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SPECIFICATIONS AND TOLERANCES FOR COMMERCIAL WEIGHING AND MEASURING DEVICES

HANDBOOK OF THE NATIONAL BUREAU OF STANDARDS

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DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

George K. Burgess, Director

HANDBOOK OF THE NATIONAL BUREAU OF STANDARDS, M85

SPECIFICATIONS AND TOLERANCES FOR COMMERCIAL WEIGHING AND MEASURING DEVICES

Miscellaneous Series, M85

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PREFACE

This volume is the second of the series of three handbooks which are designed to replace that earlier publication of the National Bureau of Standards known as Handbook No. 1, Manual of Inspection and Information for Weights and Measures Officials. The first volume of the series has already been published as Handbook No. 11, Weights and Measures Administration; the third volume, which is planned under the title Weights and Measures Technology, will probably be published in about a year from the date of the present volume.

The principal object of the present handbook is to present in form convenient for handling and reference the specifications and tolerances recommended by the National Bureau of Standards for those classes of commercial weighing and measuring devices which are customarily examined by State and local weights and measures officials. This group of specifications and tolerances corresponds to the several codes adopted by the National Conference on Weights and Measures. This material comprises Part II of this publication.

There are, however, some classes of commercial weighing and measuring devices which, although properly coming within the scope of the authority of the weights and measures officer, are, by reason of lack of suitable equipment or sufficient personnel, regularly examined by only a few such officers. Specifications and tolerances for some of these classes of equipment have not been considered by the National Conference on Weights and Measures and are, moreover, not of primary interest to the weights and measures officials of the United States as a whole. Nevertheless a handbook

on specifications would be incomplete if published specifications and tolerances of this character were to be ignored, and, accordingly, in this volume there is given a very brief description of the scope of the more important of the existing codes affecting apparatus of the character in question which have come to our attention, together with references to sources from which the complete texts of such codes may be secured. The person who may be interested in such codes is therefore informed where he may secure the specifications and tolerances which are not given in full herein. This material comprises Part III of this publication.

Finally, there is a subject closely related to specifications and tolerances upon which it is considered appropriate that some comment be offered at this time. This is concerned with the general considerations underlying the selection and approval of devices for various commercial uses; in other words, with the efficiency of utilization of equipment. It is the purpose of this discussion to emphasize the importance of the subject and especially to develop its relations to the specifications and tolerances which are presented herein. This discussion, prepared by F. S. Holbrook, of the Bureau of Standards, is entitled "Judging the suitability of use of commercial weighing and measuring equipment," and it comprises Part I of this volume.

While primarily prepared for the information of the State and local weights and measures officials of the United States and manufacturers of commercial weighing and measuring devices, it is believed that interest in the material presented in this handbook will by no means be confined to these groups, but that it will be of much assistance to other interests as well. The codes contained herein form the basis for the State and local regulations governing such devices in practically all parts of the country and in very many cases are

identical with such regulations. Industrial and manufacturing concerns and purchasers in general will thus find set forth standards for materials, design, construction, and performance which have been carefully worked out over a period of years and have received general indorsement. They may, therefore, safely be accepted as criteria for the purchase and maintenance requirements for the noncommercial as well as the commercial weighing and measuring equipment of such concerns. Finally, every purchaser of weighing or measuring equipment may find the discussion on the selection and utilization of such equipment of some assistance in choosing the devices best adapted to his particular needs.

SPECIFICATIONS AND TOLERANCES FOR COMMERCIAL WEIGHING AND MEASURING DEVICES

Part I.—GENERAL

JUDGING THE SUITABILITY OF USE OF COMMERCIAL WEIGHING AND MEASURING EQUIPMENT

By F. S. Holbrook,
Principal Scientist, National Bureau of Standards, and Secretary, National Conference on Weights and Measures

The contents of this volume will be found to be largely concerned with recommended specifications and tolerances with which it is believed that commercial weighing and measuring apparatus of various classes should comply. Experience in the enforcement of weights and measures laws has amply demonstrated the necessity of the application of such specifications and tolerances as are herein contained and there can be no question of the wisdom of purchasing commercial apparatus in compliance therewith.

It is to be recognized, however, that the whole problem of the procurement of satisfactory apparatus in various commercial uses will not necessarily have been solved, even after satisfactory codes of specifications and tolerances for commercial apparatus have been promulgated and are enforced in a given jurisdiction, valuable and necessary as this procedure may be. The painstaking official is sure to find that ideal conditions are not to be attained by these steps alone—that along with the above other precautions are to be ob-

served. One of these may be stated as the securing of a proper relation between the piece of equipment employed and the use to which it is put—the efficiency of utilization of apparatus—to the end that the best results may be obtained and the best conditions exist in all varieties of commercial transactions.

Individual weights and measures officials in striving to obtain the ideal condition in this respect in their jurisdictions have naturally come to recognize the important part which the principle involved plays in their work. However, the subject has, it seems, been but little emphasized in official publications usually in their hands. What information has been available along these lines has been in the catalogues or other publications of manufacturers of weighing and measuring devices. In relation to these, in general, we may state that it is no part of our purpose in what follows to disparage them as a source of useful information. That some of these publications contain material of value is not to be gainsaid. Certainly, in so far as his own product is concerned, the manufacturer is in an excellent position to recommend specific types for particular needs. Such suggestions deserve and should receive the careful attention of the official and of the purchaser.

It is obvious, however, that manufacturers' catalogues will almost necessarily confine their discussions to one kind and make of apparatus; they will not have occasion to present the whole subject in its broader and more general aspects. Moreover, since these publications naturally have as their primary or underlying purpose the sale of specific products, it may reasonably be supposed that the official has often discounted the contents thereof to some extent in the not unnatural belief that the suggestions advanced can hardly be wholly unprejudiced ones. Therefore such an article as this

seems none the less necessary. Likewise, there have not been available to the ordinary purchaser any general constructive suggestions which he has recognized as being unbiased, for the source mentioned above is likely to be discounted in this case as in the other. Again an official presentation of the underlying principles may serve a useful purpose.

Proceeding to this presentation, it may first be observed that the purchaser of commercial apparatus will not have taken sufficient precautions if he merely selects a piece of apparatus in compliance with the code applicable to devices of the character of the one purchased, failing to give attention to any additional considerations. Likewise, the weights and measures official will not be exercising proper and efficient supervision over the apparatus in commercial use if he merely inspects and tests apparatus and seals or condemns it solely because it complies or does not comply with the specifications and tolerances applicable to it, at the same time neglecting to examine into the conditions surrounding its use. For while it is to be taken for granted that every piece of apparatus complying with proper specifications and tolerances is, in general, a proper one, it by no means follows that every such piece of apparatus is efficient, or even satisfactory, for every use.

But little consideration will be necessary to indicate the truth of this postulate. Few would be found to defend practices such as attempting, in commercial transactions, to determine the weight of a ton of coal on a railroad track scale, of 50 pounds of fertilizer on an autotruck scale, of 10 pounds of sugar on a portable platform scale, of 5 grains of an expensive or potent drug, to be used in compounding a prescription, on a counter scale, or of 50 milligrams of a radium salt even on a prescription scale. Nor would this be on account of the fact that the railroad track scale, the autotruck scale,

the portable platform scale, the counter scale, and the prescription scale were not, in themselves, entirely satisfactory weighing machines. Each might well be of excellent design and construction, and in proper condition. It would rather be because each scale was employed in a use for which it was not designed and constructed and for which it was entirely unsuited. And yet, while it is undoubtedly uncommon, it has not been by any means unknown for scales to be misused in ways not unlike those mentioned.

It is, in short, essential that the purchaser of apparatus and the weights and measures official, in buying or in examining, respectively, apparatus intended for a certain use or being put to a certain use, should each satisfy himself that the piece of apparatus selected or employed is well designed for that particular use. Failure to observe these precautions may result in the owner receiving unsatisfactory service, and the amounts of commodity entering into commercial transactions being seriously inaccurate, even when due care is being exercised to secure the best results capable of being produced by the apparatus employed.

To be sure the weights and measures official will often not be in a position to condemn apparatus in use even though he may consider that it is not ideally suited to the use for which it is employed, nor is it even desirable that he have such broad powers. However, if serious inaccuracies are resulting, his authority will doubtless be found sufficient to correct conditions either directly by proceeding against the apparatus itself, or indirectly, but perhaps not less effectively, by proceeding against the amounts of commodities determined. Also, even in cases where mandatory action is not indicated, he can furnish valuable service by assisting a prospective purchaser to make a wise selection on the one hand, or by pointing out the inefficiencies in the case of apparatus in use on the other.

In these cases the official will naturally take care to give general advice only, covering such points as accuracy desirable, preferable capacity of device, whether one or more devices will probably be needed, etc., leaving to the purchaser in every case the decision as to the merits of similar products of the different makers. Also, when the various devices under consideration all comply with the specifications and tolerances in force, it will, we believe, be much the wiser course for the official to refrain from differentiating between devices designed upon different principles but intended for identical uses. In other words, considerations such as convenience, speed of operation, durability, etc., should be evaluated by the purchaser. We have in mind the undesirability of comparison of the relative merits of beam scales and automatic scales, spring scales and pendulum scales, piston-type and visible-type liquid-measuring devices, and meters, etc.—such matters as these should be left to the salesmen for presentation. The purchaser should inform himself along these lines and draw his own conclusions without the interposition of the official. Failure on the part of the official to observe this precaution is likely to lead him into serious difficulty even when his motives are above reproach.

Contrary to the practice in this country, which will be described later, some foreign countries adopt the practice of officially placing restrictions upon the type of apparatus allowable for particular uses. To mention one specific example, in England the regulations corresponding to our specifications and tolerances provide for three classes of "beam scales" (defined as equal-arm weighing instruments, the pans of which are below the beam), namely, classes A, B, and C. To each of these classes are applied independent requirements as to sensitiveness and accuracy. "Special trades" are then tabulated and the class or classes of scale required to be used in these trades are noted. Under such conditions

the purchaser of a scale, by being restricted in his choice, is guided as to the type to be selected.

In this country we have few such restrictions as these, and if a proper enforcement of law can be procured without them it would be our judgment that under conditions as they exist in this country it is best to allow the purchaser the greatest freedom of choice. It has always been considered that were the attempt to be made to lay down particular requirements for the kinds of apparatus to be put to various uses, the task of the weights and measures official would be greatly complicated—perhaps the majority of the weights and measures offices as at present constituted would find it impossible adequately to enforce the requirements. For these reasons the specifications and tolerances usually adopted here are general in their character, they are drawn broadly to cover devices of certain general types, and they do not generally attempt to define or restrict the uses to which apparatus may be put.[1] Thus the selection of equipment here is more untrammeled than in England, but for this reason a purchaser should, both on his own account and for the protection of those with whom he deals, feel more, rather than less, obligated properly to select apparatus satisfactory and adequate for the use to which it is to be put.

In any event even were the attempt to be made to require specific types for particular uses this object would probably best be accomplished in this country by rule and regulation promulgated by the individual offices rather than by specifi-

[1] There are several minor exceptions to this general statement; thus scales for the sale of foodstuffs other than vegetables at retail shall have graduations of 1 ounce or less (counter scales, specification No. 10a); baskets of a less capacity than one-half bushel shall not be used as dry measures (dry capacity measures, specification No. 8) except only for berries and small fruits (berry baskets or boxes, specification No. 1); the pans of scales for the sale of fish or other wet commodities shall be so constructed as to provide for drainage (scales, general specifications, No. 23); and prescription scales and balances of class B may only be used in weighing loads of 10 grains or more (prescription scales and balances, class B, specifications), etc.

cations and tolerances designed for national acceptance. This is for two reasons: First, the manner of use of apparatus is, under our system of law, the prerogative of the States, and they should be left entire freedom to work out these details in the manner which seems to them best. Second, the specifications and tolerances are not only guides for the weights and measures official in the enforcement of law but they also serve the very important purpose of advising the manufacturer of weighing and measuring devices as to what apparatus will be satisfactory in many of our far-flung jurisdictions. The approval of type by the Board of Trade appears to subordinate this purpose in England. As we understand it, their specifications may be said to serve as general guides only; each design produced by each maker is considered on its individual merits, and must be approved before it is put on the market for commercial use. Since we do not have any Federal approval of type of apparatus—and State approval in relatively few jurisdictions—the specifications and tolerances must become primarily the sole reliance of the manufacturer in judging whether his product will be satisfactory. They should, therefore, be prepared in the form which will be of most use to the manufacturer.

It seems, then, best that they be not complicated by specifications concerning the particular uses to which specific types may be put. For after all the manufacturer of the apparatus is not, perhaps, primarily concerned with this—certainly in most cases he can not be held generally responsible for the use in which a device which he produces may be employed. When he produces apparatus complying with the specifications and tolerances he fulfills the only duty to which he can be held strictly to account. He will, and usually does, when practicable, go further than this; to secure customer satisfaction, he will endeavor to see to it that the

purchaser secures apparatus nicely fitted to his particular needs. But since he will often not be fully advised as to the condition under which the apparatus is to be used, and since, in any event, a manufacturer will practically be obliged to sell the particular device ordered, the onus of securing a device properly fitted to the particular need must, in the final analysis, be borne by the purchaser.

One further word may be added in regard to the character of the requirements contained in the specifications and tolerances. We feel that the principal object to be attained by specifications and tolerances is to eliminate from commercial use generally unsatisfactory commercial types. The desirable concomitant is to secure in place of the discarded apparatus constantly improving types. This latter condition will be most effectively secured not by hedging the manufacturer about with specific and restrictive specifications, but rather by allowing his initiative the fullest play. The specifications and tolerances have, therefore, been designed to inform the manufacturer in general language of the fundamental considerations believed to be vital to the construction of proper apparatus, and of some forms of construction found by experience not to result in accuracy, dependability, or fair dealing in the field. Within these broad limits the manufacturer has been left the greatest latitude possible in the working out of his designs.

In the above, attention has been invited to the importance of careful analysis in arriving at a decision as to the suitability of apparatus for particular purposes. In the remainder a few general principles will be given and a few examples cited to assist in describing the nature of this analysis. These will not by any means cover the field, but they may serve as examples of the proper method of attack.

In the first place, a general comment may be made on the relation of price of commodity and accuracy of deter-

mination. It is almost universally accepted as being good business practice to consider that required accuracy of weighing is roughly proportional to the value of the commodity sold. In wholesale dealings this may be illustrated by the fact that the Interstate Commerce Commission regulations provide that claims may be filed against railroad companies in the case of wheat in carload lots if the discrepancy found is greater than ⅛ per cent; in the case of coal, a discrepancy eight times as great, or 1 per cent, is allowable. This is doubtless due, at least in part, to the fact that the latter is a very much cheaper commodity than the former. This is further indicated by the fact that the tolerances recommended by that body for grain scales and for general purpose scales are 0.1 per cent and 0.2 per cent, respectively. While this principle does not seem entirely consistent at first glance—an error of 1 per cent or 1 cent on the dollar would seem to be of equal importance in the case of a purchase of a certain number of dollars' worth of any commodity—nevertheless, it is doubtless a reasonable and also a necessary commercial practice since, as a rule, in wholesale transactions at least, the higher the price of a commodity the smaller will be the margin upon which it is handled, and thus there is probably a legitimate need for higher accuracy of determination of quantity in the case of the higher priced commodities.

In retail sales of commodities it is doubtless not generally true that the margin is smaller in the case of the higher priced commodities. At retail, however, attention will often be focused on the shortage per purchase and the resulting discrepancy in terms of value. Let us consider in these terms, for the sake of illustration, a shortage of one-half ounce on a purchase of various food commodities procurable at grocery stores or delicatessens.

Commodity	Ordinary price per pound	Supposed error	Resulting overcharge per purchase
	Cents	*Ounce*	*Cents*
Potatoes	4	1/2	0.125
Sugar	7		.22
Rice	10		.31
Spinach	15		.47
Domestic cheese	32		1.0
Butter	55		1.7
Boiled ham	80		2.5
Tea	100		3.1
Shelled nuts	125		3.9
Chocolates	150		4.7

We believe that in the minds of the great majority the error on the lower-priced commodity will seem a less serious matter than the same error in the higher range of the table, and the conclusion will be that the latter should be somewhat more accurately weighed than the former. While we have no quarrel with this conclusion, nevertheless we should not allow it to influence us to disregard any unjustifiable errors in commercial transactions, be the value of the commodity involved great or small.

Therefore, one of the things to be kept in mind in the selection of a piece of apparatus is the value of the commodities which are to be bought or sold, and the general criterion to be applied is that the higher the value of the commodity the greater the accuracy which should be sought.

In buying weighing apparatus for a particular purpose two important factors are to be borne in mind; one is the weights of the heaviest and of the lightest drafts which must be handled, and the other, the required percentage accuracy in the weights of the commodity—or of the highest priced of the several commodities—to be weighed. From these figures two things can be determined: First, whether one device will suffice or whether more than one must be pro-

cured, for a scale with a large enough capacity to weigh the heaviest draft may not weigh the lighter drafts within the required accuracy; and, second, the best type and capacity of the device or devices. In general, the scale purchased should be of a capacity only moderately in excess of the heaviest draft to be weighed in practice—perhaps the nearest higher capacity ordinarily marketed. It is believed to be a mistake to procure a scale of a very much greater capacity than will be needed in the normal course of business, since required sensitiveness and accuracy will often be sacrificed thereby. Again, for the same reason, a scale should not be used in weighing loads which are too small a fraction of its capacity. It will be found to be good economy to make the investment in additional apparatus when such apparatus is indicated to be necessary.

