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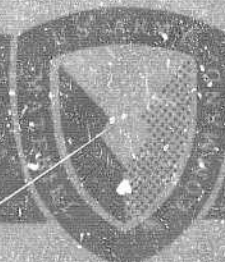
AN INTRODUCTION TO DEFENSE STANDARDIZATION

By
Richard A. Elwell



December 1970

UNITED STATES ARMY
NATICK LABORATORIES
Natick, Massachusetts 01760



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AN INTRODUCTION TO DEFENSE STANDARDIZATION

by

Richard A. Elwell
Chief, Standardization Management
and Quality Assurance Branch

Project Reference:
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FOREWORD

The concept of standardization is constant and has met the test of time; standardization is now universally accepted as an economically significant part of technology. However, the practice of standardization is constantly changing to meet new needs. This is especially true in contemporary military operations which require a changing standardization to make them economically possible. Only astute management of these changes in the practice of standardization can keep the support of the materiel requirements of military operations in balance with other national economic forces.

The purpose of this report is to outline the organizational changes in the standardization program of the Department of Defense. These changes indicate the changes yet to come from research in technological communications.

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Mr. S. Harry Meiselman, Staff Assistant, Directorate for Product and Production Engineering, Office of the Assistant Secretary of Defense for Production Engineering and Material Acquisition, Washington, D. C.

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CONTENTS

	<u>Page</u> iv
Abstract	
PART I. HISTORICAL SETTING FOR THE STANDARDIZATION MOVEMENT	
1. Ancient times	1
2. 12th to 19th centuries	2
3. Pre-World War I	2
4. World War I period	3
5. Post-World War I	4
PART II. A CONCISE HISTORY OF THE DEFENSE STANDARDIZATION PROGRAM	
1. Wars of the 19th century	6
2. Early 1900's: War Department and Navy, for own service	6
3. 1917-19: The War Department adopts industry standards	7
4. 1930's and 1940's: Joint efforts of military departments	7
5. Department of Defense: 1947-1961	8
6. Department of Defense: 1961-1968	10
PART III. ORGANIZATION LEVELS IN THE DEFENSE STANDARDIZATION PROGRAM	
1. Defense-wide administration and direction	13
2. The departmental level	13
3. The Standardization "assignees" for commodity classes	13
4. The "preparing" activity level	14
5. The departmental "custodian" activity level	14
6. The "review" activity level	14
Summary	14
References	15

ABSTRACT

This report develops in chronological order the history of the standardization concept from the time of earliest civilization to the present. A brief review of the history and meaning of standardization is presented to introduce scientists, engineers and technologists to this economically crucial aspect of modern technology. Also given is a concise review of the evolution of the organization for the management of military standardization in the United States. The cumulative evidence indicates that standardization has met the test of time and is accepted as one of the significant methods for increasing efficiency and minimizing the variety of items, processes and practices which are associated with the design, development, production and logistics support of equipment and supplies.

AN INTRODUCTION TO DEFENSE STANDARDIZATION

PART I. HISTORICAL SETTING FOR THE STANDARDIZATION MOVEMENT

1. Ancient times

Standardization began centuries ago.

The need for food, clothing and shelter caused the earliest inhabitants of the earth to use the materials spread about them by Nature to supply their needs. They had to fight with Nature for life itself, but history shows they made progress, and their labors and inventions have made the modern world.

From the earliest times standardization activity called for standard devices, tools and equipment. For instance, in the Great Pyramids built by Cheops in 2900 B.C. carvings on the Egyptian temples and monuments show standardized religious worship and military action. They also show standardized bows and arrows and a standard complement of equipment carried by each soldier. Therefore, one can say that we have in ancient Egypt one of the first examples of the making of interchangeable parts, for the arrows could be used indiscriminately with the bows, and the parts of the bow were made to stock, according to the custom of that time. (1)

In 1000 B.C. the laws of Manu concerning the manufacture of cotton gave standard regulations which severely criticized the heavy sizing of the yarn. In the time of the Pharaohs, linen (made from the fibers of flax) was the standard material for the priestly order. (2)

In the Book of Exodus, Chapter 12, standards were set for foods offered as sacrifices, e.g., "Lamb shall be without blemish, a male of the first year."

