area, in laboratory management, and must be able to communicate. Finally, we need to find and nominate individuals who meet our criteria and choose the designated NVLAP assessors.

Producing the Fastener Laboratory Accreditation Program (LAP) Handbook. The handbook pulls together the various development tasks and provides the conditions and the technical criteria that will be used to assess the competency of a fastener testing laboratory. The Fastener LAP Handbook will be made available to applicant laboratories to help in their preparation for accreditation.

Mr. Stiefel stated that the Fastener Quality Act has specific requirements with significant impact on fastener testing laboratories. Among them are the maintenance of records for at least ten years, specific information required for the test report - including a statement as to whether, based upon the representative sample of fasteners tested, the lot of fasteners conforms to the relevant specifications. This requires the laboratory to be knowledgeable about the specification's testing and sampling requirements as well as specific knowledge about the fastener lot. A laboratory needs to know, based upon the lot size, the number of samples to be tested for each type of test or inspection required by the specification. Without such knowledge it is not possible to confirm that the lot meets the specification requirements.

Describing an operational program, Mr. Stiefel stated that an applicant laboratory's competence to perform fastener testing will be assessed based upon their conformance to specific accreditation criteria, determined by: review of their quality documentation, on-site assessment, proficiency testing results and a technical evaluation. An assessment/evaluation panel will be convened to perform a technical evaluation and to make a recommendation on accreditation, which takes into account all the information collected, including the laboratory's response to resolve any deficiencies.

After the initial on-site assessment a laboratory can be expected to be re-assessed on a two-year cycle. Before an assessor(s) visits the laboratory, he will have seen the quality manual, been informed on the scope of testing and may have seen proficiency test results. If this visit is a re-assessment, he will know something about the history of the laboratory. Upon arrival, the assessor(s) will meet with the management and the supervisory staff to set the assessment agenda. The assessor will lay out what needs to be accomplished, will ask for demonstrations, and will talk with technicians to see that they are in fact following the laboratory's procedures. Various records will be examined to verify that the quality systems described in the quality assurance manual are in place. At the exit briefing, the laboratory manager will be provided written documentation of the results of the on-site, including any deficiencies requiring resolution.

Accreditation is granted following successful completion of a process which includes review of quality documentation, an on-site assessment, resolution of deficiencies identified during the on-site assessment, participation in proficiency testing, technical evaluation and administrative review. The accreditation is formalized through issuance of a Certificate of Accreditation, Scope of Accreditation and publicized by the NVLAP directory and announcement in the other government media. At NVLAP's option, an accredited laboratory may be suspended until deficiencies are corrected if they have a temporary problem. Revocation is also possible for very serious problems. Any adverse action may be appealed. Voluntary termination is an option for any laboratory choosing not to continue its accreditation.

B.2. Development of Technical Criteria for Laboratory Accreditation - Samuel R. Low, Mechanical Engineer, Metallurgy Division, NIST

Mr. Low described his support for the NVLAP program by providing technical input and by developing the assessment tools (critical elements and checklists) used by the technical experts conducting on-site assessment and evaluation of fastener testing laboratories. Initially, the fields of fastener testing have been categorized as mechanical and physical, chemical analysis, dimensional inspection, metallographic analysis, nondestructive inspection, and others.

The initial development involves the determination of which test methods to offer. Since the Act requires testing in accordance with the requirements of fastener specifications, he noted the definitions in section 3 of the Fastener Quality Act.

> standards and specifications means the provisions of a document published by a consensus standards organization, a governmental agency, or a major end-user of fasteners which defines or describes dimensional characteristics, limits of size, acceptable materials, processing, functional behavior, plating, baking, inspection, testing,packaging, and required markings of any fastener;....
>
> consensus standards organization means the American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), Society of Automotive Engineers (SAE), or any other standard-setting organization determined by the Secretary (of Commerce) to have comparable knowledge, expertise, and concern for health and safety in the field for which such organization purports to set standards.

Mr. Low provided an initial list of the publishers of fastener standards and specifications and asked the audience for advice on adding or deleting organizations from this list. The initial list included the: Aerospace Industries Association, American National Standards Institute, American Society of Mechanical Engineers, American Society for Testing and Materials, Industrial Fastener Institute, International Organization for Standardization, Society of Automotive Engineers, Federal Specifications and Standards, and Military Specifications and Standards.

In looking at fastener related documents, Mr. Low has found three classifications: fastener specifications which set the requirements for fasteners, fastener test method standards which give a description of procedures for testing fasteners, and other test method standards which give procedures for testing but not specifically for fasteners. To determine how a fastener is tested requires starting with the fastener specification and tracking references to and between the other classifications.

Mr. Low described several approaches for establishing the units of accreditation: (1) by fastener specification, (2) by fastener test method standard as described by a specific organization, and (3) by a type of fastener test method including all organizations with similar procedures and requirements. For example, grouping of test methods for testing the wedge tensile strength of full-size externally threaded fasteners could include the following test method designations: ASTM A 370-90, ASTM F 606-86, ASTM F606M-87, DOD-STD-1312-108, FED Test Method STD No151b, ISO 898-1, MIL-STD-1312-8A, SAE J429, SAE J1216.

Mr. Low explained that the critical elements of a test method are those requirements and procedures which are essential for testing the fastener including: test equipment, fixtures, instruments, calibrations, reference standards, personnel training, etc. He provided an example for proof load testing of full-size externally threaded fasteners (length measurement method):

1. testing machine - crosshead speed and load measuring device verification interval
2. gripping fixtures
3. fastener length measuring instrument - accuracy and verification interval
4. time period held at proof load

Mr. Low mentioned that in addition to the critical elements derived from the test method documentation, NVLAP asks that the technical evaluation take into account special considerations or "engineering judgement." Experience in the conduct of testing indicates that recommendations in the test method are often not explicit for enhancing the quality and consistency in measurement results. Passing on this information to the assessors, and through them to the laboratories, will improve laboratory performance.

Mr. Low also described the need to use these technical evaluations of the test methods to structure the Fastener Laboratory Accreditation Handbook and the checklists. The Handbook will be used by assessors and laboratories alike to prepare for assessment and the checklists will be used by the assessors during on-site inspections.

Finally, Mr. Low described the design of proficiency testing which will require selecting test methods, and fastener types, grade and sizes; determining the number of samples; evaluating the need for observation by assessors, and establishing a schedule for testing.

Questions and Answers, and Comments

Q: How far is NIST from developing a national standard for hardness.

A: Mr. Low - I can't answer that. That is related to fasteners and there is an on going process now to develop this hardness standard. There has been a lot going on. There is a process now looking into having a standard hardness tester developed, built and installed at NIST. But, as to a time schedule, I don't know for sure. Actually, the NIST person responsible is Dr. John Smith of the Metallurgy Division.

B.3. Remarks of the Deputy Chief Counsel for NIST - Michael R. Rubin

Mr. Rubin commented that he has been participating in the process of drafting the regulations that will implement the Fastener Quality Act. He emphasized that the Department of Commerce has a very strong team effort to draft these regulations.

During remarks on the civil and criminal penalty provisions, Mr. Rubin pointed out that the statute contains a variety of criminal and civil penalties. For this workshop he focused on the implications of the law in terms of the accreditation programs in NVLAP and also in the program that NIST will undertake to approve other accreditation programs to accredit laboratories. Mr. Rubin warned both laboratories and accreditors to be very cautious about how they hold themselves out to the public. Based on the language in the law and the regulations being drafted, a laboratory which holds itself out as accredited to test fasteners under the Act would be committing a criminal act if it has not been accredited through one of the procedures in the regulations. Since the regulations will not be final for many months, no laboratories now fit that category. Similarly, any accreditation body that holds itself out as approved to accredit individual laboratories under the Fastener Quality Act would also be in violation of the Act until such time as that entity has been approved under the regulations. This is a key point as we proceed together over the coming months to write the final regulations needed to implement this statute. We all need to be very careful about what we do and do not represent to the public in our various communications. That's really the message I want to convey to you. There are criminal and civil sanctions for misrepresentation of your status under the Fastener Quality Act. Specifically, there are civil and criminal sanctions for representing yourself to the public as being approved under the Act if you are not. So please be very careful in all your public utterances. We don't want to have any criminal or civil violations of this Act. We don't want them, you don't want them. I'll be happy to answer any questions you may have on that point.

Questions and Answers and Comments

Q: Just a more general question, do you know what the status of the regulations is now?

A: All too painfully and in much too much detail. The regulations (and this is going to be useless trivia for you) - at the moment the regulations run eighty-six single space pages in draft. They are currently undergoing review within the Department of Commerce. I expect many changes to be made to them. When that review process is completed we will seek clearance from the Office of Management and Budget to publish them under their regulatory authority. And as soon as we have that clearance and hopefully on or about the statutory date of May 15th we hope they will appear in the *Federal Register* for public comment.

Q: Could you tell me just within, so around May 15th is when you're expecting the draft regulations?

A: Plus or minus 6 months in either direction.

Q: It can't be in the other direction.

A: Well no, I don't think it can be. It's a little hard for me to guess exactly when they will come out. We are still striving very hard for a May 15th date. I will not be prepared to admit that we will not make it for quite a length of time or right up until we do miss it if we do. We are going to be doing everything we can to get it out by May 15th.

Q: Could you also tell me who within Commerce is involved at looking it, what different offices?

A: Yes, not unpredictably on a regulation of this size, first of all as you know now there will be regulatory implications for the NVLAP program and that office is going to be involved. There are implications for other parts of NIST as well on the problem of accrediting accreditors and recognizing accreditors who operate from foreign governments. Within the Patent and Trademark Office, Lynn Beresford has been working very hard on the insignia marking provision.

Q: Was that Lynn Beresford, what was his name?

A: Her name. Lynn Beresford and we have their section in. The General Counsel's Office has been working very hard to put together a set of procedures on enforcement of the law - investigatory activities, prosecutorial activities, appellate procedures. Those are primarily on civil penalties. Our game plan on criminal matters would be to make referrals to the Department of Justice. So all of those different parts in the Department of Commerce have been working very closely together to try to put this thing together. Extremely complex, but I believe we are doing a good job.

C: Thank you.

C: Good.

Q: Do you perceive any problem at all in a laboratory accredited by A2LA as representing itself to test fasteners under A2LA accreditation?

A: As long as they are representing that they are testing fasteners under A2LA accreditation that's fine. If the representation is made now that somehow qualifies them to accredit fasteners under the Fastener Quality Act, I believe that would be an inappropriate representation, because (I believe) I know it not to be true. We will not be in a position to accredit laboratories, or approve accrediting entities until the regulations become final. Once the regulations are actually published there will be a seventy-five day comment period. There will be a lengthy process of analysis of the comments afterwards. And sometime, I would guess in the fall, the regulations will become final. Until the regulation becomes final and until appropriate actions are taken under that regulation, no entity can represent lawfully to the public that it has the authority to accredit laboratories under the Act. Or that it is itself an accredited laboratory under the Act. Is that a clear statement? Do you understand what I am saying? It is a crucial point and that is really why I am here today. We don't need any problems. We want to make sure that the semantic discourse that goes on here keeps that in mind that people are alerted to the problem and that everyone is careful. Does anyone have anymore questions about it?

Q: One more question. Is the civil investigation done by the Commerce Department?

A: Yes they will. That is in the draft regulation, I think they will. We'll be providing that. I do want to make sure that everyone is clear about my message this morning because I think it is a really important message. I want to just make sure that everyone understands the orderly process that we all have to go through to get this Act implemented. In the course of time laboratories will be accredited, accreditors will be approved to accredit other laboratories, but it will all have to be done under the Act and under the regulations and in an orderly process. Thank you very much.

APPENDIX C - PRESENTATIONS (PUBLIC PARTICIPANTS)

Including Responses to Audience Questions

C.1. Harry S. Brenner, Chairman ASTM F-16 Fastener Committee and President, Almay Research and Testing Corporation, Los Angeles, CA

Mr. Brenner stated that the Fastener Quality Act represents landmark legislation in providing consumer protection by assuring that critical fasteners in fact conform to established requirements. Especially for industrial and commercial fasteners, conformance testing is now federally mandated under this legislation.

In undertaking the required tests, several significant factors should be considered. A test - or test method - should be discriminating enough to accept good parts and to reject bad or sub-standard parts. The test method should leave no ambiguity, since "how" a test is conducted can often affect the results of the test.

Several major efforts have been pursued to develop standards and methods of testing fasteners in a uniform manner. ASTM Committee F-16 has developed and issued Specifications F606 and F606M, which define techniques and requirements for testing of threaded fasteners, washers, and rivets covered by ASTM Specifications included in ASTM Volume 15.08. Separately, the Department of Defense has developed and issued MIL-STD-1312, which covers over 30 test methods applicable to Military fasteners.

The fact that these two test method standards are in place and have been widely and successfully used by the Government and Industry warrants their consideration as the basis for testing procedures under the provisions of Public Law 101-592. Accordingly, Mr. Brenner recommended that they both be accepted and used, as applicable, for the testing and evaluation of critical fasteners.

Questions & Answers, and Comments

Q: Mike Williams - Rolls Royce, U.K. - Your last words indicated that critical fasteners . What we need to know desperately in Europe is precisely how the term "critical fasteners" will be really applied. Will it be applied to the specification for the fastener or by the contract from the purchaser, because everything that everybody is doing about this Act hinges on that one basic point.

A: Harry Brenner - I don't know if anybody really has an answer to that as of this moment. One of the aspects of the terminology of the law was the reference to "critical fastener" and from what I understand I believe both NIST and the technical advisory committee will amplify further on the definition for "critical". I have used that reference to "critical fastener" because it came out of the public law. I think the definitions will be established by the advisory committee and probably published in the *Federal Register* as a basis for requirement. As you know, most military specifications do have requirements for testing whether they are a quarter inch or below or five millimeters or below or larger. Most of the specifications have test methods in them right now; very often though the industrial and commercial specifications have often referenced the requirements for testing as an agreement between the purchaser and the seller and sometimes these things have been overlooked. Testing has not always been accomplished. I have my own personal feelings on what a "critical fastener" is irrespective of size. It can be smaller than a quarter inch if it is used in what might be called a very sensitive or critical structural area. But I would refrain personally from defining a "critical fastener" at this stage until a decision was made by the Committee.

Q: Harry Brenner - Do you have anything to add to that Wayne?

A: Wayne Stiefel, NIST - (Mr. Stiefel used a view graph which paraphrased the definition of fastener in Section 3 of the Act) The definitions in the law, and this is not verbatim out of the definitions of the law, this is just a summary statement of it, but the definitions of the law do speak to "critical" but only when you add or delete items. There is a definition in the law concerning which items are included and it has to do with specifications that the fasteners are manufactured to. For example, an alloy steel,through hardened fastener greater than a quarter of an inch, or greater than five millimeters if it is metric is included. Also fasteners which bear a grade identification marking, because the specification requires it to do so, are included regardless of what size. So to that extent there is some clarity. Now there is also a provision that the Secretary of Commerce may add items, and that is where the question of "critical" really comes in and that is something that, as Harry said, the advisory committee and the Secretary will have to make some decisions about.

C: That is really no answer to the questions I have put.

A: I guess I did not understand the question. But as I said in terms of defining "critical" that will be done by the advisory committee and others.

Q: Would not that have to do with its application? What determines critical or not?

A: The problem with that is that when you sell a fastener you don't know necessarily what the application is going to be.

C: Al Herskovitz, Army AMC Command - I guess what Mike was alluding to was the fact where you have a military Designation as a "safety critical" part where there is specific definition of a "safety critical" part or a "safety thread critical part. And this would be identified by the National Stock in itself. Where you may have the same part not being designated as a safety critical part based on your application.

C.2. Steve Hengeli, Steve Hengeli & Associates, Lake Worth, FL

Mr. Hengeli noted that, after many years of consternation and deliberation the 101st Congress has enacted the subject law. Mr. Hengeli stated his belief in the law, as well as the need for the law, and stated that non-conforming and missapplication of fasteners are a real threat to our safety.

According to his reading of the law, it clearly intends to control the manufacture and sale of mis-identified fasteners, and the elimination of downright bogus and counterfeit product by accreditation of testing laboratories, whether they be captive or commercially operated organizations. Commenting on the prospects, he stated that the effort will result in some success. Postulating that maybe in a year or two a grade 8 fastener will truly meet the requirements as identified by the Society of Automotive Engineers, and A490 bolts will hold the building or bridge in place as is specified by ASTM.

Mr. Hengeli related his experiences at Jet Avion Corporation. As a commercial heat treater, they follow the manufacturing customers purchase order requirements. The customer is relied upon to apply the correct and proper documentation to the order. Jet Avion also has a contract through McDonnell Douglas Space System Company to test fasteners for NASA. In this capacity flight hardware used in the space shuttle payload are retested to verify that test results are within specification. At random, one hardness test, tensile test, micro examination and chemical analysis are performed. Of nearly 200 lots tested, two percent were found to be non-conforming. Results are submitted to NASA for action.

In the first instance, heat-treating customer parts, Mr. Hengeli pointed out that they can only hope that the manufacturer has properly addressed all quality considerations. In his opinion, the law falls short since it does not address responsibility as it pertains to suppliers of special services subcontracted work; such as heat treating and plating. After these services the lot will have to be tested or retested, but this only applies to someone that is having this service performed for resale. Controls are not provided should a manufacture decide to alter product he is assembling for his own applications and resale.

Mr. Hengeli offered an example of a quality complaint by an engine manufacturer. Connecting rod bolts were failing in torque during assembly. After review, it was determined they had received a lot of annealed bolts. The engine manufacturer decided to resolve the problem by dumping the hopper of bolts, which now contained thousands of bolts from two other vendors, and re-heat-treat all of them. If a problem with the engines would have occurred, the integrity of all fasteners would have been usurped by that action.

In another example, Hengeli reported on FAA repair stations that in the course of overhauling aircraft components, remove the fasteners and place them in containers. When the containers are filled, they are replated, sorted by part size, then reassembled into the repaired or overhauled unit. He stated his belief that this practice may extend to the major airlines. If this type of operation is practiced and is permitted to continue, it will render null and void certification and lot control by fastener manufacturers.

Mr. Hengeli recommended that the law be extended to cover users of fasteners such as: manufacturers, building contractors, repair stations, and overhaul shops, as well as auto repair shops. He suggested that they should be required to pass the laboratory accreditation requirements for documentation, lot control, and traceability of fasteners, to preclude loss during use and assembly. He further recommended, that all commercial heat treaters and platers be required to have a quality system that, as a minimum, would prevent their becoming inadvert conduits for the misuse of fasteners.

Questions & Answers, and Comments

Q: You mentioned hardness, tensile, micro examination and chemistry, do feel those four parameters are sufficient to meet the requirements of the law?

A: No.

Q: What else?

A: Whatever the specification requires.

Q: I'm talking about the public law.

A: Right.

Q: If we are we covered enough to-

A: No. Not intended to. What I was talking about is a recertification of a certified fastener. I am not certifying that fastener. I am just making sure that somebody did not make a total mistake. And as I mentioned, two percent of the time they have. They have not submitted parts to the specification and to their own certification. The documentation doesn't meet the parts.

C.3. John W. Locke, President, American Association For Laboratory Accreditation, Gaithersburg, MD

Mr. Locke reviewed pertinent requirements in the Fastener Quality Act, stating that, according to the Act, no fastener can be offered for sale unless it is part of a lot which conforms to standards and specifications to which a manufacturer represents it has been manufactured and is inspected, tested and <u>certified</u> as required by this Act. The size, selection and integrity of the sample to be inspected and tested is governed by existing standards or, in their absence, sampling procedures determined by NIST.

Mr. Locke explained that the American Association for Laboratory Accreditation (A2LA) has been in existence since 1978 and is a nonprofit professional membership society. Currently, 284 laboratories are accredited including 52 fastener testing laboratories. The fastener testing accreditation program began about two years ago with encouragement from the Defense Industrial Supply Center.

The general requirements for accreditation are based upon ISO Guide 25, with additional specific requirements, similar to those of NVLAP. The general requirements were developed through the International Laboratory Accreditation Conference. The fastener program includes over 100 tests and types of tests. Laboratories are not accredited for fastener testing alone; rather, accreditation are granted for mechanical testing or chemical testing, and fastener testing is included within that scope. See attached list of tests and types of tests.

Laboratories choose tests they can perform and tests required by specifications to which a manufacturer represents the fastener has been manufactured. Tests not on the list may be added to a laboratories scope. This is important because a manufacturer may identify tests required by various standards - such as DIN or JIS -which are not on the list.

Mr. Locke recommended the newly revised ISO Guide 25-1990 for use by NVLAP in revising its procedures. Specific recommendations by Mr. Locke included expansion on: measurement traceability and calibration, handling of test items, subcontracting, outside support services and supplies and complaints. A2LA has adopted ISO Guide 25-1990 for implementation by its accredited laboratories by the end of 1991. Mr. Locke stated that A2LA does not claim recognition for the purposes of the Act, however, A2LA does intend to apply for recognition from NIST after the procedures are published.

Mr. Locke mentioned that A2LA has eight trained assessors. The A2LA technical committee recommended that the following standards be written into the accreditation criteria requirements: ASTM A880-88 *Practice for Criteria for Use in Evaluation of Testing Laboratories and Organizations for the Examination and Inspection of Steel, Stainless Steel, and Related Alloys*, ASTM E743-80 (85) *Guide for Spectrochemical Laboratory Quality Assurance*, ASTM E807-81 (86) *Practice for Metallographic*

Laboratory Evaluation, ASTM E851-81 (85) *Practice for Evaluation of Spectrochemical Laboratories.*

In terms of proficiency testing, A2LA has been working with Collaborative Testing Services and has encouraged their program. The first test for fasteners was conducted last fall.

Questions and Answers, and Comments

Q: Al Herskovitz, Army AMC Command - There is much emphasis on the test laboratory control and inspection and the finished product. What I feel needs to be addressed is a need for assessing the statistical techniques for the inspection of fasteners in the manufacturing and process mode. I feel that there is a lack of understanding of the inspection of the manufacturing lot as opposed to the inspected lot of the finished product. Do you recognize that also?

A: Well, I think this was the issue that was deliberated when the act was passed and the act came out as it came out. Which is addressing itself to testing laboratories. The issue you are referring to speaks to sampling I believe and that's why I think sampling is just very critical to this whole process.

Q: The statistical techniques and the criteria used to inspect the product, that is being processed or manufactured, rather than at the end-product sampling of the item.

A: Oh, you are talking about the internal quality control of the manufacturing process.

Q: As opposed to the importance of a test laboratory getting an inspection of a finished product.

A: Sure. That certainly was not included as part premise of the law. There are some programs as you well know that deal with that. That may in fact be a better way of evaluating the quality of a manufactured product. And we could talk about all kinds of other standards including ISO-9000 and all kinds of quality systems registration requirements and processes and some statistical measurement control processes. I don't think that can be addressed in the restrictions defined by the law.

C: Wayne Stiefel, NIST - The issue of sampling (lot by lot sampling) is something that we have to concern ourselves with. It's really not going to be part of this discussion in the workshop we're having today. But it's an issue that we are looking at and we have statistical engineering at NIST looking at the process of sampling. The law addresses itself to lot by lot inspection and says to use the specification or standard's sampling plan if it exists. If they don't then it's up to the Secretary to provide one. But that's an issue that we're looking at in terms of how we would provide something if there were an absence of a sampling plan to be used.

C: John Locke, A2LA - That is a standard, right, not a test method. (Sampling plan?)

C: Wayne Stiefel, NIST - If there is one then it is used. That is what the law says. Are there anymore questions for John Locke?