Much the same considerations govern in the case of a widely different kind of apparatus, namely, glass graduates. In the case of cylindrical graduates, about the same absolute accuracy can be obtained at each graduation and each graduation is subject to almost the same error. The reason is that the original placing of the graduation and the accuracy with which any measured quantity can be brought into coincidence with the graduation are functions of vertical displacement from the correct position of the surface of the liquid rather than of the volume measured. The result is that the percentage accuracy is almost exactly proportional to the quantity being measured. For instance, in the case of a cylindrical graduate of 4-ounce capacity having a diameter of 0.6 inch, a maximum error of measurement of about 15 minims would not be excessive at any graduation which is itself in error by the full amount of the tolerance allowed. This would be an error of 0.8 per cent on a measured quantity equal to the capacity of the graduate. On a measured quantity of one-half ounce,

however, were the same absolute error to be made, the percentage error would be 6.4 per cent of the measured quantity. The advisability of not using a cylindrical graduate at too small a percentage of its capacity, and the desirability of supplying several sizes when quantities varying considerably in amount are regularly to be measured, is obvious. It is considerations such as these which have induced the National Bureau of Standards to make the recommendation to glassware manufacturers that approximately the first 10 per cent of the capacity of precision cylinders be left ungraduated.

In selecting a scale a factor which at first glance may be considered a minor matter, namely, the value of the minimum graduation, will be found to be of considerable importance when the requirements of the specifications are carefully analyzed. It will be discovered that a reduction in value of the minimum graduations on the beam or reading face, results in many instances in a reduction in the values of the minimum tolerance and of the sensibility reciprocal demanded by the specifications, the two latter values being directly dependent on the former. This is a reasonable demand, since a scale with a small minimum graduation holds itself out as being capable of giving more accurate results than a scale not so finely graduated; and this representation should be fulfilled. Therefore it is provided that the minimum tolerance on a used platform scale of the beam type shall in no case be less than the value of one of the minimum graduations on the beam; likewise the maximum sensibility reciprocal is the value of two of these graduations.[2] Similarly it is provided that the minimum tolerance on an automatic-indicating counter scale or on a spring scale, not new, shall in no case be less than one-fourth of the minimum graduation on the reading face or dial.[3]

[2] See "Platform scales"—"Sensibility reciprocal," and "Tolerances," pp. 86, 87.
[3] See "Counter scales" and "Spring scales"—"Tolerances," pp. 97, 101.

Now the smaller the tolerance and the sensibility reciprocal, the greater the refinement of parts necessary, to construct a scale of the required accuracy and sensitiveness. Also it will be found more difficult to maintain the scale in conformity with the more rigid requirements. In spite of this there should be no hesitation on the part of the purchaser to procure a scale having a sufficient sensitiveness and accuracy to enable him satisfactorily to weigh the smallest amount of the most expensive commodity normally to be weighed. On the other hand, the considerations indicate that he will be wise not to select a scale which is more finely graduated than is necessary.

We have seen that it is often advisible to furnish more than one device when the amounts of commodity to be weighed differ greatly. In the case cited in the preceding paragraph, if commodities differing widely in price and quality are to be weighed, the wisest course of all might well be to procure two devices of the same capacity, one to be of higher accuracy and more sensitive than the other, and perhaps of greater general refinement. The first will be kept in the best possible condition by reserving it for the commodities of high price and quality; the other can be utilized to perform the rougher work. Many merchants have recognized the benefits accruing from such a procedure and have put it into effect with excellent results. The specifications for prescription scales and balances, providing as they do for class A and class B scales, specifically recognize the desirability of this principle in the case of prescription work.

Another example of proper selection somewhat analogous to the above involves the factor of the ability to perform certain operations within tolerances or the ability to indicate with certain accuracies in the case of devices other than scales. Thus, there is incorporated in one or two of the codes of speci-

fications a principle which may be stated as follows: Apparatus must be so designed and constructed that it will successfully perform those operations which it purports to be able to perform, within the tolerance provided for such operations. For instance, if a liquid-measuring device has a graduation representing the first pint, quart, or half gallon, then such a device obviously holds itself out as capable of delivering a pint, or quart, or one-half gallon of liquid within the tolerance allowable on such a delivery—2 cubic inches—and consequently it is required that it be susceptible of being so operated. However, if 1 gallon is the first graduation, then it will be satisfactory if it is susceptible of being operated within the tolerance on this amount—3 cubic inches. If in the ordinary course of business it is to be expected that amounts less than 1 gallon will rarely or never be called for, then for the sake of obtaining the larger minimum tolerance it would seem to be good judgment to pick a device which does not purport to deliver less than this amount. A sale of a smaller quantity could be made, if occasion should arise, by the utilization of an inexpensive liquid measure.

As a final example of the character of factors important in the selection of a piece of equipment—in this case conditions of installation are also involved—we will briefly discuss a meter intended for use in a filling station retailing gasoline. In this case the most prominent factors in the mind of the purchaser will probably be accuracy and speed of service to automobiles; the latter factor will probably be considered by the purchaser as synonymous with maximum delivery rate. How are these to be evaluated?

More than one size of meter can be secured for this service having different maximum and minimum rates; also the maximum rate can be made to vary over a considerable range of values according to installation conditions. In deciding

upon the proper maximum rate (the supposed speed factor) it should be borne in mind that dependability of delivery at all delivery rates (the accuracy factor) is ordinarily more readily obtained when there is not too great a range between the maximum and minimum rates, and that in effect only the former can be varied, since the specifications dictate that the minimum rate may in no case be considered to be greater than 7 gallons per minute.[4] Another consideration involving accuracy versus speed is that it is difficult to stop the indicator accurately at the desired amount when it is moving very rapidly over the dial as the result of a high delivery rate; thus, the flow may be stopped too soon, requiring a "cracking" of the delivery valve to bring the indicator to the proper point, or it may not be stopped soon enough, with a resulting overdelivery. Finally, in case gasoline is furnished too fast to a car, spillage, resulting not only in shortage in the delivery but also in tending to customer dissatisfaction and constituting a fire hazard, is the very probable result.

It has also been suggested above that speed of delivery to cars and maximum delivery rate are not necessarily synonymous ideas. Anomalous as this statement may sound, it is true that the one may not always follow the other. In the development of this idea it may be said that it is probable that few cars will take gasoline much faster than 20 gallons per minute and that investigations seem to indicate that for many of them a slower rate of delivery than this must be employed. Now difficulty will probably be encountered in the slowing down of the delivery to just the proper speed in each case by the expedient of a partial closing of the delivery valve. Thus when some valve closure is indicated by experience to be necessary it is probable that to be on the safe side the operator will be inclined to close the valve somewhat

[4] See "Liquid-measuring devices," Spec. No. 8, p. 51.

more than is necessary. In delivery to some cars, then, a high delivery rate may result in a slower delivery than would result from a slower rate.

From the above it will be apparent that a careful analysis of the various factors involved will be well repaid. In this instance it may convince the purchaser that too high a delivery rate may not only result in incorrect deliveries and other disadvantages but that it may even defeat its own purpose and not actually result in a greater speed of delivery to the average car served.

General Conclusions.—A few general conclusions may be adduced from the above discussion, as follows:

A user should not procure weighing or measuring apparatus of a considerably larger size or capacity than is required to meet his needs. In doing so he will usually be sacrificing sensitiveness and accuracy and thus unnecessarily increasing the percentage errors of his determinations.

It is inadvisable to provide only one piece of apparatus to be used over an unjustifiably large range, and especially at too small a percentage of its total size or capacity, when two or more pieces will increase the accuracy of determination. To do so is ordinarily poor economy.

A low-grade and inaccurate type of apparatus should never be employed when it is indicated that a better and more accurate type is advisable. Conversely, it is uneconomical to procure an unnecessarily high-grade piece of apparatus to do work which could be satisfactorily handled by something of a lower and less expensive grade. Often two devices will be the proper solution.

A buyer should first familiarize himself with the specifications and tolerances applicable to the character of a device to be purchased and determine the various factors of importance in connection with the work which the apparatus

to be procured will be required to perform. With all these facts in mind he should analyze the various features of the available apparatus and purchase only when he has assured himself that the proper type of device has been found.

Finally, it is felt that there can be no better advice in closing than the following comment. Never purchase a piece of apparatus for commercial use without a guaranty from the seller that in case the weights and measures official refuses to approve it a new and satisfactory piece of apparatus will be furnished, the original purchase price refunded, or other satisfactory adjustment made. This guaranty will, we believe, be given by the seller in almost every case without hesitation; and it seems reasonable to demand it, since the seller should certainly be in a better position than the buyer to judge as to the compliance of the piece of apparatus with the official requirements.

Part II.—SPECIFICATIONS AND TOLERANCES FOR COMMERCIAL WEIGHTS AND MEASURES AND WEIGHING AND MEASURING DEVICES, AS ADOPTED BY THE NATIONAL CONFERENCE ON WEIGHTS AND MEASURES AND RECOMMENDED BY THE NATIONAL BUREAU OF STANDARDS FOR ADOPTION BY THE SEVERAL STATES

INTRODUCTION

Source.—The specifications and tolerances given herein comprise, in their latest form, all the codes which have been adopted from time to time by the National Conference on Weights and Measures,[5] the latest action reported having been taken by the Twenty-first National Conference on Weights and Measures in 1928. The conference committee on specifications and tolerances,[6] acting at the request of the conference or upon its own initiative, prepares, with the cooperation of the National Bureau of Standards, proposed amendments or additions to the material previously adopted by the conference; such amendments or additions are then presented to the conference as a whole, where they are discussed by weights and measures officials and representatives of interested manufacturers or industries; eventually the

[5] The National Conference on Weights and Measures, known until 1925 as the Annual Conference on Weights and Measures, is a body made up of State and local weights and measures officials from all parts of the United States which meets annually at the National Bureau of Standards, Washington, D. C. For a more detailed description of the conference and its activities, see chapter 12, Bureau of Standards Handbook No. 11, Weights and Measures Administration. Copies of this publication may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 70 cents each.

[6] A standing committee of the national conference, consisting of five members, the present chairman being F. S. Holbrook, of the staff of the National Bureau of Standards,

proposals of the committee, which may have been amended on the floor, are voted upon by the weights and measures officials, a majority vote being required for adoption. New codes and major changes in existing codes are first adopted tentatively, final action being deferred at least until the succeeding conference; sometimes a code will retain its tentative status for two years.

All of the specifications and tolerances given herein are recommended by the National Bureau of Standards for official promulgation in and use by the several States in exercising their control of commercial weighing and measuring apparatus; in the absence of a State department of weights and measures, a similar recommendation is made with respect to the local jurisdictions within such a State.

Purpose.—The purpose of specifications and tolerances is to eliminate from use, without prejudice to apparatus which conforms as closely as practicable to the official standards, weights and measures and weighing and measuring devices which are false, which are of such construction that they are faulty—that is, which are not reasonably permanent in their adjustment or will not repeat their indications correctly—or which facilitate the perpetration of fraud.

Application.—The specifications and tolerances given herein are intended to apply to weights and measures and weighing and measuring devices used in commercial transactions. With respect to any particular commercial device the specifications and tolerances are to be construed as being fully applicable whenever such a device falls clearly within one or more of the several classes of apparatus specifically considered. They shall also be construed to apply to other apparatus, such as that used for special purposes, whenever and in so far as they are clearly applicable, but not otherwise.

Classification of Specifications.—Two classes of specifications are established:

1. Retroactive specifications (printed in ordinary roman type) which are to be enforced with respect to all commercial apparatus in use.

2. Nonretroactive specifications (printed in *italics*) which are to be enforced only with respect to apparatus which is manufactured in or brought into the State after the promulgation of the specifications therein, and which are not to be enforced with respect to apparatus which is in the State at the time of such promulgation, either in use or in the stock of manufacturers of or dealers in such apparatus.

This classification is made in order that the requirements may be put into force and effect without unnecessary hardship and without wholesale condemnation of apparatus which, while not of the best construction, is nevertheless fairly satisfactory and may be used for some time without greatly prejudicing the rights of purchasers. The retroactive specifications are those which are most urgently required and with which all apparatus should at once be required to conform; the nonretroactive specifications are those which, while clearly desirable, are less vital, and which, as a matter of expediency in enforcement, may reasonably be suspended with respect to apparatus in use.

In order to enforce the specifications, it will be necessary to be able to distinguish that apparatus to which the nonretroactive specifications do not apply; that is, that apparatus which was in the State, either in use or in the stocks of manufacturers or dealers, at the time of promulgation of the specifications. This may be accomplished as follows: At the time of the first examination of apparatus, all devices encountered, and sealed, as the result of an accuracy test and an inspection involving the application of the retroactive

specifications only, may be permanently and clearly stamped in a prominent position, preferably near the seal, with a steel die bearing a star (*) or some other simple design. Not only apparatus in use but also that in the stocks of manufacturers and dealers should be marked as described. After the first examination, all apparatus not so marked will be subject to all of the specifications, both retroactive and nonretroactive, while the apparatus marked with the special stamp will continue to be exempt from the provisions of the nonretroactive specifications and will be regulated only by the retroactive ones.

Classification of Tolerances.—Two classes of tolerances, or maximum allowable errors, have been established:

1. Manufacturers' tolerances, or the tolerances on new apparatus.

2. Users' tolerances, or the tolerances on apparatus in use.

This classification is made because, in general, apparatus will necessarily deteriorate after being put into use and used for some time, and it would be manifestly unjust to reject or condemn, shortly after it is put into use and used, apparatus which was satisfactory when sold. It might so happen that the new apparatus had been just within tolerance when it was approved; it is obvious that but very little use might be necessary to throw the error on such apparatus outside the tolerance; therefore such a piece of apparatus would have an unreasonably short commercial life if it were not for the larger tolerance for apparatus in use, such as has been provided.

After weights and measures territory has once been covered it is customary to consider as "new" all apparatus which is subsequently being tested for the first time by the official, and to apply to such apparatus the manufacturers' tolerances. It is likewise customary to apply the manufacturers' toler-

ances in many cases when retesting apparatus which has been rejected and which has subsequently been adjusted or repaired, for the same reasons as have been outlined above.

It may also be mentioned that there are certain types of apparatus with respect to which the general principle of loss of accuracy with use does not apply, such as graduated glassware, milk bottles, etc. Therefore in the tolerances which are given hereafter it will be observed that in certain instances but a single tolerance is specified. Wherever no mention is made of manufacturers' tolerances, it is to be understood that the same tolerance applies to new and to old apparatus.

Where two classes of tolerances are specified, the manufacturers' tolerances are one-half the users' tolerances; since the latter will be employed more frequently than the former, the values appearing in the tolerance tables which are given hereafter are the users' tolerances, and the values for the manufacturers' tolerances will be one-half of those given in the tables.

Correct and Incorrect Apparatus Defined.—A weight or measure or weighing or measuring device which is defined as correct shall be understood and construed to mean only one which conforms to the standard within the tolerance, under the method of test prescribed, and which, in addition, complies with all the specifications applicable to it given in the following pages. All other weights and measures and weighing and measuring devices shall be understood and contrued to be incorrect.

Apparatus in the Metric System.—No specifications contained in the following pages shall be understood or construed to prohibit the sale or use of weights or measures or weighing or measuring devices constructed or graduated in units of the metric system.

The tolerances to be allowed on any weight or measure or weighing or measuring device constructed or graduated in units of the metric system shall be the same as those specified on similar apparatus of an equivalent size or at an equivalent load in the customary system.

SPECIFICATIONS AND TOLERANCES

Specifications printed in roman type are retroactive, and apply to all apparatus.

Specifications printed in italics are nonretroactive and apply only to apparatus manufactured in or brought into the State after the date of promulgation of the specifications.

LINEAR MEASURES

Specifications.—1. Measures of length shall be made of a material the form and dimensions of which remain reasonably permanent under normal conditions—for example, steel, brass, hardwood, etc.

2. The ends of measures of length made of wood, or of other nonmetallic material liable to wear away through use, shall be protected by some metal not softer than brass, firmly attached to the measure.

3. Rigid measures of length shall be smooth and straight.

4. Folding measures of length shall be so constructed that each section will come to a definite stop when straightened out.

5. Measures of length shall be graduated in units of the customary system and its usual subdivisions.

6. All graduations shall be clear and distinct, and the main graduations shall be plainly designated. The length of these main graduations shall be greater than that of the intermediate graduations, and the latter shall be varied in length in such a way that they may be conveniently read.

Main graduations are to be construed as those the value of which should be readily ascertainable in order to facilitate reading at any point.

7. Graduations shall not be greater in width than one-quarter of the value of the smallest subdivision: Provided, however, That if line graduations are employed, their width shall not exceed 0.03 inch; if raised graduations are employed, their width shall not exceed 0.12 inch at their widest point.

8. All graduations shall be uniformly spaced and be perpendicular to the edge of the measure.

9. Measures of length, so called, defined by tacks driven into a counter, or in any similar way, shall not be allowed.

Tolerances.—The tolerances to be allowed in excess or deficiency on all measures of length, except tapes of steel or other metal, shall be the values shown in the following table: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on all new measures of length, except tapes of steel or other metal, shall be one-half of the values given.

Length	Tolerance
Feet	*Inch*
6	3/16
5	5/32
4	1/8
3	3/32
2	1/16
1	1/32
1/2 [1]	1/64

[1] Or less.

The tolerances to be allowed in excess or deficiency on all tapes of steel or other metal shall be the values shown in the following table:

Length	Tolerance	Tension
Feet	*Inch*	*Pounds*
100	1/4	10
66	3/16	10
50	1/8	10
33	3/32	10
25	1/16	10
10	1/16	5
6	1/32	5
3	1/32	5

FABRIC-MEASURING DEVICES

Definition.—A retail fabric-measuring device, hereinafter referred to as a fabric-measuring device, is a mechanism or machine which is adapted to measure and to indicate automatically the length of fabric passed through it, and which, on account of the character of its primary indicating elements, is obviously designed for use in connection with retail sales; such devices may or may not be designed to indicate automatically the total price of the amount of material measured, for a series of unit prices.

Specifications.—1. Basis of Graduation.—Fabric-measuring devices shall be graduated in units of the customary system and its usual subdivisions. The maximum value of the minimum length graduations on fabric-measuring devices shall be one-eighth yard.

2. Character of Graduations.—The length graduations and the value graduations on all fabric-measuring devices shall be clear and distinct and their length shall be so varied

or they shall be so arranged that their meaning or value is readily apparent and their indications may be conveniently read. The width of any graduation mark shall in no case be less than 0.008 inch.