Religion is an interesting example of standardized human activity. Mohammedanism, Buddhism and Christianity, with all their sects, heresies and schisms, are standardized to the most minute detail, with regard to the time, place and form of worship, and the doctrines, ritual, beliefs, and expectations of the worshipers. (3)

The Romans standardized the construction and design of their durable military roads.

2. 12th to 19th century

1120 The "yard" The first attempt to establish a national standard by law occurred in 1120. King Henry I of England declared that the length of his extended arm, from armpit to the end of his long (middle) finger would be the "yard." Thus the arm of King Henry was made a standard unit of comparison of lengths throughout the kingdom. (4)

1631 Arms patterns In 1631 Charles I of England issued an Order on the subject of Patterns for Arms and Armour. It is one of the earliest recorded references to mandatory military standardization. This Order was concerned with providing the armed services with the most efficient and practical weapons. This objective was sought through the use of standard patterns which excluded all nonessentials. (5)

1777 Measures The Articles of Confederation, adopted by the Second Continental Congress in 1777, specifically stated that Congress would establish standards of coinage, weights and measures.

1799 Muskets In 1799 Eli Whitney manufactured assembly parts of muskets, requiring that each worker use precise measurements based on a "master ruler." Then he submitted to government experts these identical barrels, identical stocks and identical triggers. From these parts were assembled the first standardized rifles. Whitney is sometimes called "The Father of Standardization," since he was the first to manufacture products on a large scale with the idea of complete interchangeability of parts. (6)

3. Pre-World War I

1866 Railroads The railroads are another outstanding example of early standardization with the objective of eliminating odd gages for tracks. Then in 1866 occurred the necessary unification of interchange dimensions of rolling stock. (7)

1885 ASME One of the earliest technical societies founded in the United States was the American Society of Mechanical Engineers (1885). Early records of this society indicate that a standardization committee on pipe and pipe threads was appointed in 1890. This committee made its report the following year and from that time standards committees have been continuously at work. (8)

1898 ASTM The American Society for Testing Materials, organized in 1898, was another important group. Its specific purpose was to promote knowledge of the materials of engineering and the standardization of specifications and of the methods of testing. (9)

1901 NBS The National Bureau of Standards was established by Act of Congress in 1901. Since then it has been a focal point in the federal government for determining basic measurements and standards.

1910 GSC Before World War I, as noted above, standardization was mainly in the hands of trade associations and technical societies. During this period there were Congressional charges that federal procurement was inefficient and should be standardized. As a result, in 1910 the Government established by Executive Order the General Supply Committee. This was the first official recognition of the necessity and value of buying in accordance with standards and specifications. However, no further action was taken until after World War I had proved that great advantages could result from centralized procurement of materials and supplies purchased in accordance with definite specifications.

1912 RCA It is well known that the Radio Corporation of America has had a standardization program since 1912. It has acknowledged the many benefits of its program, among them improved manufacturing, simplified design and reduced cost. Their program also led to greater economies through intangible considerations, such as ease of assembly, reduced design efforts and more economical packing and transportation.

4. World War I period

Comparatively little attention was given to national standardization up to the time of World War I. Although there are some notable exceptions, such as in the railroad and automobile industry, World War I and the post-war depression brought into sharp relief, for the first time, the full significance of standardization. The War forced conservation of resources and rapid mass production.

1917 Mine parts During World War I, a significant milestone in the development of standardization was the method of manufacturing and assembling the mines the Allies laid in the North Sea. This was made possible by the cooperative work of 400 factories in the United States and Canada, each working on a small subassembly or part of the mine. So precise was their work that it was possible to assemble the mines in Scotland, an ocean away from where the parts had been manufactured. (10)

1918 ASA The American Standards Association* was founded in 1918 to serve as a clearing house for nationally coordinated voluntary safety, engineering and industrial standards. The Association includes industrial firms, trade associations, technical societies, consumer organizations and government agencies.

* Renamed the United States Standards Institute in 1969. See also 1941 in para 5 below.

