4th

130

ARMY INDUSTRIAL COLLEGE

Washington, D. C.

(Course at Army Industrial College, September '25 - January '26)

LECTURE

STANDARDIZATION

By

Captain Hal. T. Vigor, Q. M. C.

December 17, 1925.

25/672/EYS

Among technical problems of administration few are of greater importance than those connected with the operations involved in standardization of purchase requirements and in subsequently effecting purchase in accordance therewith. Many large industries have standardized their purchase requirements, not only for equipment but for maintenance and other supplies, and have consolidated their purchases, resulting in great economy, both in purchase and operation.

Standardization is now recognized as being of great importance to both the consumer and the producer. It is sometimes said that the benefits of standardization are mainly to the field of production. This is not the case. They are as great to the field of purchasing. In industrial standardization it is the consumer who is benefited most, although the immediate benefits are largely to the producer, for it at once simplifies his work and enables him to produce what is required by the consumer cheaply and expeditiously.

Objectors to standardization frequently urge that it would stifle initiative and progress and that the adoption of a standard would prevent advance through improvements in the art of manufacture. Of course this is not the case. A standard should remain standard only until something better is developed, but it should not be changed until justified from all points of view.

A given standard, to achieve its object, must be suitable for the intended use in the majority of cases. The exceptional case requires special consideration, and actual perfection will never be attained. The economies and benefits of standardization have been so thoroughly demonstrated within the past few years that they are entirely outside the argumentative field.

Intelligent standardization presupposes a definite knowledge of the conditions of use of the material or article and a reconciliation of adjustable qualities, grades and sizes. Standardization is largely a compromise, and must necessarily involve the sacrifice, in some cases, of personal preferences.

Standardization, like efficiency, is not an easy term to define, it is not always understood in its true sense and by many is looked upon with doubt and suspicion. It may be defined as the unification of methods and practices involved in industry, general business and all lines of endeavor which involve repetition work, and it may be considered under several aspects.

Standardization of Nomenclature enables the purchaser, seller and manufacturer to use and understand the same language. It is very important that there be acceptable definitions of terms used in specifications and contracts.

Standardization of variety, or simplification, involves the elimination of unnecessary types, shapes, grades and sizes of manufactured articles. Waste in industry is largely due to an over-multiplicity in the number of products, as well as to inefficiency of process. There is also a large waste due to deterioration, obsolescence and space required for stocks of unnecessary material.

One type, size or grade of an article will not meet all the requirements, neither is it desirable to have such an extensive variety that the differences are small and meaningless. The ideal condition is to have just enough variety to meet all real needs with no overlapping.

Sound business economy demands the elimination of the special or little used product and its substitution by the standard or most widely used and most efficiently produced goods.

Standardization of dimensions insures ready interchangeability of supplies, and the proper interworking of parts which may be manufactured or assembled by different manufacturers.

Standardization of specifications puts bids on an easily comparable basis, promotes fairness in trade competition, insures the proper grade of material and manufactured products for a given use, and is the most important phase of the subject, from the purchasers viewpoint. It is the first and most essential step in the economy that arises from the purchase of materials or products in large quantities, and is a necessary factor in the improvement of quality and the adaptation of quality to definite uses.

The specification is the common meeting ground for the manufacturer and user, and it is at once a statement of the user's needs and what the manufacturer is required to supply. The specification should include limiting values for properties and dimensions necessary to meet the required service, with proper tolerances. A suitable specification is one which enables bidders to know exactly what is desired or required and what procedure the purchaser will follow to satisfy himself that the specification has been complied with. Defective and incomplete specifications, whether due to compromise of quality for temporary economy, or through lack of data, should be replaced by those in which the best magnitude of each property involved is so specified as to predetermine the definite quality best meeting the need.

The writing of specifications is not a task that can be performed at any one time and be considered completed A specification that reflects the best practice for one year may be found deficient from the standpoint of succeeding years Satisfactory specifications are the result of growth and they must change from time to time to harmonize with the changes in both the methods of manufacture and the requirements of the service, and they can develop only as the area of definite knowledge expands Looking at the question from this viewpoint, the importance and necessity of continuous study in the formation of standard specifications is at once apparent

In all standardization work there are two main factors to be considered, namely, what the standards should be, and how to make them effective A specification of any kind is written to be enforced and it is of value only to the extent to which its provisions are enforced by fair and uniform inspection Unless enforced, it is valueless and becomes a dead letter Its fair enforcement is a benefit alike to the honest purchaser and seller and a stumbling block to those on either side who desire to resort to subterfuge or deception Furthermore, it must be enforced uniformly at all times to be effective