3. Interval Between Graduations.—The clear interval between one-eight yard graduation marks on fabric-measuring devices shall not be less than eleven-sixteenths inch (0.6875 inch); if inch graduation marks are employed the clear interval between such inch graduation marks shall not be less than one-eighth inch (0.125 inch). These values shall be applied to the most sensitive indicating element with which the device is equipped.

The clear interval between value graduation marks on fabric-measuring devices shall not be less than 0.02 inch.

4. Computing Charts.—Computing charts may be made in accordance with either of the following principles:

(*a*) If the device is so designed and constructed that it purports automatically to compute for a series of unit prices the total price for every length within the range of the device, then the device shall be equipped with a value pointer or indicator and value graduation marks; the value graduation marks shall be correctly placed; and in any position which the indicator or pointer and the chart may assume there shall be exposed to view a sufficient number of value figures and graduations to permit the value indications of the device to be read correctly. The value graduations shall not exceed 1 cent at all prices per yard up to and including 30 cents. At any higher price per yard the value graduations shall not exceed 2 cents: Provided, however, That nothing in the above shall be construed to prevent the placing of a special value graduation to represent each 5-cent interval. These special graduations may take the form of dots, staggered graduations, or similar forms. They shall be so placed that their

meaning and value may be clearly understood, but they shall not be placed in the space between the regular graduations.

(*b*) If the device is so designed and constructed that it purports automatically to compute only for lengths corresponding to a definite series of length graduations, then there shall be no value graduation marks, and at no position which the chart may assume shall two value figures for the same unit price be completely and clearly exposed to view at the same time. One of the following alternatives shall also be compiled with:

(1) There shall be a value computation for each length graduation throughout the range of the device; or

(2) No value indication may be exposed to view except at such times that the device registers a length indication for which a correct value indication is provided; or

(3) Each column or row of value graduations shall be clearly and conspicuously marked with the length graduation to which the values correspond, the device shall be marked with the character and limitations of the computations made, and there shall be a computation for at least each one-eighth yard throughout the range of the device.

All money values corresponding to definite length graduations must be mathematically correct except as follows: If the mathematically correct amount includes a fractional part of a cent, the fraction shall be dropped if it is less than ½, but if the fraction is ½ or more the next higher cent may be shown.

5. Pointers and Indicators.—Each pointer or indicator used in a fabric-measuring device shall be so designed and constructed that a clear, distinct, and accurate reading is given. All pointers or indicators shall be symmetrical about the graduation marks at which they may stand and shall reach to all such graduation marks. The width of the pointer or indicator, or of the end thereof, shall not exceed the

width of the smallest graduation marks on the scale with which it is used, and in no case shall such width exceed 0.015 inch. The distance between the pointer or indicator and its scale or chart shall not exceed 0.06 inch.

6. Readability of Indications.—Fabric-measuring devices shall be so designed and constructed that in any position which the length indicator or pointer and scale or chart may assume in their operation, there will be exposed to view a sufficient number of figures and graduations readily to permit the length indications of the device to be read correctly.

7. Return of Indicating Element to Zero.—Fabric-measuring devices shall be so designed and constructed that the indicating elements used in registering lengths or prices of deliveries to individual purchasers are returnable readily to a definite and clear zero reading before the next measuring operation is begun.

8. Increasing and Decreasing Indications.—All fabric-measuring devices shall be correct in their length and value indications whether the indications are being increased or decreased.

9. Limitation of Use.—If a fabric-measuring device will not give correct results when used for the measurement of all fabrics, then the device shall be so marked as clearly to indicate its limitations.

10. Lettering and Graduations.—All markings, instructions, figures, and graduations required under these specifications shall be of such size, design, material, and location and shall be so applied or affixed that they will not tend easily to become obliterated or illegible.

11. Fraudulent Construction.—All fabric-measuring devices and all devices designed to be attached thereto and used in connection therewith shall be of such design and construction that they do not facilitate the perpetration of fraud.

Tolerances.—The tolerances to be allowed on the delivery [7] of fabric-measuring devices in excess (underregistration of device) and in deficiency (overregistration of device), to be applied on both increasing and decreasing registrations of the machine, shall be the values shown in the following table: Provided, however, That the manufacturers' tolerances or the tolerances on all new fabric-measuring devices shall be one-half of the values given:

Machine indication	Tolerances on delivery [a]	
	In deficiency (overregistration)	In excess (underregistration)
Yards	*Inch*	*Inches*
1 [b]	1/4	3/8
2	1/4	3/8
3	5/16	3/8
4	5/16	1/2
5	3/8	5/8
6	3/8	3/4
7	1/2	1
8	1/2	1
9	5/8	1¼
10	3/4	1½
11	3/4	1½
12	7/8	1¾
13	7/8	1¾
14	1	2
15	1	2

[a] See footnote 7 below. [b] Or less.

For machine indications of more than 15 yards add one-sixteenth inch in deficiency and one-eighth inch in excess per indicated yard.

[7] "Tolerances on delivery" refers to the variations between the indications of the fabric-measuring device and the corresponding actual lengths of testing strip passed through the device, and does not apply to check measurements made upon lengths of fabrics which have been commercially measured.

TAXIMETERS

Definitions.—A "taximeter" is a machine adapted automatically to calculate, at a predetermined rate or rates, and to register, the charge for hire of a vehicle.

The "fare" is that portion of the charge to be paid by the passenger for the hire of a vehicle, which is automatically calculated by the taximeter through the operation of the mileage mechanism, the time mechanism, or a combination of these.

The "extras" are those charges which are to be paid by the passenger in addition to the fare, and include any charge at a flat rate assessed for the transportation of passengers in excess of a stated minimum number as well as any charge for the transportation of baggage.

The "face" of a taximeter is that side upon which the charge to be paid by the passenger for the hire of a vehicle is indicated.

A "single-tariff" taximeter is one designed to calculate fares based on mileage at a single rate only.

A "multiple-tariff" taximeter is one so designed that it may be set to calculate fares based on mileage at any one of two or more rates.

A taximeter shall be considered to be "cleared" when it is inoperative with respect to all fare registration, when no figures indicating fare or extras are exposed to view, and when all of the parts are in that position in which they are designed to be when the vehicle to which the taximeter is or may be attached is not engaged by a passenger.

A "money drop" is an increment of fare registration. The "initial money drop" is the initial increment of fare registration following the flag pull.

The "flag" is the metal plate attached to the end of the lever arm by means of which the operating condition of the taximeter may be manually controlled.

Specifications.—1. Basis of Fare Calculation.—Taximeters shall be so designed and constructed as to calculate the fare only upon one of the following bases:

(*a*) Mileage traveled.

(*b*) Time elapsed.

(*c*) A combination of mileage traveled and time elapsed such that when the taximeter is operable with respect to fare registration, the fare-registering mechanism is actuated by the mileage mechanism whenever the vehicle upon which the taximeter is installed is in motion at such a speed that the rate of mileage revenue per unit of time equals or exceeds the time rate, and may be actuated by the time mechanism, whenever the speed of the vehicle is less than this, or when the vehicle is stopped. When constructed upon this principle, provision shall be made whereby the driver of the vehicle may cause the clock mechanism to be operative or inoperative with respect to the fare-registering mechanism, as the occasion may demand.

2. Character of Indications.—Taximeters shall be so designed and constructed that the following indications are shown upon the face:

(*a*) The condition of the taximeter, that is, whether it is inoperative or operative, and, if the latter, the character of fare registration for which it is set. This specification shall be construed to require (1) that while a taximeter is cleared, the indication "Not registering," "Vacant," or an equivalent expression shall appear; (2) that in the case of single-tariff taximeters, while the taximeter is in condition for fare registration on any basis, the indication "Registering," "Hired,"

or an equivalent expression shall appear; (3) that in the case of multiple-tariff taximeters, while in the condition described in (2) preceding, the basis for the particular tariff for which the taximeter is set shall be shown. In the case of the lowest rate for which the taximeter is adjusted the indication specified in (2) preceding shall be considered satisfactory; *in the case of any higher rate the indication shall be shown by such an expression as " 3 or more persons," etc.;* and (4) that while the taximeter is so set that the clock mechanism is inoperative with respect to fare registration, the indication "Time not recording" or an equivalent expression shall appear, except when the taximeter is cleared. This indication may replace the indication specified in (2) preceding, *but shall be in addition to the indication specified in (3) preceding for the higher rates on multiple-tariff taximeters.*

(*b*) The accumulated fare. The indications shall be identified by the word "Fare" or by an equivalent expression, and their values shall be defined by suitable words or monetary signs.

(*c*) The extras. Taximeters are not required to be constructed so as to register charges for extras, but when so constructed the following shall apply: Extras shall never be included in the fare registration, but shall always be indicated as a separate item. They shall be identified by the word "Extras" or by an equivalent expression, and their values shall be defined by suitable words or monetary signs.

The indications required by this specification shall be displayed through, and shall be entirely protected by, glass which shall be securely attached to the metal housing of the taximeter, so that the indications will be protected by the official seals.

NOTE.—Whenever charges for extras are prohibited by legal authority, or whenever the assessment of extras has been discontinued by a given taxicab operator, if the taximeters in use in the jurisdiction or by the operator in question are constructed to register extras, the extras

mechanism on such taximeters shall be rendered inoperable or all indications on the faces of the taximeters of charges for extras shall be effectively obscured by permanent means.

3. Obscuring of Indications.—Except as provided by the "Note" of specification No. 2, and except when a taximeter is cleared, indications of the amount of fare and extras registered shall never be obscured, and the apertures through which such indications are read shall never be covered.

4. Readability of Indications.—All apertures through which any indications or markings are viewed at any time shall be of such location, size, and design that the indications may be read with precision. This specification shall be construed to require that in the case of drums or dials designed to advance intermittently, but one indication shall be exposed to view at one time, and that in the case of graduated drums or dials designed to advance gradually and continuously and to be read in combination with an indicator, a sufficient number of graduations and figures shall be exposed to view at all times readily to permit the indications to be read correctly.

5. Statement of Rates.—*All taximeters shall be marked upon their faces to show the rates, both for mileage and time, for which they are adjusted, and the schedule of extras when such charges are recognized. This specification shall be construed to require a statement of the mileage and time rates for the initial as well as for subsequent intervals whenever the rates are not uniform throughout. The words "Rate," "Rates," or "Rates of fare" shall precede the actual statement of the rates, and the latter shall be self-explanatory and readily understandable by the ordinary passenger.*

The marking required by this specification shall either be of a permanent character, or shall be displayed through, and shall be entirely protected by, glass securely attached to the

metal housing of the taximeter, so that the marking will be protected by the official seals.

6. Marking of Change Gears.—*All individual change gears utilized in compensating for differences in tire diameters shall be plainly marked to show the number of their teeth.*

7. Lettering and Graduations.—All indications and markings required under these specifications shall be of such size, design, material, and location and shall be so applied or affixed that they are definite and distinct and that they will not tend easily to become obliterated or illegible.

8. Flag.—All taximeters shall be equipped with a flag. The positions of the flag, corresponding to the different conditions of a taximeter, shall be mechanically defined, and displacement from any one of these positions shall be sufficiently obstructed so that the accidental or inadvertent changing of the condition of the taximeter is improbable. The flag shall be at its highest position when the taximeter is cleared *and in this position the whole of the flag shall be above the level of the taximeter housing.* Adequate provision shall be made so that the attempted movement of the flag to an operating position immediately following its movement to the cleared position shall automatically be so delayed that the taximeter mechanism may come to complete rest in the cleared condition before such subsequent movement is begun.

9. "Extras" Knob or Handle.—The knob, handle, or other means utilized to actuate the "extras" mechanism shall be inoperative whenever the taximeter is in the cleared condition; that is, whenever it is not in a condition to register fares.

10. Provision for Sealing.—Adequate provision shall be made for sealing all taximeters, and in the case of complete assemblies—that is, installations upon cabs of taximeters and

the various gears and other parts required for service operation—adequate provision shall be made for sealing all of the parts in place, in such manner that no adjustments, alterations, or replacements, affecting in any way the indications, the time or mileage rates, or, in general, the accuracy of the taximeters or the assemblies, can be made without mutilating or destroying the seal or seals.

11. Visibility of Indications.—When mounted upon a cab a taximeter shall be so placed that its face is in plain view of a passenger seated upon the rear seat of the cab. Adequate lighting facilities shall be provided for so illuminating the face of the taximeter that the indications thereof may be conveniently read by the passenger and the face of the taximeter shall be so illuminated whenever the taximeter is in operation and artificial illumination is necessary for the convenient reading of its indications.

12. Permanence.—*Taximeters shall be of such design, construction, and materials that they may reasonably be expected to withstand ordinary usage without impairment of their accuracy or the correct functioning of their operating and indicating parts. This specification shall be construed to require that in the case of ratchets and pawls and similar combinations, wherever the accuracy or consistency of the indications of the taximeter would be affected by the wearing away or the deformation of one or both of the cooperating parts, the ratchets and pawls shall be fabricated of such material and shall be hardened to such a degree and extent that the wear or deformation resulting from use will be reduced to a minimum.*

13. Fraudulent Construction.—All taximeters and all mechanisms and devices designed to be attached thereto and used in connection therewith shall be of such design and construction and shall be so installed for use that they do not facilitate the perpetration of fraud.

Tolerances.—DEFINITIONS.—A "bench test" is a test of a taximeter head alone, except that the gear box—that is, the change gears designed to compensate for tires of different sizes—may be attached.

A "wheel test" is a test of the entire taximeter assembly when mounted upon a vehicle, the mechanism being actuated by the mechanical revolution of the vehicle wheel while the cab remains at rest.

A "road test" is a test similar to a wheel test except that the mechanism is actuated as a result of cab travel.

The "initial" mileage or time interval is the mileage or time interval corresponding to the initial money drop.

"Tolerance in deficiency" and "tolerance in excess" are the allowable errors in the directions of overregistration and underregistration, respectively.

VALUES.—The tolerances to be allowed on all taximeters shall be as follows:

1. On Mileage Tests.—(*a*) On bench test.—With respect to the nominal number of spindle revolutions, no tolerance in deficiency and a tolerance in excess, of 2 per cent of the interval under test, with an added tolerance of 100 feet whenever the initial interval is included in the interval under test.

(*b*) On wheel and road tests.—With respect to distance computed or actually traveled, no tolerance in deficiency and a tolerance in excess, of 4 per cent of the interval under test, with an added tolerance of 100 feet whenever the initial interval is included in the interval under test: Provided, however, That on a road test if the vehicle tires are obviously worn, a tolerance in deficiency, of 1 per cent shall be allowed.

NOTE.—In computing road results and calculating the values of change gears for the purpose of applying tolerances, the mean effective circumference of tire shall be used. This shall be determined upon a new tire of the size, kind, and make in use, inflated to the pressure recommended by the manufacturer, and mounted upon a vehicle,

by causing the tire to describe several complete revolutions upon a smooth surface, finding the average distance advanced per revolution, and deducting from the result 1 per cent.

2. On Time Tests.—(*a*) On individual time intervals.—A tolerance of 3 seconds per minute (5 per cent) in deficiency and a tolerance of 6 seconds per minute (10 per cent) in excess: Provided, however, That on the initial time interval the tolerance in excess shall be 9 seconds per minute (15 per cent).

(*b*) On the average time interval (computed after excluding the initial interval).—No tolerance in deficiency and a tolerance of 3 seconds per minute (5 per cent) in excess.

LIQUID CAPACITY MEASURES

Specifications.—1. Liquid measures shall be made of metal, glass, earthenware, enameled ware, composition, or similar and suitable material, and shall be of sufficient strength and rigidity to withstand ordinary usage without becoming bent, indented, distorted, or otherwise damaged: *Provided, however, That when the measure is made of iron or steel, or iron or steel plated with tin, zinc, or copper, or is made of copper, the minimum thicknesses of the metal shall be those given in the following table:*

Capacity of measure	*Minimum thickness if of iron or steel or of plated iron or steel* [1]	*Minimum thickness if of copper*
	Inch	*Inch*
Over 1 gallon	*0. 016*	*0. 032*
1 gallon	*. 014*	*. 028*
½ gallon	*. 014*	*. 028*
1 quart	*. 014*	*. 028*
1 pint or less	*. 010*	*. 020*

[1] The following commercial tin plates will comply with these requirements: Over 1 gallon, 2XL; 1 gallon, ½ gallon, and 1 quart, IX; 1 pint or less, ICL.

2. Liquid measures of the customary system shall be of one of the following capacities only: One gallon, a multiple of the gallon, or a binary submultiple of the gallon, that is, a measure obtained by dividing the gallon by the number 2 or by a power of the number 2: Provided, however, That nothing in this specification shall be construed to prevent the use of forms for ice cream, exclusively, in 5-pint and 3-pint sizes, or bottles for milk or cream in the 3-pint size.

3. Liquid measures shall be so constructed that the capacity is determined by a definite edge, plate, bar, or wire at or near the top of the measure. When one of the last three forms is employed the capacity shall be determined to the lowest portion of such plate, bar, or wire.

4. No subdivided liquid measures shall be allowed, and the only reinforcing rings which may be used are those which are firmly attached to the outside of the measure and do not, by indentations or in any other manner, show divisions or lines on the inside surface of the measure.

5. The capacity of the measure shall be conspicuously, legibly, and permanently indicated on the side of the measure. This shall be in combination with the word "Liquid" or the letters "Liq" in the case of measures in which the word "quart" or "pint" occurs. In the case of measures made of earthenware, enameled ware, or composition, this marking shall be of a different color than the measure.

6. If a liquid measure is provided with a tap or spigot, the construction shall be such that the measure may be completely emptied by the tap or spigot while it is standing upon a level surface.

7. When a lip or rim, designed both to facilitate pouring and to receive any overflow, is provided, the measure shall be so constructed as to hold its full capacity exclusive of the lip or rim, while it is standing upon a level surface.

Tolerances.—The tolerances to be allowed in excess and in deficiency on all liquid capacity measures shall be the values shown in the following table: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on all new liquid capacity measures shall be one-half of the values given.