American Association For Laboratory Accreditation

FIELDS OF TESTING AND TEST METHODS REFERENCED
IN THE
A2LA FASTENER QUALITY TESTING REQUIREMENTS

The program focusses on the following types of tests and standards:

MECHANICAL FIELD: Mechanical/Physical Testing

Test	Equipment	Standards/ Specifications
Hardness	Rockwell Tester	ASTM E18 MIL-STD-1312-6
Micro Hardness	Microhardness Tester Prep. Equipment	ASTM E92 ASTM E384 MIL-STD-1312-6
Tensile and Proof	Tensile Tester	ASTM F606 SAE J429 SAE J995 MIL-STD-1312-8
Discontinuities	Macro-etch Microscope Magnetic Particle Liquid Penetrant	ASTM F788 ASTM F812 ASTM E709 ASTM E165 ASTM E340 SAE J122 SAE J123 MIL-STD-1949 MIL-STD-6866
Stress Durability (Hydrogen Embrittlement)	Torque Wrenches Test Plates Test Washers	MIL-STD-1312-5 ASTM F606
Decarburization	Macro-etch	SAE J419
Shear	Tensile Tester Universal Tester Hydraulic Press	ASTM F606 MIL-STD-1312-13 MIL-STD-1312-28 MIL-STD-1312-20
Impact	Impact Tester	ASTM A540 ASTM A370
Permeability	MU Gage	MIL-STD-17214 ASTM A342
Torsional Strength	Torque Wrench Torque Fixture	ASME B18.6.4 ASTM F738
Hex Socket Strength	Torque Wrench Fixture	ASTM F880 ASTM F912
Recess Torsional Strength	Torque Wrench Fixture	MIL-B-87114 MIL-STD-1312-25
Ductility	Ductility Block	SAE J78 SAE J81 IFI 112 IFI 113
Salt Spray	Salt Spray Cabinet	ASTM B117 MIL-STD-1312-1

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Test	Equipment	Specification
Plating Thickness	Various Microscopes	MIL-STD-1312-12
		ASTM B487
	Magnetic Tester	ASTM B499
	Coulometric Tester	ASTM B504
	X-Ray	ASTM B568
Case Depth	Macro-etch	SAE J423
	Microhardnessy	
Torque Tension	Torque Wrenches	SAE J174
	Load Cells	IFI 101
		MIL-STD-1312-15
Tensile (elevated temp)	Tensile Tester w/furnace	MIL-STD-1312-18
Double Shear (elevated temp)	Tensile Tester or Hydraulic Press w/ furnace	MIL-STD-1312-28
Humidity	Humidity Cabinet	MIL-STD-1312-3
Vibration	Vibration Tester	MIL-STD-1312-7
Fatigue	Fatigue Tester	MIL-STD-1312-11
Drill Drive Testing	Drill-Drive Tester	SAE J78
		IFI 113
Metallographic Analysis:		
Preparation		ASTM E3
Grain Size		ASTM E112
Banding/orientation of microstructures		ASTM E1268
Depth of Decarburization		ASTM E1077
Plating Adhesion		ASTM B571
Panel Fastener Tests		
Push-out		MIL-STD-1312-22
Tensile		MIL-STD-1312-23
Torque-out		MIL-STD-1312-24
Shear		MIL-STD-1312-26
Pull-up		MIL-STD-1312-27
Fastener Sealing		MIL-STD-1312-19
Stress Relaxation		MIL-STD-1312-17
Stress Corrosion		MIL-STD-1312-9
Blind Rivet Tests		SAE J1200
		IFI 114
		IFI 116
		IFI 117
		IFI 119

MECHANICAL FIELD: Dimensional Inspections

Feature	Equipment	Standards/ Specifications
Threads	Indicating Type	ASME B1.3M-1988
		FED-STD-H28/20A
		MIL-S-7742B
		MIL-S-8879A
Linear Measurements	Gage Blocks	MIL-STD-120
	Outside Micrometers	
	Inside Micrometers	
	Calipers	
	Plug Gages	

Test	Equipment	Specification
Angle and Radii	Optical Comparators	MIL-STD-120
Recesses	Recess Penetration	ASME B18.6.4
	Recess Wobble	ASME B18.3
Straightness	Straightness Gage	IFI 136
		ASME B18.2.1
Thread Runout	Thread Runout Gage	IFI 136
		ASME B18.2.1
Flat Head	Protrusion Gage	ASME B18.6.4
	Protrusion	ASME B18.6.2
Hex Head Height (across corners)	Gaging Ring	ASME B18.6.4
Slotted Nut	Slot Gage	ASME B18.2.2

CHEMICAL FIELD: Chemical Analysis

Type of Test Technology:

Spectroscopy
- Atomic absorption
- Emission/ICP
- X-ray fluorescence

Wet Chemistry Measurements
- Volumetric
- Gravimetric
- Spectrophotometric

Physical Properties
- Density
- Porosity

Light Microscopy

Electrochemical Deposition

Material	Specifications
	ASTM E30
	ASTM A751
	ASTM E212
	ASTM E322
	ASTM E350
	ASTM E352
	ASTM E403
	ASTM E415
	ASTM E572
	ASTM E663
Stainless Steel	ASTM E353
Aluminum & Alloys	ASTM E34
	ASTM E101
Brass & Bronze	ASTM E54
Copper & Alloys	ASTM E53
	ASTM E62
	ASTM E75
	ASTM E76
Titanium	ASTM E120
Zinc Coating	ASTM B633
Cadmium Coating	ASTM B766

C.4. Stanley P. Johnson, President, The Johnson Gage Company, Bloomfield, CT

Mr. Johnson outlined the dimensional requirements he feels are necessary to implement the law. His presentation focused on means and methods for achieving the objective, through use of existing standards. His list of required specifications for screw thread dimensional conformance included: FED-STD-H28/6 *Gages and Gaging for Unified Screw Threads - UN and UNR Thread Forms*, FED-STD-H28/20 *Inspection Methods for Acceptability of UN, UNR, UNJ, M, and MJ Screw Threads*, ANSI/ASME B1.1 *Unified Inch Screw Threads (UN and UNR Thread Form*, ANSI/ASME B1.2 *Gages & Gaging for Unified Inch Screw Threads*, ANSI/ASME B1.3 *Screw Thread Gaging Systems For Dimensional Acceptability - Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)*, MIL-S-1222H *Studs, Bolts, Hex Cap Screws, Socket Head Cap Screws and Nuts*, MIL-S-7742 *Screw Threads, Standard, Optimum Selected Series:General Specification*, and MIL-S-8879 *Screw Threads, Controlled Radius Root with Increased Minor Diameter:General Specification*. According to Mr. Johnson, the capability to utilize these standards effectively will promote the proper measurement of fasteners and the success of the law.

A primary standard is FED-STD-H28, section 20, which covers the acceptability requirements. This standard together with ANSI/ASME B1.3M, a commercial standard, cover three levels of inspection: system 21, system 22, and system 23.

A screw thread has many diameters, and angles; a laboratory has to process these measurements using system 21, 22 or 23. There are major, pitch and minor diameters, included angles and other aspects of screw thread. Both internal and external threads must be measured. Some of the key characteristics that will bind all of these measurement together in the most sophisticated system, system 23, will be a measurement of the maximum material functional diameter size, which is the assembleability size. It assures that product will go together if it is within particular limits. Also, there is minimum material pitch diameter size, which measures the minimum amount of material which exists in that particular product. He remarked that the discussion so far has only dealt with the threaded portion of the screw. Also, measurements may involve taper, roundness, circularity, ovality, lead, flank angle, major and minor diameter, root radius (external UNJ threads), runout and surface roughness. The laboratories are faced with these measurement requirements and must provide for a measured value in most cases. Attribute data is meaningless relative to this type of inspection and certification. It requires an indicated value of what is wrong with the part. Mr Johnson in making his point stated, we are living in the 1990's no longer are we living in the 1960's or 1970's. We have to have numbers. If you provide a certification that the fastener is OK to this gage it virtually is meaningless. Concrete data are required to accept or reject the part. For 90 to 95 percent of the applications inspections are looking to see if a screw thread falls within the minimum and maximum tolerance values. A screw thread basically has two sizes: pitch diameter and functional size. If these two measurements are performed almost 90 percent of the work will be completed.

In his discussion of System 22, Mr. Johnson described system 22 as basically a measurement for the minimum material of the product screw thread, the pitch diameter, the maximum material functional size, the major diameter of the external thread, the minor diameter of the external and the internal thread, and the root radius in case of the UNJ profile. These are the measurements required by system 22 requirements.

System 23 goes a step beyond system 22 and requires measurement of the following characteristics: minimum material (pitch diameter), maximum material (functional size), major diameter, minor diameter (UJN external only), root radius (UJN external only), lead (including uniformity of helix), and in certain cases angle, taper, circularity, runout roundness, and surface roughness. There are many ways of making these measurements: including optically, and mechanically. He recommended that the laboratories utilize the ANSI/ASME B1.3M-1986 document, which (once a particular characteristic to be inspected is selected) provides a list of instruments to measure the characteristic.

In Mr. Johnson's summary, he stated there is system 21, 22 and 23. System 22 covers 90-95 percent of the work load, with system 23 significantly less. He suggested the inspection requirements and methods be fashioned out of the ANSI/ASME B1.3M document which is working well in the field. His final recommendation was that all measurements for product dimensions must generate actual size readings. If actual numbers are not on the report, disputes about the validity of the certification will revolve around the equipment which was involved. System 21 and method A will not allow you to determine dimensional conformance.

Questions and Answers, and Comments

Q: Jack Smith, Fairchild Fasteners - I noticed that you have listed revision D-7742 and C-8879. As you should know, there is quite a bit of controversy regarding these revisions. And it's my understanding that these revisions do not replace earlier revisions unless there is something you specified.

A: Yes, I must qualify that too. 8879C and 7742D have not been released yet but have gotten tri-service approval between the Army, the Navy and the Air Force. They do not replace existing MIL-STD 8879A or 7742B.

Q: You put a lot of stress playing into your corkscrew, and you put a lot of stress on the fact that you can tell us the actual numbers to be determined on the certification. Is that right?

A: That's correct sir.

Q: Can you speak to the ability to calibrate the gages on which those numbers can be achieve?

A: Yes. The gages have been proven. The gages are calibrated to reflect the class X tolerance on the working gaging elements or to reflect the class W tolerance on set masters. Studies have been done that reflect this.

Q: There seems to be some arguments-

A: There is a great deal of argument about a lot of things regarding MIL-STD 8879 and 7742 but I contend when a document is on the street, a document should be allowed to assure whether a product is conforming or not conforming. And this new document 8879C and 7742D permit that. Yes, sir.

Q: Larry Galowin, NVLAP/NIST - Could you dare speculate with us how you would see implementing a proficiency test program and also on-site assessments to assure the team that will eventually accredit the laboratory or turn it down or report on its deficiencies, to some of the level of detail that you just addressed.

A: How many people are involved in going out into these field and certifying these labs?

Q: Wayne is responsible I guess for making some recommendation and coming to some decision. It could be more than one individual I understand. But just to speculate with us how do you perceive it functioning?

A: I would see educating the individuals that are going out into the field with the definitions and nomenclature and what the systems mean and what the requirements are and what the specifications carry in specific areas and if they understand the B1.3M they would be in a position to do it very easily. Yes sir.

Q: Dick Kerr, Kerr Lakeside, Euclid, Ohio - I don't argue with your position about saying all these inspections should have the dimensions on it. It is going to take a tremendous amount of people or equipment or something to get this all done. We are talking about thousands and thousands of lots and you want dimensions on maybe 20-25 attributes per each size fastener. And at times the number of pieces you are going to inspect in that lot and you might have a book to go with each certification. It is very easy for the person that doesn't have to do it to say how it should be done.

A: These operations and techniques also have the ability to connect to a computer, so that you can actually get all the elements and the characteristics in one run. And the operator really doesn't have to know what the reading is, he just has to insert it into the device or whatever, get a reading and it will perform those measurements for the various thread elements and characteristics. There is no writing down of data. I see your point, where you would have to individually write data down for elements and characteristics to do this and that. This is part of it. This would be time consuming. Yes.

Q: John Locke, A2LA - Do you expect also that the laboratory should have some sort of a statistical measurement of their statistical control measurement process, which will identify how good the measurement is, whether in terms of plus or minus values because if you assume that the data are fact you are obviously that's not correct. They (any number) are a part of a variable process or a measurement process which is subject to statistical measurement control. So do you expect to have some sort of identification of how good that measurement process is with each one of these numbers?

A: I think that would be something that would be needed. Absolutely, but I think you have to step into it before you are going to run into it.

C.5. Al Balogh, U.S. Navy Gage & Standards Center, Pomona, CA

Mr. Balogh explained that his organization's primary function is the interface gage program for the Naval Sea Systems Command. Interface control planning involves analysis of weapon system designs to determine if interfaces meet specification and design requirements. He provided examples of the safety considerations for having interfaces controlled. Safety critical is defined by DOD-STD-2101 for major and minor characteristics which apply to design. Critical is a safety consideration. Measure is an interchangeability consideration. Safety and interchangeability are the areas of concentration for the Navy Gage & Standards Center (NGSC). Critical safety examples include: bombs falling out of the sky, because they are falling off of lugs at the wrong time; or missiles or bombs being left behind on a carrier deck; or aircraft landing with stores aboard and breaking loose from aircraft being arrested upon landing on a carrier; or fastener failure causing fins to fall from aircraft in populated areas. In addition to interface control planning, the Center is involved in designing and approving acceptance inspection equipment and running a gage certification laboratory (thread, functional and automated gages and masters for gages).

Also, at Corona is the principal Naval Sea Systems Command Standards Laboratory. All measurement equipment are calibrated in this laboratory to standards traceable to NIST.

Mr. Balogh stated, that in the design of thread gages and functional gages containing threaded features, the NGSC adhere to the following standards:

ANSI/ASME B1.2	*Gages and Gaging for Unified Inch Screw Threads*
MIL-STD-114C	*Gages, Plug, Thread 'GO' Class X*
MIL-STD-115B	*Gages, Plug, Thread 'NOT GO'*
MIL-STD-116B	*Gages, Ring, Thread 'GO' Class X*
MIL-STD-117B	*Gages, Ring, Thread 'NOT GO'*
MIL-STD-273	*Gages, Plug, Thread Setting, Class W, for 'GO' Gages*
MIL-STD-274	*Gages, Plug, Thread Setting, Class W, for 'NOT GO' Gages*

Mr. Balogh explained, that in addition to the requirement in ANSI/ASME B1.2, the Military Standards require a specific surface finish and cover American National Standard (N series) threads, which are still used on some military equipment.

NGSC also utilize the following standards as guidance during certification/calibration of thread elements:

ANSI B1.1	*Unified Inch Screw Threads (UN and UNR Thread Form)*
ANSI B1.3	*Screw Thread Gaging Systems for Dimensional Acceptability*
ANSI B1.7	*Nomenclature, Definitions, and Letters Symbols for Screw Thread*s
ANSI B47.1	*Gage Blanks*
ANSI B89.1.6	*Measurement of Qualified Plain Internal Diameters for Use as Master Rings and Ring Gages*
ANSI B89.3.1	*Measurement of Out-of-Roundness*

Mr. Balogh provided a list of critical thread attributes and measurement methods for critical thread attributes (external and internal threads). He noted that this list is the minimal measurement requirement; measurement of other attributes may be required depending on the specific application.

NGSC utilizes the following established methods and procedures for the certification and acceptance of these thread attributes.

For External Threads:

(1) Pitch Dia.:	"3 Wire Method" in conjunction with a Linear Measuring Machine (Pratt & Whitney Standard Measuring Machine)
(2) Major Dia.	Linear Measuring Machine, to measure effective Major Diameter at various locations about the diameter
(3) Minor Dia.:	Optical Comparator or Contour Tracer

(4) Flank Angle:	Optical Comparator or Contour Tracer used to verify angle and Flank Angle wear
(5) Helical Path:	Pratt & Whitney Helical Path Analyzer or Sheffield Lead Check taking various radial measurements about the diameter
(6) Lead:	Sheffield Lead Check for measurement of cumulative lead, deviation of first thread lead, and helical path deviation (Drunkness)
(7) Surface finish:	Control of surface finish is accomplished by visual
(8) Hardness:	Rockwell Hardness Tester

For Internal Threads:

(1) Pitch Dia.:	Split type adjustable ring, set to a precision Thread Setting Plug or through complicated open set-ups using 3 Axis Moore Measuring Machine
(2) Major Dia.	Contour Tracer or through mold thread casting in conjunction with an Optical Comparator
(3) Minor Dia.:	Brown & Sharp Intrimiks
(4) Flank Angle:	Contour Reader or through mold thread casting in conjunction with Optical Comparator
(5) Helical Path:	Not normally performed but can be measured if thread diameter is large enough to allow access using probe, 3 Axis Moore Measuring Machine and Precision Rotary Table
(6) Lead:	Contour Tracer, Set Thread Plug, or casting in conjunction with Optical Comparator
(7) Surface finish:	Inspection of surface finish is accomplished by visual comparison to known surface finishes
(8) Hardness:	Rockwell Hardness Tester
(9) MAEMD:	Open set up techniques

Mr. Balogh recommended that environmental factors be considered during laboratory accreditation. He listed temperature, humidity, lighting, contamination and voltage regulation.

Questions and Answers, and Comments

Q: Dick Kerr, Kerr Lakeside, Inc., Euclid, OH - I think that we are starting to get to the point, depending on what we are talking about, of being impracticable. When you start having a laboratory with temperature control, humidity and things like that, you're talking about working down to tens of thousandths. We're talking about fasteners and most fasteners are not tens of thousandths. And I am not arguing basic concept but if every laboratory in the country has got to have a controlled laboratory with humidity and temperature and everything else, you're going to put an awful lot of people out of business in this country. And you just don't need those requirements for inspection of most parts in fasteners. Thank you.

A: I did not intend to imply for every application and every tolerance zone that the same level of laboratory and measurement controls is needed. But we are, in many cases, working down in the tenths and hundred thousandths of an inch. When we are trying to achieve those kinds of tolerancing and certification, we need to have those kind of controls. So it would be a range of measurements that should be talked to in the accreditation program.

C.6. Charles Wilson, Director of Engineering, Industrial Fasteners Institute, Cleveland, OH

Mr. Wilson recommended an Industrial Fastener Institute (IFI) Document, IFI-139, as the basis for defining the quality assurance requirements for a fastener testing laboratory. IFI-139 provides a minimal set of requirements for a fastener testing laboratory. It also covers: proficiency testing, laboratory quality system and quality manual, staff training and the sample test report. Mr. Wilson went on to provide reasons for establishing such requirements including:

1) Assurance of uniform fastener quality test results.
2) Prevention of fraudulent practices by those seeking to "short cut" legitimate testing.
3) Eliminate claims by "garage type operations" having little if any installed capabilities i.e., "We have a hardness tester and we subcontract all other testing".
4) An expectation that many will deliberately seek out methods to "accomplish short cuts",and
5) The fastener industry looks at testing from a somewhat different vantage point than most broad based laboratories - testing and inspection is focused on conformance to standards and suitability for its intended application in terms of both fit and function.

Since the basis for fastener evaluation rests on evaluation of conformance to the requirements of standards, Mr. Wilson listed the fastener requirements and the corresponding standards to be validated as: dimensional (ASME/ANSI), mechanical (ASTM/SAE), metallurgical (ASTM/SAE), physical property (ASTM), visual (ASTM/ASME), and performance (SAE/IFI).

According to Mr. Wilson dimensional inspection may be the most controversial area. Key dimensional characteristics which relate directly to the functioning of the part should be inspected and these key characteristics may be different from product to product. The IFI suggested that the ASME B18 Committee undertake a complete examination of ASME B18.18.2M *Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners*. The examination would determine which characteristics are appropriate for measurement during final inspection, for use in the absence of existing published characteristics within a given standard.

When making final dimensional inspections, Mr. Wilson stated that the IFI recommends a distinction be made between manufacturers having verified in process controls and manufacturers that do not. The

Fastener Accreditation Program (FAP-1) run by ASME is a third party program that could be used to verify in-process control. Mr. Wilson pointed out that dimensions are controlled during the manufacturing process and verified by the inspection department not the testing laboratory.

Mechanical testing verifies the mechanical properties which identify the reaction of a fastener to applied loads. These properties are the result of manufacturing methods and metallurgical treatments employed for a given material. Typical mechanical tests are: tensile (axial/wedge), yield, hardness, proof load, torsional strength, creep, stress rupture, shear and ductility. All of these requirements are identified within respective standards and are listed in the appendix of IFI-139. Mr. Wilson noted that tensile (axial/wedge), hardness, and proof load testing should be required for a fastener testing laboratory.

The evaluation of metallurgical characteristics imparted to fasteners through material selection, forming and heat treatments may include: chemistry, grain size, microstructure, decarburization, case depth, and through hardness. Chemistry is usually certified by raw material suppliers traceable to a heat of material. A fastener laboratory should be required to have the capability of testing for decarbuization, case depth, and through hardness, according to Mr. Wilson.

In discussing physical property testing, Mr. Wilson noted that these properties are inherent in basic raw material and generally are unchanged or only slightly altered by the manufacturing process. Typical properties include: electrical resistivity, thermal conductivity, density, coefficient of thermal expansion, and magnetic susceptibility. These tests are only rarely conducted in the fastener industry.

The capability of making visual examinations for workmanship and surface discontinuities should be required by fastener testing laboratories. These examinations include: quench cracks, forging cracks, shear burst, folds, voids, tool marks, and nicks and gouges. An ASTM standard ASTM F-788 documents examinations for surface discontinuities.

Performance tests are conducted to verify that the functional design features of the fasteners which satisfy the specification requirements are present. Typical tests are fatigue, corrosion resistance, torque-tension, locking, thread forming, and sealing.

Mr. Wilson suggested that there should be a minimum installed capability for laboratories testing fasteners. Laboratories should be able to measure fastener geometry, proof load, surface hardness, thread acceptability, tensile strength, decarburization/carburization, coating thickness, core hardness, and surface discontinuity. For each of these fastener characteristics Mr. Wilson provided the following list of necessary equipment including: dimensional (gage blocks, outside and inside micrometers, calipers, thread gaging), hardness (Rockwell, Vickers or Brinnel tester), tensile and proof (tensile tester), decarburization/carburization (microscopic, or micro-hardness), coating thickness and surface discontinuities (per specification - microscopic, magnetic, columetric).

Addressing himself to sampling, Mr. Wilson stated that the integrity of the entire process rests on the sampling process. Mr. Wilson cited Federal investigations which indicated that the same fasteners or fasteners from the same lot were being submitted over and over again to represent other lots. In this way fasteners were fraudulently accepted as passing requirements without being tested. Samples must be selected in a random manner such that each unit in the lot has an equal chance of selection (not just from the top or a side layer of a container or lot).

Questions and Answers, and Comments

C: Dick Kerr, Kerr Lakeside, Euclid, Ohio - How many manufactures are in this room besides me? Not too many, there's a few I guess. I think as a whole from talking to some people, that the manufactures have taken this thing kind of light (this law). At Kerr Lakeside it looks like we haven't. But I just want to comment, in process control Charlie is all well and good. To me it is a common buzz word right now. You're going to have to process control let's say on a bolt maker and you get the parts all done and you stick it in the heat treater (and the heat treater nicks the threads) what good would this in-process control have done on the threads. Nothing.

A: Mr. Wilson - Nobody would disagree that nicking of threads is going to a problem.

Q: Charlie Spiegel, Penn Screw Machine Works - Is it IFI's position that you have to be accredited for everything to be an accredited laboratory, or can you differentiate among those aspects you wish to test.

A: Mr. Wilson - No, I think what we have suggested there. There are of course, you know well over 50 some tests, that have been identified for mechanical fasteners. But we have really narrowed it down to about 6 or 7 tests that we think are relevantly important to define what we call the core for a fastener testing laboratory.

Q: Speaking as a manufacture who has had a considerable amount of capital investment in measuring technology, I do not feel that in order to inspect my own product that I must get into the destructive field of testing as well. I think it is an unfair burden you are asking us to assume.

A: I don't disagree with you but on the other hand I think the real abuse in fasteners has been totally in the destructive testing area. And this is the one where the attention really has to be focused, because for the most part most of the failures that have been reported relate directly to metallurgical and mechanical failure.