5. Post-World War I

1921 FSB Legislation enacted in 1921 directed the Bureau of the Budget to assemble, correlate, revise, reduce or increase the budgetary estimates of the federal departments and agencies. Under this Act, the Federal Specification Board was formed. Membership consisted of representatives from each government department or agency and from industry. Their duties were to compile or adopt and publish Government specifications for materials and supplies and to insure that these specifications were in accord with the best commercial practice. (11)

There was a tremendous post-war growth of the standardization movement which gave rise to a multiplicity of standards of all types. Trade associations, engineering societies, private firms and government groups were engaged in drafting and recommending standards. This resulted in a considerable duplication of effort, since many standards were designed to meet the particular needs of a particular group. It was recognition of this fact that led to the formation of national standards bodies.

1921 Fed AE Soc After World War I, the Federated American Engineering Societies organized a committee with Herbert Hoover as chairman. Hoover appointed subcommittees to see how much waste could be eliminated by reducing needless varieties of commodities. The reports of these committees stimulated another wave of standardization, this time voluntary, organized by industry groups. New government offices were set up to promote the adoption of commercial standards and simplified practices. Their emphasis was on such matters as dimensional standards, material specifications and testing, drafting practices, definitions and symbols used in engineering. (12)

1930 Canned Goods During the early 1930's grading of canned goods began, with the canners themselves appealing to the government to set up standards to define such technical specifics as color, content, quality and uniformity. Such standards made it much easier to set a value on the stock and to borrow money on the season's output, pending sales. (13)

1941 ASA In 1941 the American Standards Association* issued a standard which for the first time cited graphical symbols for use on drawings in mechanical engineering. This document was a very significant accomplishment, since one of the most important components of engineering drawings which determines whether they are effective in translating the designer's intentions to the shop, is the system of symbols. (14)

* See 1918 note and footnote

1945 Bell Tel The Bell Telephone System has documented many specific cases of cost reduction and product improvement, ranging from raw materials to plant design, achieved through standardization measures. Two significant results of this process which was accelerated with the introduction of direct dialing in 1945 are: 1) standardization based on careful consideration of the requirements of the telephone subscriber resulted in more convenient and dependable service at the lowest possible cost and 2) standardization greatly facilitated development work, since improvement in a new item usually required coordinating it with fewer associated parts than previously.

Modern industrial civilization has been built on the interdependence of three classic elements: men, money and machines. In this development of a new kind of society, standardization has had a powerful role in preventing chaos and promoting a healthy and controlled growth.

Standardization may sometimes be mistaken to mean stagnation. An item design is fixed; a manufacturing process is continued without change; a craft or trade is described and protected by law. But these are isolated instances. Standardization must always resist change based only on chance or whim. But if there is a real need and demand for change, a healthy standardization program will be responsive and quickly adapt itself to new conditions.

PART II A CONCISE HISTORY OF THE DEFENSE STANDARDIZATION PROGRAM

1. Wars of the 19th century

Military standardization, born of necessity, has a long history. The problems involved in the effective use of masses of men and materiel made standardization essential.

1812 War of Contemporary records indicate that during the War of 1812 technical descriptions for the uniforms of the United States Army were given in the Army Register.

1861-65 Civil War The War Department (Quartermaster General's Office) issued brief specifications during the 1800's (especially during the Civil War period) covering clothing items and components, flags and pennants, musical instruments, tents and beds.

2. Early 1900's: War Department and Navy, for own service

Records indicate that in the early 1900's several Army and Navy activities published documents which served as master drawings and specifications peculiar to their services. Three examples are given below:

War Dept QMC The War Department (Quartermaster Corps) issued documents covering: 1) Folding Canvas Cots; this included a brief description of required components, such as types of wood, frame, rivets, painting, cover, thread, tacks, straps and handles; and 2) Last, Munson, Field Shoe; this included brief descriptions of the requirements, such as materials, construction, stamping, finishing and measurements; and 3) Trunk Lockers; this included brief descriptions of required components such as materials and construction framework.

Navy Bur Aero During the same pre-World War I period the Navy (Bureau of Aeronautics) issued standards covering materials used in the construction of aircraft, including articles of equipment (such as instruments), processes of manufacture and design requirements.

War Dept Ord The War Department (Ordnance) issued documents which standardized etching reagents for microscopic examination of metals; also, it developed suitable gun steels without nickel content.