It is a basic principle of purchasing that competition reacts to the benefit of the purchaser If competition is to be secured and maintained there must be a clear definition of standards so that tenders may be made intelligently. The purchase of materials and products in accordance with well defined standards, understood and agreed upon by the purchaser and produced alike in the contract, is the only way by which they

can successfully be purchased by competitive bids. With such standards, a purchaser is enabled to take advantage of this method in securing the lowest price that can be obtained for an article of the required standard. Without them the reputable bidder is not only at the mercy of the unscrupulous one, but the purchaser is deprived of the legitimate economy resulting from this method of purchasing.

The suitability of ar article for the service required is equally important, otherwise money would be wasted in the purchase of materials of a quality better than needed, and economic losses would result from the use of cheap out low grade materials The great value and business importance of specification standardization from the standpoint of any large purchaser, lies in consolidated purchases to a single standard specification for a given article. This results in economy

The development of specifications---especially specifications which are to be used as a basis for competitive bidding---is a problem of no small difficulty The difficulty is to frame specifications which shall be sufficiently precise and detailed to secure all the advantages that flow from precision and definiteness without at the same time making them so voluminous and intricate as to discourage and hinder competition. The advantages which results from precision and definiteness in the specifications contained in the invitations to bidders are manifold

A full and precise specification greatly enhances the trading reputation of the purchaser for exact knowledge of his needs It informs the dealer that shiftiness during the course of a purchase agreement is not a part of the purchaser's policy---a certainty which obviously encourages competition among the most desirable vendors and secures the

lowest prices. Examination of the best modern practice in purchasing leads to the conclusion that specifications should be written in detailed and complete terms with reference to every possible controversial point, in short, individual preferences or partiality of users of goods and of inspectors should be reduced to a minimum.

Large organizations now have a central authority for the development of specifications Some railroad systems have an engineer of standards, and in other cases this is combined with the chief purchasing function. Where this is done there invariably results a marked standardization in the articles used in the several branches of the service

Standardization is now recognized by purchasing officers as the proper basis for efficiency in purchsing, for it tends to secure for all similar needs the article which experience has shown to be the best for the purpose. By reducing the number of items to be purchased, it simplifies the work of the purchasing office---a matter of great importance to the Government, which uses many thousand items of material It simplifies the work of inspection by reducing the variety of items on which inspectors must exercise their judgment, and the work of accounting and auditing.

Standardization in the Army is achieved by contact with Government standardizing bodies and with industry The Government bodies engaged in standardization work are the Federal Specifications Board and the Division of Simplified Practice, Department of Commerce

The Federal Specifications Board was authorized under authority of Circular No. 42, Bureau of the Budget, October 10, 1921, in which it was stated that the establishment of the Board was for the purpose of coordination and economy in the procurement of materials and services used by the Government under specifications prepared by the various branches thereof, to avoid duplication of effort and better utilization of industries.

The duties of the Federal Specifications Board were to compile and adopt standard specifications for materials and services and to bring the Government specifications into harmony with the best commercial practice wherever conditions permitted, bearing in mind the desirability of broadening the field of supply.

The procedure adopted for the consideration of the specifications, is as follows: The need of specifications for a given article of material, for either technical or business reasons, is fully considered by the Executive Committee and the subject is then referred to a technical committee composed of the Government experts in the particular subject, for consideration of all existing Government of commercial specifications. A specification is selected, or written, which will be suitable for the uses of all departments and establishments of the Government. The cooperation and advice of interested commercial and industrial concerns is requested and their recommendations are fully considered by the technical committees. The specification as agreed on by the technical committee is then submitted to all departments and establishments of the Government, through their

respective representatives on the Federal Specifications Board, for comment and criticism At the same time, copies of the proposed specifications are submitted to the American Engineering Standards Committee with a request for their assistance in securing comment and criticism from the various interested engineering and technical societies all over the country. All criticisms received are referred back to the respective technical committees for consideration on their merits. When the specification is finally agreed upon, it is promulgated by the Federal Specifications Board as official Government Standard for use in connection with the purchase of material covered by the specification.

The work of the Federal Specifications Board is closely related to the general subject of standardization, and standardization of specifications is the first and most essential step in the economy that arises from the purchase of materials in large quantities. It is a necessary factor in the improvement of the quality of materials purchased and the adaptation of quality to definite uses. The purchase of materials in accordance with well defined standards, understood and agreed upon by the purchaser and producer alike in the contract, is the only way by which materials can successfully be purchased by competitive bids. With such standards the Government is enabled to take advantage of this method in securing the lowest price that can be obtained for an article of the required standard. Without them the reputable bidder is not only at the mercy of the unscrupulous one, but the Government is deprived of the legitimate economy resulting from this method of purchasing.