Q: I agree, but what you are proposing by making an accredited laboratory have to do all of them is in effect, saying to the manufacturer that you can no longer inspect dimensionally your own product. That's the part I am saying does not seem to be -

A: I don't think that it says that at all. I think it says that if you want to have what might be considered an accredited laboratory, this is what it ought to have as a minimum. You may not agree, as you obviously don't, but I have to think you have to have certain floor. If you don't you are going to have any number of people that they are going to be working out of a garage with a hardness tester and then you are not going to have any quality at all.

Q: Well, just to wind-up, if that person is working out of his garage has a hardness tester, and it is certified, that hardness tester and is properly calibrated and that person should be able to be certified to be a hardness tester and nothing more.

A: Well, that is quite true and that is what he would be, a certified hardness tester.

Q: John Locke, A2LA - We'd be happy to accredited a laboratory to 139 if we are requested to do so, but I have another question having to do with the quality. You emphasized the need for a statistical quality control in the manufacturing process, but we would like to say that the measurement process is also subject to statistical measurement control and the data that comes from measurement process is a representation of - it is an estimate that falls within some limits having to do the measurement process and has nothing to do with the manufacturing process. Where do you stand in terms of requirements for quality control in the measurement process?

A: What I am suggesting to you is that most fastener manufacturers are set up to manufacture a product, and have to do most of their dimensional controls and checks in the actual manufacturing process itself. And those manufactures that are actually doing it should receive some kind of credit where it is possible to verify they are indeed doing it - during the course of the manufacturing process. After the process is all finished to check dimensions is fine, but if you haven't checked them in process all you are going to do is verify that the fastener is within conformance or out of conformance. But that tells me your process probably is out of control. A good manufacture today cannot make fasteners without having good in process controls. It just can't be done.

Q: The question deals with how good is the number that you got, where ever you got that number, whether it's in process or not and that is the subject of statistical verification?

A: There is a measurement uncertainty which is not really clearly defined. There has been work going on in Standards Committee B1 which has attempted to define the measurement uncertainty for fixed gaging but variables gaging needs further effort to define the degree of uncertainty.

Q: You do not have any position then on whether a laboratory should have that kind of quality control?

A: As I see it at the moment, the area is so cloudy and open to great dispute as you probably know, the Government Accounting Office right now is running a very major investigation and study of a required system 23 gaging proposals that were mentioned earlier today. And I would think it would be perhaps incorrect to make any statements until we see what the Government Accounting Office study reveals.

C.7. Jon R. Lewis, Sales Engineer, Fabrication Specialty Inc., Dallas, TX

Mr. Lewis commented on certifications that were often about 1x 2" in little bitty letters on the last carboned page of the packing slip. And it said, "we hereby certify to the best of our <u>knowledge</u> that these parts comply."

Certifications have come a long way. Mr. Lewis illustrated with a manufacturers test report (MTR) dated 2-29-91 on a 1/2-13 x 7/8 grade 8 HHCS, stating that this manufacturer is one of the finest producers in the world and has state of the art equipment. I love to inspect their fine product. However, their MTR leaves the following questions unanswered:

What are the dimensions made to?
How is the screw marked & what does the logo look like?
How was it manufactured? SAE J429 requires this size to be upset and roll threaded.
Was it tempered in excess of 800 deg?
What was their sampling plan?
Did it pass visual inspection SAE J1061 (as required in SAE J429)?

Illustrating with a second certification, also from a high quality manufacturer with a excellent reputation, he noted, their MTR also has many unanswered questions regarding SAE J429. He stated his concern that they use a word that totally destroys the credibility of the test report. The word is "substantially" conforms.

According to Mr. Lewis, Our goal is two fold. We are requesting that you the committee that determines the direction of P.L.101-592 that you mandate specifications for certain strength fasteners to contain:

#1 minimum certification criteria for that specification.

#2 A fill in the blank type checklist.

If sample fasteners are sent to an independent laboratory are we going to just hand them the specification and say read it? Or, are we going to tell them the test criteria? If a specification has the minimum criteria listed, then the laboratory can run down the list and preform the necessary test.

Mr. Lewis presented sample forms using SAE J429A and ANSI B18.2.1, as examples. Exhibit #1 is the minimum certification criteria for certifying to SAE J429. The listed requirements are from SAE J429, FAP-1 and P.L. 101-592. On the far right side is the paragraph # in the specification for reference. Exhibit #2 is a sample fill in the blank CMTR derived from the requirements in exhibit #1. Since SAE J429 covers only mechanical and chemical, this form only covers that specific information. Exhibit #3 is the same form but filled in and signed. Mr. Lewis commented that this is his company's form and their personal style in designing the form. I am not trying to force our style or our form on this committee but form and style is a huge issue. Somehow, someway, I am hoping for an industry wide homogeneous form that can be adopted. Mr. Lewis said that he sees ANSI B18, or some society, selling a book of forms for reproduction purposes containing all the listed inspection criteria for all of the ANSI B18 fasteners.

He remarked that when he receives a fully documented certification it usually contains several pages. Almost without exception, anyone reading the package usually goes wow, that's a lot of information. The multi-page package is somewhat intimidating to say the least.

To illustrate his point he asked, if any of you has seen the movie class action starring Gene Hackman, as the prosecuting attorney. He asked for a certain test report from the defending counsel. The defending attorneys sent him about 400 or so file boxes. Gene Hackman felt the information he wanted was probably buried in the files, but his office had to spend many hours researching the boxes. Mr. Lewis recommended the industry adopt a homogeneous form, so that it is easy to search for the required information. If a foreign manufacturer produces a 1/2 x 7/8 hex head grade 8, or if a Cleveland, Ohio manufacturer produces the same product then each manufacturer's certification looks the same. Even a laymen customs officer checking inbound fasteners would quickly learn how to read a certification and tell if it conforms or it doesn't.

Exhibit #4 is a table, which is a picture of a hex head from ANSI B18.2.1. This table contains eight dimensions and makes reference to many more dimensions in the form of formulas or references other tables.

Exhibit #5 relates to the same fastener but it is a MS 90728. It contains six dimensions.

(THIS IS A SAMPLE THAT WOULD BE LISTED IN THE BACK OF SAE J429-83)

MINIMUM CERTIFICATION CRITERIA FOR CERTIFYING TO SAE J429

	Spec. Para. Reference
*Grade of Steel, Chemical analysis, with min. and max. values listed from Table 2	3.1
*Method of Manufacture for forming and threading	3.2&3.3
*Heat Treat Practice	3.4
*Decarburization-if requested by purchaser	3.5
*Surface Discontinuities-Shall conform to SAE J1061	3.6
*Mechanical Requirements-with required max./min. values	4.0&Table 1&3
*Hardness-conformance to SAE J417 & table 1 (core & surface)	5.1&5.2
*Proof Load-If required	5.3
*Axial Tensile Strength-If required	5.4
*Wedge Test-If required	Table 5 &5.5.1
*Marking-Specify marking and logo	Table 1&6.0
*Sampling Plan	7.1

*Quantity & Item Description-with reference to dimensional source (for example ANSI B18.2.1-81)

*Company name and address

*Conformance paragraph-Signed(paragraph shall contain language to assure conformance. Words like "substantially" conforms are not permitted.)

*Lot or control number for traceability.

*Customer and order number and date shipped

*Report shall be titled-"Certified Material Test Report"

SAEJ429

EXHIBIT #1

CERTIFIED MATERIAL TEST REPORT
(Mechanical & Chemical 150KSI, SAE J429)

Sold to: Date shipped:
Customer PO#:

Quantity: Lot Number: Material Grade:

Description:

Chemistry	SAE J429 REQUIREMENT	ACTUAL	INSPECTOR
Carbon	.28-.55		.
Manganese	n-a		.
Phos.	.040max.		.
Sulfur	.045max.		.
SI	n-a		.
CR	n-a		.
OTHER			.
OTHER			.
Mechanical			
Surface Hardness 30N	58.6max.		.
Av. Core Hardness	C33-C39		.
Proof Load/Elong.	if reqd		.
Tensile Test	150ksi		.
Heat Treat:	oil quench & temper >800deg.		.
Method of Mfg:			.
Decarburization:	if reqd		.
Surface Discontinuities:	SAE J1061		.
Marking:	6radial + logo		.
Sampling Plan:	Para 7.3		.

Qty inspected:
Qty accepted:
Reject on: Accept on:

ALL TESTS ARE IN ACCORDANCE WITH THE METHODS PRESCRIBED IN THE APPLICABLE SPECIFICATIONS. VISUAL AND DIMENSIONAL INSPECTIONS WERE FOUND SATISFACTORY. I CERTIFY THE ABOVE RESULTS AND/OR DATA TO BE CORRECT AS CONTAINED IN THE RECORDS OF THIS COMPANY.

JOHN DOE BOLT MANUFACTURING
1991 West 3000th ST., Wash.D.C.

SIGNED ______________________.
JAMES DOE
QUALITY ASSURANCE SUPERVISOR MTR1

EXHIBIT #2

CERTIFIED MATERIAL TEST REPORT
(Mechanical & Chemical 150KSI, SAE J429)

Sold to: Stormin Norman Fasteners

Date shipped: JAN 16, 91
Customer PO#: 911

Quantity: 32,000 Pcs   Lot Number: 666   Material Grade: 5140 H

Description: 1/4-20UNC2A x 1 1/4 Hx Hd Cap Screw Gr 8 ANSI B18.2.1-81 SAE J429

Chemistry	SAE J429 REQUIREMENT	ACTUAL	INSPECTOR
Carbon	.28-.55	.39	JDn.
Manganese	n-a	.79	JDn.
Phos.	.040max.	.01	JDn.
Sulfur	.045max.	.006	JDn.
SI	n-a	.19	JDn.
CR	n-a	.82	JDn.
OTHER			.
OTHER			.
Mechanical			
Surface Hardness 30N	58.6max.	57.3	JDn.
Av. Core Hardness	C33-C39	36	JDn.
Proof Load/Elong.	if reqd		.
Tensile Test	WEDGE 150ksi (4750#)	4965#	JDn.
Heat Treat:	oil quench & temper >800deg.	oil Quench Temper 915°	JDn.
Method of Mfg:	UPSET & Roll THD	UPSET & Roll THD	JDn.
Decarburization:	if reqd	N-A	.
Surface Discontinuities:	SAE J1061	OKAY	JDn.
Marking:	6radial + logo	6 RADIAL + "JDB"	JDn.
Sampling Plan:	Para 7.3	✓	.

Qty inspected: 5
Qty accepted: All
Reject on: 1   Accept on: 0

ALL TESTS ARE IN ACCORDANCE WITH THE METHODS PRESCRIBED IN THE APPLICABLE SPECIFICATIONS. VISUAL AND DIMENSIONAL INSPECTIONS WERE FOUND SATISFACTORY. I CERTIFY THE ABOVE RESULTS AND/OR DATA TO BE CORRECT AS CONTAINED IN THE RECORDS OF THIS COMPANY.

JOHN DOE BOLT MANUFACTURING
1991 West 3000th ST., Wash.D.C.

SIGNED James Doe
JAMES DOE
QUALITY ASSURANCE SUPERVISOR   MTR1

EXHIBIT #3

EXHIBIT #4

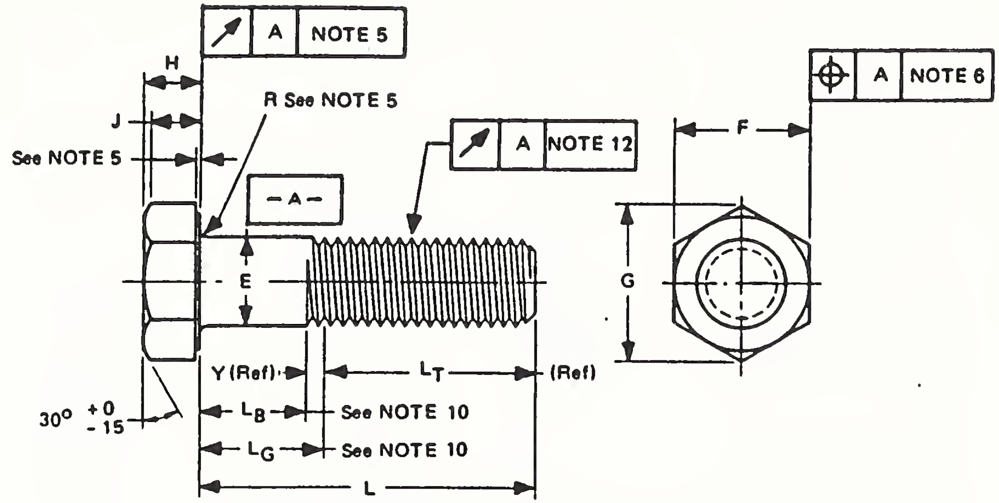


TABLE 4 DIMENSIONS OF HEX CAP SCREWS (FINISHED HEX BOLTS)

Nominal Size or Basic Product Dia (18)		E Body Dia (8)		F Width Across Flats			G Width Across Corners (4)		H Height			J Wrenching Height (4)	L_T Thread Length For Screw Lengths (10): 6 in. and Shorter	L_T Thread Length For Screw Lengths (10): Over 6 in.	Y Transition Thread Length (10)	Runout of Bearing Surface FIM (5)
		Max	Min	Basic	Max	Min	Max	Min	Basic	Max	Min	Min	Basic	Basic	Max	Max
1/4	0.2500	0.2500	0.2450	7/16	0.438	0.428	0.505	0.488	5/32	0.163	0.150	0.106	0.750	1.000	0.250	0.010
5/16	0.3125	0.3125	0.3065	1/2	0.500	0.489	0.577	0.557	13/64	0.211	0.195	0.140	0.875	1.125	0.278	0.011
3/8	0.3750	0.3750	0.3690	9/16	0.562	0.551	0.650	0.628	15/64	0.243	0.226	0.160	1.000	1.250	0.312	0.012
7/16	0.4375	0.4375	0.4305	5/8	0.625	0.612	0.722	0.698	9/32	0.291	0.272	0.195	1.125	1.375	0.357	0.013
1/2	0.5000	0.5000	0.4930	3/4	0.750	0.736	0.866	0.840	5/16	0.323	0.302	0.215	1.250	1.500	0.385	0.014
9/16	0.5625	0.5625	0.5545	13/16	0.812	0.798	0.938	0.910	23/64	0.371	0.348	0.250	1.375	1.625	0.417	0.015
5/8	0.6250	0.6250	0.6170	15/16	0.938	0.922	1.083	1.051	25/64	0.403	0.378	0.269	1.500	1.750	0.455	0.017
3/4	0.7500	0.7500	0.7410	1 1/8	1.125	1.100	1.299	1.254	15/32	0.483	0.455	0.324	1.750	2.000	0.500	0.020
7/8	0.8750	0.8750	0.8660	1 5/16	1.312	1.285	1.516	1.465	35/64	0.563	0.531	0.378	2.000	2.250	0.556	0.023
1	1.0000	1.0000	0.9900	1 1/2	1.500	1.469	1.732	1.675	39/64	0.627	0.591	0.416	2.250	2.500	0.625	0.026
1 1/8	1.1250	1.1250	1.1140	1 11/16	1.688	1.631	1.949	1.859	11/16	0.718	0.658	0.461	2.500	2.750	0.714	0.029
1 1/4	1.2500	1.2500	1.2390	1 7/8	1.875	1.812	2.165	2.066	25/32	0.813	0.749	0.530	2.750	3.000	0.714	0.033
1 3/8	1.3750	1.3750	1.3630	2 1/16	2.062	1.994	2.382	2.273	27/32	0.878	0.810	0.569	3.000	3.250	0.833	0.036
1 1/2	1.5000	1.5000	1.4880	2 1/4	2.230	2.175	2.598	2.480	1 5/16	0.974	0.902	0.640	3.250	3.500	0.833	0.039
1 3/4	1.7500	1.7500	1.7380	2 5/8	2.625	2.538	3.031	2.893	1 3/32	1.134	1.054	0.748	3.750	4.000	1.000	0.046
2	2.0000	2.0000	1.9880	3	3.000	2.900	3.464	3.306	1 7/32	1.263	1.175	0.825	4.250	4.500	1.111	0.052
2 1/4	2.2500	2.2500	2.2380	3 3/8	3.375	3.262	3.897	3.719	1 3/8	1.423	1.327	0.933	4.750	5.000	1.111	0.059
2 1/2	2.5000	2.5000	2.4880	3 3/4	3.750	3.625	4.330	4.133	1 17/32	1.583	1.479	1.042	5.250	5.500	1.250	0.065
2 3/4	2.7500	2.7500	2.7380	4 1/8	4.125	3.988	4.763	4.546	1 11/16	1.744	1.632	1.151	5.750	6.000	1.250	0.072
3	3.0000	3.0000	2.9880	4 1/2	4.500	4.350	5.196	4.959	1 7/8	1.935	1.816	1.290	6.250	6.500	1.250	0.079

FED SUP CLASS 5305

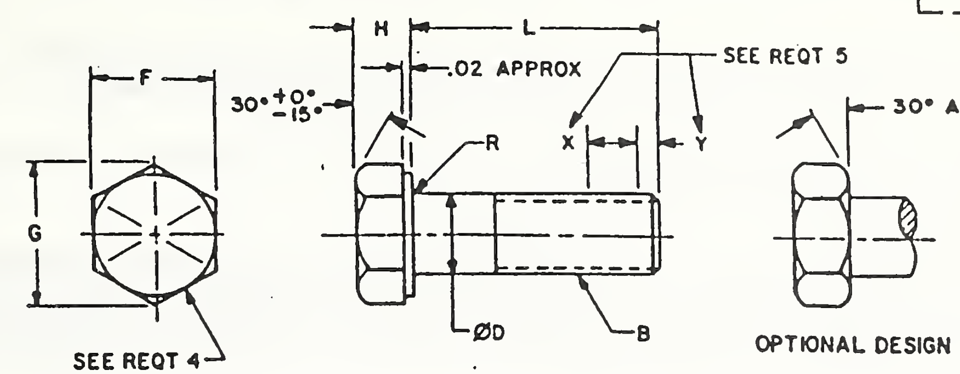


TABLE 1. DASH NUMBERS AND DIMENSIONS.

NOMINAL SIZE		1/4 .2500	5/16 .3125	3/8 .3750	7/16 .4375	1/2 .5000	9/16 .5625	5/8 .6250	3/4 .7500	7/8 .8750
B THREADS PER INCH		20UNC-2A	18UNC-2A	16UNC-2A	14UNC-2A	13UNC-2A	12UNC-2A	11UNC-2A	10UNC-2A	9UNC-2A
ØD BODY DIAMETER	MAX MIN	.2500 .2450	.3125 .3065	.3750 .3690	.4375 .4305	.5000 .4930	.5625 .5545	.6250 .6170	.7500 .7410	.8750 .8660
F WIDTH ACROSS FLATS	MAX MIN	.4375 .4280	.5000 .4890	.5625 .5510	.6250 .6120	.7500 .7360	.8125 .7980	.9375 .9220	1.1250 1.1000	1.3125 1.2850
G WIDTH ACROSS CORNERS	MAX MIN	.505 .488	.577 .557	.650 .628	.722 .698	.866 .840	.938 .910	1.083 1.051	1.299 1.254	1.516 1.465
H HEAD HEIGHT	MAX MIN	.163 .150	.211 .195	.243 .226	.291 .272	.323 .302	.371 .348	.405 .378	.483 .455	.563 .531
R RADIUS	MAX MIN	.025 .015	.025 .015	.025 .015	.025 .015	.025 .015	.045 .020	.045 .020	.045 .020	.065 .040
1/ MIN TENSILE STRENGTH - LBS		4,750	7,850	11,600	15,900	21,300	27,300	33,900	50,100	69,300

L LENGTH	TOLERANCE SIZE .750 AND UNDER	TOLERANCE SIZE .875	DASH NO.	DASH NO.	DASH NO.	DASH 2/ NO.	DASH NO.	DASH 2/ NO.	DASH NO.	DASH NO.	DASH 2/ NO.
.375			1	27	53						
.438			2	28	54	79					
.500			3	29	55	80	104				
.562	+0 −.031	+0 −.062	4	30	56	81	105	130			
.625			5	31	57	82	106	131	155		
.750			6	32	58	83	107	132	156	179	
.875			7	33	59	84	108	133	157	180	202
1.000			8	34	60	85	109	134	158	181	203
1.125			9	35	61	86	110	135	159	182	204
1.250			10	36	62	87	111	136	160	183	205
1.375	+0 −.062	+0 −.125	11	37	63	88	112	137	161	184	206
1.500			12	38	64	89	113	138	162	185	207
1.750			13	39	65	90	114	139	163	186	208
2.000			14	40	66	91	115	140	164	187	209
2.250			15	41	67	92	116	141	165	188	210
2.500			16	42	68	93	117	142	166	189	211
2.750			17	43	69	94	118	143	167	190	212
3.000			18	44	70	95	119	144	168	191	213
3.250		+0 −.186	19	45	71	96	120	145	169	192	214
3.500	+0 −.094		20	46	72	97	121	146	170	193	215
3.750			21	47	73	98	122	147	171	194	216
4.000			22	48	74	99	123	148	172	195	217
4.250			23	49	75	100	124	149	173	196	218
4.500			24	50	76	101	125	150	174	197	219
4.750			25	51	77	102	126	151	175	198	220
5.000			26	52	78	103	127	152	176	199	221
5.500							128	153	177	200	222
6.000							129	154	178	201	223

1/ SEE NOTE 2

2/ INACTIVE FOR NEW DESIGN AFTER 21 JUN 76

(G) DENOTES CHANGES

USER ACTIVITIES:
ARMY - ME
NAVY - MC, OS, YD

REVIEWER ACTIVITIES:
ARMY - AT, AV, MI
AIR FORCE - 82
NSA - NS
DLA - IS

STATEMENT A. Approved for public release; distribution is unlimited.

7 MAY 63 REVISED (A) 14 OCT 68 (B) 1 MAY 69 (C) 22 OCT 70 (D) 21 JUNE 76 (E) 20 DEC 83 (F) 30 OCT 84 (G) 4 NOV 88

APPROVED

EXHIBIT #5

99

TITLE
SCREW, CAP, HEXAGON HEAD (FINISH HEXAGON BOLT), ALLOY STEEL, GRADE 8, ZINC COATED PLAIN AND SELF-LOCKING, UNC-2A (G)

MILITARY STANDARD

MS90728

PROCUREMENT SPECIFICATION
ANSI B18.2.1-1981

SUPERSEDES MS35301, MS35303, MS35305, BCVX7 IN PART, BUBX14, 14.1, 15, 15.1, 16 AND 16.1

PAGE 1 OF 3

Exhibit #6 is our form derived from ANSI B18.2.1, and it contains more than 20 dimensional requirements. This is our sample fill in the blank for the dimensional requirements.

Exhibit #7 is the same form filled in for 1/4" diameter screw. The ideal way is to have one form that would cover 1/4" diameter in all lengths.

Mr. Lewis remarked that he has heard two-arguments. One is the MS print takes precedence over other referenced documents and that your inspection form only has to contain the characteristics in the MS print. The other argument is that the MS print is just the beginning and all the information in the procurement specification is also required.

He raised the following question if any of us in this room asks for a fully documented inspection report from your supplier what will it look like? Will it contain six dimensions or will it contain 26? Maybe the real question is, what dimensions did they really check? All of the suppliers that I use have advertising literature that makes reference to some high powered specifications. But are they testing these bolts to these specifications? In most cases, no they are not, unless you specifically ask for such testing. He noted that he was assuming one of his suppliers was supplying totally and completely to SAE J429. But when he had a problem at his independent lab concerning discontinuities on top of the head, he found out that his supplier did not want to section all of the required sample quantity as called out in SAE J429. They agreed to section only <u>one</u> piece. But the specification calls for 10 pieces to be sectioned if forging cracks exceed a certain length. He had to personally section the 10 pieces and have them retested.