Each document was considered not only for its military value, but also for its adaptability to commercial standards as well. This procedure was necessary because of the lack of standardization within the industry. These documents were primarily for use by the military.

3. 1917-19: The War Department adopts industry standards

The War Department, in its standardization work other than the strictly military, was directly associated with the Federal Specifications Board, the American Standards Association and the National Bureau of Standards and cooperated with engineering societies and trade associations. The Department was involved in standardization in two ways. First, it was concerned with the indiscriminately large range of specifications available for procurement of supplies. Secondly, it was able to benefit from the results of many research and engineering problems being investigated and solved by industry. While the military Departments did not formally recognize industrial standards until the late 1940's, they tacitly accepted the benefits resulting from them. This is exemplified by the frequent requirement "shall be made in accordance with the best commercial practice."

Two of the earlier documents adopted by the War Department are mentioned below.

1917 Color Card In 1917 the War Department (Quartermaster Corps) approved and accepted for use the United States Army Color Card which showed the official colors for the services. These cards were first developed by the Textile Color Card Association of the United States.

1919 Controller stds In 1919 the War Department (Ordnance) issued a document for Motor Starters and Controllers which specified, in part, that the general construction of the controller should conform to the Standardization Rules of the American Institute of Electrical Engineers* and to the regulations of the National Electrical Code for electric wiring and apparatus.

4. 1930's and 1940's: Joint efforts of military departments

During the early 1930's Congressional criticism was again directed at the large number of duplicate documents that existed within both federal and military agencies. Therefore, in the interest of economy and efficiency within the government, a program was instituted to revise many existing military documents pertaining to commercial types to conform with federal documents.

1937 Working Committee In 1937 the military services organized a joint standardization activity. Approved by the Secretaries for War and Navy and the Aeronautical Board, it was known as the "Working Committee," and became responsible for the preparation of specifications in the aeronautical area.

1941 Signal Corps Std Off Early in 1941 the Signal Corps established a Standards Office to develop specifications for electronic parts which, at that time, were critical to expanding communications and the development of radar.

* Renamed the Institute of Electrical and Electronic Engineers in 1968

1945 Joint Spec Council The Army-Navy Joint Specification Council and Board was established in 1945. This element developed, on a limited scale, joint Army-Navy specifications to support procurement.

5 Department of Defense: 1947-1961

1948 MB Std Agcy The National Security Act of 1947 created the Munitions Board (replacing the Joint Army and Navy Munitions Board). In 1948 the Munitions Board established the Munitions Board Standards Agency.

1951 SoD Memo The Secretary of Defense issued a Memorandum on 25 April 1951 emphasizing the importance of reinstating the standardization program which had been relaxed during the War; he directed that all new specifications and standards be issued in either the Federal or the Military series. He also directed that all existing service and departmental specifications be converted to the Federal or Military series by July 1955.

1952 DSMA The 82nd Congress passed Public Law 436, titled "Defense Cataloging and Standardization Act" in July 1952. (It was later codified as Public Law 1028, 84th Congress, Chapter 145.) This Act created the Defense Supply Management Agency (DSMA) as a separate element of the Department of Defense. The responsibilities of the Secretary of Defense in the area of standardization required that he accomplish the following "to the highest degree practicable."

DEFENSE CATALOGING AND STANDARDIZATION ACT, 1952
Responsibilities of Secretary of Defense

1. Standardize items used throughout the Department of Defense by:
 - a. Developing and using single specifications
 - b. Eliminating overlapping and duplicate specifications
 - c. Reducing the number, sizes and kinds of items that are generally similar
2. Standardize the methods of packing, packaging and preserving standardized items

1953 DoD Dir 4120.3 On 2 February 1953 the Director of Defense Supply Management Agency issued the important Department of Defense Directive 4120.3.

DEPARTMENT OF DEFENSE DIRECTIVE 4120.3

Responsibilities of the Defense Supply Management Agency

1. Optimum use of commercial end items and parts
2. Optimum referencing of industry standards in development of specifications and standards.
3. Coordination with industry in development of specifications and standards

1953 OASD (S&L) The enactment of the Department of Defense Reorganization Plan No. 6 in June 1953 abolished the DSMA and transferred its functions to the Secretary of Defense. At the same time the Office of the Assistant Secretary of Defense (Supply and Logistics) (OASD(S&L)) was created. Responsibilities included the administration of the Defense Cataloging and Standardization Act of 1952 (see above).