The Division of Simplified Practice is a branch of the Department of Commerce, whose function is reduction of industrial waste through the elimination of unnecessary diversities in sizes, types, styles and other

varieties of manufactured products. This Division has achieved astonishing results in its three years of existence. Some of these results are as follows.

Paving Brick, reduced from 66 types to 6.

Woven Wire Fencing, from 552 types to 69.

Bed Blanket sizes from 78 to 12.

These are just a few examples of the results being accomplished by that Department. The results of this work are far-reaching and result in savings of millions of dollars to industry every year. These savings are immediate to the producers and jobbers, but are reflected in reduced prices to the consumer.

Simplification reduces stocks, production costs, selling expenses, investment, seasonal employment and misunderstanding. It increases turnover, promptness of delivery, quality of product and aids in promoting foreign commerce.

In addition to working through these established Government standardizing bodies, the War Department branches in the preparation of specifications for strictly military articles, secure contact with industry through trade associations and independent producers.

The development of types of articles in the War Department is carried on as follows

The requirement for an article is decided upon. A preliminary investigation and research is started. Samples are then constructed and comparative tests made of these samples. The best sample is then selected and a test is made in comparison with previously adopted types. A preliminary test is then made by an organization, and defects found are corrected after this test. Investigation is made as to whether the

required quantities of the article can be produced in a major emergency. The samples then are submitted to a service test The results of these tests are then considered by the Technical Committee of the Supply Branch charged with the procurement of the article. The article, if satisfactory, is recommended for adoption. Clearance for procurement is then secured through the Office of the Assistant Secretary of War Approval of type is then secured from the Secretary of War Complete specifications are prepared after approval of type These specifications are then forwarded to the Office of the Assistant Secretary with a statement that the article can be procured in sufficient quantities in an emergency, that it does or does not contain strategic raw material If it does contain strategic raw materials, the approval of the Chairman of the Commodity Committee for these strategic materials are secured With the approval of the Assistant Secretary the article becomes a standard article of issue.

An example of this is the development of an insulated food container It has been determined that we require an insulated food container for the transportation of cooked rations from the rolling kitchens to front line troops.

The development of this insulated food container was started in 1920 A number of containers of commercial design were furnished the Infantry Board for a comparative test with the Marmite can used during the war It was decided that the Marmite can, with exterior dimensions 11 inches in diameter and 12¾ inches in height, should be given a thorough test

The results of this test indicated that the insulation of the can was excellent, that food could be served from it conveniently and in

a sanitary manner It was, however, believed that changes should be made the lid, in the padding that went between the can and the soldier's back, that there should be at least four points at which the lid is clamped to the can

It was also found that due to the shape of the can, the center of gravity being about 7 inches away from the back when carried, that this caused the straps to cut into the shoulders and tended to pull straight back instead of down. It was recommended that a kidney-shaped can be procured, as this shape can would fit a man's back, only a thin pad being necessary. The capacity should be made the same as the experimental Marmite can, that is with sufficient capacity to feed eight men one ration. Due to the fact that this varied greatly from any commercial shapes then in existence, and the desirability of adhering to commercial practice whenever possible, this kidney-shaped can was not constructed at that time, but several types of pads were manufactured and furnished the Board for test with a view to eliminating the trouble found in the first test.

These cans were found, in general, to be satisfactory, but the Board was of the following opinion:-

> "The Board realizes the desirability of adhering to commercial types of equipment whenever possible in order to simplify production and procurement problems in times of emergency The place and manner of use of Insulated Food Containers must however be borne in mind. They will be carried at the extreme front lines by men who are probably daily being called on to put forth the maximum physical effort and at the same time are being subjected to a severe nervous strain. Any addition to the physical strain necessarily imposed on men under such conditions is not warranted.

> The adoption of such a principle while it may simplify procurement of equipment would it is believed tend to an increase in the difficulties of procurement of man power by needlessly adding to the number of men returned from front lines on account of disease or injury. Wherever possible the "strain" should be kept as far to the rear as possible and equipment procurement difficulties be solved on the basis of reducing to a minimum the difficulties of the soldier at the front."

The Board recommended that the kidney-shaped can be manufactured and furnished for test. These cans are now being tested. Upon the completion of this test such changes as are found necessary will be made.