Speaking as a supplier he stated, we the suppliers in the fastener industry are going to supply these parts that often deal "in harms way" then lets all play not only by the same rules but lets all play in the same ball game. If I'm going to fly a Cessna airplane across the country then the checklist I use was produced by Cessna, a rather competent source. In fact, anyone flying in that particular Cessna model will use the same checklist. Can you imagine a novice pilot reading the manual prior to take off and making up his own checklist? Cessna's checklist has years and years of valuable experience ingrained into that checklist. SAE, ANSI, ASME, ASTM,and IFI also give us years of valuable experience, lets just gather up some of that knowledge and put it on a form for inspection purposes.

The federal specification FF-S-85 has been around for many decades. It has multiple areas in it that are either vague or in error. Our company has spent hours agonizing over some of its requirements. We have inquired to industry experts and they confirm its errors and vagueness. How can a specification like this exist for a decade with all these inadequacies? If it had the checklist requirement then FF-S-85 and specifications like it would have been "proofed out" in its early genesis stages. How can a law put a guy in jail for not complying to such a specification as FF-S-85?

I heard someone say:

sloppy buying = sloppy supplying.

And to that comment I say:

clear precise specification criteria = a sound fastener industry.

Mr. Lewis went on to say, we can't stop liars and cheats, but liars and cheats had much rather sign a 1" x 2" small printed COC rather than a fully documented inspection report. What are the advantages of "form type" inspection reports?

CERTIFIED MATERIAL TEST REPORT
(Dimensional for Hx Hd Cap ANSI B18.2.1-81)

Sold to:

Date shipped:
Customer PO#:

Quantity: Lot Number: Material Grade:

Description:

DIMENSION DESCRIPTION	REQUIRED DIMENSIONS	HIGH-LOW RESULTS	INSPECTOR
Thread Data before finish			
Thread Data after finish			
Body Dia.			
Across Flats			
Across Corners			
Head Height			
Wrenching Height			
Thread Len.			
Transition Thread Len.			
Runout of bearing surface			
Thickness of Washer Face			
Dia. of Washer Face			
Chamfer Top Head			
Dia. of Chamfer Circle			
Fillet Radius			
Shank len.			
Lg			
Lb.			
True Position of Hd.			
Point Data			
Major Dia. Thread			
Thread Runout			
Straightness			
Ident symbols			
Finish			
Other			
Other			
Other			

Quantity Inspected: Quantity Accepted:
Sample Plan:
Reject on: Accept on:

ALL TESTS ARE IN ACCORDANCE WITH THE METHODS PRESCRIBED IN THE APPLICABLE SPECIFICATIONS. VISUAL AND DIMENSIONAL INSPECTIONS WERE FOUND SATISFACTORY. I CERTIFY THE ABOVE RESULTS AND/OR DATA TO BE CORRECT AS CONTAINED IN THE RECORDS OF THIS COMPANY.

JOHN DOE BOLT MANUFACTURING
1991 West 3000th ST.,Wash.D.C.

EXHIBIT #6

SIGNED
JAMES DOE
QUALITY ASSURANCE SUPERVISOR MTR2

CERTIFIED MATERIAL TEST REPORT
(Dimensional for Hx Hd Cap ANSI B18.2.1-81)

Sold to: Stormin Norman Fasteners

Date shipped: Jan. 16, 91
Customer PO#: 911

Quantity: 32,000 Lot Number: 666 Material Grade: 5140 H

Description: 1/4-20UNC2A X 1 1/4 Hx Hd Cap Screw GR8 ANSI B18.21-81 SAE J429

DIMENSION DESCRIPTION	REQUIRED DIMENSIONS	HIGH-LOW RESULTS	INSPECTOR
Thread Data before finish	1/4-20UNC 2A	Rings 1/4-20UNC2A go/nogo	JD
Thread Data after finish	1/4-20 UNC 3A	" " 3A "	JD
Body Dia.	.2450 - .2500	.249 - .250	JD
Across Flats	.428 - .438	.430 - .433	JD
Across Corners	.488 - .505	.494 - .496	JD
Head Height	.150 - .163	.155 - .158	JD
Wrenching Height	.106 MIN.	7.106	JD
Thread Len.	.750 BASIC	OKAY	JD
Transition Thread Len.	.250 MAX.	< .200	JD
Runout of bearing surface	.010 MAX	< .005	JD
Thickness of Washer Face	.015 - .025	.020	JD
Dia. of Washer Face	.394 - .438	.400	JD
Chamfer Top Head	15° - 30°	25°	JD
Dia. of Chamfer Circle	.372 - .438	.400	JD
Fillet Radius	.015 - .025 R	.020	JD
Shank len.	1.210 - 1.250	1.215 - 1.220	JD
Lg	.075 MAX	OKAY	JD
Lb.	N-A	—	
True Position of Hd.	.026 FIR	< .015	JD
Point Data	.1876 x 1/2 TO 1 1/2 THDS	OKAY	JD
Major Dia. Thread	.2408 - .2489	.245 - .246	JD
Thread Runout	.031	< .011	JD
Straightness	.031	< .004	JD
Ident symbols	6 RADIAL + LOGO	6 RADIAL + "JDB"	JD
Finish CAD & BAKE	QQ-P-416 TY2 CL2	OKAY - Billmark Cert	JD
Other			
Other			
Other			

Quantity Inspected: 50 Quantity Accepted: All
Sample Plan: Mil-Std-105 J-4 .65 AQL
Reject on: 1 Accept on: 2

ALL TESTS ARE IN ACCORDANCE WITH THE METHODS PRESCRIBED IN THE APPLICABLE SPECIFICATIONS. VISUAL AND DIMENSIONAL INSPECTIONS WERE FOUND SATISFACTORY. I CERTIFY THE ABOVE RESULTS AND/OR DATA TO BE CORRECT AS CONTAINED IN THE RECORDS OF THIS COMPANY.

EXHIBIT #7

JOHN DOE BOLT MANUFACTURING
1991 West 3000th ST., Wash.D.C.

SIGNED James Doe
JAMES DOE
QUALITY ASSURANCE SUPERVISOR

MTR2

The mandatory form would serve to police testing requirements and take away any economic reward for producing non-tested fasteners

The form would be produced or approved by the specification authors thus giving the industry a professional interpretation and guidelines of testing requirements

Anyone reading or using the form would have the benefit of a homogeneous form, thus saving hours in having to make their own inspection report

Decreases inspection time

Increases faith in product, supplier and specification

Maybe lessons insurance risk and exposure because it is clear to the user how product has or has not been tested

Some critics have argued that this would be an awesome task. If the minimum testing criteria and a checklist type form were listed in about a dozen specifications then about 90% of the bogus bolts would have been covered by one or more of these specifications.

Once this concept catches on it is highly efficient and liberating knowing that total compliance has been performed. Mr. Lewis noted that he had personally done the ANSI B18.2.1 checklist for all sizes through 1" diameter. When he inspects one of these products then all of his ground work has been done.

Mr. Lewis commented that what he is asking for is within the spirit of the P.L. 101-592. In sec. 5 (c) Laboratory report of testing ... The report, which shall be in a form (I want to add homogenous form) prescribed by the Secretary.....

Questions and Answers, and Comments

Q: Joe McAuliffe, Lake Erie Screw Corp. - One of the certifications you had overhead was an older certification I just wanted to clarify that with you and with the audience here. That certification was at least two years old and since January of 1990 that certification was changed. If you could put that presentation out again, I'd appreciate you asking for a current certification.

A: Well I do take off Lake Erie's name and any reference to it, but Lake Erie's recertification still contains the word substantially and that was the only thing I used it for.

Q: To completely do legal work, you look at the current certification I think you could get some current information.

A: As far as the uniformity in certification I think it's a little presumptuous to assume that the manufacture should be responsible to provide a uniform certification for the either use of the end user. I think the manufacture should have the opportunity to present his data for whatever the specification is and it's going to be different data for different specifications. He should have the opportunity to present that in a form that is usable and reasonable for that manufacture. The specification requirements should be laid out and I don't differ with the requirements on the certification on what should be there and what shouldn't be there but the format itself should be up to the manufacture. Should we go with the homogenous form I think that opens the door for falsification and for cheaters to use that form to their advantage. I think that the manufacture's form would preclude that from happening. Thanks.

C: Al Herskovitz, Army AMC Command - As you know we speak quite a bit on the telephone. First of all, the hex head cap screws as you indicated in the by the MS90728 as well as 90727, 18153 and 18154 have been canceled and even superseded by a non-government standard to B18.2.1. And by the way, this is the thrust that the Department of Defense (DOD) is going to, and that is replacement of Military MS parts with ANSI B18 coverage. Second of all, you had mentioned what is on the MS and how it differs with the general specification, for example, FFS-85. FFS-85 covers a number of different materials and different requirements. And this is called out specifically on the various MS's. So the idea of the 85 and the MS, they have to be used in conjunction with one another. The 85 covers the general requirements and the MS specifically to the requirements of the specific needs of the 85. FFS-85 is currently being revised and it will be circulated to the industry for their input. Just in the same manner as we did with FFS-86 for socket head cap screws and we have pinpointed where the inaccuracies have occurred and tried to address everybody's need. But again, the DOD thrust is to go to non-government standards.

C.8. Richard W. Kerr, President, Kerr Lakeside, Inc, Euclid, OH

Mr. Kerr commented that Public Law 101-592 means that each lot of the various types of fasteners covered by this act must have a complete final inspection.

There are many different specifications for the various types of products included under this legislation. The most stringent of these specifications require:

1. Material Conformance
2. Dimensional Conformance
3. Strength Conformance, which is usually a by-product of correct hardness, which is a by-product of proper heat treatment.
4. Surface Discontinuities Conformance.

A laboratory and/or a combination of laboratories accredited under this law must perform the final inspections and testings required by the various specifications to confirm that the lot meets the standards.

Some specifications include some sort of a final inspection plan and many do not.

It is not possible for a general inspection and testing plan to be written that will include all of the various types of products covered by this law. For this reason, it is necessary that a final inspection and testing procedure be written for each and every type of fastener, SPECIFICATION BY SPECIFICATION.

As an example, ANSI/ASME B18.3 covers socket cap screws, socket flat head countersunk cap screws, button head socket cap screws, socket head shoulder screws and socket set screws. These products are additionally covered by specifications ASTM A574, F788/F788M and F835. Nowhere in any of these specifications is there an exact final inspection and testing procedure. The final inspection and testing procedure is different for each one of these items. Undoubtedly, this is true of many other specifications.

Since this law is going to have a large economic impact on many companies, it is necessary that all fasteners of the same size, type and specification, of either domestic or foreign origin, be governed by the same exact final inspection and testing rules.

All laboratories should be accredited, SPECIFICATION BY SPECIFICATION, rather than being accredited for a given type of inspection or testing procedure. Additionally, the accredited laboratory must have a current copy of every specification for which they are accredited. The Industrial Fastener Institute Handbook cannot serve as a source reference for these specifications. The latest edition of The Industrial Fastener Institute Handbook was published in 1988. Specifications are constantly being changed, and the specification as listed in The Industrial Fastener Institute Handbook, in many cases, would not be the current specification. There are too many foreign manufacturers that insist that the IFI Handbook is the specification of record, and this simply is not true.

The reason that all laboratories should be accredited, SPECIFICATION BY SPECIFICATION, is best answered by the question, will the laboratory, (unless part of the fabricator's operation), really be familiar with all of the required specifications, and interpretation of same? As I have stated previously, the accredited laboratory must have a current copy of every specification for which they are accredited. This is not always easy to do. Many specifications refer to other specifications. After these specifications have been obtained, many of these new specifications now refer to additional specifications. Sometimes the search can go on endlessly until all the necessary specifications have been procured. As an example, ASTM F606-90 refers to eight other specifications, one of which is ASTM A394-90, STANDARD SPECIFICATION FOR ZINC COATED STEEL TRANSMISSION TOWER BOLTS. This specification refers to 16 additional specifications. These additional specifications likewise refer to additional specifications. I have not taken the time to research this, I am just trying to point out the problem and why an accredited laboratory must be familiar with, and have on hand, all of the specifications involved for the types of products to which they are accredited.

I am submitting proposed final inspection and testing criteria procedures, including sample sizes and inspection and testing levels for various lot sizes for each of the socket screw products mentioned above. This is my area of expertise and consequently this is the area that I will dwell on, although in most respects, the procedures necessary to comply with Public Law 101-592, will apply to all other types of products and specifications.

Along with these proposed inspection procedure check sheets, I have enclosed two representative sheets showing how the final inspection report would look after it has been completed. It is my proposal that a conforming inspection or testing result be marked with a check mark, and a nonconforming inspection or testing result be marked with an "X".

I am also enclosing copies of drawings of functional gages used by Kerr Lakeside Inc. to inspect the head height and flushness tolerance for socket flat head countersunk cap screws.

The steel, or any other type of material used to fabricate the fasteners covered by this law, shall be inspected and tested by an accredited laboratory. The chemical analysis and all other information pertaining to this raw material, will be furnished by the raw material supplier to the fastener manufacturer. The fastener manufacturer will not be responsible for any further inspection or testing of this material.

PROPOSED

FINAL INSPECTION CRITERIA OF ALLOY STEEL SOCKET HEAD CAP SCREWS

(INCH SERIES - ASME/ANSI B18.3)

CHARACTERISTIC	INSPECTION LEVEL
Body Diameter	C
Length	B
Head Diameter	B
Head Height	C
Head Side Height	C
Angularity of Bearing Surface (Note 1)	C
Bearing Surface Diameter (Note 1)	C
Fillet Length (Note 1)	C
Juncture Radius (Note 1)	C
Socket Size (Note 2)	B
Key Engagement	C
Wall Thickness	B
Thread Acceptability (Note 3)	B
Body Length-LB-LG	C
Surface Finish	C
Concentricity-Body to Head (Note 4)	C
Concentricity-Body to Socket (Note 4)	C
Visual Inspection (Note 5)	A

NOTES:

1. Inspect with an optical comparator.
2. Inspect with go and no go hex plug gages per ANSI/ASME B18.3.
3. ANSI/ASME B1.3M, System 22. Inspect with functional segments and single element rolls.
4. Per ANSI/ASME B18.3.
5. Visual inspection for duds, surface discontinuities, bottom of head outside diameter chamfer, closeness of thread to head and general workmanship.

PROPOSED

FINAL TESTING CRITERIA OF ALLOY STEEL HEX SOCKET CAP SCREWS

CHARACTERISTIC	TESTING LEVEL
Proof Load (Note 1)	C
Tensile Strength (wedge)(Note 1)	B
Hardness (Note 2)	A
Decarburization (Note 3)	B
Seam Inspection (Note 4) (Note 5)	D
Hydrogen Embrittlement(If plated)(Note 6)	A

NOTES:

1. Per ASTM A574 and ASTM F606.
2. Per ASTM E18 and ASTM F606.
3. Per ASTM A574.
4. Per ASTM A788/788M.
5. Sample size for destructive testing level D has been selected so that the testing will also conform with ASTM F788/F788M.
6. Per ASTM F606.

All specifications are to be the current edition.

PROPOSED

SAMPLE SIZE FOR INSPECTION AND TESTING OF ALLOY STEEL SOCKET HEAD CAP SCREWS

LOT SIZE	LEVEL OF INSPECTION & TESTING	NONDESTRUCTIVE INSPECTION	DESTRUCTIVE TESTING
5,001-250,000	A	100	8
	B	32	4
	C	8	1
	D	N/A (Note 1)	80
1,000-5,000	A	50	6
	B	16	3
	C	4	1
	D	N/A (Note 1)	32
(For Nondestructive Inspection)	A	25	
Up to 1,000	B	8	
	C	2	
(where sample size exceeds lot size, 100% inspection to be applied)	D	N/A (Note 1)	
(For Destructive Testing)	A		4
Up to 1,000	B		2
	C		1
(where sample size exceeds lot size, 100% inspection to be applied) Manufacturer will have to make enough extra pieces so that after destructive testing, there will be enough pieces left to satisfy the order quantity.	D		20

NOTES:

1. N/A - not applicable.

Acceptance and Rejection

If a single non-conforming characteristic is found in final inspection or final testing, the lot may be resampled for this characteristic with a sample 4 times the size of the original final acceptance sample. The acceptance criteria will be zero discrepancies in this larger sample.

For destructive testing of small lots, there may not be enough pieces to sample 4 times the size of the original final acceptance sample. In this case, the parts will have to be reproduced as a new lot.

The above proposed final inspection and final testing plans have been patterned after ANSI/ASME B18.18.2M-1987.

chart2

SIZE	SOURCE	INSPECTED BY / APPROVED BY	DATE
1/4-20 x 2	XYZ Socket Screw	INSPECTED BY T. Doe	DATE 4/1/91
		APPROVED BY T. Boss	DATE 4/2/91
LOT QUANTITY 201280	ORDER NO. 19650	HEAT NO. RN 1943	

LEVEL	LOT SIZE	DIMENSIONS AS PER ANSI/ASME B18.3		
B	32	THREADS ACCEPTABLE (NOTE 1)	P.D. .2147 - .2175	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
C	8	BODY DIAM.	.2435 - .2500	✓✓✓✓✓✓✓✓
C	8	BEARING SURFACE DIAM. (NOTE 2)	.2615 - .2780	✓✓✓✓✓✓✓✓
B	32	HEAD DIAM.	.365 - .375	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
B	32	HEX SOCKET SIZE (NOTE 3)	.1875 - .1900	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
B	32	LENGTH	1.960-2.000	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
C	8	BODY LENGTH LB MIN., LG MAX.	.750-1.000	✓✓✓✓✓✓✓✓
C	8	HEAD HEIGHT	.244 - .250	✓✓✓✓✓✓✓✓
C	8	SIDE HEAD HEIGHT	.225 MIN	✓✓✓✓✓✓✓✓
C	8	HEX KEY ENGAGEMENT	.120 MIN	✓✓✓✓✓✓✓✓
B	32	WALL THICKNESS	.095 MIN	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
C	8	FILLET LENGTH (NOTE 2)	.024 MAX	✓✓✓✓✓✓✓✓
C	8	JUNCTURE RADIUS (NOTE 2)	.007 MIN	✓✓✓✓✓✓✓✓
C	8	BEARING SURFACE ANGULARITY (NOTE 2)	90 ± 1 DEGREES	✓✓✓✓✓✓✓✓
C	8	SURFACE FINISH		✓✓✓✓✓✓✓✓
C	8	CONCENTRICITY BODY TO HEAD (NOTE 4)	.006 MAX T.I.R.	✓✓✓✓✓✓✓✓
C	8	CONCENTRICITY BODY TO SOCKET (NOTE 4)	.0075 MAX T.I.R.	✓✓✓✓✓✓✓✓
A	100	VISUAL INSPECTION		OK
A	8	HARDNESS	RC 39-45	39.5 / 41 / 41 / 41.5 / 42.5 / 42 / 41 / 42.5
C	1	PROOF LOAD	LBS MIN 4450	OK
B	4	WEDGE TENSILE STRENGTH	LBS MIN 5730 / TENSILE FAILURE AREA	5920 Thrds / 5900 Thrds / 6170 Thrds / 5980 Thrds
B	4	DECARBURIZATION	KNOOP OR DPH 136 DEGREE INDENTOR 200 GRAM LOAD PER ASTM A574	

MOUNT NUMBER	BASE (#1)	.75h (#2)	.003 (#3)	.1h (#4)	ACCEPT	REJECT
280 (A)	442	436	426	420	✓	
280 (B)	465	442	436	449	✓	
281 (A)	449	426	422	426	✓	
281 (B)	462	459	445	442	✓	

LEVEL	LOT SIZE		
D	80	SURFACE DISCONTINUITIES*	all MAGNA FluxeD OK

REMARKS: NOTE (1) ANSI/ASME B1.3M, System 22. Inspect with functional segments and single element rolls.
NOTE (2) Inspect with an optical comparator.
NOTE (3) Inspect with GO and NO GO Hex Plug Gages per ANSI/ASME B18.3.
NOTE (4) Inspect per ANSI/ASME B18.3.

MECHANICAL REQUIREMENTS ARE TO ASTM A574, E18 AND F606
*SURFACE DISCONTINUITIES ARE TO ASTM F788/F788M, PARAGRAPH 6.5
ALL SPECIFICATIONS ARE TO THE CURRENT EDITIONS
MARK X FOR NONCONFORMANCE

PROPOSED

FINAL INSPECTION CRITERIA OF ALLOY STEEL HEX SOCKET HEAD SHOULDER SCREWS

(INCH SERIES - ANSI/ASME B18.3)

CHARACTERISTIC	INSPECTION LEVEL
Shoulder Diameter	B
Shoulder Length	B
Head Diameter	B
Head Height	C
Head Side Height	C
Angularity of Bearing Surface (Note 1)	C
Socket Size (Note 2)	B
Key Engagement	C
Thread Acceptability (Note 3)	B
Head Fillet Diameter (Note 1)	C
Head Fillet Radius (Note 1)	C
Shoulder Neck Width (Note 1)	C
Shoulder Neck Diameter	C
Thread Length	C
Thread Neck Diameter	C
Thread Neck Width (Note 1)	C
Thread Neck Fillet (Note 1)	C
Thread Neck Fillet Diameter (Note 1)	C
Shoulder Cornerbreak (Note 1)	C
Go Ring Gage-Seat Against Neck	C
Shoulder Surface Finish (Note 4)	C
Concentricity-Shoulder to Head (Note 5)	C
Concentricity-Thread P.D. to Shoulder (Note 5)	C
Concentricity, Bow, Parallelism, Squareness of Shoulder to Thread (Note 5)	C

NOTES:

1. Inspect with an optical comparator.
2. Inspect with go and no go hex plug gages per ANSI/ASME B18.3.
3. ANSI/ASME B1.3M, System 22. Inspect with functional segments and single element rolls.
4. Inspect with a profilometer.
5. Per ANSI/ASME B18.3.
6. Visual inspection for duds, surface discontinuities, top of head chamfer, thread chamfer and general workmanship.

PROPOSED

FINAL TESTING CRITERIA OF ALLOY STEEL HEX SOCKET HEAD SHOULDER SCREWS

CHARACTERISTIC	TESTING LEVEL
Tensile Strength (Note 1)	B
Hardness (Note 2)	A
Decarburization (Note 3)	B

NOTES:

1. Per ASTM F574 and ASTM F606.
2. Per ASTM E18 and ASTM F606.
3. Per ASTM F574.

All specifications are to be the current edition.

PROPOSED

SAMPLE SIZE FOR INSPECTION AND TESTING OF ALLOY STEEL

HEX SOCKET HEAD SHOULDER SCREWS

LOT SIZE	LEVEL OF INSPECTION & TESTING	NONDESTRUCTIVE INSPECTION	DESTRUCTIVE TESTING
5,001-250,000	A	100	8
	B	32	4
	C	8	1
1,000-5,000	A	50	6
	B	16	3
	C	4	1
(For Nondestructive Inspection) Up to 1,000	A	25	
	B	8	
	C	2	
(where sample size exceeds lot size, 100% inspection to be applied)			
(For Destructive Testing) Up to 1,000	A		4
	B		2
	C		1

(where sample size exceeds lot size, 100% inspection to be applied) Manufacturer will have to make enough extra pieces so that after destructive testing, there will be enough pieces left to satisfy the order quantity.

Acceptance and Rejection

If a single non-conforming characteristic is found in final inspection or final testing, the lot may be resampled for this characteristic with a sample 4 times the size of the original final acceptance sample. The acceptance criteria will be zero discrepancies in this larger sample.

For destructive testing of small lots, there may not be enough pieces to sample 4 times the size of the original final acceptance sample. In this case, the parts will have to be reproduced as a new lot.