Capacity of measure	Tolerance			
	In excess		In deficiency	
	Liquid ounces	*Cubic inches*	*Liquid ounces*	*Cubic inches*
10 gallons	10	18. 0	5. 0	9. 0
5 gallons	6	11. 0	3. 0	5. 4
4 gallons	4	7. 0	2. 0	3. 6
3 gallons	4	7. 0	2. 0	3. 6
2 gallons	2	3. 5	1. 0	1. 8
	Drams		*Drams*	
1 gallon	1	1. 8	4. 0	. 9
½ gallon	6	1. 4	3. 0	. 7
1 quart	4	. 9	2. 0	. 5
1 pint	3	. 7	1. 5	. 3
½ pint	2	. 4	1. 0	. 2
1 gill	2	. 4	1. 0	. 2

GLASS GRADUATES

Specifications.—*1. Graduates shall be made to contain or to deliver the indicated volume at 20° C. (68°F.). They shall be legibly, conspicuously, and permanently marked to indicate whether they are graduated to contain or to deliver.*

2. Graduates shall be either cylindrical or conical in shape. In the case of all cylindrical graduates the ratio of length of the graduated scale to the internal diameter shall not be less than five to one. In the case of conical graduates the ratio of length of the graduated scale to the internal diameter at the highest graduation shall not be less than two to one, and at one-fourth of the total capacity this ratio shall not be less than one to one.

3. Graduates shall be made of good quality glass, thoroughly annealed, clear, transparent, of uniform but not excessive thickness, and free from bubbles and streaks.

4. Graduates shall be provided with a base at right angles to the axis *and of such a diameter that the graduate will stand when placed on a surface making an angle of 25 per cent, or approximately 15°, with the horizontal.*

5. All graduates shall be provided with pouring lips.

6. The graduation marks shall be perpendicular to the axis and parallel to the base and to each other.

7. Main graduation marks are those indicating the principal subdivisions into which a graduate is divided, the value of which should readily be ascertainable in order to facilitate the reading of the graduate at any point on its scale. *All main graduation marks shall extend around the same proportional part of the circumference of the graduate. All graduation marks of this character shall be construed to be main graduation marks. These graduations shall extend at least one-half of the distance around the graduate: Provided, however, That on duplex, or double-scale, graduates a clear space shall be left between the ends of the main graduation marks on the two scales, and this space, measured parallel to the graduation marks, shall conform to the following values:*

Circumference of graduate at the graduation marks	*Distance between ends of graduation marks*
	Inch
Up to 5 inches	*1/8–1/4*
From 5 inches to 10 inches, inclusive	*1/4–1/2*
More than 10 inches	*3/8–5/8*

Intermediate graduation marks are those which extend around a smaller proportional part of the circumference of the

graduate than do the main graduation marks, and when these are employed the graduations shall be varied in length in such a manner that the scale may be conveniently read, *but in no case shall any graduation mark extend less than one-fourth of the distance around the graduate.*

8. Graduation marks shall be clear and distinct and uniform in character. They shall be etched or engraved, *and shall not exceed 0.015 inch (0.38 mm) in width.* Blown or pressed graduation marks shall not be allowed.

9. The clear interval between the graduation marks shall not be less than 0.04 inch (1 mm).

10. The value of the main graduation marks shall be plainly designated, *each number being placed either directly upon or immediately above the graduation mark to which it refers,* but the position of the numbers shall be consistent throughout the graduated scale. *If placed upon the graduation marks, the numbers shall be placed from the ends a sufficient distance to allow the ends to be used in making a setting. Intermediate graduation marks shall not be numbered.*

11. On all single-scale graduates, where the main graduation marks do not completely encircle the graduate, the middle points of the main graduation marks shall be directly opposite the lip. On duplex, or double-scale, graduates the center of the clear spaces between the ends of the main graduation marks, provided for in specification 7, shall be approximately 90° from the lip.

Tolerances.—The tolerances to be allowed in excess or deficiency on glass graduates marked "to contain" shall be the values shown in the following tables; the tolerances to be allowed on graduates marked "to deliver" shall be 25 per cent greater than the values given.

NOTE.—The tolerance to be used at any point on any graduate shall be determined by measuring the inside diameter of the graduate at the point under test and taking from the table the tolerance value corresponding to this diameter.

Tolerance for Graduates of Various Diameters

Values Expressed in U. S. Customary Units

Diameter		Tolerance		Diameter		Tolerance	
Inches	Sixteenths	Drams	Minims	Inches	Sixteenths	Drams	Minims
--	6	--	0. 6	2	4	--	32
--	7	--	. 8	2	5	--	34
--	8	--	1. 0	2	6	--	36
--	9	--	1. 3	2	7	--	39
--	10	--	1. 6	2	8	--	41
--	11	--	2. 0				
--	12	--	2. 5	2	9	--	44
--	13	--	3. 0	2	10	--	47
--	14	--	3. 5	2	11	--	49
--	15	--	4. 0	2	12	--	52
				2	13	--	55
1	0	--	5				
1	1	--	6	2	14	--	58
1	2	--	6	2	15	1	2
1	3	--	7	3	0	1	5
1	4	--	8	3	1	1	8
				3	2	1	12
1	5	--	9				
1	6	--	10	3	3	1	15
1	7	--	11	3	4	1	18
1	8	--	12	3	5	1	21
1	9	--	14	3	6	1	24
				3	7	1	27
1	10	--	15				
1	11	--	16	3	8	1	31
1	12	--	17	3	9	1	34
1	13	--	19	3	10	1	38
1	14	--	21	3	11	1	41
				3	12	1	44
1	15	--	22				
2	0	--	24	3	13	1	47
2	1	--	26	3	14	1	51
2	2	--	28	3	15	1	55
2	3	--	30	4	0	2	0

Tolerance for Graduates of Various Diameters

Values Expressed in Metric Units

Diameter	Tolerance	Diameter	Tolerance	Diameter	Tolerance
mm	*ml*[1]	*mm*	*ml*[1]	*mm*	*ml*[1]
10	0. 04	40	0. 85	70	3. 2
11	. 05	41	. 90	71	3. 4
12	. 06	42	. 95	72	3. 5
13	. 07	43	1. 00	73	3. 6
14	. 08	44	1. 05	74	3. 7
15	. 09	45	1. 10	75	3. 9
16	. 10	46	1. 15	76	4. 0
17	. 12	47	1. 25	77	4. 1
18	. 14	48	1. 30	78	4. 2
19	. 16	49	1. 35	79	4. 4
20	. 18	50	1. 4	80	4. 5
21	. 20	51	1. 5	81	4. 6
22	. 22	52	1. 6	82	4. 8
23	. 24	53	1. 6	83	4. 9
24	. 26	54	1. 7	84	5. 0
25	. 28	55	1. 8	85	5. 1
26	. 30	56	1. 9	86	5. 2
27	. 35	57	2. 0	87	5. 4
28	. 35	58	2. 0	88	5. 5
29	. 40	59	2. 1	89	5. 6
30	. 45	60	2. 2	90	5. 7
31	. 45	61	2. 3	91	5. 9
32	. 50	62	2. 4	92	6. 0
33	. 55	63	2. 5	93	6. 1
34	. 60	64	2. 6	94	6. 2
35	. 60	65	2. 7	95	6. 4
36	. 65	66	2. 8	96	6. 5
37	. 70	67	2. 9	97	6. 6
38	. 75	68	3. 0	98	6. 8
39	. 80	69	3. 1	99	6. 9
				100	7. 1

[1] The term milliliter, or "ml," is used herein to designate the one-thousandth part of the liter. This unit is also commonly known as the cubic centimeter, or the "cc." The latter is not an accurate usage, as the units are not exactly equal, but the difference between them is of no consequence for the purposes of this table, and therefore they may be used interchangeably.

MILK BOTTLES

Specifications.—1. Bottles used for the sale of milk or cream shall be made only in sizes heretofore specified under the heading "Liquid capacity measures," and they shall be made to contain their indicated capacities at a temperature of 20° C. (68° F.).

2. Each bottle shall have its capacity clearly blown or otherwise clearly and permanently marked in or on the side of the bottle, and in or on the side or bottom the name, initials, or trade-mark of the manufacturer thereof.

3. Glass bottles with an inside diameter of not over 2 inches immediately below the cap seat or stopple shall hold the correct capacity when filled to within one-fourth inch of this cap seat or stopple; bottles with an inside diameter of over this amount immediately below the cap seat or stopple shall hold the correct capacity when filled to within one-eighth inch of this cap seat or stopple: Provided, however, That a larger distance shall be allowed below the cap seat or stopple when the bottles are provided with a clearly defined line blown or otherwise clearly and permanently marked in or on the bottle, and extending at least halfway around it, which indicates the correct capacity, and directly over, below, or beside this line, with the words "Fill to line" or a similar and suitable inscription clearly and permanently marked in or on the bottle. The distance between the line herein mentioned and the cap seat or stopple shall in no case exceed that given in the table below.

Capacity of bottle	Maximum distance allowable
	Inches
2 quarts	2
3 pints	1¾
1 quart	1½
1 pint	1
½ pint	5/8
1 gill	5/8

Tolerances.—The tolerances to be allowed in excess or deficiency on bottles to be used in the sale of milk or cream shall be as follows:

(1) When a test comprises less than 25 bottles of the same capacity and ownership, the tolerances shall be those given in Table A below.

(2) When a test comprises 25 or more bottles of the same capacity and ownership, the tolerances shall be applied not only to the individual bottles but also to the average capacity of at least 25 such bottles, these to be taken at random when the whole supply available is not tested. The error on any individual bottle among those tested shall not exceed the values shown in Table A below. The average error on the bottles tested shall not exceed the values shown in Table B below: Provided, however, That in the case of bottles already in use, if the average error is greater than that above specified, then, if desired, all of the bottles of the particular size and ownership in question may be treated as individual measures, in which case all of these bottles shall be separately tested, and the tolerances shown in Table C below shall be applied.

NOTE.—To find the average error on a number of bottles, first add all those errors which are in excess; then add all those errors which are in deficiency; then subtract the smaller sum from the larger; and finally divide this result by the total number of bottles tested.

Capacity of bottle	Table A, tolerance on individual bottles		Table B, tolerance on average capacity		Table C, special tolerance for individual bottles already in use			
					In excess		In deficiency	
	Drams	Cubic inches	Drams	Cubic inch	Drams	Cubic inches	Drams	Cubic inch
2 quarts	6	1. 4	1. 5	0. 35	6	1. 4	3	0. 7
3 pints	5	1. 2	1. 25	. 29	5	1. 2	2. 5	. 6
1 quart	4	. 9	1. 0	. 23	4	. 9	2	. 5
1 pint	3	. 7	. 75	. 17	3	. 7	1. 5	. 3
½ pint	2	. 5	. 5	. 12	2	. 5	1. 0	. 2
1 gill	2	. 5	. 5	. 12	2	. 5	1. 0	. 2

LUBRICATING-OIL BOTTLES

NOTE.—These specifications and tolerances are to be put into force and effect on January 1, 1929, and are to be nonretroactive. However, after July 1, 1930, all bottles in use may be required to comply with these specifications and tolerances.

Specifications.—1. *Bottles used for the sale of lubricating oil shall be made of clear, uncolored glass and only in sizes heretofore specified under the heading "Liquid capacity measures." They shall be made to contain their indicated capacities at a temperature of 20° C. (68° F.), and they shall not be subdivided.*

2. *The over-all heights of bottles of the various capacities shall not be greater than the values shown in the following table:*

Capacity of bottle	*Maximum height* [1]
2 quarts	*12¾ inches.*
1 quart	*10½ inches.*
1 pint	*8¼ inches.*

[1] COMMITTEE NOTE.—Bottles are now being developed and produced in which the bottle and the spout are integral; for instance, a metal top may be permanently attached to the bottle, or the bottle may be so shaped as to include a glass spout. In such cases it seems that compliance with these specifications will be substantially secured when the over-all height of the bottle and the permanently attached spout, or the over-all height of a bottle blown integral with the spout, does not exceed the height specified in this table, plus 6 inches which is the figure given in specification No. 5 as the allowable length of a detachable spout.

3. *Each bottle shall have its capacity clearly blown or otherwise clearly and permanently marked in or on the side of the bottle, and in or on the side or bottom the name, initials, or trade-mark of the manufacturer thereof.*

4. *Bottles shall be provided with a clearly defined graduation line blown or otherwise clearly and permanently marked in or on the bottle, and extending at least halfway around it, which indicates the correct capacity, and with the words "Fill to line" or a similar and suitable inscription clearly and permanently marked in or on the bottle and clearly referable to this graduation line. This line shall in no case be more than 0.10 inch in width and the bottom edge of the line shall define the top of the meniscus of the water which is used in the test of the bottle. This graduation line shall be placed so that it is at least one-fourth inch below the bottom of any metal top when this is screwed firmly into place. The capacity of that portion of the bottle above the bottom of the graduation line shall be at least 3 cubic inches.*

5. *When a bottle is equipped with a spout, this shall be so constructed that free and unobstructed drainage is provided. This specification shall be construed to require that there be an effective air vent in the spout and no shoulder or other obstruction tending to result in a trapping of the liquid being delivered. The spout shall not be over 6 inches in length measured from the point of contact with the top of the bottle to the tip of the spout.* (See footnote to table in Spec. No. 2 above.)

Tolerances.—*The tolerances to be allowed on all bottles used for the sale of lubricating oils shall be in excess only and shall be the values shown in the following table. There shall be no tolerance allowed in deficiency.*

Capacity of bottle	Tolerance	
	Drams	Cubic inches
2 quarts	12	2. 7
1 quart	8	1. 8
1 pint	6	1. 4

LIQUID-MEASURING DEVICES

Definition.—A mechanically operated retail liquid-measuring device, hereinafter referred to as a liquid-measuring device, is a mechanism or machine adapted to measure and deliver liquid by volume, and which, on account of the character of its primary indicating elements, is obviously designed for unit deliveries of less than 50 gallons: Provided, however, That for the purpose of these specifications and tolerances, this definition is not to be construed to include grease-measuring devices.

Specifications.—1. Permanence.—*All liquid-measuring devices shall be of such design, construction, and materials that they may reasonably be expected to withstand ordinary usage without impairment of the accuracy of their measurement or the correct functioning of their operating or indicating parts.*

2. Plumb and Level Conditions.—*All liquid-measuring devices shall be so designed and constructed that they will be in normal operating position when they are in level. All liquid-measuring devices shall be installed plumb and level, and their installation shall be of such strength and rigidity as to maintain this condition.*

3. Means to Determine Level.—*Liquid-measuring devices, the indications or deliveries of which are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent*

or approximately 3° with the horizontal, shall be equipped with suitable means by which the level can be determined and established, such as a two-way or a circular level, a plumb bob, leveling lugs, etc.

4. UNITS OF DELIVERY.—*Liquid-measuring devices shall have the following discharge capacities per stroke or per cycle of the primary indicating elements, and these only: 1 gallon, a multiple of the gallon, 2½ gallons, or a binary submultiple of the gallon, that is, the quantity obtained by dividing the gallon by the number 2 or a power of the number 2: Provided, however, That a device may be constructed to deliver other amounts than the above, corresponding to predetermined money values at a definite price per gallon, but in such cases either the device shall be so constructed that the price per gallon at which it is set at any time will be clearly indicated to the customer by automatic means or this price shall be shown by means of a sign conspicuously displayed on the device.*

5. DEVICE TO INDICATE WHEN SYSTEM IS PROPERLY FILLED.—*All liquid-measuring devices other than those of the visible type shall be equipped with a device which will indicate whether or not the system is properly filled before a delivery is begun. This specification shall be construed to prohibit a check valve in the discharge line in such a position that the partial emptying of the system would not be disclosed, but not to prohibit a manually operated valve in the standpipe.*

NOTE.—This specification shall not be put into force and effect prior to July 1, 1929.

6. INDICATION OF DELIVERY.—All liquid-measuring devices shall be so designed and constructed that *the initial zero condition and* the amount delivered shall be clearly and definitely indicated by automatic means, and the indication of any delivery shall take place only when the full discharge has, in fact, occurred: Provided, however, That the require-

ment that the full discharge shall have been completed before registration shall not apply to the dribble flow caused by the displacement of a piston rod during the return of a piston to its initial position, *when a clear statement conspicuous to the customer and adjacent to the indicating means is placed on the liquid-measuring device to the effect that the full amount can not be delivered until the piston or the pointer or indicator has been returned to its initial position.*

7. SENSITIVENESS.—*All liquid-measuring devices shall be so designed and constructed that they can readily be operated to deliver each quantity for which a graduation, stop, overflow pipe, or other indicating means is provided, within the tolerance on such amount hereinafter provided.*

This specification shall be construed to require that in the case of all devices which have a graduated scale or dial or similar indicating means which at some point or points or at all points constitutes the sole or most sensitive means of determining the amount of liquid discharged, the length on such scale or dial equivalent to the tolerance at any graduation must be readily appreciable when the character of the indicating element and its normal distance from and position in reference to the observer's eye are taken into consideration, and in no case shall this length be less than 0.04 inch. For example, if a device is designed and constructed so that (1) 1 gallon is the first graduation; (2) there is no stop, overflow pipe, or other automatic means of terminating the delivery; (3) the graduations are equally spaced; and (4) if the cross section of the measuring chamber is the same throughout its length, the minimum length on the scale or dial shall be 3.1 inches per measured gallon, the maximum effective cross-sectional area of the measuring chamber shall be 75 square inches, and, if cylindrical, the maximum effective diameter shall be 9.75 inches.

NOTE.—The second paragraph of the above specification was adopted tentatively only.

8. CONSTANCY OF DELIVERY.—The amounts delivered by any liquid-measuring device shall not vary from the standard by more than the tolerances hereinafter provided (1) irrespective of the speed at which the device is operated, except that when operated considerably faster or slower than normal speed of operation the tolerance shall be applied in deficiency only—that is, the device shall not be deemed to be incorrect by reason of the tolerance in excess being exceeded during such unusual methods of operation—and (2) irrespective of the time elapsing between operations, subject to the conditions of the special elapsed-time test described below.