The Assistant Secretary of War will be requested to approve for procurement this can, and upon receipt of his approval, the Secretary of War will be requested to approve the insulated food container as a standard article of issue.

The next question, then, is a proper specification which will convey to the manufacturer the requirements in a clear, concise manner. Drawings and specification, when approved, will be furnished manufacturers of this type of equipment for their comments. All comments received will be given serious consideration and such comments as have merit will be adopted with the concurrence of all interested branches.

This is a good example of the difficulties sometimes encountered in trying to stay as near commercial practice in construction of our military articles, as possible, in order to simplify procurement in a major emergency, and at the same time, secure an article which is satisfactory for field service.

Although, as stated before, the writing of specifications is not a task that can be performed at any one time and be considered completed, too much stress cannot be placed upon the evil effects of changing specifications after orders have been placed.

After specifications have been submitted to the manufacturer for his study with a view to production, no change should be made unless it is imperatively demanded by the tactical situation, or when the benefits outweigh the delay.

A study of a specification is gone into by the manufacturer, his production engineers and his designing and planning department in a very thorough, whole-hearted and energetic way. This is particularly true in time of war, when the morale of the organization is high in anticipation of munitions work, and every man is keyed up to producing for our Armies at the front. If the design is subsequently changed, every department of the plant is affected. Confusion exists for a time, production is greatly delayed, interest begins to wane, there is a bad effect on the morale of all employees in the plant, extending down even to the machine operators, and finally if several changes are received, the prospective manufacturer washes his hands of the whole matter.

A change in a specification after an order has been started may cause great loss to the manufacturer, due to changes in jigs, dies, machine tools, etc. It may mean also that raw material purchased for the order is unsuitable and will have to be discarded. It unquestionably retards production when it requires changes in design, in set-up of plant operation, and the instruction of plant personnel necessary in any change.

5/672/MYS

A few examples of this are as follows -

Contract #418-P dated December 15, 1917, awarded to Roxford Knitting Co , Phila , Pa , for furnishing 360,000 Undershirts and 1,080,000 pcs Drawers as per revised Specifications #4, complete delivery of which should have been made by October 31, 1918 In March, 1918, tariff of sizes as called for under specifications was changed, increasing the percentage of larger sizes, for which the Government made an additional allowance of $ 05 per garment. This necessitated the use of a greater amount of material, required increased time for manufacture, affected production on other Government contracts held by this firm, and consequently was the cause of delayed completion of said contract until January 1919.

Limber and Caisson Wagons - The Chassis for the limber and caisson were primarily designed to carry the 24 inch portable searchlight In the emergency, to have a limber and a caisson tool wagon to replace the Brown type tool wagon, sample limber and caisson bodies were quickly developed and fitted to the chassis Orders were placed to build the limber and caisson wagons from the sample, with instructions to the manufacturer to furnish any further reinforcements to carry the loads. Production was progrssing rapidly until some wagons were placed in the field The limber and caisson chassis, designed by the manufacturer for the 24 inch searchlights, failed to meet the requirements for the loaded limber and caisson wagons. This failure required that a change in design be made in the chassis by adding stiffening brackets, etc., all of which retarded production to a great extent This change involved loss to the manufacturer, and additional expense as well as loss of delivery to the government

Ordnance Material - When the French 75 mm. field gun replaced the American 3-inch, the ammunition had to be changed to correspond For the shrapnel case, this meant a decrease in external diameter of .05 inches and a correspondingly slight decrease in the cavity diameter. These changes are entirely in the machining. There were no forging changes whatever. The caseswere being produced very successfully by an American firm which had been established about eighty years and which had had three years' experience in making munitions for our allies.

The firm made every possible preparation to change over with the minimum of delay. New guages and fixtures were on hand and everything was set for the change which was put into effect about October 1, 1917. It was anticipated by the firm that there would be no falling off in production but as a result production fell during the week of October 2nd to 8th from 38,000 shrapnel cases to 20,000 cases, and did not again reach 36,000 until the week ending November 5th. The delay due to this slight change is estimated as equivalent to the loss of nine whole days' production. It was entirely due to the difficulties incident to getting lathe hands and other operators into production on very slightly changed dimensions. There were absolutely no changes in operations. A large part of the trouble is said to have been psychological, - a reflection in the average workman's mind of the apparent indecision on the part of the Government in making the change. It is easily apparent that if a very minor change involves a delay of nine days, a radical change may mean a paralysis of production which would require months to cure.