The above proposed final inspection and final testing plans have been patterned after ANSI/ASME B18.18.2M-1987.

chart5

ALLOY STEEL HEX SOCKET SHOULDER SCREW
(Inch Series) ANSI/ASME B18.3

SIZE 1/4 x 2 1/2	SOURCE ABC Co.	INSPECTED BY J. Doe	DATE 4/3/91
		APPROVED BY T. Boss	DATE 4/3/91
LOT QUANTITY 4339	ORDER NO. 15215	HEAT NO. 53N7491	

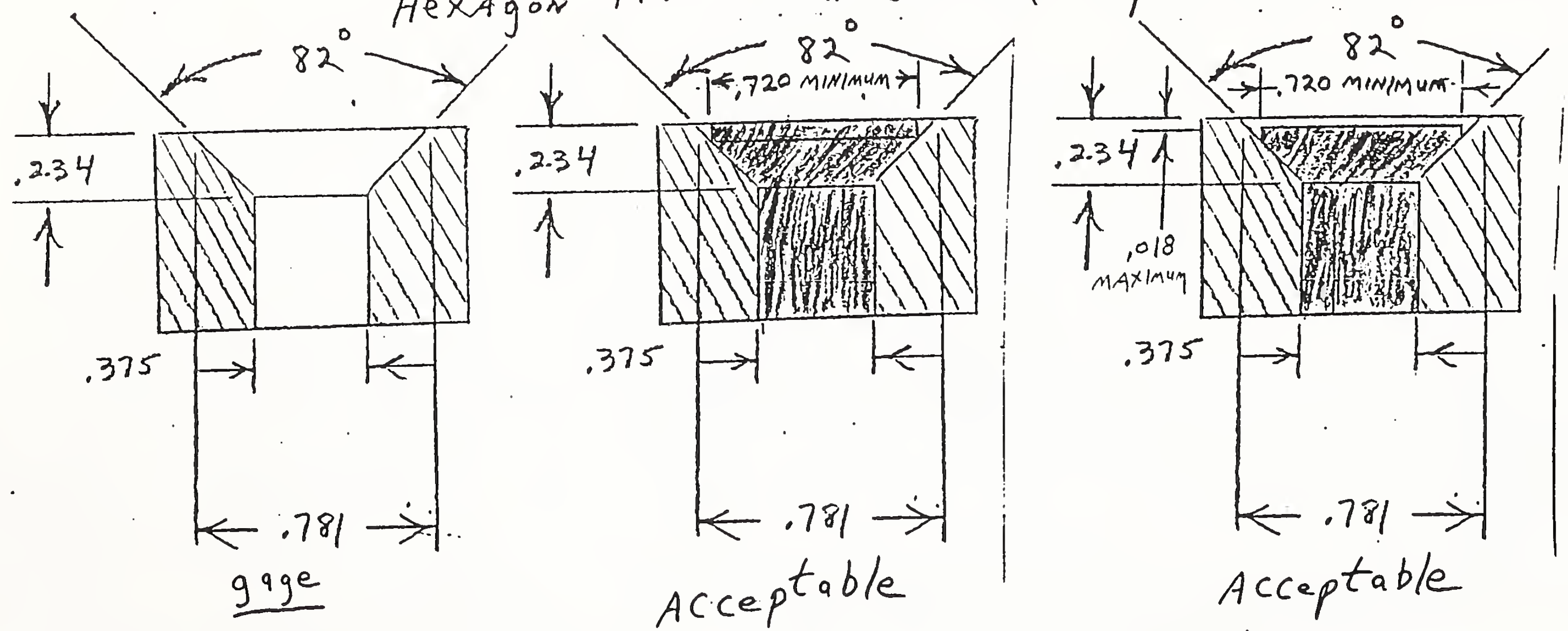
LEVEL	LOT SIZE	DIMENSIONS AS PER ANSI/ASME B18.3			
B	16	THREADS ACCEPTABLE (NOTE 1) #10-24	P.D. .1604 - .1629		✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
B	16	SHOULDER DIAM.	.246 - .248		✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
B	16	SHOULDER LENGTH	2.495-2.555		✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
B	16	HEAD DIAM.	.357 - .375		✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
B	16	HEX SOCKET SIZE (NOTE 3)	.125 - .127		✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
C	4	HEAD HEIGHT	.177 - .188		✓✓✓✓
C	4	SIDE HEAD HEIGHT	.157	MIN	✓✓✓✓
C	4	HEX KEY ENGAGEMENT	.094	MIN	✓✓✓✓
C	4	HEAD FILLET DIAMETER (NOTE 2)	.276	MAX	✓✓✓✓
C	4	HEAD FILLET RADIUS (NOTE 2)	.009	MIN	✓✓✓✓
C	4	SHOULDER NECK WIDTH (NOTE 2)	.093	MAX	✓✓✓✓
C	4	SHOULDER NECK DIAM.	.227	MIN	✓✓✓✓
C	4	THREAD LENGTH	.355 - .375		✓✓✓✓
C	4	THREAD NECK DIAMETER	.133 - .142		✓✓✓✓
C	4	THREAD NECK WIDTH (NOTE 2)	.083	MAX	✓✓✓✓
C	4	THREAD NECK FILLET (NOTE 2)	.017 - .023		✓✓✓✓
C	4	THREAD NECK FILLET DIAM. (NOTE 2)	.190	MAX	✓✓✓✓
C	4	BEARING SURFACE ANGULARITY	90 ± 2 DEGREES		✓✓✓✓
C	4	SHOULDER SURFACE FINISH (NOTE 5)	32 MICRO	MAX	✓✓✓✓
C	4	SHOULDER CORNER BREAK (NOTE 2)	.005	MAX	✓✓✓✓
C	4	GO RING GAGE - SEAT AGAINST NECK (NOTE 4)			✓✓✓✓
C	4	CONCENTRICITY SHOULDER TO HEAD (NOTE 4)	.006	MAX T.I.R.	✓✓✓✓
C	4	CONCENTRICITY P.D. TO SHOULDER (NOTE 4)	.004	MAX T.I.R.	✓✓✓✓
C	4	CONCENTRICITY, BOW, PARALLELISM, SQUARENESS OF SHOULDER TO THREAD (NOTE 4)	.0125	MAX T.I.R.	✓✓✓✓
A	50	VISUAL INSPECTION	OK		
A	6	HARDNESS	RC 32-43		40 / 38.5 / 39 / 39.5 / 39 / 40
B	3	TENSILE STRENGTH	LBS MIN 2220		3370 / 3410 / 3450
B	3	DECARBURIZATION	KNOOP OR DPH 136 DEGREE INDENTOR 200 GRAM LOAD PER ASTM A574		

MOUNT NUMBER	BASE (#1)	.75h (#2)	.003 (#3)	.1h (#4)	ACCEPT	REJECT
1030 (A)	473	473	475	463	✓	
1030 (B)	488	487	483	468	✓	
1030 (C)	476	469	470	457	✓	

REMARKS: NOTE (1) ANSI/ASME B1.3M, System 22. Inspect with functional segments and single element rolls.
NOTE (2) Inspect with an optical comparator.
NOTE (3) Inspect with GO and NO GO Hex Plug Gages per ANSI/ASME B18.3.
NOTE (4) Inspect per ANSI/ASME B18.3.
NOTE (5) Inspect with a profilometer.

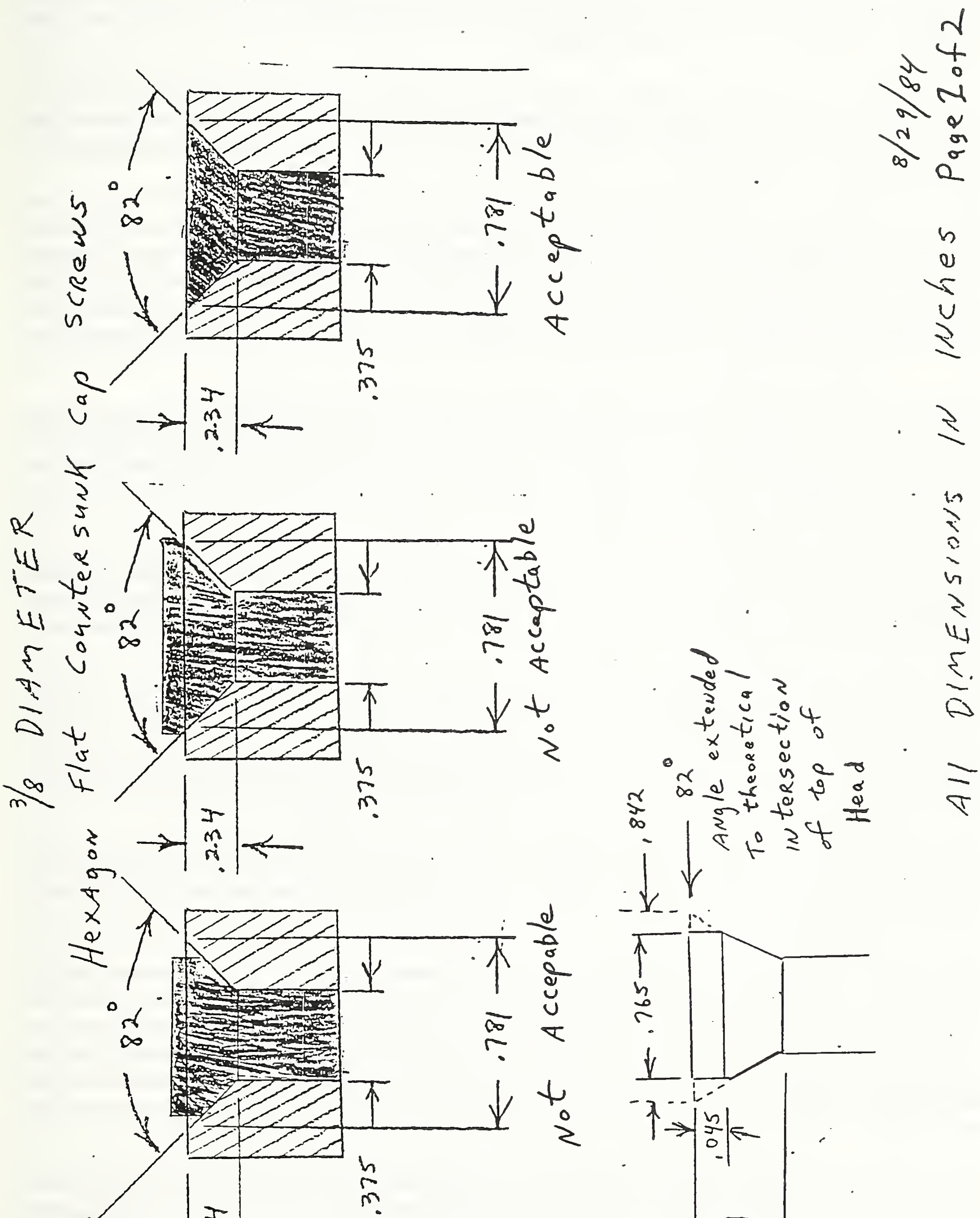
MECHANICAL REQUIREMENTS ARE TO ASTM A574, E18 AND F606
ALL SPECIFICATIONS ARE TO THE CURRENT EDITIONS
MARK X FOR NONCONFORMANCE

3/8 DIAMETER
Hexagon Flat Countersunk Cap Screws



8/29/84

All DIMENSIONS IN INCHES Page 1 of 2


3/8 DIAMETER
Flat Countersunk Cap Screws
Hexagon
82°
82°
82°
.234
.234
.234
.375
.375
.375
.781
.781
.781
Not Accepable
Not Acceptable
Acceptable
.842
.765
.045
.269
82°
Angle extended
To theoretical
intersection
of top of
Head
All DIMENSIONS IN Inches
8/29/84
Page 2 of 2

The fasteners will be fabricated in accordance with the governing specifications and after they are completed, they will be subject to a final inspection and testing procedure. (Such as the proposed procedures submitted for socket screw products.)

In the event these proposed procedures for socket screw products are adopted, additional procedures would have to be written for metric series products, (the procedures are similar, but they are not the same) and also for U.S. Government specifications (the procedures for U.S. Government specifications are similar, but are not the same).

There are many problems that will have to be addressed in order to comply with this law. Many specifications are very poorly written and are hard to understand or are just not accurate. As an example, ASTM F912-90, Paragraph 6.2 states: "socket set screws shall have a hardness of 45 to 53 HRC. The hardness limits shall apply throughout the screw from core to surface." This requirement is not possible to achieve in some of the larger diameter screws. NOTE: This specification covers alloy steel socket set screws up through 2" diameter.

The current title of the socket screw specification is ASME/ANSI B18.3-1986. The preceding specification's title was ANSI/ASME B18.3-1982. It is listed in the current edition catalog (1990-91) for American National Standards as ANSI/ASME B18.3-1986. It has also always been listed in the previous editions of the catalog for American National Standards as ANSI/AMSE B18.3-1986. This is nothing but confusion to the uninitiated.

ASTM F606-90, Section 7, tests for embrittlement of metallic coated externally threaded fasteners, Paragraph 7.1 states as follows, "This is one test method for determining if embrittlement exists in a metallic coated externally threaded fastener covered by the product specifications of ASTM Committee F-16."

The specifications say this is one test method, but no other test methods are given. Paragraph 7.4 of the same specification says in part, "If the torque method of tightening is used" (this is the test method referred to in the specification). Instructions are then given, and frankly I do not think it would be physically possible (unless a company had some kind of machine) to torque by hand the requirements as specified in this paragraph for a large diameter screw, such as 1" or larger.

There are many other problems with the specifications, and they cannot all be listed or resolved with this communication. Many or all of the specifications are going to have to be rewritten so they are actually completely workable.

In the case of socket cap screws, there are many very small quantities used of sizes that are not ordinarily considered as a stock item. ASTM A574-90, covering alloy steel socket head cap screws, and ASTM F835-90, covering alloy steel socket button and flat countersunk head cap screws, state that screws up to 1-1/2" diameter shall be made either by hot or cold forging. In most cases, the only practical method for making these parts in these small quantities is to machine them from bar. This has been done under many, many occasions, by many different companies, but frankly, these parts do not meet the specifications.

Another problem is that socket screws of all types are not ordinarily stocked in a plated condition. Kerr Lakeside Inc. has numerous requests for small lots of plated, standard socket cap screws. The standard socket cap screw has a Class 3A thread, which means there is no plating allowance on these threads. We have quoted and furnished many parts, advising our customer that these parts will be Class 3A thread before plating and will not pass a thread inspection after the parts have been plated; however, the parts will ordinarily assemble with their mating part. Under Public Law 101-592, these parts can no longer be supplied in this manner.

Section 7 (d) of the law reads in part, "Any person who significantly alters a fastener." What is the difference between "significantly alter" a fastener and "alter" a fastener'?

Does a fastener to which a self-locking plastic element has been applied have to be re-tested? I have been advised by one such manufacturer that they heat the parts up to 400 deg F to apply this plastic part. Have these parts been altered by this process? Continuing on with this problem, an alloy steel socket set screw has a hardness of HRC45-53. It is not practical to insert a nyloc pellet locking device into a screw that is this hard. This type of product is tempered down to a lower Rockwell hardness so that the nylocking operation can be performed. Since these parts are now softer than RC45-53, they therefore would not meet the specifications as spelled out. How would they be tested and inspected?

It is not going to be possible for the United States Government to enforce any fines or prison sentences if a foreign accredited laboratory approves inferior parts. They would not be subject to any laws of the United States of America. The only recourse is to have their accreditation withdrawn.

Some procedure must be set up for arbitration. Kerr Lakeside Inc. recently had a problem when an incoming fastener failed to meet our tensile testing. The part was made in Japan, and samples were returned to Japan. The Japanese manufacturer claimed that there was nothing wrong with the tensile requirements of this part. We sent samples of this part to two outside accredited laboratories for tensile testing, and both of these laboratories came up with a satisfactory tensile test result. Kerr Lakeside Inc., who is also accredited for tensile testing, re-tested additional pieces of the same lot and they again failed our tensile testing. They were close to being to specification, but they did not make it. Our tensile testing machine had just been recalibrated approximately three weeks before this happened.

There should be some method for deviation of parts that are not completely to the specification, but from a practical standpoint, would be very functional. Examples I give are if the diameter of a cup point on a socket set screw was a thousandth or two oversize, this would not hurt anything whatsoever, but the part is not in accordance with the specification. The same principle could apply to a hex socket that was slightly oversize and would accept a no go hex plug gage. Again, if the head side height of a socket head cap screw, or socket head shoulder screw was slightly undersize, the parts would still be very functional. There are many other situations that I have not listed that would also make it desirable to have a deviation for parts that are not completely to the specification. I have no ideas as to how any procedure can be written for deviations, but I think it is something that should be addressed. Why should a lot of good functional fasteners have to be scrapped because they are slightly out of specification?

Most specifications do not require that screws larger than 1-1/4" in diameter be tensile tested in full size. The specifications give alternate methods of testing, which really tells nothing about the quality of the fastener. All these alternate methods of testing only show that a good heat treatment has been performed. Since the law was passed to ensure the quality of fasteners, shouldn't these specifications be modified that the larger size fasteners be tensile tested in full size? The reason that the specifications do not currently call for it, and it is a good reason, is the fact that this larger size testing equipment is tremendously expensive.

However, there are many companies that make nothing but larger diameter screws, and I feel that they should have the proper tensile testing equipment to test their product.

My written submission includes a copy of a paper that I have recently written, "Answers To Questions Concerning Hex Socket Screw Products That You May Not Enough Knowledge To Ask." This paper addresses some other problems that will arise in the near future.

Undoubtedly, many other unforeseen problems will arise that will have to be addressed at the proper time.

I will close this report with a quotation not original with me, but very apropos, "Laws are made by politicians, engineers have to live with reality."

Questions and Answers, and Comments

Q: Bruce Armstrong, US Navy - What is practical fastener testing material regulation?

A: You just can't go two inch diameter and get it hard in the core, get the hardness required, I left part of that out - the Rockwell Hardness, the Rockwell C45 to 53. And sorry about that, but with the type of steel you are going to use for socket screws you are just not going to get it. And that is one of the reasons you check Rockwell Hardness on the mid-radius, because the core on the big part is not the same hardness as the mid-radius or the outside diameter. There are all kinds of specifications that are vague and incorrect. I've got a list of some of them at home. If I had known twenty years ago what I know now, I might of been on some of these committees. Because I know some of these specifications were not too good, and I just lived with them.

C.9. William E. Perry, Consulting Partner, Miller, Canfield, Paddock & Stone, on behalf of the Taiwan Fastener Association

Mr. Perry provided a summary of what is currently going on in Taiwan. The Metals Industry Development Center, which is funded by the Government, has a laboratory testing all fasteners being exported to the United States, pursuant to IFI Standards. The Bureau of Commercial Production Inspection and Quality is a government agency overseeing that laboratory.

Mr. Perry stated that the Taiwan Fastener Association supports NIST's consideration of the IFI statements when implementing the Fastener Quality Act. The Taiwan Fastener Association will be providing NIST with additional information about the testing methods and specifications used in Taiwan.

In his final point, Mr Perry commented on the magnitude of the task ahead. NIST is certifying foreign laboratories in every single county in the world, producing fasteners for export to the United States - China, Taiwan, Korea, Japan, Thailand, the EC. This diversity should be considered in coming up with the specifications and test methods implementing the Act. He noted, that these laboratories are going to be operating in many foreign languages including Chinese.

Questions and Answers, and Comments

C: Mike Williams, Rolls Royce - I am here representing both the United Kingdom and Europe. At the formulation of the advisory group to look at this particular law I know that at least thirty countries, I was informed, have asked to have representatives on the advisory group. However, Taiwan could not be there as could not the United Kingdom or even a representative from the EEC in Europe. The set-up, I understand, is that the advisory committee is totally U. S. - whereas, in fact the whole concept of this law will as you say quite rightly cover the whole world. And one of the difficulties I think that the rest of the whole world, which is not insignificant, is that here we are today discussing the possible ramification of this bill, whereas, in fact what we have is a lot of very vague information regarding the application of the bill. Today's session looking at the accreditation of the laboratories is one tiny fraction of what the real situation will be and what the difficulties will, particularly prime contractors in the aerospace business, will be if this bill is implemented to the full extent that it is possible under the wording of the bill.

C: I may make one interesting point, which as you mentioned, there is no definition of critical application. Does that mean that when Honda sends a replacement screw to the United States for when a piece comes off its engine that screw must be certified? That is going to be creating unbelievable amounts of money you're putting on replacement parts. We are going to have the million dollar proverbial toilet seat.

C: Steve Hengeli - I have one question or one comment to make. In the law, in Section 2 - Findings and Purpose, and then D - The Purpose. "In order to protect the public safety". And that is a statement our United States Congress made for United States citizens. If other countries want to participate, they should by design learn what we want to do. And then if they meet it fine. But to have other countries telling us how we should make our fasteners is one of the reasons the fastener business has the problems it has today. When I started in this business in 1952 there were probably fifty thousand people - maybe not that many but pretty close to that - in Cleveland in the fastener business. There isn't five hundred in the fastener business in Cleveland anymore. It has gone somewhere else. And now we have problems. Thank you.

C: Mr. Perry - We agree with you completely. I mean in the sense of you set the standards. Frankly, we don't tell the domestic manufactures. The people who tell both of us are the customers.

C: Richard Kerr, Kerr Lakeside, - I feel very strongly when you made the statement, "IFI Standards". They are not the standards. And this is one of the big problems. And frankly, the fellow who just talked ahead of me; what he said is really true. And I have seen a lot of junk come into this country. We inspect everything that comes into our place. And when you get a quarter-twenty socket set screw that's got a pitch diameter six thousandths undersize and you have to argue with the people that supply that it's no good, this is ridiculous. And this is some of the problems that this country has been facing for the last many years. And I want it on record again and again, IFI is not the standard in that book. Thank you.

C: Roger Crane, private consultant in international trade - I worked for the US Customs Service. I was the person who developed the Customs Laboratory Accreditation Program. Then I ran that program for two years before I left Federal service. I would like to amplify the comment that was previously made by Mr. Perry; that the Custom Service does indeed inspect almost all shipments. The Customs had a significant inspection program for industrial fasteners and the standard that NIST develops for laboratory accreditation should keep in mind the custom service program, because Customs is going to be using the data that is developed by this organization in its enforcement efforts on imported fasteners. Thank you.

C.10. Gus Tirado, Government Affairs Analyst, Toyota Corporate Motor Services of North America, Washington, DC

My name is Gus Tirado, I am here from Toyota Motor Corporate Services of North America to speak on behalf of Toyota Motor Corporation. I would like to thank NIST for providing Toyota with the opportunity to speak at today's workshop. Unfortunately, our engineers from Japan were unable to be here today so I will be limited in my ability to answer any questions you may have. However, if you do have any questions I can submit them to our office in Japan and have them answered for you.

In any industry, there is always the problem of a product manufacturer unknowingly purchasing and using substandard parts, furnished under false pretenses by unscrupulous individuals driven by one of the oldest of human vices, greed. Since fasteners of one kind or another are used in nearly everything we come into contact with, the inclusion of substandard fasteners into any manufactured product, be it commercial aircraft, building materials, or automobiles does pose a threat to everyone's safety.

Toyota is here today to state that while we agree that events have demonstrated the need for creating the Fastener Quality Act (Public Law 101-592), we also wish to bring NIST's attention in this public workshop to the following points concerning Public Law 101-592 as NIST considers drafting proposals to implement its provisions.