1954 Dir 4120.3 Revised A revision of DoD Directive 4120.3 was issued on 15 October 1954. This revision restated and clarified the scope, purpose and basic objectives of this program. It further stated that the program would be accelerated and decentralized by assigning responsibilities and authority to the military departments.

1958 AFSSC In June 1958 the administration of this program was delegated to the newly established Armed Forces Supply Support Center (AFSSC) under the policy direction of the Assistant Secretary of Defense (Supply and Logistics).

1959 DDR&E The Director of Defense Research and Engineering was given collateral responsibilities for certain phases of the program on 27 January 1959. (Memorandum of Agreement between ASD (S&L) and DDR&E)

1961 ASD (I&L) The Assistant Secretary of Defense (Installations and Logistics) was designated on 30 January 1961 and assumed the responsibilities previously delegated to ASD (S&L), which included the responsibility for supply cataloging, standardization and quality control. It should be noted that the Armed Forces Supply Support Center continued to be responsible for administering the Standardization program.

1961 DSA The Defense Supply Agency was established on 6 November 1961 (DoD Directive 5105.22). At that time the Armed Forces Supply Support Center was transferred to the DSA. The DSA reported directly to the Secretary of Defense.

DEFENSE SUPPLY AGENCY: RESPONSIBILITIES
DoD Directive 5105.22 1961

1. Administering the Defense Standardization Program
2. Recommending to the Secretary of Defense assignments among the military departments of responsibility for defense engineering standardization
3. Directing the item simplification for all items assigned
4. Reviewing and evaluating the operation of the Defense Standardization Program and making changes as required to improve the effectiveness of operation.

6. Department of Defense 1961-68

1961 TDSP Council Several recent studies designed to improve the Defense Standardization Program resulted in the establishment of the high-level Technical Data and Standardization Policy Council. The Departmental Assistant Secretaries for Research and Development and for Installations and Logistics are members of this Council. The Council is co-chaired by the Director, Defense Research and Engineering and the Assistant Secretary of Defense (Installations and Logistics). The formation of this Council demonstrates the high level of interest in this program within the Department of Defense.

1964 Off TDSP On 15 June 1964 the Secretary of Defense established an Office of Technical Data and Standardization Policy. Responsibilities included policy making and implementation of policies and basic Department of Defense procedures in the field of technical logistics data acquisition and use, including technical data storage and retrieval systems. Administration of the Department of Defense-wide Standardization program was also assigned to this Office. The Director of this Office reported directly to the Assistant Secretary of Defense (Installations and Logistics).

1964 TDSPC In addition, there is a Technical Data and Standardization Policy Committee with representation from Departmental and OSD level (R&E and I&L) elements. (The Army is represented on this Committee by a representative of the Technical Data Office, Hq,AMC.)

For years standardization has been an important element of military logistics, including research and development. It has provided the bases for mass production and distribution of commodities to military and civilian users. However, the problems encountered in international affairs and the demand for more economical operations within the Department of Defense have placed an increased emphasis on standardization. Therefore the entire program has been remodeled to improve the efficiency and effectiveness of logistical support and of operational readiness of the military services.

1965 DoD 4120.3, 2d Revision Department of Defense Directive 4120.3 was revised and issued 23 April 1965. This revision stated, in part, that standardization is the adoption and use (by consensus or decision) of engineering criteria to achieve the objectives listed below

DEPARTMENT OF DEFENSE DIRECTIVE 4120.3
1965 REVISION
Objectives of Standardization

1. To improve the operational readiness of the military services by increasing efficiency of design, development, materiel acquisition and logistics support.
2. To conserve money, manpower, time, facilities and natural resources.
3. To minimize the variety of items, processes and practices which are associated with the design, development, production and logistics support of equipment and supplies.
4. To enhance interchangeability, reliability and maintainability of military equipment and supplies.

Engineering criteria are applied, as appropriate, in design, development, procurement, production, inspection, supply, maintenance and disposal of equipment and supplies.