A special elapsed-time test shall be made to determine whether the device is satisfactory in respect to condition (2) above. In order to comply with this test the condition of the device shall be such that a period of nonuse of one hour shall not result in an error on the first delivery of the device after such period of nonuse greater than the appropriate tolerance allowable on the smallest amount which the device is designed to deliver, this tolerance being selected according to whether the device is or is not a new device; and a period of nonuse of 6 hours shall not result in an error on the first delivery of the device after such period of nonuse greater than 10 cubic inches, or in the case of a new device 5 cubic inches.

"Normal speed of operation" shall be construed to mean that range of operating speeds which may reasonably be employed in ordinary commercial usage; in the case of meters used for the purpose of determining the quantity of liquid delivered to an individual purchaser, this shall mean operation within the limits of the discharge rates ordinarily developed under conditions of installation recommended or specified by the manufacturer for the particular type of meter under test, *and all such meters shall be legibly marked to show the maximum discharge rates under normal conditions*

of installation and the minimum discharge rates and the maximum working pressures for which they are intended to be used: Provided, however, That the value of the minimum rate shall not be greater than 7 gallons per minute.

NOTE.—The italicized portion of the preceding paragraph shall not be put into force and effect prior to July 1, 1929.

NOTES.—In the special elapsed-time test described above, allowance shall be made for errors due solely to a change in volume of the contained liquid, resulting from temperature variations alone, since an error of this character is unavoidable in the case of volumetric measurements of this kind when the apparatus is standing unused. This change in volume due to temperature variations is, however, small in amount for all ordinary variations of temperature, amounting in the case of gasoline to about 0.6 per cent for each 10° F. change of temperature, or about 1.1 per cent for each 10° C. change of temperature.

In applying the elapsed-time test outlined above it is recommended that the delivery be not made through a hose, since the amount of gasoline necessary to wet the inside of the hose will cause an additional shortage in the delivery.

All meters encountered in the field should be tested at the maximum discharge rate developed under the conditions of installation actually employed regardless of whether this rate exceeds or is less than the maximum discharge rate marked on the meter, and also either at the rate of 7 gallons per minute or at any lower discharge rate marked by the manufacturer.

9. INDICATING AND REGISTERING PARTS.—Counters and graduated scales and dials used on liquid-measuring devices to tally sales and deliveries to individual purchasers or to indicate the amount delivered when any portion of the cycle or stroke has been completed, shall be of such size and style and shall be so located and disposed that they are clearly visible to and readable by the customer from any position which he may reasonably be expected to assume. The graduations shall be of such character and arrangement that the major ones *are more prominent than and* are clearly distinguishable from the minor ones. *In all types of liquid-*

measuring devices which have a graduated scale which at some point or points or at all points constitutes the sole or most sensitive means of determining the amount of liquid discharged, the width of the graduation marks shall not exceed 0.04 inch.

10. Pointers and Indicators.—All pointers and indicators which when used in conjunction with a graduated scale or dial indicate the amount of liquid discharged or the money value of the delivery at a predetermined price per unit of volume, shall be so shaped that a correct and accurate reading is given.

Pointers and indicators are required to be symmetrical about the graduation lines at which they may stand: Provided, however, That in the case of pointers and indicators used in connection with straight scales having nonparallel graduation lines and in respect to the nonhorizontal lines on such scales, this requirement shall be waived if the pointers and indicators are so designed and constructed that as the pointer or indicator approaches the correct indicating position in respect to any graduation line, only such portion of such graduation line as has not yet been reached by the index of the pointer or indicator or by a horizontal line extended forward from the end thereof, shall be exposed to view, and all other portions of such graduation line adjacent to the index of the pointer or indicator shall be automatically obscured.

Pointers and indicators which when used in conjunction with a graduated scale or dial constitute at some point or points or at all points the sole or most sensitive means of determining the amount of liquid discharged or the money value of the delivery at a predetermined price per unit of volume, shall reach to the finest graduation marks, and the width of the pointer or indicator, or of the end thereof, shall not be greater than the width of such marks.

11. Parallax.—*All liquid-measuring devices in which the accuracy of the readings of any indicating mechanism is affected*

by parallax shall be so designed and constructed as to reduce to a minimum the errors due to this cause.

This specification shall be construed to require that in the case of all devices which are equipped with a glass measuring chamber and in which the quantities delivered are determined by bringing the liquid surface into coincidence with indicators, pointers, or graduations, which at some point or points or at all points constitute the sole or most sensitive means of determining the amount of liquid discharged, such pointers, indicators, or graduations shall be located inside the glass measuring chamber and not more than 1/16 inch from the surface thereof.

12. Graduated Scales.—When a liquid-measuring device is provided with a graduated scale or dial, this shall be riveted to its supports or otherwise permanently fixed in position: Provided, however, That in the case of liquid-measuring devices of the gauge-glass type a sliding scale will be permitted when the displacement of such scale is, by suitable means, automatically prevented at all times when liquid is being discharged from the delivery outlet.

13. Numbering of Graduations.—*Figures defining the value of graduations shall be uniformly placed in reference to the graduation marks and shall be as close thereto as practicable, but shall not be so placed as to interfere with the accuracy of reading. Such figures shall be in regular sequence; that is, sequences such as 5, 1, 2, 3, 4, shall not be permitted.*

14. Scales Reading in Opposite Directions.—The use on a liquid-measuring device of two graduated scales reading in opposite directions and referable to the same indicating means shall not be permitted.

15. Lettering and Graduations.—*All markings, instructions, figures, and graduations required under these specifications shall be of such size, design, material, and location, and shall*

be so applied or affixed, that they will not tend easily to become obliterated or illegible.

16. Return of Indicating Element to Zero.—All liquid-measuring devices shall be so designed and constructed that the indicating element used in tallying deliveries to individual purchasers is returnable readily to a definite and clear zero reading before the next delivery is begun.

17. Positive Stops.—*When the stops or other stroke-limiting devices on a liquid-measuring device are subject to direct pressure or impact in the operation of the device, such stops shall be of such construction that the permanence and security of their positions is provided for by a positive, nonfrictional engagement of the parts whose relative motions are to be prevented. Such stops shall be so designed and constructed that adjustment within the prescribed tolerances can be made.*

18. Positioning of Stop Mechanism.—All liquid-measuring devices designed to deliver two or more different predetermined amounts by bringing into operation different stops or other means of defining the delivery, shall be so designed and constructed that the position for the proper setting of each stop is definitely and accurately defined, inadvertent displacement from this position is obstructed, and the delivery for which the device is set at any time is clearly and conspicuously indicated.

19. Provision for Sealing.—*All devices adapted to be altered for adjusting or correcting the delivery of a liquid-measuring device, or for changing the maximum delivery rate of a meter when this change tends to affect the accuracy of the deliveries, shall be of such construction that they can be sealed, either separately or together, in such a manner that the position of none of them can be changed without destroying the seal or seals: Provided, however, That this shall not apply to such devices as alter the deliveries to conform to different prices per*

gallon on such a liquid-measuring device as is described in the proviso of specification No. 4.

NOTE.—In this specification the words "or for changing the maximum delivery rate of a meter when this change tends to affect the accuracy of the deliveries" are to be put into force and effect not prior to July 1, 1929.

20. USE OF ADJUSTMENTS.—No adjustment of the delivery of a defined-stroke liquid-measuring device shall be permitted except that intended to produce a piston displacement per cycle of 231 cubic inches per indicated gallon of delivery. Adjustments of piston displacement to correct for leaks, slippage, excessive length of pipe line, or other defects of the device or of the installation shall not be permitted.

21. ASSURANCE OF COMPLETE DELIVERY.—All liquid-measuring devices shall be so designed and constructed as to furnish assurance that all measured liquid which is apparently being delivered from that delivery outlet which is being employed in any particular operation of the liquid-measuring device, is actually being delivered so long as there is any liquid passing through this delivery outlet.

This specification is to be construed to require that all valves in the supply line intended to prevent the reversal of flow of the liquid shall be of such design and construction that their closure is automatically effected in the use of the device and that when two or more delivery outlets for the liquid are provided a delivery made through one delivery outlet shall not affect the subsequent delivery through any other delivery outlet. It is further to be construed that either (1) there shall be no means provided by which any of the measured liquid can be diverted from the measuring chamber or the discharge line to the supply tank or elsewhere during the period that liquid is flowing from the delivery outlet apparently in sole use, or (2) if there be any means whatever

by which an incomplete delivery or any diversion of measured liquid can be accomplished or made, then the device must be so designed and constructed that such fact will automatically become an immediately obvious one to anyone observing the operation of the device.

21a. Auxiliary Visible Indicating Devices.— *Whenever a liquid-measuring device of the visible type is so designed and constructed that measured liquid continues to pass through the discharge valve for an appreciable time (3 seconds or more) after the liquid has disappeared from sight in the glass measuring chamber, then the device shall be equipped with an auxiliary visible indicating device, adjacent to the discharge valve and so constructed that it will indicate after the completion of the delivery when any portion of the measured liquid has not been discharged through such valve at the time of the closing thereof: Provided, however, That in the case of any nominal delivery which is such that it does not cause the liquid to disappear from the chamber, the time interval mentioned above shall be measured from the time that the liquid apparently ceases to fall in such chamber.*

Such auxiliary visible indicating device shall be so designed and constructed and so located and disposed that its indication is conspicuous and that, during the operation of the liquid-measuring device, it is clearly visible to and readable by the customer. Whenever an auxiliary visible indicating device designed to indicate drainage of liquid and/or completeness of delivery shall be employed, whether or not it is required by the terms of this specification, it shall comply with all the above requirements.

Note.—This specification is to be put into force and effect not prior to July 1, 1929.

21b. Time Allowed for Completion of Delivery.— *All liquid-measuring devices shall be so designed and con-*

structed, or so calibrated, that on a nominal delivery of 5 gallons they will deliver this quantity into the discharge line on the delivery side of the discharge valve, within the tolerance for devices in use, within a period of 10 seconds after the main flow of liquid has ceased.

The main flow shall be construed to cease, in the case of a device of the piston type, at the completion of the upward stroke of the piston, and in the case of a device of the visible type, at the time of the disappearance of the liquid in the glass measuring chamber: Provided, however, That in the case of any nominal delivery which is such that it does not cause the liquid to disappear from the chamber, the time that the liquid apparently ceases to fall in such chamber shall be used in lieu of the time of the disappearance of the liquid: And provided further, That in the case of any liquid-measuring device equipped with an auxiliary visible indicating device such as is described in specification No. 21a, any conspicuous change of indication in this device, such as a sudden drop in the level of the liquid, occurring after the major portion of the delivery has been completed, shall be used in lieu of either of the indications mentioned above.

All tests and calibrations shall be made on the basis outlined above, that is, the delivery valve shall be closed, or the operation of the liquid-measuring device otherwise discontinued, at the termination of the period of time mentioned above, and the amount which shall then have been delivered shall be taken as the full delivery of the device.

NOTE.—This specification shall be limited to apply only to liquid-measuring devices when used in the sale of motor fuels.

NOTE.—This specification is to be put into force and effect not prior to July 1, 1929.

COMMITTEE NOTE.—Since upon review following the Twenty-first National Conference the Committee on Specifications and Tolerances is convinced that the foregoing specification in its present form does

not accomplish the purpose for which it was designed, the committee proposes for consideration at this time:

First, that the first paragraph of this specification be amended to read as follows:

All liquid-measuring devices shall be so designed and constructed, or so calibrated, that they will deliver into the discharge line on the delivery side of the discharge valve, within the tolerances hereinafter provided, any nominal quantity which they are designed to deliver, within a period of 10 seconds after the main flow of liquid has ceased.

Second, that the following words be added at the end of the third paragraph of the specification:

for the nominal quantity being delivered.

It is the present intention of the committee to propose these amendments to the Twenty-second National Conference which is to be held in May or June, 1929. This material is included here so that timely notice may be given to interested parties.

22. Valves in Discharge Line.—No liquid-measuring device shall be equipped with a discharge valve at the extremity of the hose or elsewhere in the hose line unless the device is so designed and constructed either that it must be operated with the hose full of liquid at all times or that the fact that the hose is drained will automatically become an immediately obvious one to anyone observing the operation of the device. In case the discharge valve is so positioned, any other valve not immediately adjacent thereto, in any portion of the discharge line leading to this outlet, shall be so designed and constructed that it can only be closed off in one of the following ways: (1) By the use of some tool or device which is outside of and entirely separate from the measuring device itself, such as a wrench, screw driver, etc., but not an adjusting pin; or (2) by the destruction of a seal. In case the latter construction is used means shall be provided so that a seal of the usual lead-and-wire type may readily be employed to seal the valve open and the manufacturer shall furnish his

device with the valve sealed open; there shall be a metal tag or plate attached to the device adjacent to this valve handle clearly stating that the device should not be used unless the valve handle is secured by a seal.

This specification is not to be construed as allowing a discharge valve in the hose in the case of devices in which, without the fact being obvious to the observer, the hose or any part thereof can be drained of liquid after the actual mechanical operation of the mechanism of the liquid-measuring device is discontinued, in any way except as follows: (1) By means of the mechanically operated valve, or (2) by delivering from the measuring device more than the full measuring capacity thereof during the actual mechanical operation of the mechanism thereof.

23. Drainage of Discharge Line.—All liquid-measuring devices shall be so constructed and installed that they will provide for the complete and rapid drainage, to a definite and uniform level, of the liquid contained in the hose or outlet pipe, and will not permit a siphoning or a continuous trickle of liquid from the discharge outlet after the operation of the mechanism is discontinued.

This specification will be construed to require that if hose is used its inlet end shall be at least 5 feet above the normal level upon which the receiving vehicle or vessel stands and the liquid-measuring device shall be equipped with an automatic vacuum breaker or equivalent means to insure the complete and rapid drainage of the hose, that is required by the above. The hose shall be properly reinforced and shall be of such length and stiffness that no movable portion thereof will be readily disposed in such a way as to tend to retain liquid after the operation of the device is completed: Provided, however, That this specification shall not be construed to apply to devices which, under the terms of specification

No. 22, may be equipped with two shut-off valves or cocks and are to be operated with the hose full of liquid at all times.

24. Height of Suction Lift.—No defined-stroke, piston-type, liquid-measuring device shall be so installed as to work under a total suction head sufficient to cause vaporization of the liquid for which it is used under the highest temperature and lowest barometric pressure likely to occur.

25. Limitation of Use.—*Liquid-measuring devices which will not give correct results except when used with liquids having particular properties—as, for example, high viscosity—shall be conspicuously, clearly, and permanently marked to indicate this limitation. Such wording may take the form, "Not suitable for gasoline or light oils," "Use only for molasses or heavy oils," or "For viscous liquids only."*

26. Computing Charts.—*When liquid-measuring devices are equipped with money-value computing charts these shall be made in accordance with one of the following principles:*

(*a*) *If the device is so designed and constructed that it purports to compute for one or for a series of unit prices the total price for every delivery within the range of the device, then the device shall be equipped with a value pointer or indicator and value graduation marks; the value graduation marks shall be correctly placed; and in any position which the indicator or pointer and the chart may assume there shall be exposed to view a sufficient number of value figures and graduations to permit the value indications of the device to be read correctly. The value graduations shall not exceed 1 cent at all prices per gallon up to and including 30 cents. At any higher price per gallon the value graduations shall not exceed 2 cents: Provided, however, That nothing in the above shall be construed to prevent the placing of a special value graduation to represent each 5-cent interval. These special graduations may take the form*

of dots, staggered graduations, or similar forms. They shall be so placed that their meaning and value may be clearly understood, but they shall not be placed in the space between the regular graduations.

(b) If the device is so designed and constructed that it purports automatically to compute only for deliveries corresponding to a definite series of quantity graduations, then one of the following alternatives shall be complied with: (1) There shall be a value computation for each quantity graduation throughout the range of the device; or (2) no value indications may be exposed to view except at such times that the device registers a quantity indication for which a correct value indication is provided; or (3) each value graduation or each column or row of such graduations shall be clearly and conspicuously marked with the quantity graduation to which the value corresponds and the device shall be marked with the character and limitations of the computations made. All money values corresponding to definite quantity graduations must be mathematically correct except as follows: If the mathematically correct amount includes a fractional part of a cent, the fraction shall be dropped if it is less than one-half, but if the fraction is one-half or more the next higher cent may be shown.

27. Fraudulent Construction.—All liquid-measuring devices and all devices designed to be attached thereto and used in connection therewith shall be of such design and construction that they do not facilitate the perpetration of fraud.

General Note.—Conflict of Laws and Regulations.—In the above specifications certain items appear which may conflict in certain jurisdictions with present State or local laws or ordinances or regulations of State or local fire marshals or boards of safety. In such cases of conflict an attempt should be made by the weights and measures officials to harmonize the two codes, and in the meanwhile it may be found necessary to suspend the enforcement of such specifications.

Tolerances.—Except in special tests described above the tolerances to be allowed in excess or deficiency on all liquid-measuring devices shall be the values shown in the following table: Provided, however, That the manufacturers' tolerances or the tolerances on all new liquid-measuring devices shall be one-half of the values given: And provided further, That these latter tolerances shall also be applied to all devices which are being retested after having been found incorrect and subsequently adjusted or repaired.

Delivery	Tolerance
Gallons	*Cubic inches*
1/2 or less	2
1	3
2	4
3	5
4	6
5	7
6	8
7	9
8	10
9	11
10	12

For deliveries of over 10 gallons add 1 cubic inch per indicated gallon.

GREASE-MEASURING DEVICES

NOTE.—The following code of specifications and tolerances for grease-measuring devices was adopted tentatively by the Twenty-first National Conference on Weights and Measures, May 24, 1928. In accordance with the usual conference procedure this will come up for review and final action at the meeting of the conference to be held in 1929. The Bureau of Standards recommends that this code be not put into force and effect by the States prior to final action thereon by the conference.

Definition.—A mechanically operated grease measuring and dispensing device, hereinafter referred to as a grease-measuring device, is a mechanism or machine adapted to measure and deliver grease or transmission oil by volume. This definition is not to be construed to include devices which are obviously designed and intended solely for high-pressure lubrication of bearings and similar parts.