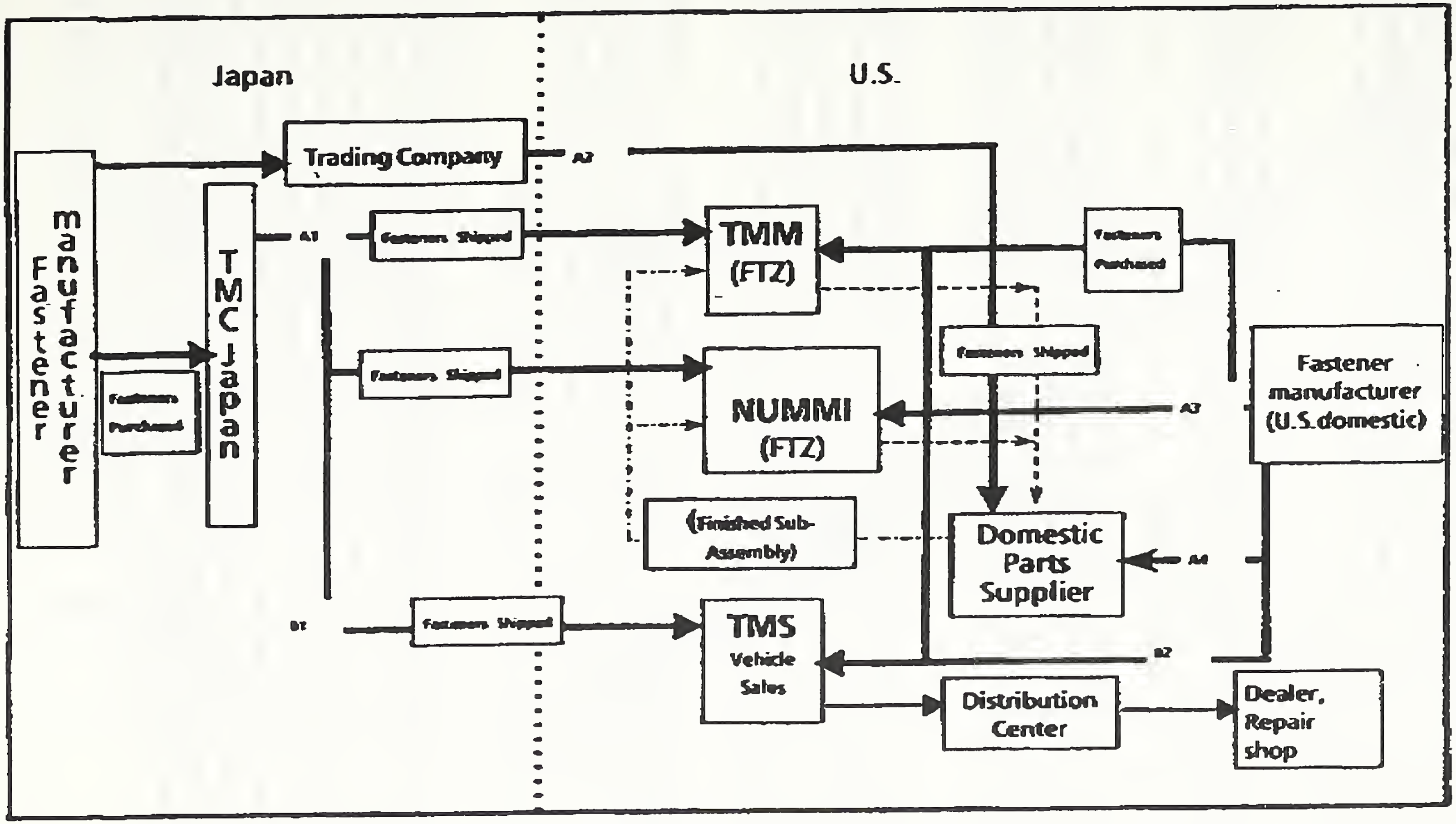
<u>TECHNICAL PROBLEMS</u> Central to the Fastener Quality Act is the definition of a fastener and which fasteners are to be covered under this Act. Of particular concern in the automobile industry, is the definition of a fastener with respect to the components included in an automobile. The answer may seem obvious, but the scope of the Act's definition of a fastener could be interpreted as broadly as to include components such as a motor vehicles's engine block, since it does have internal threads and of course has a diameter greater than 5mm.

Also, under the Fastener Quality Act all fasteners subject to the Act will need to bear a manufacturer's insignia to aid in tracing a fastener's origins. But there will be many instances in which markings will be either impossible or impractical. There will be cases in which nuts, bolts, or washers may be too small or oddly shaped to mark without upsetting the balance or integrity of the fastener.

<u>PUBLIC LAW 101-592'S APPLICABILITY</u> Long before the Fastener Quality Act was even drafted, many industries, including our own, have had in place strict and thorough part's development, evaluation, inspection, procurement, and shipping safeguards to prevent substandard components from slipping through. As just stated, circumstances have made government regulation of fastener quality necessary. However, Toyota believes that regulations should be carried out when they provide measurable benefits. It is our opinion that for industries such as ours, compliance with the Fastener Quality Act will only duplicate the safeguards already in place.

With this illustration (figure 1) let me briefly explain Toyota's Parts purchasing and shipping systems. Toyota procures fasteners from both Japanese and U.S. fastener manufacturers, which are shipped to its

Examples of Fastener Purchasing and Shipping Routes



, Fasteners shipped solely for vehicle Assembly

A1, Fasteners sold directly via TMC to TMM and NUMMI

A2, Fasteners sold by a trading company (Toyota Tsusho) to domestic parts suppliers for sub assembly construction which are then shipped to TMM and NUMMI.

A3, Fasteners sold by a domestic fastener manufacturer directly to TMM and NUMMI

A4, Fasteners sold by a domestic fastener manufacturer to a domestic parts suppliers, who uses the fasteners to complete a sub-assembly, which is in turn, sent to TMM and/or TMM.

Fasteners exported and sold as genuine Toyota supply parts

B1, Fasteners sold by TMC or TMS to dealers or repair shops as genuine Toyota supply parts.

B2, Fasteners sold by domestic fastener manufacturer to dealers or repair shops.

U.S. vehicle manufacturing plant Toyota Motor Manufacturing (TMM) in Georgetown, Kentucky, to its joint-venture vehicle manufacturing plant New United Motor Manufacturing, Inc. (NUMMI) in Freemont, California, for final vehicle assembly, and to its vehicle sales agent Toyota Motor Sales U.S.A., (TMS) as after market service parts.

Before Toyota accepts any fastener from any fastener manufacturer, the supplier like all other suppliers of any other component used in the assembly of Toyota vehicles, must first demonstrate to Toyota's satisfaction, that the fastener they wish to sell us fully meets the material and performance specifications to which Toyota has ordered the part to be made. Once compliance with our specifications has been demonstrated to our satisfaction, the fastener is given, a Toyota part number which indicates both the fastener's material and performance properties.

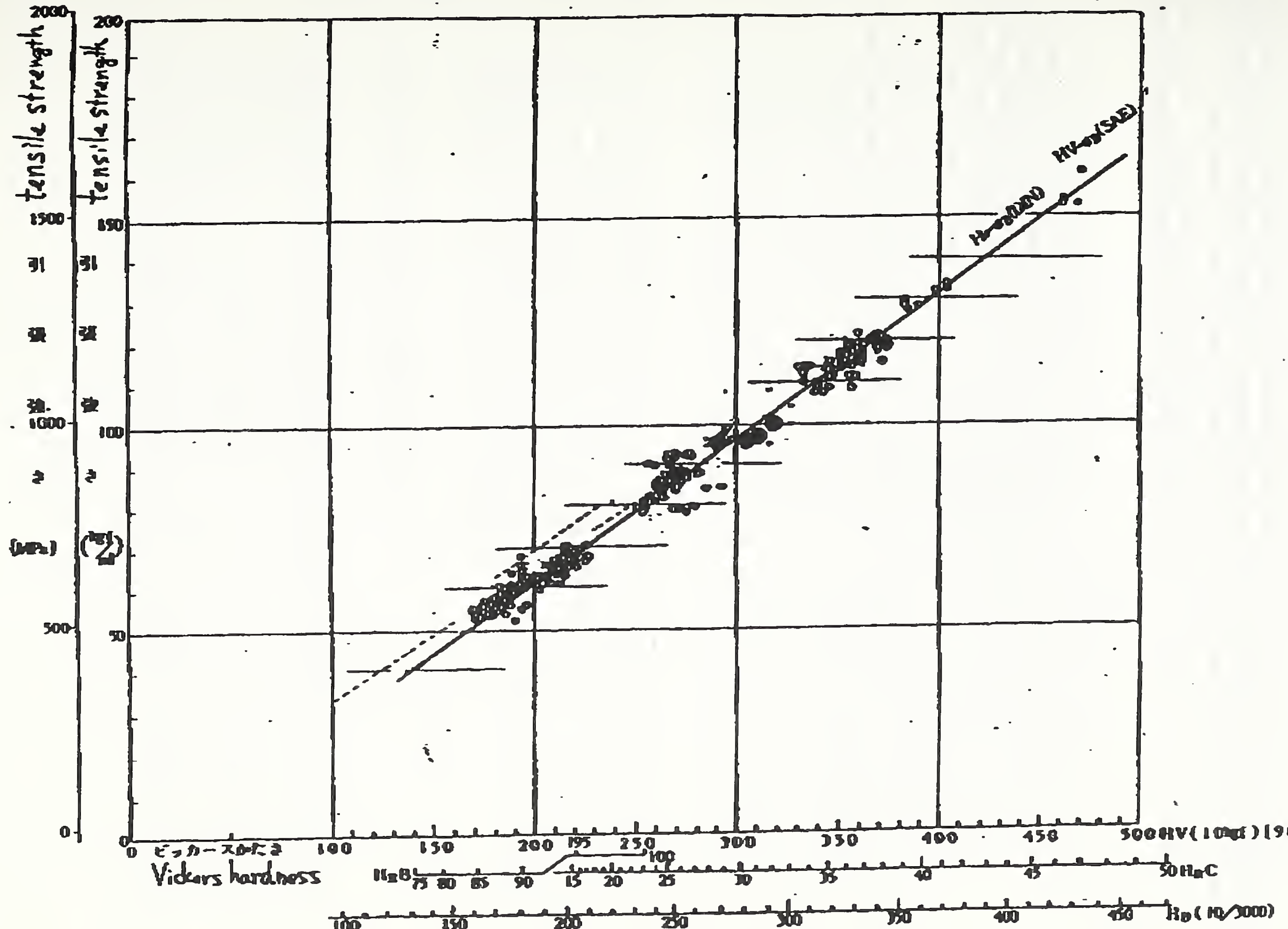
These part numbers insure that each fastener will be used only in its intended place and only for its intended purpose. Our fasteners are exported to the United States, or purchased locally, solely for the assembly or servicing of Toyota motor vehicles, they are kept within our control and will not be used in any application other than their intended purpose.

Since our own in-house parts procurement and shipping system accomplishes the same task as Public Law 101-592, compliance with its requirements will, as I have just stated, only mean duplication of effort and add nothing, except extra cost, which in the end we will have to pass on to the consumer. We ask then that consideration be given in the final regulation for those who can prove that their own in-house parts procurement and shipping practices would have an equal or greater effect as compliance with Public Law 101-592.

At Toyota, we sometimes receive orders from some of our final product manufacturers for fasteners which are no longer in production. In such cases, we must make a small quantity of those fasteners to fill such an order. We believe that under these circumstances small quantities of fasteners should be exempt from the requirements of this law. Such an exemption would not detract from the integrity of the law since, any fastener manufacturer trying to circumvent the law by marketing substandard parts would find it economically impractical to do so with a small quantity of fasteners.

FASTENER STANDARDS AND TESTING We wish to point out that Japanese industry uses Japanese Industrial Standards (JIS) which correspond to ASTM and SAE standards which are of course widely used in the United States. Further, Toyota has its own internal standards for fasteners, as do other automobile manufacturers, such as Nissan Motor Corporation. We ask that compliance testing be permitted, upon approval from NIST or the Department of Commerce, of the standards of manufacturers, industrial associations or other parties which have their own fastener performance standards.

In general, we believe that the evaluation of fastener quality would best be served by allowing for a standards organization for a given industrial field to set the testing criteria. Toyota's fastener testing standards are set for fasteners used solely in Toyota products and vehicle design is done on the premise that the fasteners to be used are those which meet Toyota standards. Therefore, we believe that Toyota should be allowed to decide which fastener testing and inspection procedures it will use.The relationship between a fastener's tensile strength and hardness is shown in this overhead (figure 2), because fastener tensile strength and hardness is interdependent. Toyota believes that if a fastener's hardness is adequately controlled, inspection for tensile strength is unnecessary. Toyota has in the past conducted wedge loading strength testing and head impact testing and found through these tests that the radius of the fastener shank controls how well a fastener performs in these tests. Thus with careful control over the fastener's shank



ボルトの引張強さとビッカースかたさの関係
The relation between tensile strength and Vickers hardness

radius we can accurately estimate if it will pass or fail, which makes, we believe, additional testing unnecessary.

<u>LABORATORY ACCREDITATION</u> Toyota requests that consideration be given to allowing the Japanese Government or JIS to give approval for laboratory accreditation as well as allowing for a mechanism for individual manufacturers to apply for laboratory accreditation on their own.

This concludes Toyota's presentation. Thank you for allowing us this opportunity to present our views.

Questions and Answers, and Comments

C: Richard Kerr, Kerr Lakeside, Inc. - I have been on both sides of the street and your statement that the hardness of a screw guarantees its tensile strength is not correct. And we just had a case of some parts here about six months ago that came from Japan that had very fine Rockwell hardness but they failed the tensile strength miserably. The heads popped off and they were not made good. But the way you're talking they would be perfectly good screws and that is not a statement of fact at all.

C: I have received that information from our people in Japan and I'll pass what you said along on to them but I can't comment.

APPENDIX D - OPEN DISCUSSIONS BY PARTICIPANTS

Mr. Stiefel opened up the floor for comments. In preliminary remarks he noted that NIST has received additional written comments, and these comments together with the workshop presentations are providing much information to be considered in putting together the accreditation program. Also, many tangential issues not directly related to the development of test list were commented on, which nevertheless impact on accreditation. Such issues as sampling and the suggestion to consider use of the ASME B18.18.2M document. The floor was opened up for discussion.

Q: Murray Dwight, Dwight Estimate Company, NJ - We are a metrology laboratory and we have been testing fasteners but my question is now what is the process from here and I am asking your estimate. There is a follow-up meeting, there is another group and then they break up, and what is the time frame were talking about, do you have any estimate of that?

A: Wayne Stiefel, NIST/NVLAP - One thing that was told to us by Mike Rubin of the General Counsel's Office earlier this morning was that the final procedures would have to be in place before the accreditation program could go forward. That's what he said this morning. In terms of the timing, I certainly would not second guess what he said. The process for developing the accreditation process is going forward, and we will be developing the technical assessment tools, the handbooks, looking at the critical elements for all these test methods and putting together the technical basis for doing the accreditation. That is going ahead, and we are in the process of doing that right now. So, I would just say that even in the absence of the final regulations, we are in the process of developing a program. And that program will be ready, hopefully, as soon as those final regulations are ready, so that we can initiate the process of doing the accreditation.

Q: Jack Smith, Fairchild Fasteners Corp. - We have talked briefly today about manufacturing insignias and the requirement for that. We have not talked about the alteration subsequent to the original manufacture. And I like to express a concern regarding the possible liability on the original manufacture if a part has been reworked without his knowledge. Does this require the deletions of the original insignia and for that remanufacture to apply their own? I suggest that's impossible and I also suggest that lot traceability is often lost by the end user. If there were catastrophic accident the original manufacturer head marking would still be on there. And I would like the committee to give this some consideration.

A: Wayne Stiefel, NIST/NVLAP - I am not going to attempt to answer some of these question. I think it's enough that you put them on the record.

Q: Jim Duke, Phillip Screw/Division 6, Aerospace Group of Industrial Fasteners Institute - One general comment, and I don't think anyone here would really argue, the advisory group and NIST are going to have to have the wisdom of the Deity and probably eons of time to resolve of the problems that have been put in front of you this morning. I'm glad that the use of May 15th as an estimated date was not related to either a year or a decade. A lot has been said about the accreditation of laboratories. I believe the Bill, unless I am misinformed, also provides for means of disaccrediting laboratories and I think that's a point that needs to be related to Mr. Lewis' remark and others' remarks about the vagueness and in some cases the downright disaccuracy (a coin word) of some of these specifications and standards that exist. And once you get into that rat's nest and start dealing with some of the standardization bodies, maybe we are not talking about this century to really work out the regulations. God be with you. Manufacturers, presumably there labs will be accredited somewhere along the line. The process of doing this is through accreditation laboratory services and/or NIST am I correct?

A: Wayne Stiefel, NIST/NVLAP - Manufacturers are certainly allowed to apply for accreditation within the Laboratory Accreditation Program.

Q: Jim Duke - Yes. How long a period is allowed here and how do the priorities get established to which manufacturers get accredited first or second or third tier or what have you, because there are some definite competitive factors that will be involved in those priorities?

A: Wayne Stiefel - Well without committing ourselves to anything, I can tell you something that we have done in the past. For asbestos testing we opened up (announced) the program, and during a time frame we allowed anyone to apply that wanted to be accredited. They were all treated as a block. In other words, the accreditation went on over a period of time, but they all received their accreditation simultaneously on one date.

Q: Jim Duke - That's an interesting approach. Just a couple of comments on Mr. Rubin's remarks and warning all of us not to go public with any thought of being accredited until it was an actual fact. He mentioned that some draft of regulations were being circulated in various groups within the Department of Commerce and one of those was the Patent & Trademark Group, am I correct in that?

A: Wayne Stiefel - Yes, that's correct.

Q: Jim Duke - I think the advisory committee should take into account that particularity in the aerospace industry there are a number of fasteners, Phillips being one, who have trademarked or patented devices which are shown on the standards. The various originating bodies, in fact, made a contract with companies like Phillips in establishing the dimensional and other controls, gages, drivers, and things of that nature that are on those standards. That any activity to remove those trademarks or those patent numbers without the express permission of the licensor has to be done with a great deal of trepidation because a formal contract actually existed at the time those standards were established. And one final point, reference was made by Jack to reworking alterations of fasteners. In many cases that occurs in the distribution portion of the fastener system for getting a part from a manufacture to the end customer. The law makes a lot of references to lot control. It would seem to me that among the regulations there should be included the means by which lot integrity is maintained from a large purchased lot to the smaller lots which are distributed to end customers. A number of the manufactures, particularity in the aerospace industry, have established such systems and I think it should be formalized in the regulations.

A: Wayne Stiefel - Thank you, sir.

C: Bill Hayes, Hawaii Nut & Bolt, Honolulu, HI - I am one of those distributors you have been hearing so much about. But what I like to address Mr. Kerr suggestion with regards to accrediting per specification versus accrediting by the equipment or process capabilities. I agree one hundred percent. In the distribution arena quite frequently we are required to supply, and

I am speaking primarily to such groups as nuclear submarines repair facilities. We are required to supply to specifications that have been superseded. Just this last weekend I had a very good opportunity to speak to a gentleman by the name of Bill Baker, who is with the Newport News Shipbuilding and Drydock, who I am sure you all know is a major manufacture of nuclear submarines and aircraft carriers. And they are continuing their practice to use specifications that have been superseded, mainly because it would be such a huge undertaking to readdress the engineering of the completed vessel as this case may be. So again, If I may just reinforce, I concur that specifications versus equipment and process should be definitely considered. Thank you.

C: Arney Hendrickson, Engineering Components, Schaumberg, IL - I am also here representing the Chicago Bolt, Nut & Screw, Association, which has over two hundred member-companies and I was also involved with the Fastener Coalition and in some of the language in the Bill, representing twenty-two hundred fastener *********end of tape*****************
the approval that gives somebody, manufacturer or distributor, the right to ship the parts and test them later over fifty pieces. The other point I wanted to make for the record, Dick Kerr brought up that Rockwell reading does not guarantee tensile. We found that to be the case many times. We just had a two million piece rejection where the heat-treaters argue with us if the Rockwell was there than it meets the tensile requirements. And they failed miserably the same as his experience.

Q: I noticed in some of the speakers you are going to have the same criteria at the laboratory level whether it's a military part, whether it's an aerospace part or whether it's a commercial part. Now, either the aerospace or military are going to come up on the short end of the stick, or we are going to have problems at the commercial level with cost. There should be some kind of a separation. I realize, theoretically, all parts going anywhere should meet the same specification but when it comes down to commercial use sometimes it's not realistic. Also, there should be something at some level whether it's the laboratory level where you have an option at again the customers approval to ship a part that doesn't meet a specification. Example, somebody has a three-quarter ten grade 8 bolt and it's one thousandth too low on the head height. It doesn't mean anything as far function if you follow the bill the way it stands you could not ship the part. If you don't have some kind of exception, what you are going to have is many Standards will become specials. Because at the customer level all they have to do is redraw the drawings, the three-quarter ten grade 8 bolt, lower the head height by two or three thousandth of an inch and it becomes the customers Standard. So there should be something there that gives something where the customer could approve parts that are off just a little bit. OK, I have two questions and the first question would be I believe to Michael Rubin. If there are people in the market place right now, distributors or manufacturers or laboratories, that say and there are people out there saying that they are accredited under this Law, who should it be reported to?

A: Wayne Stiefel, NIST/NVLAP - Well Michael Rubin is not here but I suggest you report it to Michael Rubin.

Q: The other question is earlier there was something that was put up that said that there were twelve hundred laboratories, how many of those twelve hundred laboratories do fastener work?

A: Wayne Stiefel, NIST/NVLAP - As I explained when I put the slide up there, that field of testing is not included in the twelve hundred laboratories. It maybe that some of those laboratories are doing mechanical testing, as well as the other kinds of testing they're doing. We don't accredit right now for fastener testing, so the answer is we are not counting them as if they were testing fasteners.

Q: But you don't know presently how many of them actually do fasteners work at this time?

A: Wayne Stiefel, NIST/NVLAP - No, I don't know that.

C: Thank you.

C: Charlie Wilson, Industrial Fasteners Institute - I have one point I would like to put on the record. It hasn't been mentioned this morning but it is a critical problem in trying to control fastener quality. Although Division six of the IFI is primarily involved with aircraft fasteners, it certainly relates primarily to them but certainly to other areas as well. And this is the so-called issue of surplus fasteners. There are major OEMs, there are major air frame and air engine manufactures in the United States and throughout the world, who routinely make a practice of dumping thousands and thousands of fasteners into the so-called gray market; either trading them for hotel room and airline tickets or selling them at surplus. This is an uncontrolled problem that has caused serious problems and it must hopefully be brought under control through the regulations.

C: Chris Weckrow, MNP, Corp. - Just to give you a bit of background information, MNP, Corp. is a high volume manufacturer of fasteners primarily automotive but we do supply a substantial amount fasteners that are distributed to Network America. I'd like to let everyone know about the experiences that we have had in dealing with automotive. As you probably have heard in the newspaper and stuff like that there is a substantial drive to bring down the cost of an automobile and one of the main areas of attack for that has been improvement of quality and that's been a strategy over the years. An unfortunate thing with the Bill is that it doesn't really give any allowance, OK, for people who have substantial quality programs for which they're quality of the product is a given. A problem we face, certainly the one I'm approaching at this particular point is at a substantial degree of control actually takes place at the actual operation. To such a point we have gotten our processes at such a level of control that in many different areas of final inspection is really not required. In fact, we really do it. We do have certain safety-type product which are mandated by our customers which are essentially mandated again by the government. And we essentially do this because we are required to do it because it is in the contract. However, as one might expect, we don't find anything to really report in the way of non-conformity. The concern I have is we do not do final inspection on a substantial quantity of these automotive parts because for the reasons I mentioned earlier. The concern that we have in our company is that if we do go this practice, doing a final inspection and a full test report layout we are really going to be substantially adding to the cost. And that has been approach a few times in this meeting so far. I would like to mention that I thought the comment made by Charlie Wilson with regards to the inclusion of a quality standard and he recommended FAP-1 as part of the criteria I think it is a very important one because unfortunately the bill doesn't really require anything up from the manufacturer as far as I can see. Essentially, it just requires that someone manufactured some fasteners and just get them qualified by a lab. We rather feel that this is a little bit, this really does not make a whole lot of sense. I think one has to look at the automotive experience. Automotive companies, if they are going to be viable suppliers of fasteners in the community anymore, have to have qualified systems. There is a system out there which each company uses and it's essentially called self-certification. It all started when you had automotive which did a substantial amount of receiving inspection and they said that "Well no, we are not going to being doing that anymore. We are going to have our suppliers certify their product to us, they have to make it right." So those systems are well ingrained and I think it's a great learning experience. I think there's a lot that can be learned by this group of people here by the automotive experience. I'd be very happy to discuss at a great length to people should they choose. I think the one thing that should be approached from an accredited laboratory is that they certainly would have to have the necessary basic equipment so that they can do ninety percent of the testing. And the experience we had with A2LA, for example, when we first became accredited by them is that we put down the list of every single specification we can think of that we wanted to be accredited to because we were automotive, GM, Ford, Chrysler and a whole bunch of other people. The trouble is it took about maybe two or three pages to put them all on there. However, when we approached it from the direction of saying what test are common to each one it filled maybe about a page, maybe less than that. So, we feel there's a lot of merit to looking at the actual unique test procedure by name, since there's a heck of lot of this in common between the all the fastener standards. I might make mention about one particular item that's in automotive standards that we use and we think it makes a heck of a lot of sense is that final auditing in some of the standards says that it is not required if there was an adequate degree of control, and they do define what that means but I won't go into that right now. But if there were no changes to previously acquired properties, that there we no changes put on by subsequent operations, then that characteristic can not be re-checked. That we feel that's a very, very smart particular statement and we feel it is very, very valid. And like I said if anybody would like to know more about how the automotive process works, it's been approached from the direction of having a lot of hard evidence of statistical process control, control plans, procedures, that type of thing. Substantial amounts of in process activity where it really belongs because really when all is said and done, if the process is any good then the final audit on the use of testing by the accredited lab really becomes unnecessary. Thank you.