1967 DoD 4120.3, Change On 13 January 1967 Change 1 to Department of Defense Directive 4120.3 was issued by the Office of the Assistant Secretary of Defense (Installations and Logistics)

DEPARTMENT OF DEFENSE DIRECTIVE 4120.3
CHANGE 1, 1965
Significant Changes

1. The standardization project report; this will be used as the principal source data collection form in the management structure of the standardization effort.
2. The delegation of authority to the standardization assignee* to act for the Secretary of Defense to resolve differences between the military departments or Department of Defense agencies in matters pertaining to standardization.

1968 Direct. TDSP&QA In 1968 the Office of Technical Data and Standardization Policy was reassigned to the Deputy Assistant Secretary of Defense and at the same time was combined with the Directorate for Quality and Reliability Assurance. It is now designated as the Directorate for Technical Data, Standardization Policy and Quality Assurance.

* See Part III, para 3 below

PART III ORGANIZATIONAL LEVELS IN THE DEFENSE STANDARDIZATION PROGRAM

1. Defense-wide administration and direction

This Defense function has been delegated by the Secretary of Defense to the newly established Directorate of Technical Data, Standardization Policy and Quality Assurance, Office of the Assistant Secretary of Defense (I&L). At this organization level, the Directorate prepares and publishes Department of Defense policies and procedures in consultation with the military departments and the Defense Supply Agency, establishes broad goals, measures progress, and prepares reports to the Secretary of Defense and Congress, recommends to the Secretary of Defense assignments of broad standardization responsibilities to the military departments and the Defense Supply Agency, and reconciles differences between military departments and the Defense Supply Agency.

2. The departmental level

At the Headquarters level of each military department (Army, Navy and Air Force), the Departmental Standardization Office (DepSO), administers the program within that military department. At the Headquarters level of the Defense Supply Agency a similar organization administers the standardization activities of the Defense Supply Centers. These department level offices monitor progress within their department or agency. They also implement policies and procedures, reconcile inter-departmental differences, and participate in the development of the Department of Defense policies and procedures.

3. The Standardization "assignees" for commodity classes

For each Federal Supply Class (FSC) Department of Defense-wide management responsibility has been decentralized to an assigned Department or agency, called the "assignee". After Public Law 436* was passed, it was obvious that the management workload for specific standardization areas had to be further divided and delegated to specific organizational elements within the military department or agency to avoid a single top-heavy department-level management group. Therefore department level management was delegated by Federal Supply Class to "assignee" activities.** These assignee activities have been given Department of Defense-wide responsibility to assure optimum standardization in assigned FSC classes or areas in coordination with counterpart elements in other departments referred to as "participating" activities; to assign projects to "preparing" activities (see below) based on interest and technical capability; to monitor progress and report accomplishments.

* The Defense Cataloging and Standardization Act of 1952 (see under 1952)

** "Activity" is used here and in the following text to represent organizational elements within the Department of Defense.

4. The "preparing" activity level

This level is also referred to as the "technical" level. The preparing activity is responsible for the preparation, issuance and maintenance of assigned specifications and standards covering individual items, parts, systems, commodities and practices. They are also responsible for effecting coordination with other military activities, civil agencies and industry. Preparing activities are normally the subordinate Commands and activities in the Army, Navy, Air Force and Defense Supply Centers. The Laboratories and Arsenals of the Army are examples of Engineering and Development activities that are designated as preparing activities.

5. The departmental "custodian" activity level

This activity is one of the technical elements of the Army, Navy and Air Force designated by its Department to effect departmental coordination; to review documents and studies submitted by preparing activities; and to submit coordinated department position.

6. The "review" activity level

This is the interested military activity using or planning to use a document and asserting a justifiable requirement to review the document in draft form. Such a requirement is based on essential technical interest.

Summary

An indication of the diversity and complexity of the national engineering standardization effort and the importance placed on Standardization and Technical Data Management by both the Congress and the Department of Defense has been presented. The evidence of past experience, briefly summarized in this report, indicates conclusively that standardization is essential to the economic survival of an industrial society. This emphasis on engineering standardization must be maintained and increased so that the interdependence of men, money and machines will be economically used to insure the continued growth of our industrial society.

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