Specifications.—1. PERMANENCE.—*All grease-measuring devices shall be of such design, construction, and materials that they may reasonably be expected to withstand ordinary usage without impairment of the accuracy of their measurement, or the correct functioning of their operating or indicating parts.*

2. UNITS OF DELIVERY.—*Grease-measuring devices shall have the following discharge capacities per stroke or per cycle of the primary indicating elements, and these only: 1 pint, a multiple of the pint, or a binary submultiple of the pint, that is, the quantity obtained by dividing the pint by the number 2 or a power of the number 2.*

3. INDICATION OF DELIVERY.—All grease-measuring devices shall be so designed and constructed that the initial zero condition and the amount delivered in terms of liquid measure shall be clearly and definitely indicated by automatic means, and the indication of any delivery shall take place only when the full discharge has in fact occurred.

4. SENSITIVENESS.—*All grease-measuring devices shall be so designed and constructed that they can readily be operated to deliver each quantity for which a graduation, stop, or other indicating means is provided, within the tolerance on such amount hereinafter provided, and whenever any scale or dial is at some point or points or at all points the sole or most sensitive means of determining the amount of lubricant discharged, a volume of 1 pint shall be represented on such scale or dial by a length of not less than 1 inch.*

5. Constancy of Delivery.—The amounts delivered by any grease-measuring device shall not vary from the standard by more than the tolerances hereinafter provided (1) irrespective of the speed at which the device is operated, except that in the case of devices operated by air pressure when operated at an air pressure lower than the minimum pressure specified by the manufacturer, the tolerance shall be applied in deficiency only—that is, the device shall not be deemed to be incorrect by reason of the tolerance in excess being exceeded during such method of operation—and (2) irrespective of the time elapsing between operations. *In the case of all devices operated by air pressure there shall be legibly marked on the dial of the air-pressure gauge, by special graduations or otherwise, the maximum and minimum working pressures recommended by the manufacturer.*

6. Indicating and Registering Parts.—Counters and graduated scales and dials used on grease-measuring devices to tally sales and deliveries to individual purchasers or to indicate the amount delivered when any portion of the cycle or stroke has been completed, shall be of such size and style and shall be so located and disposed that they may be easily read. *The graduations shall be of such character and arrangement that the major ones are more prominent than and are clearly distinguishable from the minor ones. In all types of grease-measuring devices which utilize a graduated scale or dial to indicate the amount of lubricant discharged, the width of the graduation marks shall not exceed 0.04 inch.*

7. Pointers and Indicators.—*All pointers and indicators which when used in conjunction with a graduated scale or dial indicate the amount of lubricant discharged shall be so shaped that a correct and accurate indication is given. Such pointers and indicators are required to be symmetrical about the graduation lines at which they may stand and shall reach to the*

finest graduation marks; the width of the end of the pointer or indicator shall not be greater than the width of such marks.

8. Parallax.—*All grease-measuring devices in which the accuracy of the readings of any indicating mechanism is affected by parallax shall be so designed and constructed as to reduce to a minimum the errors due to this cause.*

9. Graduated Scales.—When a grease-measuring device is provided with a graduated scale or dial, this shall be riveted or otherwise permanently attached to its supports.

10. Numbering of Graduations.—*Figures defining the value of graduations shall be uniformly placed in reference to the graduation marks and shall be as close thereto as practicable, but shall not be so placed as to interfere with the accuracy of reading.*

11. Lettering and Graduations.—*All markings, instructions, figures, and graduations required under these specifications shall be of such size, design, material, and location, and shall be so applied or affixed, that they will not tend easily to become obliterated or illegible.*

12. Movement of Indicating Element.—*All grease-measuring devices shall be so designed and constructed that the indicating element used in tallying deliveries to individual purchasers shall only be susceptible of forward movement by the mechanical operation of the device itself. The indicating element shall be returnable readily to a definite and clear zero indication before the next delivery is begun. Means shall be provided to prevent the indicating element from being returned beyond the zero indication.*

13. Positive Stops.—*When stops or other stroke-limiting devices are employed on a grease-measuring device and these are subject to direct pressure or impact in the operation of the device, such stops shall be of such construction that the permanence and security of their positions is provided for by a positive, nonfrictional engagement of the parts whose relative*

motions are to be prevented. Such stops shall be so designed and constructed that adjustment within the prescribed tolerances can be made.

14. Positioning of Stop Mechanism.—*All grease-measuring devices designed to deliver two or more different predetermined amounts by bringing into operation different stops or other means of defining the delivery, shall be so designed and constructed that the position for the proper setting of each stop is definitely and accurately defined, inadvertent displacement from this position is obstructed, and the delivery for which the device is set at any time is clearly and conspicuously indicated.*

15. Provision for Sealing.—*All devices adapted to be altered for adjusting or correcting the delivery of a grease-measuring device shall be of such construction that they can be sealed, either separately or together, in such a manner that the position of none of them can be changed without destroying the seal or seals.*

16. Use of Adjustments.—No adjustment of the delivery of a defined-stroke grease-measuring device shall be permitted except that intended to produce a piston displacement per cycle of 28.875 cubic inches per indicated pint of delivery. Adjustments of piston displacement to correct for leaks, slippage, or other defects shall not be permitted.

17. Assurance of Complete Delivery.—All grease-measuring devices shall be so designed and constructed that there shall be no means provided by which any of the measured lubricant can be diverted from the measuring chamber or the discharge line to the supply tank or elsewhere during the period of operation of the device. All valves in the supply line intended to prevent the reversal of flow of the lubricant shall be of such design and construction that their closure is automatically effected in the use of the device.

18. Limitation of Use.—*Grease-measuring devices which will not give correct results except when used with lubricants having particular properties shall be conspicuously, clearly, and permanently marked to indicate this limitation.*

19. Fraudulent Construction.—All grease-measuring devices and all devices designed to be attached thereto and used in connection therewith shall be of such design and construction that they do not facilitate the perpetration of fraud.

Tolerances.—Except under special conditions as described in specification No. 5, the tolerances to be allowed in excess or deficiency on all grease-measuring devices shall be 1¼ cubic inches (about 5/8 liquid ounce) on a delivery of 1 pint or less; for deliveries of more than 1 pint add 1 cubic inch (about 1/2 liquid ounce) per indicated pint: Provided, however, That the manufacturers' tolerances or the tolerances on all new grease-measuring devices shall be one-half of the values given: And provided further, That these latter tolerances shall also be applied to all devices which are being retested after having been found incorrect and subsequently adjusted or repaired.

VEHICLE TANKS

[When used as Measures]

Notes.—The following specifications and tolerances shall apply to vehicle tanks and their accessory piping, valves, etc., in those cases in which the tanks or the compartments thereof are used or to be used as measures to determine the amount of liquid delivered, and such use shall be permitted only when these specifications and tolerances are complied with.

If a tank is damaged in any way (as from collision, etc.), or if repairs which might in any way affect the accuracy of measurement are made, such tank shall not again be used as a measure until inspected and, if deemed necessary, tested, by the weights and measures official.

In determining or checking the capacity of tanks, water is recommended as a testing medium. In general, petroleum products are not

recommended because the change in volume due to temperature variations is large, and evaporation during the test may result in serious inaccuracies in the calibration. If the conditions are such that the use of a petroleum product seems necessary, a neutral oil of high boiling point should be selected, and great care exercised to eliminate the inaccuracies mentioned or to reduce them to a minimum.

Definition.—A vehicle tank, hereinafter referred to as a "tank," shall, for the purpose of these specifications and tolerances, mean a container, which may or may not be subdivided into two or more compartments, mounted upon a wagon or automobile truck and used for the delivery of liquids. The term "compartment" shall mean the entire tank whenever the tank is not subdivided; otherwise it shall mean any one of those subdivided portions of the tank which is designed to hold liquid.

Specifications.—1. PERMANENCE.—*All tanks and all indicators, piping, valves, etc., attached thereto and used in connection therewith shall be of such design, construction, and material that they may reasonably be expected to withstand ordinary usage without impairment of the accuracy of measurement.*

2. INDICATORS.—*An indicator shall be provided within the fill opening of each compartment, which shall be located approximately midway between the ends of the compartment. The indicator shall be so designed that it will clearly, distinctly, and unmistakably define the height to which the compartment must be filled in order to contain its marked capacity. If this indicator is adjustable it shall be so constructed that it can be sealed in such a manner that its position can not be changed without destroying or mutilating the seal.*

3. EXPANSION SPACE.—*The indicator shall be so positioned that when a compartment is filled to the indicator there will remain an expansion space of not less than 0.75 per cent of the nominal capacity of the compartment.*

4. Venting Means.—Each compartment shall be provided with suitable venting means to prevent the formation of air pockets by permitting the escape of air from all parts of the compartment designed to be filled with liquid and to permit the influx of air to the compartment during the process of delivery.

5. Provision for Complete Delivery.—Each tank, and all delivery piping attached thereto and used in connection therewith, shall be so designed and constructed and shall be so mounted upon the vehicle that when this is standing upon a level surface complete delivery may be made from any compartment through the delivery faucets or valves whether other compartments are full or empty.

6. Piping.—When emergency valves designed to close the discharge outlets from compartments are provided, the capacities of such compartments shall be construed as including the capacity of the piping leading therefrom, and such emergency valves shall always be open when compartments are being filled or their capacities are being checked.

7. Marking of Capacity.—Each compartment of a tank shall be plainly and conspicuously marked with a designating letter or figure, and each delivery faucet or valve shall be correspondingly marked to indicate the compartment of which it is the outlet. In addition, the tank shall be plainly and conspicuously marked to show the capacity, to the nearest half gallon, of each compartment *and such marking shall indicate that the capacities given are measured to the indicators provided. This latter marking shall be placed adjacent to the faucets or valves.*

8. Lettering and Graduations.—All markings, figures, and graduations required under these specifications shall be

of such size, design, material, and location, and shall be so applied or affixed, that they will not tend easily to become obliterated or illegible.

9. Fraudulent Construction.—All tanks and all devices designed to be attached thereto and used in connection therewith shall be of such design and construction that they do not facilitate the perpetration of fraud.

Tolerances.—The tolerance to be allowed in excess or deficiency on all vehicle tank compartments which are being tested by the weights and measures official for the first time, to verify the accuracy of a capacity marked by a manufacturer or user, shall be the values shown in the column headed "On first test" in the following table. The tolerance to be allowed in excess or deficiency on all subsequent tests made by the official, to verify the accuracy of a marked capacity, shall be the values shown in the column headed "On subsequent test." These tolerances are to be applied to the difference between the actual result of the calibration and the marked capacity of the compartment. Whenever the result of a calibration indicates that the marked capacity of a compartment is not correct within the tolerance to be applied, if the capacity of the compartment is adjustable, then the marking shall be changed in accordance with the provisions of specification No. 7, or the result of the calibration shall be taken as the basis of an adjustment and the adjustment shall be so made that the capacity of the compartment agrees as nearly as may be with such marked capacity; if the capacity of the compartment can not be adjusted to agree with the marked capacity, then the marking shall be changed in accordance with the provisions of specification No. 7.

Capacity of compartment		Tolerance	
From—	Up to and including—	On first test	On subsequent test
Gallons	*Gallons*	*Gallons*	*Gallons*
---	175	1/2	1/2
175	325	1/2	1
325	475	3/4	1½
475	575	1	2
575	725	1¼	2½
725	875	1½	3
875	975	1¾	3½
975	1, 125	2	4
1, 125	1, 325	2½	5
1, 325	1, 500	3	6

DRY CAPACITY MEASURES

Specifications.—1. Dry capacity measures, and baskets used as dry measures, shall be made of metal, well-dried wood, or composition, or similar and suitable material, and shall be of sufficient strength and rigidity to withstand ordinary usage without becoming materially warped, bent, dented, distorted, or otherwise damaged.

2. Dry measures, and baskets used as dry measures when such are allowed by the other specifications, shall be of one of the following capacities only: 1 bushel, a multiple of the bushel, or a binary submultiple of the bushel, that is, a measure obtained by dividing the bushel by the number 2 or by a power of the number 2.

3. The capacity of all dry measures, and baskets used as dry measures, shall be conspicuously, legibly, and permanently indicated on the side of the measure. This shall be in combination with the word "Dry" in the case of measures in which the word "quart" or "pint" occurs. The letters shall

be at least one-half inch high and one-quarter inch wide on measures having a capacity of 1 peck or less and at least 1 inch high and one-half inch wide on those having a capacity of one-half bushel or more.

4. All dry measures having a capacity of one-half bushel or less shall be cylindrical or conical in shape. If of the latter shape, the top diameter shall be greater than the bottom diameter, but never by an amount exceeding 10 per cent of the latter. In no case shall the bottom diameter exceed the top diameter.

5. The bottoms of all dry measures shall be perpendicular to the axis of the measure and shall be flat, or when made of metal may be slightly corrugated when such corrugations aid in strengthening the measure. Such corrugations, when employed, shall be parallel or radial straight lines only.

6. Wooden dry measures having a capacity of more than 1 pint shall have a metal band firmly attached around the top. All metal dry measures shall be adequately reinforced around the top.

7. Dry measures, and baskets used as dry measures, having a capacity of 1 bushel or more shall be equipped with handles.

8. Baskets shall not be used as dry measures when having a capacity of less than one-half bushel.

9. Dry measures, and baskets used as dry measures, shall be of such construction that the capacity is determined by the top rim of the measure, and no subdivided measures or baskets shall be allowed.

10. Dry measures shall not be double-ended; that is, have the bottom set part way up into the measure so that both ends may be utilized as measures, either of the same or of different capacities.

11. Dry measures, and baskets used as dry measures, shall not have adjustable or movable bottoms.

12. The minimum diameters of dry measures of various capacities shall conform to the following table:

Capacity of measure	Minimum diameter
	Inches
½ bushel	13¾
1 peck	10⅞
½ peck	8½
2 quarts	6⅝
1 quart	5⅜
1 pint	4

Tolerances.—The tolerances to be allowed in excess and in deficiency on dry capacity measures, and baskets used as dry capacity measures, shall be the values shown in the following table: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on all new dry capacity measures and baskets used as dry capacity measures shall be one-half of the values given:

Capacity of measure	Tolerance	
	In excess	In deficiency
	Cubic inches	*Cubic inches*
1 bushel	50. 0	25. 0
½ bushel	30. 0	15. 0
1 peck	16. 0	8. 0
½ peck	10. 0	5. 0
2 quarts	5. 0	2. 5
1 quart	3. 0	1. 5
1 pint	2. 0	1. 0
½ pint	1. 0	. 5
¼ pint	. 5	. 3

BERRY BASKETS OR BOXES

Specifications.—1. Baskets or boxes for berries or small fruits, of a capacity of 1 dry quart or less, shall be of one of the following sizes: 1 quart, 1 pint, or one-half pint, dry measure.

Tolerances.—The tolerances to be allowed in excess and in deficiency on baskets or boxes for berries or small fruits, constructed of wood, shall be the values shown in the following table:

Capacity of basket	Tolerance	
	In excess	In deficiency
	Cubic inches	*Cubic inches*
1 quart	3	1. 5
1 pint	2	1. 0
½ pint	1	. 5

The tolerances to be allowed in excess and in deficiency on baskets or boxes for berries or small fruits, constructed of pasteboard or fiber, shall be the values shown in the following table:

Capacity of measure	Tolerance	
	In excess	In deficiency
	Cubic inches	*Cubic inches*
1 quart	2. 0	1. 0
1 pint	1. 0	. 5
½ pint	. 5	. 25

SCALES

General Specifications.—1. The nominal or rated capacity of a scale is the largest weight indication which can be obtained by the use of all its reading or recording elements in combination.

When one reading or recording element of the scale is designed for auxiliary use only, such as a small bar and poise intended for use in determining weights intermediate between two graduations on the principal bar of the beam, the weight value of this reading or recording element is not to be included in the sum, provided that it does not exceed 2 per cent of the sum of the weight values of the remaining reading or recording elements. (Thus, a platform scale with the principal bar of the beam graduated to 100,000 pounds by 1,000-pound subdivisions and with an auxiliary bar graduated to 1,000 pounds by 20-pound subdivisions is to be considered as having a nominal capacity of 100,000 pounds.)

When a scale is designed for use with removable weights and these are furnished with the scale, the amount which these represent when used on the scale shall be included in the sum of the weight values of the reading elements. When the scale is designed for use with removable weights but these are not furnished with the scale, the amount which those represent on the scale that are usually furnished with the scale when weights are included shall be included in the sum of the weight values of the reading elements.

2. All scales not equipped with a beam or reading face graduated to the full capacity of the scale, or those not equipped with a graduated beam or reading face, which, taken in connection with another graduated beam or beams or with a graduated runner, indicates the capacity of the scale, shall have the

nominal or rated capacity conspicuously, clearly, and permanently marked upon them.

2a. No scale shall be used in weighing loads greater than its nominal or rated capacity.

3. All scales shall be of such construction that they will support a load of maximum capacity without undue bending or straining of the parts.

3a. The construction of all scales shall be such that when the beam is displaced to the full extent allowed by the construction of the scale, it will return to its normal position.

4. All pivots shall be firmly secured in or to the levers.

5. All knife-edges shall be of hardened and tempered steel, except that agate may be used for special classes of scales when specifically permitted by the specifications therefor. They shall be sharp and bear throughout the entire length of the parts designed to be in contact.

6. All bearings shall be smooth and at least as hard as the knife-edges. For scales of more than 5,000 pounds capacity, the bearings shall be made of hardened and tempered steel. (The term "bearing" used in this specification refers to the entire surface which is designed to be in contact with a knife-edge or with a point bearing.)

7. When plates or caps are used to limit the longitudinal motion of a knife-edge, the parts of such plates or caps which are liable to come into contact with the knife-edge shall be smooth and at least as hard as the knife-edge. The parts of the knife-edge liable to come into contact with these plates or caps shall be so formed that the friction between them is reduced to a minimum.

8. If a scale has a nose iron, the proper position of this, as determined by the factory sealing operation, shall be clearly, accurately, and permanently indicated. A nose iron is defined as a slidably-mounted, manually-adjustable pivot assembly designed for changing the multiplication of a lever.