Q: Larry Andrews, Special-T-Metals, Lenexa, KS - We are a distributor. I just wanted to reinforce the statement that we made earlier. I think the Act needs a little more clarification in the matter of altering distributors or alteration to an original manufacture's part. We have on an occasion ourselves upgraded parts. But we have an in-house policy we don't upgrade a part if it has another manufacturer's head marking on it. We do receive upgraded parts from other distributors on occasion but this isn't the case. And they also come in without correct head markings. I like the idea of the standard test form, because when you are dealing with as many people as we deal with, every distributor trying to find all the information on the test reports and the consistency of it would be an improvement. We also deal with the MIL-S-1222H specification. We also deal with the Newport News, Bill Baker was mentioned earlier. The idea of maybe qualifying or accrediting via a specification I am not so much in favor of that. I like the idea of before where you looked at accrediting on a test method like wedge tensile. And even cross-referencing a wedge tensile like a F606 versus an ASTM F1312 test method A. That you'd not have to be accredited in each one of those procedures to be accredited for the function. Thank you.

CLOSING REMARKS

C: Wayne Stiefel, NIST/NVLAP - There being no more speakers, I like to once again thank you for attending our meeting. Your presentations and discussions have provided us a very valuable resource for putting together our test method list. And I would like to thank each and every one of you for the time and effort that you expended to come here and speak to us. And with that, I'd like to adjourn the meeting. Thank you.

APPENDIX E - COMPILATION OF RECOMMENDED TEST METHODS

The March 22, 1991 notice in the *Federal Register* resulted in 27 lists (which included fastener specifications and recommended test methods). There were 76 fastener related specifications and 211 test methods recommended (105 mechanical, 23 metallographic, 42 dimensional, 32 chemical and 9 nondestructive). The 27 organizations submitting lists have been classified as accreditor, laboratory, distributor, manufacturer, foreign manufacturer, private user, government user, standard organization, and importer.

This appendix contains a compilation of the 27 lists. Table E-1 is an alphabetical listing of the recommended fastener test methods and fastener related specifications. Table E-2 is a matrix of the fastener related specifications indicating the number of times each specification was recommended for consideration by class of organization. The test methods have been divided by type of testing and tables E-3 through E-7 are matrices for chemical, dimensional, mechanical, metallographic, and nondestructive test methods. The cell entries indicate the number of times an organization of a particular class recommended including a specific test method.

The recommended test methods will be reviewed to provide guidance in the determination of an initial list of test methods to be offered for accreditation. Additional evaluations of the technical requirements for fastener testing may extend or contract the list.

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS

Designation	Title
ANSI B1.7	Nomenclature, Definitions, and Letter Symbols for Screw Threads
ANSI B18.2.1	Square and Hex Bolts and Screws, Inch Series
ANSI B89.3.1	Out-of-Roundness, Measurement of
ANSI/ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI/ASME B1.2	Gages and Gaging for Unified Screw Threads
ANSI/ASME B1.3M	Gaging Systems for Dimensional Acceptability, Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)
ANSI/ASME B18.2.2	Square and Hex Nuts (Inch Series)
ANSI/ASME B18.3	Socket Cap, Shoulder, and Set Screws (Inch Series)
ANSI/ASME B18.18.2M	Machine Assembly Fasteners, Inspection and Quality Assurance for High Volume
ANSI/ASME B47.1	Gage Blanks
ANSI/ASME B89.1.6	Qualified Plain Internal Diameters For Use as Master Rings and Ring Gages, Measurements of
AS 7478	Bolts and Screws - Steel, Corrosion and Heat Resistant, Heat Treated Roll Threaded, Sol & Precip. Treated
ASME B18.2.1	Square and Hex Bolts and Screws Inch Series
ASME B18.6.2	Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws
ASME B18.6.4	Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch Series)

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
ASTM A193	Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A194	Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A262	Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
ASTM A307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
ASTM A320	Specification for Alloys-Steel Bolting Materials for Low-Temperature Service
ASTM A325	Specifications for High-Strength Bolts for Structural Steel Joints
ASTM A325M	Specification for High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A342	Test Methods for Permeability of Feebly Magnetic Materials
ASTM A354	Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A370	Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A449	Specification for Quenched and Tempered Steel Bolts and Studs
ASTM A489	Specification for Carbon Steel Eyebolts
ASTM A490	Specification for Heat-Treated, Steel Structural Bolts, 150 ksi (1035MPa) Tensile Strength
ASTM A490M	Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
ASTM A540	Specification for Alloy-Steel Bolting Materials for Special Applications
ASTM A563	Specification for Carbon and Alloy Steel Nuts
ASTM A563M	Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A574	Specification for Alloy Steel Socket-Head Cap Screws
ASTM A574M	Specification for Alloy Steel Socket-Head Cap Screws (Metric)
ASTM A751	Methods, Practices, and Definitions for Chemical Analysis of Steel Products
ASTM A754	Test Method for Coating Thickness by X-Ray Fluorescence
ASTM B117	Method of Salt Spray (Fog) Testing
ASTM B201	Practice for Testing Chromate Coating on Zinc and Cadmium Surfaces
ASTM B487	Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM B499	Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals
ASTM B504	Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method
ASTM B568	Method for Measurement of Coating Thickness by X-Ray Spectrometry
ASTM B571	Test Methods for Adhesion of Metallic Coatings

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
ASTM B633	Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM B695	Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM B696	Specification for Coating of Cadmium Mechanically Deposited
ASTM B766	Specification for Electrodeposited Coatings of Cadmium
ASTM D476	Specification for Titanium Dioxide Pigments
ASTM E3	Methods of Preparation of Metallographic Specimens
ASTM E8	Test Methods of Tension Testing of Metallic Materials
ASTM E10	Test Method for Brinell Hardness of Metallic Materials
ASTM E18	Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E23	Methods for Notched Bar Impact Testing of Metallic Materials
ASTM E30	Method for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron
ASTM E34	Test Method for Chemical Analysis of Aluminum and Aluminum Alloys
ASTM E45	Practice for Determining the Inclusion Content of Steel
ASTM E53	Method for Chemical Analysis of Copper
ASTM E54	Methods for Chemical Analysis of Special Brasses and Bronzes

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
ASTM E62	Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)
ASTM E75	Method for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys
ASTM E76	Methods for Chemical Analysis of Nickel-Copper Alloys
ASTM E92	Test Method for Vickers Hardness of Metallic Materials
ASTM E101	Method for Spectrographic Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique
ASTM E112	Methods for Determining Average Grain Size
ASTM E116	Recommended Practice for Photographic Photometry in Spectrochemical Analysis
ASTM E120	Method for Chemical Analysis of Titanium and Titanium Alloys,
ASTM E121	Method for Chemical Analysis of Copper-Tellurium Alloys
ASTM E165	Practice for Liquid Penetrant Inspection Method
ASTM E190	Method for Guided Bend Test for Ductility of Welds
ASTM E212	Method for Spectrographic Analysis of Carbon and Low-Alloy Steel by the Rod-to-Rod Technique
ASTM E227	Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique
ASTM E290	Test Method for Semi-guided Bend Test for Ductility of Metallic Materials

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
ASTM E305	Recommended Practices for Establishing and Controlling Spectrochemical Analytical Curves
ASTM E322	Method for X-Ray Emission Spectrometric Analysis of Low-Alloy steels and Cast Irons
ASTM E340	Method for Macroetching Metals and Alloys
ASTM E350	Test Method for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
ASTM E352	Methods for Chemical Analysis of Tool Steels and Other Similar Medium- and High-Alloy Steels
ASTM E353	Method for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E354	Method for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel and Cobalt Alloys
ASTM E384	Test Method for Microhardness of Materials
ASTM E403	Test Method for Optical Emission Spectrometric Analysis of Carbon and Low-Alloy Steel by the Point-to-Plane Technique
ASTM E415	Method for Optical Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel
ASTM E478	Method for Chemical Analysis of Copper Alloys
ASTM E572	Test Method for X-Ray Emission Spectrometric Analysis of Stainless Steel

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
ASTM E663	Practice for Flame Atomic Absorption Analysis
ASTM E709	Practice for Magnetic Particle Examination
ASTM E751	Practice for Acoustic Emission Monitoring During Resistance Spot Welding
ASTM E807	Practice for Metallographic Laboratory Evaluation
ASTM E876	Practice for Use of Statistics in the Evaluation of Spectrometric Data
ASTM E1077	Test Method for Estimating the Depth of Decarburization of Steel Specimens
ASTM E1097	Guide for Direct Current Plasma Emission Spectrometry Analysis
ASTM E1268	Practice for Assessing the Degree of Banding or Orientation of Microstructures
ASTM F436	Specification for Hardened Steel Washers
ASTM F593	Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Specification for Stainless Steel Nuts
ASTM F606	Method for Conducting Tests to Determine the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets
ASTM F606M	Test Method for Conducting Tests to Determine the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets (Metric)
ASTM F738	Specification for Stainless Steel Metric Bolts, Screws, and Studs
ASTM F788	Specification for Surface Discontinuities of Bolts, Screws, and Studs, and Inch and Metric Series

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
ASTM F788M	Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series
ASTM F812	Specification for Surface Discontinuities of Nuts, Inch and Metric Series
ASTM F835	Specification for Alloy Steel Socket button and Flat Countersunk Cap Screws
ASTM F835M	Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws (Metric)
ASTM F837	Specification for Stainless Steel Socket Head Cap Screws
ASTM F880	Specifications for Stainless Steel Socket Set Screws
ASTM F912	Specification for Alloy Steel Socket Set Screws
DIN 13	ISO Metric Threads; (Dimensional requirements)
DIN 76	Thread Run-Outs and Thread Undercuts (for metric threads; pipe threads; trapezoidal threads, Buttress threads and knuckle threads and other threads of course, pitch)
DIN 267	Fasteners; Technical Delivery Conditions
DIN 861	Gauge Blocks; Concepts, Requirements, Testing
DIN 863	Micrometers
DIN 1319	Basic Concepts in Metrology
DIN 50145	Testing of Metallic Materials; Tensile Test
DIN 54152	Non-Destructive Testing; Penetrant Inspection

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
FED-STD-151	Metals: Test Methods
FED-STD-H28	Screw-Thread Standards for Federal Services
FED-STD-H28/6	Screw-Thread Standards for Federal Services Section 6 Gages and Gaging for Unified Screw Threads-UN and UNR Thread Forms
FED-STD-H28/20	Screw-Thread Standards for Federal Services Section 20 Inspection Methods for Acceptability of UN, UNR, UNJ, M, and MJ Screw Threads
FF-S-85	Screw, Cap, Slotted and Hexagon Head
FF-S-86	Screw, Cap, Socket-Head
FF-S-92	Screw, Machine: Slotted, Cross-Recessed or Hexagon Head
FF-S-200	Set Screws: Hexagon Socket and Spline Socket, Headless
GGG-W-686	Wrench, Torque
IFI 101	Torque-Tension Requirements for Prevailing-Torque Type Steel Hex and Flange Nuts
IFI 114	Break Mandrel Blind Rivets
IFI 116	Structural Self-Plugging Pull Mandrel Blind Rivets
IFI 117	Pull Through Mandrel Blind Rivets
IFI 119	Structural Flush Break Pull Mandrel Self-Plugging Blind Rivets
IFI 136	Studs and Bent Bolts
ISO 898	Mechanical Properties of Fasteners

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
ISO 1502	ISO General Purpose Metric Screw Threads - Gauging
ISO 2639	Steel - Determination and Verification of the Effective Depth of Carburized and Hardened Cases
ISO 3059	Non-Destructive Testing - Method for Indirect Assessment of Black Light Sources
ISO 3452	Non-Destructive Testing - Penetran¦ Inspecting - General Principles
ISO 3508	Thread Run-Outs for Fasteners with Thread in Accordance with ISO 261 and ISO 262
ISO 3611	Micrometer Callipers for External Measurement
ISO 3650	Gauge Blocks
ISO 3887	Steel, Non-Alloy and Low-Alloy - Determination of Depth of Decarburization
ISO 6157-1	Fasteners - Surface Discontinuities - Part 1: Bolts, Screws and Studs nor General Requirements
ISO 6157-3	Fasteners - Surface Discontinuities - Part 3: Bolts, Screws and Studs for Special Requirements
ISO 6506	Metallic Material - Hardness Test - Brinell Test
ISO 6507	Metallic Materials - Hardness Test - Vickers Test
ISO 6508	Metallic Materials - Hardness Test - Rockwell Test (Scales A-B-C-D-E-F-G-H-K)
ISO 6892	Metallic Materials - Tensile Testing
ISO 6906	Vernier Callipers Reading to 0.02mm

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
ISO 6955	Analytical Spectroscopic Methods - Flame Emission, Atomic Absorption, and Atomic Fluorescence - Vocabulary
JIS B 0215	Tolerance System for Metric Screw Threads
JIS B 0401	System of Limits and Fits
JIS B 1001	Diameter of Clearance Holes and Counterbores for Bolts and Screws
JIS B 1051	Mechanical Properties of Steel Bolts and Screws
JIS B 1052	Mechanical Properties of Steel Nuts
JIS B 1082	Stress Area and Bearing Area for Threaded Fasteners
JIS G 0551	Methods of Austenite Grain Size Test for Steel
JIS G 0552	Method of Ferrite Grain Size Test for Steel
JIS G 0557	Method of Measuring Case Depth for Steel
JIS G 0558	Methods of Measuring Decarburized Depth for Steel
JIS Z 2201	Test Pieces for Tensile Test for Metallic Materials
JIS Z 2202	Test Pieces for Impact Test for Metallic Materials
JIS Z 2204	Bend Test Pieces for Metallic Materials
JIS Z 2241	Method of Tensile Test for Metallic Materials
JIS Z 2242	Method of Impact Test for Metallic Materials
JIS Z 2243	Method of Brinell Hardness Test

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
JIS Z 2244	Method of Vickers Hardness Test
JIS Z 2245	Method of Rockwell and Rockwell Superficial Hardness Test
JIS Z 2251	Method of Micro Hardness Test for Vickers and Knoop Hardness
MIL-B-7838	Bolt, Internal Wrenching, 160 KSI FTU
MIL-B-87114	Bolts, Structural, Recess Drive, General Specification For
MIL-F-18240	Fastener Element, Self-Locking, Threaded Fastener, 250 Deg. F Maximum
MIL-I-6866	Inspection, Liquid Penetrant
MIL-I-17214	Indicator, Permeability; Low-Mu (Go-No Go)
MIL-N-25027	Nut, Self-Locking, Heavy Hex, (Non-Metallic Insert) 250 Deg. F, UNJC-3B, 1/4 through 2-1/2 Inch Nominal Diameters, Nickel-Copper Alloy
MIL-R-5674	Rivets, Structural, Aluminum Alloy, Titanium Columbium Alloy General Specification for
MIL-S-1222	Studs, Bolts, Hex Cap Screws, Socket Head Cap Screws, and Nuts
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series: General Specification for
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification for
MIL-STD-114	Gages, Plug, Thread, Go.(Class X) for Unified and American National Standard Internal Threads

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
MIL-STD-115	Gages, Plug, Thread HI (Not Go) for Unified & American National Standard Internal Threads
MIL-STD-116	Gages, Ring, Thread, Go (Class X) and Related Thread Setting Plug Gages, Go & Not Go Plain Plug Minor Diameter Acceptance Check Gages for Unified & American National Standard External Threads
MIL-STD-117	Gages, Ring, Thread Not Go Related Thread Setting Plug Gages, Go and Not Go Plain Plug Minor Diameter Acceptance Check Gages
MIL-STD-120	Gage Inspection
MIL-STD-273	Gages, Plug, Thread Setting, Class W, For Go Gages Unified Standard Classes 2A and 3A and American National Standard Class 3 External Threads
MIL-STD-274	Gages, Plug, Thread, Setting, Class W, for Lo (Not Go) Gages, Unified Standard Classes 2A and 3A and American National Standard Class 3 External Threads
MIL-STD-767	Cleaning Requirements for Special Purpose Equipment, including Piping Systems (Issue Controlled-Requests by Other than DOD Activities must be Submitted Via the Preparing Activity of the Spec)
MIL-STL-1312	Fastener Test Methods
MIL-STD-1312-1	Fastener Test methods Method 1, Salt Spray
MIL-STD-1312-3	Fastener Test Methods Method 3, Humidity
MIL-STD-1312-5	Fastener Test Methods Method 5 Stress Durability
MIL-STD-1312-6	Fastener Test Methods Method 6, Hardness
MIL-STD-1312-7	Fastener Test Methods Method 7, Vibration

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
MIL-STD-1312-8	Fastener Test Methods Method 8, Tensile Strength
MIL-STD-1312-9	Fastener Test Methods Method 9, Stress Corrosion
MIL-STD-1312-11	Fastener Test Methods Method 11, Tension Fatigue
MIL-STD-1312-12	Fastener Test Methods Method 12, Thickness of Metallic Coatings
MIL-STD-1312-13	Fastener Test Methods Method 13, Double Shear Test
MIL-STD-1312-14	Fastener Test Methods Method 14 Stress Durability Internally Threaded Fasteners
MIL-STD-1312-15	Fastener Test Methods Method 15, Torque-Tension
MIL-STD-1312-17	Fastener Test Methods Method 17, Stress Relaxation
MIL-STD-1312-18	Fastener Test Methods Method 18, Elevated Temperature Tensile Strength
MIL-STD-1312-19	Fastener Test Methods Method 19, Fastener Sealing
MIL-STD-1312-20	Fastener Test Methods Method 20, Single Shear
MIL-STD-1312-22	Fastener Test Methods Method 22, Shear Joint Fatigue
MIL-STD-1312-23	Fastener Test Methods Method 23, Tensile Strength of Panel Fasteners
MIL-STD-1312-24	Fastener Test Methods Method 24, Receptacle Torque-Out Panel Fasteners
MIL-STD-1312-25	Fastener Test Methods Method 25, Driving Recess Torque Quality Conformance Test

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
MIL-STD-1312-26	Fastener Test Methods Method 26, Structural Panel Fastener Lap Joint Shear
MIL-STD-1312-27	Fastener Test Methods Method 27, Panel Fastener Sheet Pull-Up
MIL-STD-1312-28	Fastener Test Methods Method 28, Elevated Temperature Double Shear
MIL-STD-1949	Inspection, Magnetic Particle
MIL-STD-6866	Inspection, Liquid Penetrant
MIL-STD-45662	Calibration Systems Requirements
MS9006	Recesses-Cross, Low Torque Drive, Dimensions and Gage Dimensions for
MS21045	Nut, Self-Locking, Hexagon-Regular Height, 450 Deg. F, 125 KSI FTU
MS21046	Nut, Self-Locking, Hexagon-Regular Height, 800 Deg. F, 125 KSI FTU
MS25281	Clamp, Loop, Plastic, Wire Support
MS33781	Recess-Torque-Set,(Dimensions of Recess, Gage, and Driver for
MS51971	Nut, Plain, Hexagon-Steel, Corrosion Resisting, 300 Series, Passivated, UNC-2B
MS51972	Nut, Plain, Hexagon-Steel, Corrosion Resisting, 300 Series, Passivated, UNF-2B
MS90725	Screw, Cap, Hexagon Head (Finished Hexagon Bolt), Steel, Grade 5, Cadmium Plated, UNC-2A
MS90727	Screw, Cap, Hexagon Head (Finished Hexagon Bolt), Alloy Steel, Grade 8, Zinc Coated UNF-2A, Plain and Self-Locking
MS90728	Screw, Cap, Hexagon Head (Finished Hexagon Bolt), Alloy Steel, Grade 8, Zinc Coated Plain and Self-Locking, UNC-2A

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
NAS1190	Screw, Self-Locking - Pan Head, Full Thread
NAS1351	Screw, Cap, Socket Head-Undrilled and Drilled, Plain and Self-Locking, Alloy steel and Corrosion-Resisting Steel, UNRF-3A
NAS1352	Screw, Cap, Socket Head-Undrilled and Drilled, Plain and Self-Locking, Alloy Steel and Corrosion Resisting Steel, UNRC-3A
NAS4003	Fasteners, A286 CRES, Externally Threaded
NES D 1012	(Nissan Engineering Standard - Nissan Internal Standard)
NES T 7073	(Nissan Engineering Standard - Nissan Internal Standard)
NES T 7201	(Nissan Engineering Standard - Nissan Internal Standard)
QQ-P-416	Plating, Cadmium (Electrodeposited)
SAE HS1086	Fifth Edition Unified Numbering System Handbook for Metals and Alloys
SAE J78	Steel Self-Drilling Tapping Screws
SAE J81	Thread Rolling Screws
SAE J121	Decarburization in Hardened and Tempered Threaded Fasteners
SAE J122a	Surface Discontinuities on Nuts
SAE J123c	Surface Discontinuities on Bolts, Screws, and Studs
SAE J174	Torque-Tension Test Procedure for Steel Threaded Fasteners
SAE J349	Detection of Surface Imperfections in Ferrous Rods, Bars, Tubes, and Wires

Table E-1 FASTENER TEST METHODS AND FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Title
SAE J416	Tensile Test Specimens
SAE J417	Hardness Tests and hardness Number Conversions
SAE J418	Grain Size Determination of Steels
SAE J419	Methods of Measuring Decarburization
SAE J422	Microscopic Determination of Inclusions in Steels
SAE J423	Methods of Measuring Case Depth
SAE J429	Mechanical and Material Requirements for Externally Threaded Fasteners
SAE J449a	Surface Texture Control
SAE J478a	Slotted and Recessed Head Screws
SAE J482	Hexagon High Nuts
SAE J864	Surface Hardness Testing with Files
SAE J933	Mechanical and Quality Requirements for Tapping Screws
SAE J995	Mechanical and Material Requirements for Steel Nuts
SAE J1061a	Surface Discontinuities on General Application Bolts, Screws, and Studs
SAE J1102	Mechanical and Material Requirements for Wheel Bolts
SAE J1199	Mechanical and Material Requirements for Metric Externally Threaded Steel Fasteners
SAE J1200	Blind Rivets-Break Mandrel type
SAE J1216	Test Methods for Metric Threaded Fasteners
SAE J1237	Metric Thread Rolling Screws

Table E-2 FASTENER RELATED SPECIFICATIONS

Designation	Source of Recommendation GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
ANSI B18.2.1	1	0	0	0	0	0	0	0	0	0	1
ANSI/ASME B1.1	1	0	0	0	0	0	0	0	0	0	1
ANSI/ASME B18.2.2	1	0	0	0	0	0	0	0	0	0	1
ANSI/ASME B18.3	1	0	0	0	1	0	0	0	0	0	2
AS 7478	0	0	1	0	0	0	0	0	0	0	1
ASTM A193	1	0	0	0	0	0	0	0	0	0	4
ASTM A194	1	0	2	0	0	0	0	0	0	0	3
ASTM A307	1	0	2	1	0	1	0	0	0	0	5
ASTM A320	0	0	1	0	0	0	0	0	0	0	1
ASTM A325	1	0	3	1	0	0	0	0	0	0	5
ASTM A325M	0	0	0	1	0	0	0	0	0	0	1
ASTM A354	0	0	3	1	0	0	0	0	0	0	4
ASTM A449	0	0	1	1	0	0	0	0	0	0	2
ASTM A489	0	0	1	0	0	0	0	0	0	0	1
ASTM A490	1	0	1	1	0	0	0	0	0	0	3
ASTM A490M	0	0	0	1	0	0	0	0	0	0	1
ASTM A540	0	0	0	0	0	0	0	0	0	1	1
ASTM A563	0	0	3	1	0	0	0	0	0	0	4
ASTM A563M	0	0	0	1	0	0	0	0	0	0	1
ASTM A574	1	0	3	2	1	1	1	0	0	0	9