9. If the scale has interchangeable or reversible parts, these shall be so constructed that their interchange or reversal will not affect the balance or the accuracy of the instrument.

10. No scale shall be equipped with a scoop counterbalanced by a removable poise or weight.

11. When the scale is equipped with a permanently attached device intended to counterbalance the weight of a removable scoop, this device shall clearly indicate on the customers' side of the scale whether the scoop should be on or off the scale.

12. The graduations on all beams shall consist of lines, or notches, or of a combination of these. All lines shall be uniform in spacing and parallel to each other. All notches shall be evenly cut, and the lines formed by the intersection of the sloping planes of their sides shall be uniform in spacing and parallel to each other. When a combination of lines and notches is employed, the lines shall be properly placed with reference to the notches so as to indicate the value of each notch clearly and correctly.

12a. The graduations on all beams and reading faces shall be clear and distinct *and in no case shall their width be less than 0.008 inch.*

12b. The clear interval between the graduations on all beams shall not be less than 0.04 inch.

13. Each main weight graduation shall be so marked as to indicate the weight represented by the poise or other indicator. Main graduations are to be construed as those the value of which should be readily ascertainable in order to facilitate reading at any point.

14. Shoulders or stops shall be provided on all beams to prevent the poise traveling and remaining back of the zero graduation.

15. The adjusting material in all poises shall be securely inclosed and firmly fixed in position. If of lead or other

material softer than brass, it shall not be in contact with the beam.

16. Poises shall be so constructed that no part can be easily detached, and if equipped with a set screw this shall not be removable.

17. Poises on notched beams shall be provided with a pawl or other device, so constructed as to cause the poises to be seated into a definite and correct position in each notch, wherever in the notch the pawl or other device is placed, and to be held there firmly and without appreciable movement.

18. The bearing edge of a hanging poise shall be hard and sharp, and shall be so formed as to allow the poise to swing freely in the notches of the beam.

19. Reading edges or indicators of poises shall be sharply defined, and all reading edges shall be parallel to the graduations on the beam.

20. Poises shall not be readily detachable from the beam: Provided, however, That this specification shall not apply to poises on steelyards unless there is a zero graduation on the beam.

21. When a scale is equipped with a beam, the position or oscillation of which is used to indicate the balance of the scale, the normal position of this beam shall be horizontal, and it shall have equal play above and below the normal horizontal position.

22. No scale shall be so constructed that the beam is unstable or accelerating.

23. Scale pans in which fish or other wet commodities are placed when weighed shall be so constructed as to provide for drainage.

23a. When tests are being made with both increasing and decreasing loads on any scale, the indications on all increasing loads shall be within the usual tolerances provided, and also at any stage of the test the range between corresponding

observations for increasing and decreasing loads shall not be greater than the sum of the tolerances in excess and in deficiency for the load in question. This specification is to be construed as applying only to automatic-indicating scales.

23b. All devices intended to increase or decrease the capacity of a scale by the addition or subtraction of a weight or weights shall operate properly irrespective of the speed with which they are manipulated.

24. All scales shall be of such design and construction that they are reasonably permanent in their adjustment and will repeat their weight indications correctly, and do not facilitate the perpetration of fraud.

25. All scales shall be maintained in balance.

A scale is in balance, as the term is used herein, when it correctly gives a weight indication of zero when there is no load on the platform, plate, or other load-receiving element.

A lever scale of the nonautomatic type not having an indicator and a graduated scale or arc is in balance when the beam comes to rest at, or oscillates through approximately equal arcs above and below, the center of the trig-loop when one is provided; or a position midway between other stops when these are provided; or a horizontal position when no trig-loop or other stops are provided.

A scale of the nonautomatic type having an indicator and a graduated scale or arc is in balance when the indicator comes to rest at, or oscillates through progressively smaller arcs about, a definite and clear zero graduation.

A scale of the automatic-indicating type—that is, one having a reading face or dial—is in balance when the indicator comes to rest at a definite and clear zero graduation.

Sensibility Reciprocal (SR).—The term "sensibility reciprocal" or "SR" hereinafter referred to is defined as the weight required to move the position of equilibrium of the

beam, pan, pointer, or other indicating device of a scale a definite amount at the capacity or at any lesser load.

In scales provided with a beam and trig-loop, the SR is the weight required to be placed upon the platform to turn the beam from a horizontal position of equilibrium in the middle of the trip-loop to a position of equilibrium at the top of the loop. The SR may be determined by subtracting the weight instead of adding it, thereby causing the beam to assume a position of equilibrium at the bottom of the loop; or indirectly, by moving the sliding poise on the beam the required amount in either direction, to obtain the specified change in the position of equilibrium of the beam; or by adding or subtracting small weights to or from the counterpoise until the specified change is obtained, and determining the equivalent of the small weights used in terms of weight on the platform.

In the case of equal-arm scales and scales with a single pan or plate above, or hanging from, the beam, which are not provided with a pointer moving over a graduated arc or scale, the SR is the amount of weight required on the pan or plate to cause it to move from its position of equilibrium, when the scale is in balance, to a position of equilibrium at the limit of its motion.

In the case of scales provided with a single indicator and a graduated scale or arc, one of which oscillates with reference to the other to form a convenient means for determining the position of equilibrium of the beam, and which does not of itself directly indicate in terms of weight, the SR is the weight required to cause a change in the position of rest of the pointer equal to one division of the graduated scale or arc.

In the case of scales equipped with two indicators which move in opposite directions and oscillate with reference to each other to form a convenient means for determining the

position of equilibrium of the beam, the SR is the weight required to cause a separation of the indicators of 0.04 inch, measured in the direction of their movement.

NOTE.—The two preceding paragraphs are limited to apply only to cream-test or butterfat-test scales and apothecaries' prescription scales, but they are included here for the sake of completeness of the definition.

The SR does not apply to reading faces or dials which indicate directly in terms of weight, but no such reading face or dial which is purely auxiliary to the scale mechanism—such as one, for instance, which may or may not be employed in the determination of weight—shall be construed to exempt a scale from the SR requirement when this face or dial is detached.

NOTE.—The effect of friction on a scale is to make possible a variation of the load on the pan, plate, or platform without any corresponding change in the indication. The value of the SR which is determined with the effect of friction present will, therefore, be in error by a variable amount. However, in making tests this error must be neglected.

PLATFORM SCALES

[Including Counter Platform Scales]

Definitions.—A platform scale is a scale having a load-receiving platform carried on multiplying levers which transmit the load to the beam or other reading element, such platform having four or more lines of support comprised in bearings which rest directly upon knife-edges in the multiplying levers.

A counter platform scale is a scale of the above type which is especially adapted on account of its compactness, light weight, moderate capacity, and arrangement of parts, for use upon a counter or table. Within the meaning of this

definition, a platform scale is a counter platform scale when it conforms to both of the following:

(1) Its weighing capacity is not more than 400 pounds.

(2) Its beam or other reading element is located at an elevation sufficiently low in relation to the weighing platform to be accessible and easily read when the scale is used upon a table or counter.

Specifications.—1. The foundations of all built-in scales shall be firm and substantial.

2. Platform scales having an outside frame around the platform shall be equipped with means for centering and checking the platform. These shall cause the platform bearings to return to their normal line of contact on the knife-edges when the platform is displaced to the full extent allowed and also shall prevent the platform bearings from such a displacement that the centering will not take place. The above results may be obtained by any proper means that will not introduce excessive friction and will not cause binding when the parts have been so caused to return to their normal weighing positions.

3. Platform scales shall be so constructed that there is sufficient clearance between the platform and the frame to allow for any expansion due to weather effects. Sufficient clearance shall also be provided to prevent the live parts of the scale from binding on account of an ordinary accumulation of dirt or other ordinary causes.

4. A wagon scale should have at least 12 feet of straight driveway on either end of the scale in the same plane as the platform.

5. Platforms and levers shall be of sufficiently rigid construction that the degree of deflection under the maximum load will not endanger the accuracy of the scale.

6. If a scale is equipped with a relieving device, this shall be so constructed that when the beam is balanced and

the device is used to relieve it and engage it again, one or more times, the former balance will again be assumed by the beam.

7. When corner platform loops are removable, each shall be so marked or shaped as to identify it with its proper corner.

7a. The maximum value of the minimum graduations of the graduated beams of counter platform scales used in the sale of food stuffs at retail shall be 1 ounce: Provided, however, That this shall not apply to scales used exclusively in the sale of vegetables.

8. All devices for adjusting the balance of a counter platform scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the movable mechanism of the scale itself, such as a screw driver, wrench, etc., but not an adjusting pin.

9. All devices for adjusting the level of a counter platform scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the leveling devices, such as a screw driver, wrench, etc., but not an adjusting pin.

9a. Counter platform scales whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3° with the horizontal, shall be equipped with a device which will indicate when the scale is level, and in no case shall any pendulum operating the scale be considered a leveling device. The scale shall be rebalanced at zero each time its position is altered during the test contemplated by this specification.

10. All platform scales, except track scales, shall be so constructed that when a load consisting of test weights repre-

senting one-half or more than one-half of the capacity of the scale, and not exceeding such capacity, is placed so that its center of gravity lies over the points designated by circles in diagram No. 1, the error at each point shall not exceed the tolerance allowed for the load employed. If a load equal to one-quarter of the capacity is used, this shall be placed so that its center of gravity lies directly over the platform bearings designated by the circles in diagram No. 2, and the errors shall not exceed those indicated above.

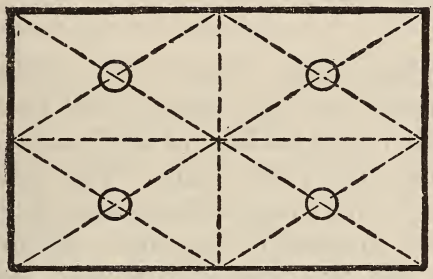

Diagram No. 1

Diagram No. 2

11. Any device for altering the sensibility of a scale shall be so limited in its adjustment that the beam can not be made unstable by the manipulation of the device.

12. The minimum travel of the beam in the trig-loop shall conform to the following table:

Distance from beam fulcrum to trig-loop	*Minimum travel of beam in trig-loop*
	Inch
Under 12 inches	*0. 4*
Over 12 inches, including 20 inches	*. 5*
Over 20 inches, including 40 inches	*. 7*
Over 40 inches	*. 9*

13. All weighing beams shall be so marked and graduated and all poises on these beams shall be so constructed that the weight corresponding to any position of the poise can be read directly on the beam. This condition shall be fulfilled whether or not a registering or stamping device is used.

14. When not modified by the above and in so far as they are applicable, the following specifications shall also apply; general for scales; those for spring scales relating to automatic-indicating elements, when the scale is so equipped (except that graduations need not be equally spaced); and also those under any heading hereafter when the scale is so constructed as to fall within the definition under such heading.

Sensibility Reciprocal (SR).—The maximum SR allowable on all platform scales, except counter platform scales, shall be the value of two of the minimum graduations on the beam, at the capacity of the scale or at any lesser load: Provided, however, That the manufacturers' maximum SR or the maximum SR on all new platform scales, except counter platform scales, shall be the value of one of the minimum graduations on the beam at the capacity or at any lesser load. The maximum SRs for counter platform scales are given hereafter under the heading "Counter scales."

(The term "sensibility reciprocal" or "SR" means the weight required to move the position of equilibrium of the beam, pan, pointer, or other indicating device of a scale a definite amount. In scales provided with a beam and trig-loop the SR is the weight required to be placed upon the platform to turn the beam from a horizontal position of equilibrium in the middle of the trig-loop to a position of equilibrium at the top of the loop. The SR may be determined by subtracting the weight instead of adding it, thereby causing the beam to assume a position of equilibrium at the bottom of the loop; or indirectly, by moving the sliding poise on the beam the required amount in either direction, to obtain the specified change in the position of equilibrium of the beam; or by adding or subtracting small weights to or from the counterpoise until the specified change is obtained, and determining the equivalent of the small weights used in terms of weight on the platform.)

Tolerances.—The tolerances to be allowed in excess or deficiency on all platform scales, except counter platform scales and large-capacity automatic-indicating scales, shall be the values shown in the following table: Provided, however, That the manufacturers' tolerances or the tolerances on all new platform scales, except counter platform scales and large-capacity automatic-indicating scales, shall be one-half of the values given: And provided further, That these tolerances on all these platform scales shall in no case be less than the value of one of the minimum graduations on the beam, except that the manufacturers' tolerances or the tolerances on new apparatus shall in no case be less than the value of one-half of one of the minimum graduations on the beam. The tolerances for counter platform scales are given hereafter under the heading "Counter scales."

Load	Tolerance, Class A		Tolerance, Class B	
	On ratio	On beam or reading face	On ratio	On beam or reading face
Pounds	*Ounces*	*Ounces*	*Ounces*	*Pounds*
50	1/2	1		
100	1	2		
200	2	4		
240	3	6		
300	3	6		
400	4	8		
500	5	10	10	1¼
600	6	12	12	1½
		Pounds	*Pounds*	
800	8	1	1	2
1,000	8	1	1	2
1,200	10	1¼	1¼	2½
1,500	12	1½	1½	3
1,800	14	1¾	1¾	3½
	Pounds			
2,000	1	2	2	4
2,500	1¼	2½	2½	5
4,000	2	4	4	8
6,000	3	6	6	12
8,000	4	8	8	16
10,000	5	10	10	20
12,000	6	12	12	24
16,000	8	16	16	32
20,000	10	20	20	40
24,000	12	24	24	48
30,000	15	30	30	60
40,000	20	40	40	80
80,000	40	80	80	160
100,000	50	100	100	200
160,000	80	160	160	320
200,000	100	200	200	400
300,000	150	300	300	600
400,000	200	400	400	800

Explanation of Preceding Table.—"Class A" scales include the following: Scales of the portable platform type; and also scales of the dormant or built-in type which are installed inside of a building having side walls and roof which protect the scale from weather effects and from sudden changes of temperature.

"Class B" scales include the following: Scales of the railroad track, autotruck, and wagon types; and also scales of the dormant or built-in type which are not installed inside of a building having side walls and roof, and which are exposed to weather effects and sudden changes of temperature.

NOTE.—The latter effect, since it causes the condensation of moisture on the scale parts, often has as serious results on the condition of the scale as have weather effects.

The columns with the heading "Tolerance on ratio" refer to the error in the ratio or multiplying power of scales with which counterpoise weights are used.

The columns with the heading "Tolerance on beam or reading face" refer to those parts of scales not requiring the use of removable weights; for example, a beam.

The column with the heading "Load" refers to the amount of weight on the platform of the scale.

Application of Tolerances to Railroad Track Scales.—In the case of railroad track scales designed and used for weighing ordinary freight traffic, when the test load consists of a one-truck test car, the largest algebraic mean of any two errors found for different positions of the test truck shall not exceed the tolerance corresponding to the test load used: Provided, however, That no two errors shall be selected corresponding to positions of the test truck closer together than the distance between similar points on adjacent spans. The tolerance given in the table is not to be applied to the error found for a single position of the test load. (The largest

algebraic mean of any two errors may be defined as one-half of the largest plus (+) or minus (−) sum that can be obtained by adding any two errors, such as two plus errors, two minus errors, a numerically large plus error and a numerically small minus error, or a numerically large minus error and a numerically small plus error.)

In order that the largest algebraic mean of any two errors, which represents the maximum error of freight-car weighing, may not differ appreciably from the true amount, a test car having a wheel base not exceeding 7 feet should be used.

LARGE-CAPACITY AUTOMATIC-INDICATING SCALES

Definition.—A large-capacity automatic-indicating scale is a scale, other than of the counter scale type, in which is embodied or to which is attached a self-acting mechanism, the capacity of which may be equal to or less than the total capacity of the scale, through the agency of which the indicated or recorded weights of variable loads may be obtained. This definition is not to be construed to include scales which automatically weigh out commodities in predetermined drafts, such as automatic grain hopper scales, packaging scales, etc.

NOTES.—The following tolerances are not intended to be applied strictly to scales already in use.[8]

These tolerances shall not be applied to railroad track scales, notwithstanding that automatic-indicating devices are embodied in or attached to such scales.

Tolerances.—The tolerances to be allowed in excess or deficiency for tests at increasing loads [9] on large-capacity

[8] For a discussion of this matter, see committee report, p. 132, Report of the Sixteenth Annual Conference on Weights and Measures, Miscellaneous Publications of the Bureau of Standards No. 55.

[9] In the case of tests at decreasing loads specification No. 23a under the heading "Scales: General specifications," applies. See p. 79.

automatic-indicating scales shall be the values shown in the appropriate column in the tolerance table under the heading "Platform scales" (see p. 88): Provided, however, That the tolerances on the dial or reading face shall in no case be less than the value of one of the minimum graduations on the dial or reading face, or one five-hundredth of the capacity of the dial or reading face, whichever is less, except that on such of these scales as have a minimum graduation of 1 pound or more on the dial or reading face such tolerance shall not be less than 1 pound. The tolerances on any beam or beams with which the scales may be equipped shall be the same as those specified above, except in cases where the value of the minimum graduation on any such beam is less than that of the minimum graduation on the dial or reading face, or one five-hundredth of the capacity thereof, whichever determines the minimum tolerance on the dial or reading face, in which cases the minimum tolerance on any such beam shall be the minimum graduation on any beam with which the scale may be equipped.

The minimum tolerance to be allowed on the ratio or the multiplying power of the scale shall be the same as the minimum tolerance allowed on the beam: And provided further, That the manufacturers' tolerances or the tolerances on all new large-capacity automatic-indicating scales shall be one-half of the values specified above.

The tolerances to be allowed on large-capacity automatic-indicating scales used exclusively in determining weights for the sole purpose of fixing charges for the transportation of freight shall be twice those specified above.

WHEEL-LOAD WEIGHERS

NOTE.—Wheel-load weighers are intended solely for official use in the enforcement of traffic or highway laws. When sealed by the weights and measures official they are to be sealed for the above purpose only; they are never to be allowed in commercial use.

Definition.—Wheel-load weighers shall, for the purpose of these tolerances, mean portable devices designed for determining the axle loads of loaded trucks on highways.