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Table E-2 FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Source of Recommendation										
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
ASTM A574M	0	0	1	1	1	1	0	0	0	0	4
ASTM B201	0	0	0	0	0	1	0	0	0	0	1
ASTM B633	0	0	0	0	0	1	0	0	0	0	1
ASTM B695	0	0	0	1	0	0	0	0	0	0	1
ASTM B696	0	0	0	1	0	0	0	0	0	0	1
ASTM E709	0	0	0	0	0	0	0	0	0	1	1
ASTM F436	0	0	2	0	0	0	0	0	0	0	2
ASTM F593	1	0	3	0	0	0	0	0	0	0	4
ASTM F594	1	0	1	0	0	0	0	0	0	0	2
ASTM F738	0	0	0	0	0	0	1	0	0	1	2
ASTM F835	1	0	0	1	0	1	0	0	0	0	3
ASTM F835M	0	0	0	0	0	1	0	0	0	0	1
ASTM F837	0	0	2	0	0	0	0	0	0	0	2
ASTM F880	0	0	0	0	0	0	0	0	0	1	1
ASTM F912	0	0	0	1	0	0	0	0	0	0	1
FED-STD-H28	1	0	0	0	0	0	0	0	0	0	1
FF-S-85	0	0	2	1	0	0	0	0	0	0	3
FF-S-86	1	0	1	0	0	0	0	0	0	0	2
FF-S-92	0	0	1	0	0	0	0	0	0	0	1
FF-S-200	1	0	0	0	0	0	0	0	0	0	1

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Table E-2 FASTENER RELATED SPECIFICATIONS (Continued)

Designation	Source of Recommendation									
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
GGG-W-686	0	0	1	0	0	0	0	0	0	0	1
JIS B 0215	0	0	0	0	0	0	0	1	0	0	1
JIS B 0401	0	0	0	0	0	0	0	1	0	0	1
JIS B 1001	0	0	0	0	0	0	0	1	0	0	1
JIS B 1051	0	0	0	0	0	0	0	1	0	0	1
JIS B 1082	0	0	0	0	0	0	0	1	0	0	1
MIL-B-7838	1	0	0	0	0	0	0	0	0	0	1
MIL-B-87114	0	0	0	0	0	0	0	0	0	1	1
MIL-F-18240	0	0	1	0	0	0	0	0	0	0	1
MIL-N-25027	1	0	1	0	0	0	0	0	0	0	2
MIL-R-5674	0	0	1	0	0	0	0	0	0	0	1
MIL-S-1222	1	0	2	0	1	0	0	0	0	0	4
MIL-S-7742	0	0	1	0	1	0	0	0	0	0	2
MIL-S-8879	0	0	1	0	1	0	0	0	0	0	2
MIL-STD-767	0	0	1	0	0	0	0	0	0	0	1
MS9006	0	0	1	0	0	0	0	0	0	0	1
MS21045	0	0	1	0	0	0	0	0	0	0	1
MS21046	0	0	1	0	0	0	0	0	0	0	1
MS25281	0	0	1	0	0	0	0	0	0	0	1
MS33781	0	0	1	0	0	0	0	0	0	0	1

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Table E-2 FASTENER RELATED SPECIFICATIONS (Continued)

	Source of Recommendation										
Designation	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
MS51971	0	0	1	0	0	0	0	0	0	0	1
MS51972	0	0	1	0	0	0	0	0	0	0	1
MS90725	0	0	1	0	0	0	0	0	0	0	1
MS90727	0	0	1	0	0	0	0	0	0	0	1
MS90728	0	0	0	1	0	0	0	0	0	0	1
NAS1190	0	0	1	0	0	0	0	0	0	0	1
NAS1351	0	0	1	0	1	0	0	0	0	0	2
NAS1352	0	0	1	0	1	0	0	0	0	0	2
NAS4003	0	0	1	0	0	0	0	0	0	0	1
QQ-P-416	0	0	1	0	0	0	0	0	0	0	1
SAE HS1086	0	0	1	0	0	0	0	0	0	0	1
SAE J78	0	0	1	0	0	0	0	0	0	1	2
SAE J81	0	0	0	0	0	0	0	0	0	1	1
SAE J429	1	0	2	0	0	0	0	0	0	0	3
SAE J482	0	0	1	0	0	0	0	0	0	0	1
SAE J995	1	0	1	0	0	0	0	0	0	0	2

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Table E-3 CHEMICAL TEST METHODS FOR FASTENERS

Designation	Source of Recommendation									
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
ASTM A751	1	0	1	0	0	0	0	0	0	0	2
ASTM B633	0	0	0	0	0	0	0	0	0	1	1
ASTM B766	0	0	0	0	0	0	0	0	0	1	1
ASTM E30	0	0	1	0	0	0	1	0	0	1	3
ASTM E34	1	0	0	0	0	0	1	0	0	1	3
ASTM E53	1	0	0	0	0	0	1	0	0	1	3
ASTM E54	1	0	0	0	0	0	1	0	0	1	3
ASTM E62	1	0	0	0	0	0	1	0	0	1	3
ASTM E75	1	0	0	0	0	0	0	0	0	1	2
ASTM E76	1	0	0	0	0	0	0	0	0	1	2
ASTM E101	1	0	0	0	0	0	0	0	0	1	2
ASTM E116	0	0	0	1	0	0	0	0	0	0	1
ASTM E120	0	0	0	0	0	0	0	0	0	1	1
ASTM E121	1	0	0	0	0	0	0	0	0	0	1
ASTM E212	0	0	0	0	0	0	0	0	0	1	1
ASTM E227	1	0	0	0	0	0	0	0	0	0	1
ASTM E305	0	0	0	1	0	0	0	0	0	0	1
ASTM E322	0	0	0	0	0	0	0	0	0	1	1
ASTM E350	1	0	1	0	0	0	0	0	0	1	3
ASTM E352	0	0	0	0	0	0	0	0	0	1	1

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Table E-3 CHEMICAL TEST METHODS FOR FASTENERS (Continued)

Designation	Source of Recommendation										
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
ASTM E353	1	0	1	0	0	0	1	0	0	1	4
ASTM E354	1	0	0	0	0	0	0	0	0	0	1
ASTM E403	0	0	0	0	0	0	0	0	0	1	1
ASTM E415	0	0	1	0	0	0	0	0	0	1	2
ASTM E478	1	0	0	0	0	0	0	0	0	0	1
ASTM E572	0	0	0	0	0	0	0	0	0	1	1
ASTM E663	0	0	0	0	0	0	0	0	0	1	1
ASTM E751	0	0	0	0	0	0	0	0	0	1	1
ASTM E876	0	0	0	1	0	0	0	0	0	0	1
ASTM E1097	0	0	1	0	0	0	0	0	0	0	1
FED-STD-151	1	0	0	0	0	0	0	0	0	0	1
ISO 6955	0	0	0	0	0	0	0	1	0	0	1

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Table E-4 DIMENSIONAL TEST METHODS FOR FASTENERS

Designation	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
	Source of Recommendation										
ANSI B1.7	0	0	0	0	1	0	0	0	0	0	1
ANSI B18.2.1	0	0	1	1	0	1	0	0	0	0	3
ANSI B89.3.1	0	0	0	0	1	0	0	0	0	0	1
ANSI/ASME B1.1	1	0	0	0	2	0	0	0	0	0	3
ANSI/ASME B1.2	1	0	0	0	2	0	0	0	0	0	3
ANSI/ASME B1.3M	0	0	2	1	1	0	1	0	0	1	6
ANSI/ASME B18.2.2	0	0	0	0	0	0	0	0	0	1	1
ANSI/ASME B18.3	0	0	1	1	0	1	1	0	0	1	5
ANSI/ASME B18.18.2M	0	0	0	1	0	0	1	0	0	0	2
ANSI/ASME B47.1	0	0	0	0	1	0	0	0	0	0	1
ANSI/ASME B89.1.6	0	0	0	0	1	0	0	0	0	0	1
ASME B18.2.1	0	0	0	0	0	0	0	0	0	1	1
ASME B18.6.2	0	0	0	0	0	0	0	0	0	1	1
ASME B18.6.4	0	0	0	0	0	0	0	0	0	1	1
ASTM A754	0	0	1	0	0	0	0	0	0	0	1
ASTM B487	0	0	3	0	0	0	1	0	0	0	4
DIN 13	0	0	0	0	0	0	0	1	0	0	1
DIN 76	0	0	0	0	0	0	0	1	0	0	1
DIN 861	0	0	0	0	0	0	0	1	0	0	1
DIN 863	0	0	0	0	0	0	0	1	0	0	1

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Table E-4 DIMENSIONAL TEST METHODS FOR FASTENERS (Continued)

Designation	Source of Recommendation										
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
DIN 1319	0	0	0	0	0	0	0	1	0	0	1
FED-STD-H28	1	0	0	0	0	0	0	0	0	0	1
FED-STD-H28/6	0	0	0	0	1	0	0	0	0	0	1
FED-STD-H28/20	0	0	1	0	1	0	0	0	0	1	3
IFI 136	0	0	0	0	0	0	0	0	0	1	1
ISO 1502	0	0	0	0	0	0	0	1	0	0	1
ISO 3508	0	0	0	0	0	0	0	1	0	0	1
ISO 3611	0	0	0	0	0	0	0	1	0	0	1
ISO 3650	0	0	0	0	0	0	0	1	0	0	1
ISO 6906	0	0	0	0	0	0	0	1	0	0	1
MIL-S-7742	0	0	0	0	0	0	0	0	0	1	1
MIL-S-8879	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-114	0	0	0	0	1	0	0	0	0	0	1
MIL-STD-115	0	0	0	0	1	0	0	0	0	0	1
MIL-STD-116	0	0	0	0	1	0	0	0	0	0	1
MIL-STD-117	0	0	0	0	1	0	0	0	0	0	1
MIL-STD-120	0	0	1	0	0	0	1	0	0	1	3
MIL-STD-273	0	0	0	0	1	0	0	0	0	0	1
MIL-STD-274	0	0	0	0	1	0	0	0	0	0	1
MIL-STD-45662	0	0	1	0	0	0	0	0	0	0	1

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Table E-4 DIMENSIONAL TEST METHODS FOR FASTENERS (Continued)

Designation	Source of Recommendation										
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
NES T 7073	0	0	0	0	0	0	0	1	0	0	1
NES T 7201	0	0	0	0	0	0	0	1	0	0	1

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Table E-5 MECHANICAL TEST METHODS FOR FASTENERS

	Souzce of Recommendation										
Designation	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
ANSI B18.2.1	0	0	1	0	0	0	0	0	0	0	1
ASME B18.6.4	0	0	0	0	0	0	0	0	0	1	1
ASTM A342	0	0	0	0	0	0	0	0	0	1	1
ASTM A370	1	0	1	0	0	0	1	0	0	1	4
ASTM A754	0	0	1	0	0	0	0	0	0	0	1
ASTM B117	0	0	3	1	0	0	0	0	0	1	5
ASTM B487	0	0	0	0	0	0	0	0	0	1	1
ASTM B499	0	0	0	0	0	0	0	0	0	1	1
ASTM B504	0	0	0	0	0	0	0	0	0	1	1
ASTM B568	0	0	0	0	0	0	0	0	0	1	1
ASTM B571	0	0	0	0	0	0	0	0	0	1	1
ASTM D476	0	0	1	0	0	0	0	0	0	0	1
ASTM E8	0	0	1	0	0	0	0	0	0	0	1
ASTM E10	0	0	0	0	0	0	1	0	0	0	1
ASTM E18	1	0	2	1	0	0	1	0	0	1	6
ASTM E23	0	0	0	0	0	0	1	0	0	0	1
ASTM E45	0	0	0	0	0	0	1	0	0	0	1
ASTM E92	0	0	0	0	0	0	1	0	0	1	2
ASTM E112	0	0	0	0	0	0	1	0	0	0	1
ASTM E190	0	0	0	0	0	0	1	0	0	0	1

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Table E-5 MECHANICAL TEST METHODS FOR FASTENERS (Continued)

Designation	Source of Recommendation										
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
ASTM E290	0	0	0	0	0	0	1	0	0	0	1
ASTM E384	0	0	0	0	0	0	1	0	0	1	2
ASTM F606	1	0	7	2	1	1	2	0	0	1	15
ASTM F606M	0	0	2	0	0	1	0	0	0	0	3
ASTM F812	0	0	0	0	0	0	0	0	0	1	1
ASTM F912	0	0	0	0	0	0	0	0	0	1	1
DIN 267	0	0	0	0	0	0	0	1	0	0	1
DIN 50145	0	0	0	0	0	0	0	1	0	0	1
DIN 54152	0	0	0	0	0	0	0	1	0	0	1
IFI 101	0	0	0	0	0	0	0	0	0	1	1
IFI 114	0	0	0	0	0	0	0	0	0	1	1
IFI 116	0	0	0	0	0	0	0	0	0	1	1
IFI 117	0	0	0	0	0	0	0	0	0	1	1
IFI 119	0	0	0	0	0	0	0	0	0	1	1
ISO 898	0	0	0	1	0	0	0	1	0	0	2
ISO 2639	0	0	0	0	0	0	0	1	0	0	1
ISO 3059	0	0	0	0	0	0	0	1	0	0	1
ISO 3452	0	0	0	0	0	0	0	1	0	0	1
ISO 3887	0	0	0	0	0	0	0	1	0	0	1
ISO 6157-1	0	0	0	0	0	0	0	1	0	0	1

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Table E-5 MECHANICAL TEST METHODS FOR FASTENERS (Continued)

Designation	Source of Recommendation										
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
ISO 6157-3	0	0	0	0	0	0	0	1	0	0	1
ISO 6506	0	0	0	0	0	0	0	1	0	0	1
ISO 6507	0	0	0	0	0	0	0	1	0	0	1
ISO 6508	0	0	0	0	0	0	0	1	0	0	1
ISO 6892	0	0	0	0	0	0	0	1	0	0	1
JIS B 1052	0	0	0	0	0	0	0	1	0	0	1
JIS G 0551	0	0	0	0	0	0	1	0	0	0	1
JIS G 0552	0	0	0	0	0	0	1	0	0	0	1
JIS G 0557	0	0	0	0	0	0	1	0	0	0	1
JIS G 0558	0	0	0	0	0	0	1	0	0	0	1
JIS Z 2201	0	0	0	0	0	0	0	1	0	0	1
JIS Z 2202	0	0	0	0	0	0	1	0	0	0	1
JIS Z 2204	0	0	0	0	0	0	1	0	0	0	1
JIS Z 2241	0	0	0	0	0	0	0	1	0	0	1
JIS Z 2242	0	0	0	0	0	0	1	0	0	0	1
JIS Z 2243	0	0	0	0	0	0	1	1	0	0	2
JIS Z 2244	0	0	0	0	0	0	0	1	0	0	1
JIS Z 2245	0	0	0	0	0	0	1	1	0	0	2
JIS Z 2251	0	0	0	0	0	0	1	0	0	0	1
MIL-I-17214	0	0	1	0	0	0	0	0	0	1	2

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Table E-5 MECHANICAL TEST METHODS FOR FASTENERS (Continued)

Designation	Source of Recommendation										
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
MIL-STD-1312	1	0	3	0	0	0	0	0	0	0	4
MIL-STD-1312-1	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-3	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-5	1	0	0	0	0	0	0	0	0	1	2
MIL-STD-1312-6	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-7	1	0	0	0	0	0	0	0	0	1	2
MIL-STD-1312-8	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-9	1	0	0	0	0	0	0	0	0	1	2
MIL-STD-1312-11	0	0	0	0	0	0	1	0	0	1	2
MIL-STD-1312-12	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-13	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-14	1	0	0	0	0	0	0	0	0	0	1
MIL-STD-1312-15	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-17	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-18	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-19	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-20	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-22	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-23	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-24	0	0	0	0	0	0	0	0	0	1	1

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Table E-5 MECHANICAL TEST METHODS FOR FASTENERS (Continued)

Designation	Source of Recommendation										
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
MIL-STD-1312-25	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-26	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-27	0	0	0	0	0	0	0	0	0	1	1
MIL-STD-1312-28	0	0	0	0	0	0	0	0	0	1	1
NES D 1012	0	0	0	0	0	1	0	0	0	0	1
SAE J78	0	0	0	1	0	0	0	0	0	1	2
SAE J81	0	0	0	1	0	0	0	0	0	1	2
SAE J121	0	0	2	1	0	1	0	0	0	0	4
SAE J122a	0	0	0	1	0	0	0	0	0	1	2
SAE J174	0	0	0	0	0	0	0	0	0	1	1
SAE J349	0	0	0	1	0	0	0	0	0	0	1
SAE J416	0	0	0	0	0	1	0	0	0	0	1
SAE J417	0	0	1	1	0	0	0	0	0	0	2
SAE J419	0	0	0	1	0	1	0	0	0	1	3
SAE J423	0	0	0	0	0	0	0	0	0	1	1
SAE J429	1	0	5	2	0	1	0	0	0	1	10
SAE J478a	0	0	0	1	0	0	0	0	0	0	1
SAE J864	0	0	0	0	0	1	0	0	0	0	1
SAE J933	0	0	0	1	0	0	0	0	0	0	1
SAE J995	1	0	1	1	0	0	0	0	0	1	4

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Table E-5 MECHANICAL TEST METHODS FOR FASTENERS (Continued)

Designation	Source of Recommendation										
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
SAE J1102	0	0	0	1	0	0	0	0	0	0	1
SAE J1199	0	0	1	1	0	0	0	0	0	0	2
SAE J1200	0	0	0	0	0	0	0	0	0	1	1
SAE J1216	0	0	1	1	0	0	0	0	0	0	2
SAE J1237	0	0	0	1	0	0	0	0	0	0	1

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Table E-6 METALLOGRAPHIC TEST METHODS FOR FASTENERS

Designation	Source of Recommendation										
	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
ASTM A262	1	0	0	0	0	0	0	0	0	0	1
ASTM B117	0	0	0	0	0	0	1	0	0	0	1
ASTM B487	0	0	3	0	0	0	0	0	0	0	3
ASTM E3	0	0	0	0	0	0	0	0	0	1	1
ASTM E45	0	0	0	1	0	0	0	0	0	0	1
ASTM E112	0	0	0	1	0	0	0	0	0	1	2
ASTM E340	0	0	0	0	0	0	1	0	0	1	2
ASTM E807	0	0	1	0	0	0	0	0	0	0	1
ASTM E1077	0	0	0	0	0	0	0	0	0	1	1
ASTM E1268	0	0	0	0	0	0	0	0	0	1	1
ASTM F788	0	0	2	1	0	0	1	0	0	1	5
ASTM F788M	0	0	0	1	0	0	0	0	0	0	1
ASTM F812	0	0	1	0	0	0	1	0	0	1	3
MIL-B-7838	1	0	0	0	0	0	0	0	0	0	1
SAE J121	0	0	2	1	0	0	0	0	0	0	3
SAE J122a	1	0	0	1	0	0	0	0	0	0	2
SAE J123c	1	0	0	1	0	0	0	0	0	1	3
SAE J349	0	0	0	1	0	0	0	0	0	0	1
SAE J418	0	0	0	1	0	0	0	0	0	0	1
SAE J419	0	0	0	1	0	0	0	0	0	0	1

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Table E-6 METALLOGRAPHIC TEST METHODS FOR FASTENERS (Continued)

	Source of Recommendation										
Designation	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
SAE J422	0	0	0	1	0	0	0	0	0	0	1
SAE J449a	0	0	0	0	0	1	0	0	0	0	1
SAE J1061a	0	0	0	2	0	0	0	0	0	0	2

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Table E-7 NONDESTRUCTIVE TEST METHODS FOR FASTENERS

	Source of Recommendation										
Designation	GU	PU	LA	MF	IM	FM	SO	IP	DI	AC	TOT
ASTM E165	0	0	1	0	0	0	1	0	0	1	3
ASTM E340	0	0	1	0	0	0	0	0	0	0	1
ASTM F788	0	0	2	0	0	0	0	0	0	0	2
MIL-I-6866	1	0	0	0	0	0	0	0	0	0	1
MIL-STD-1949	1	0	0	0	0	0	0	0	0	1	2
MIL-STD-6866	0	0	1	0	0	0	0	0	0	1	2
SAE J122a	0	0	0	1	0	0	0	0	0	0	1
SAE J123c	0	0	0	1	0	0	0	0	0	1	2
SAE J1061a	0	0	0	2	0	0	0	0	0	0	2

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NIST-114A (REV. 3-90)	U.S. DEPARTMENT OF COMMERCE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY	1. PUBLICATION OR REPORT NUMBER NISTIR 4818
	BIBLIOGRAPHIC DATA SHEET	2. PERFORMING ORGANIZATION REPORT NUMBER
		3. PUBLICATION DATE April 1992

4. TITLE AND SUBTITLE

National Voluntary Laboratory Accreditation Program Workshop on Fastener Test Methods - Part II: Appendices

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6. PERFORMING ORGANIZATION (IF JOINT OR OTHER THAN NIST, SEE INSTRUCTIONS)	7. CONTRACT/GRANT NUMBER
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11. ABSTRACT (A 200-WORD OR LESS FACTUAL SUMMARY OF MOST SIGNIFICANT INFORMATION. IF DOCUMENT INCLUDES A SIGNIFICANT BIBLIOGRAPHY OR LITERATURE SURVEY, MENTION IT HERE.)

The President signed the Fastener Quality Act(FQA), Public Law 101-592, on November 16, 1990. The intent of the Act is to increase fastener quality and reduce the danger of fastener failure. The Act requires the Secretary of Commerce, acting through the Director of the National Institute of Standards and Technology(NIST), to establish a laboratory accreditation program for fastener testing laboratories under the procedures of the National Voluntary Laboratory Accreditation Program(NVLAP).

A notice was published in the Federal Register March 22, 1991, anouncing an April 22, 1991 workshop at NIST to provide interested parties an opportunity to participate in the development of a list of test methods to be included in the laboratory accreditation program. The workshop resulted in presentations and lists of fastener specifications and test methods submitted by laboratories, users (both public and private), manufacturers, standards organizations, instrument manufacturers, distributors and importers. The presentations and summary statistics for the lists are presented in this report. The lists have been categorized by fastener specification, and by type of fastener inspection or testing. The workshop results and list of test methods will be used in the determination of an initial list of test methods to be offered for accreditation. Part I of this report (NISTIR 4817) summarizes the workshop presentations and the test method categories submitted in response to the notice published in the Federal Register. Part II of this report (NISTIR 4818) contains the appendices.

12. KEY WORDS (6 TO 12 ENTRIES; ALPHABETICAL ORDER; CAPITALIZE ONLY PROPER NAMES; AND SEPARATE KEY WORDS BY SEMICOLONS)

fasteners; Fastener Quality Act; laboratory accreditation; National Voluntary Laboratory Accreditation Program; test methods

13. AVAILABILITY	14. NUMBER OF PRINTED PAGES
[X] UNLIMITED	114
[ ] FOR OFFICIAL DISTRIBUTION. DO NOT RELEASE TO NATIONAL TECHNICAL INFORMATION SERVICE (NTIS).	
[ ] ORDER FROM SUPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT PRINTING OFFICE, WASHINGTON, DC 20402.	15. PRICE
[ ] ORDER FROM NATIONAL TECHNICAL INFORMATION SERVICE (NTIS), SPRINGFIELD, VA 22161.	A06

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