Tolerances.—The tolerance to be allowed in excess or deficiency on wheel-load weighers shall be 5 per cent of the load applied: Provided, however, That the manufacturers' tolerance or the tolerance on all new devices shall be 3 per cent, in excess or deficiency, of the load applied: And provided further, That this latter tolerance shall also be applied to all devices which are being retested after having been found incorrect and subsequently adjusted or repaired. When the devices are tested in pairs, the above tolerances shall be applied to the sum of the indications of the two devices and both shall be approved or condemned upon the sum of their indications; in this case each of the pair of machines shall be appropriately marked to identify the pair tested together.

COUNTER SCALES

Definition.—A counter scale is a scale of any type which is especially adapted on account of its compactness, light weight, moderate capacity, and arrangement of parts, for use upon a counter or table. However, those types embraced in the definitions of platform (including counter platform), spring, computing, cream-test, and prescription scales are considered under specific headings; the specifications given here apply to the first three classes, but only when applicable and not modified by the specifications therefor.

Specifications.—1. Bearings shall be so shaped that when the beam or levers are displaced in any manner the knife-edges will return to their proper lines of contact. (The term "bearing" as used in this specification is defined as that part of the scale designed to be in contact with the knife-edge.)

2. All loose material used for adjusting the balance of a scale shall be securely inclosed.

3. All devices for adjusting the balance of a counter scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the movable mechanism of the scale itself, such as a screw driver, wrench, etc., but not an adjusting pin.

4. All devices for adjusting the level of a counter scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the leveling devices, such as a screw driver, wrench, etc., but not an adjusting pin.

5. Counter scales whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3° with the horizontal, shall be equipped with a device which will indicate when the scale is level, and in no case shall any pendulum operating the scale be considered a leveling device. The scale shall be rebalanced at zero each time its position is altered during the test contemplated by this specification.

6. In the case of equal-arm scales, either with stabilized pans or plates—that is, those above the beam—or with suspended

pans or plates, the minimum fall or drop of the pans or plates from their highest point shall be as follows:

Capacity	*Minimum fall*
	Inch
Four pounds and below	*0. 35*
From 4 pounds, including 12 pounds	*. 5*
From 12 pounds, including 26 pounds	*. 75*
Over 26 pounds	*1. 0*

7. In the case of counter scales having unequal arms or having a compound lever system, and equipped with a graduated beam which is not provided at or near its end with a trig-loop or graduated scale or arc or other suitable reference interval or point for establishing the proper position of balance of the beam, the beam shall have a minimum total angular play of 8 per cent or approximately 5°. (The angular motion of the beam in terms of per cent may be obtained by dividing the total fall or drop of the beam at its end by the distance from the fulcrum to the end of the beam and multiplying this quotient by 100.)

In case such scales are provided with a trig-loop or graduated scale or arc or other suitable reference interval or point, the minimum total movement of the beam at such point shall be 0.4 inch if the distance from the beam fulcrum to the reference means is 12 inches or less and 0.5 inch if the distance is over 12 inches.

8. Scales of such construction that any weight or weights which are not visible can be added so as to affect the indications of the scale shall be equipped with a device which will plainly indicate on the customers' side of the scale when the weight or weights have been added and the value which it or they represent on the scale.

9. On scales of the equal-arm type with stabilized pans—that is, pans above the beam—the under connections and a

line connecting the outer knife-edges in the beam shall form a parallelogram. These under connections shall be straight and work freely.

10. All scales shall be so constructed that when a weight whose body has approximately equal diameter and height and which represents one-half of the capacity of the scale is shifted in any direction on the weight plate or on the commodity plate, pan, or scoop to a point one-half the distance between the center and edge of the weight plate or the commodity plate, pan, or scoop, the additional resulting error in the weight indication, due to this cause alone, shall not exceed the tolerance allowed at the load in question given in the column headed "Tolerance on parts requiring employment of removable weights": Provided, however, That in this test the edge of the weight shall not be made to project over the edge of the weight plate or the commodity plate, pan, or scoop.

10a. The maximum value of the minimum graduations of the graduated beams of counter scales used in the sale of foodstuffs at retail shall be 1 ounce: Provided, however, That this shall not apply to scales used exclusively in the sale of vegetables.

11. In the case of counter scales equipped with an indicator and a reading face or dial, such parts shall conform to all the specifications applicable to them, given under the heading "Spring scales," except that the graduations are not required to be equally spaced.

12. All counter scales shall be maintained in level.

13. When not modified by the above, the specifications given under the heading "Scales: General specifications" shall apply to counter scales in so far as they are applicable.

Sensibility Reciprocal (SR).—The maximum SRs allowable for counter scales shall be the values given in the table below, at the capacity or at any lesser load, with the excep-

tion that when the maximum SR herein given is a larger value than that represented by two of the minimum graduations on any beam with which the scale may be equipped, the latter value shall be applied and used as the maximum SR at the capacity or at any lesser load: Provided, however, That the manufacturers' maximum SRs or the maximum SRs on all new counter scales shall be one-half of the values given in the table unless this value is greater than one of the minimum graduations on the beam, in which case this latter value shall be used.

(The term "sensibility reciprocal" or "SR" means the weight required to move the position of equilibrium of the beam, pan, pointer, or other indicating device of a scale a definite amount. In the case of equal-arm scales and scales with a single pan or plate above, or hanging from, the beam, which are not provided with a pointer moving over a graduated scale or arc, the SR is the amount of weight required on the pan or plate to cause it to move from its position of equilibrium, when the scale is in balance, to a position of equilibrium at the limit of its motion.)

Capacity	Maximum sensibility reciprocal allowable	Capacity	Maximum sensibility reciprocal allowable
Pounds	*Ounces*	*Pounds*	*Ounces*
1	1/8	24	1
2	1/8	25	1
4	1/4	30	1
5	1/4	40	1¼
6	1/4	50	1½
8	1/2	60	1½
10	1/2	75	2
12	1/2	90	2½
15	3/4	100	3
20	3/4		

Tolerances.—Except on the special tests described above, the tolerances to be allowed in excess or deficiency on counter scales shall be the values shown in the following table: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on new counter scales shall be one-half of the values given: And provided further, That the tolerance on counter scales at any load shall in no case be less than one-half of the SR of the scale at the load in question; and when the scale has a reading face or dial, the tolerance shall in no case be less than one-fourth of the minimum graduation on the reading face or dial, except that on new scales it shall in no case be less than one-eighth of such minimum graduation.

Load	Tolerance on parts requiring employment of removable weights	Tolerance on beam or reading face	Load	Tolerance on parts requiring employment of removable weights	Tolerance on beam or reading face
Pounds	*Ounce*	*Ounce*	*Pounds*	*Ounces*	*Ounces*
1	1/16	1/16	40	7/16	5/8
2	1/16	1/8	50	1/2	3/4
4	1/8	3/16	60	5/8	1
5	1/8	3/16	75	3/4	1
6	1/8	3/16	90	7/8	1¼
8	1/4	3/8	100	1	1½
10	1/4	3/8	150	1½	2
12	1/4	3/8	200	2	3
15	5/16	1/2	240	2½	4
16	5/16	1/2	250	2½	4
20	5/16	1/2	300	3	4½
24	3/8	1/2	350	3½	5
25	3/8	1/2	400	4	6
30	3/8	5/8			

SUSPENSION SCALES OF THE LEVER TYPE

Definition.—Suspension scales of the lever type are lever scales designed and adapted to be hung from or attached to some support above and outside of the structure of the scale itself, and which are not included within other classes herein defined. This class shall include steelyards, butchers' meat beams, suspension abattoir scales, crane scales, overhead tramway scales, suspension creamery scales, suspension pendulum scales, and the like.

Specifications and Tolerances.—Suspension scales of the lever type having a capacity of more than 400 pounds shall be subject to the same specifications, in so far as these are applicable, and the same SRs and tolerances as platform scales. Suspension scales of the lever type having a capacity of 400 pounds or less shall be subject to the same specifications, in so far as these are applicable, and the same SRs and tolerances as counter scales. In the case of suspension scales of the lever type equipped with an indicator and a reading face or dial, such parts shall conform to all the specifications applicable to them, given under the heading "Spring scales," except that the graduations are not required to be equally spaced.

SPRING SCALES

Definition.—A spring scale is a scale in which the weight indications depend upon the change of shape or of dimensions of an elastic body or system of such bodies: Provided, however, That scales in which metallic bands or strips are employed for the primary purpose of fulfilling the functions of knife-edges and bearings shall not be considered spring scales within the meaning of this definition.

Specifications.—1. Reading faces shall be permanently fixed in position.

2. All graduations shall be clear and distinct and equally spaced *and in no case shall their width be less than 0.008 inch.*

3. The clear interval between the graduations shall not be less than 0.04 inch.

4. The maximum value of the graduations on spring scales used in the sale of foodstuffs at retail shall be 1 ounce: Provided, however, That this shall not apply to scales used exclusively in the sale of vegetables.

5. A spring scale shall have a definite and clear zero graduation and there shall be no stop to prevent the indicator from going beyond the zero graduation. These conditions shall be fulfilled whether the entire face is graduated or the graduations commence at a fixed load.

6. The indicator shall be firmly attached and reach to the graduated divisions; or if the construction is such that the indicator and reading face are in the same plane then there shall not be a separation of the ends of the graduation lines and the end of the indicator, of more than 0.04 inch, this distance to be measured along the line of the graduations.

7. All indicators shall be so designed and constructed that the indications are definite and may be read with precision.

8. The distance between the indicator and the reading face shall not exceed 0.12 inch: Provided, however, That this shall not be construed to prohibit the employment of an additional indicator at a greater distance from the reading face, designed and constructed so as to facilitate the correct positioning of the eye of the observer properly to read the indications of the scale and reduce parallax, when such additional indicator is clearly differentiated from the weight indicator so that it will not be mistaken therefor.

9. All devices for adjusting the balance of a spring scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside

of and entirely separate from the movable mechanism of the scale itself, such as a screw driver, wrench, etc., but not an adjusting pin.

10. All devices for adjusting the level of a spring scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the leveling devices, such as a screw driver, wrench, etc., but not an adjusting pin.

11. No device to alter the working or effective length of the spring shall be placed on the outside of a spring scale.

12. Spring scales of the hanging type shall be freely suspended from the ring when in use.

13. If spring scales are provided with a hanging pan, this shall be suspended from a ring and no hook will be allowed. A hook may be used only on those scales for which no pan is provided.

14. Spring scales shall be so constructed that when a weight whose body has approximately equal diameter and height and which represents one-half of the capacity of the scale is shifted in any direction on the commodity plate, pan, or scoop to a point one-half the distance between the center and the edge of the plate, pan, or scoop, the additional resulting error in the weight indication, due to this cause alone, shall not exceed the tolerance allowed at the load in question given in the tolerance table in the column headed "Tolerance for shift test at half capacity": Provided, however, That in this test the edge of the weight shall not be made to project over the edge of the commodity plate, pan, or scoop.

15. Spring scales whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3° with the horizontal shall be equipped

with a device which will indicate when the scale is level. The scale shall be rebalanced at zero each time its position is altered during the test contemplated by this specification.

16. Spring scales of such construction that a weight or weights which are not visible can be added so as to affect the indications of the scale, shall be equipped with a device which will clearly indicate on the customers' side of the scale when the weight or weights have been added, and the value which it or they represent on the scale.

17. When tests are being made with both increasing and decreasing loads on any spring scale, the indications on all increasing loads shall be within the usual tolerances provided, and also at any stage of the test the range between corresponding observations for increasing and decreasing loads shall not be greater than the sum of the tolerances in excess and in deficiency for the load in question.

18. The specifications for each part of combination spring and lever scales shall be the same as those for the type of scale to which such part belongs.

19. All counter spring scales shall be maintained in level.

20. When not modified by the above, the specifications given under the heading "Scales: General specifications" shall apply to spring scales in so far as they are applicable.

Tolerances.—Except on the special tests described above, the tolerances to be allowed in excess or deficiency on all spring scales equipped with a device intended to compensate for changes in the elasticity of the springs due to temperature effects, shall be the values given in the appropriate column in the tolerance table under the heading "Counter scales." (See p. 97.)

Except on the special tests described above, the tolerances to be allowed in excess or deficiency on all spring scales not equipped with a device intended to compensate for

changes in the elasticity of the springs due to temperature effects, shall be the values shown in the following table.

Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on all new spring scales described herein shall be one-half of the values given: And provided further, That the tolerance shall in no case be less than one-fourth of the minimum graduation on the reading face or dial, except that on new scales it shall in no case be less than one-eighth of such minimum graduation.

Load	Tolerance	Tolerance for shift test at half capacity	Load	Tolerance	Tolerance for shift test at half capacity
Pounds	*Ounces*	*Ounce*	*Pounds*	*Ounces*	*Ounces*
1	1/8	1/16	30	2	3/8
2	1/4	1/16	40	2	7/16
3	1/4	1/16	50	3	1/2
4	1/2	1/8	60	3	5/8
5	1/2	1/8	75	4	3/4
6	1/2	1/8	90	4	7/8
7	1/2	1/4	120	5	1¼
8	3/4	1/4	150	6	1½
10	3/4	1/4	200	8	2
12	1	1/4	300	12	3
15	1	5/16		*Pounds*	
20	1½	5/16	400	1	----------
24	1½	3/8	500	1¼	----------
25	1½	3/8	600	1½	----------

STRAIGHT-FACE SPRING SCALES

Definition.—A straight-face spring scale is a spring scale in which an indicator is affixed to a spring without intervening mechanism and registers the extension of the spring on a straight graduated face.

Specifications.—1. The support for the spring shall be of sufficient strength and rigidity to sustain the capacity load of the scale without perceptible strain, and such support shall be permanently affixed to the frame of the scale.

2. The graduated face shall be firmly riveted to the frame at not less than three points.

3. The indicator shall be pointed in order to facilitate accurate reading, and it shall not obscure the figures showing the value of the graduations.

4. The value and spacing of the graduations shall satisfy the requirements of the following table:

Capacity	*Maximum value of interval*	*Minimum distance between graduations*
Pounds	*Pounds*	*Inch*
25	*1/2*	*0. 03*
50	*1*	*. 03*
100	*1*	*. 03*
200	*2*	*. 03*
300	*5*	*. 04*
400	*5*	*. 04*
500	*5*	*. 04*

5. When not modified by the above, the specifications given under the headings "Scales: General specifications" and "Spring scales" shall apply to straight-face spring scales in so far as they are applicable.

Tolerances.—The tolerances to be allowed in excess or deficiency on all straight-face spring scales shall be four times the values given under the heading "Spring scales: Tolerances."

COMPUTING SCALES

Definition.—A computing scale is a scale which, in addition to indicating the weight, indicates the total price of the amount of commodity weighed, for a series of unit prices.

Specifications.—1. Computing scales shall be correct in both their weight and value indications.

2. Computing scale charts shall not repeat the same values in any given column or row. This applies also to charts on which the value graduations are correctly placed, but which, in addition, have a duplication of value figures in any given column or row.

3. The value graduations on all computing charts shall not exceed 1 cent on all prices per pound up to and including 30 cents. At any higher price per pound the value graduation shall not exceed 2 cents: Provided, however, That nothing in the above shall be construed to prevent the placing of a special value graduation to represent each 5-cent interval. These special graduations may take the form of dots, staggered graduations, or similar forms. They shall be so placed that their meaning and value may be clearly understood, but they shall not be placed in the space between the regular graduations.

4. All computing scales equipped with a drum-shaped chart shall be so constructed that the opening on the dealers' side discloses at least two value graduations at the lowest price per pound. These scales shall be so constructed that the opening on the customers' side discloses the smallest graduations and a figure representing the proper number of main weight units when any load is placed on the pan or platform.

5. All computing scales shall be equipped with weight indicators on both the dealers' and customers' sides, and with a value indicator on the dealers' side, and the width of such indicators shall not exceed 0.015 inch. The distance

between the chart and the weight and the value indicators shall in no case exceed 0.06 inch: Provident, however, That this shall not be construed to prohibit the employment of an additional indicator at a greater distance from the chart, designed and constructed so as to facilitate the correct positioning of the eye of the observer properly to read the indications of the scale and reduce parallax, when such additional indicator is clearly differentiated from the weight or the value indicator so that it will not be mistaken therefor.

6. Each indicator shall reach to each graduation of the graduated scale in conjunction with which it is designed to be used; or if the construction is such that the indicator and graduated scale are in the same plane then there shall not be a separation of the ends of the graduations and the end of the indicator of more than 0.04 inch, this distance to be measured along the line of the graduations.

7. The weight graduations and the value graduations shall be clear and distinct, but in no case shall their width be less than 0.008 inch.

8. The maximum value of the weight graduations on computing scales used in the sale of foodstuffs at retail shall be 1 ounce: Provided, however, That this shall not apply to scales used exclusively in the sale of vegetables.

9. The clear interval between the weight graduation marks on all computing scales shall not be less than 0.04 inch. The clear interval between the value graduation marks on all computing scales shall not be less than 0.02 inch: Provided, however, That the latter requirement shall not be construed to apply to the special value graduation denoting the 5-cent interval, mentioned heretofore.

10. All devices for adjusting the balance of a computing scale shall be of such construction that they are operative or accessible only by the use of some tool or device which

is outside of and entirely separate from the movable mechanism of the scale itself, such as a screw driver, wrench, etc., but not an adjusting pin.

11. All devices for adjusting the level of a computing scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the leveling devices, such as a screw driver, wrench, etc., but not an adjusting pin.

12. Computing scales whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3° with the horizontal, shall be equipped with a device which will indicate when the scale is level, and in no case shall any pendulum operating the scale be considered a leveling device. The scale shall be rebalanced at zero each time its position is altered during the test contemplated by this specification.

13. When tests are being made with both increasing and decreasing loads on any computing scale, indications on all increasing loads shall be within the usual tolerances provided, and also at any stage of the test the range between corresponding observations for increasing and decreasing loads shall not be greater than the sum of the tolerances in excess and in deficiency for the load in question. This specification is to be construed as applying only to automatic-indicating scales.

14. All devices intended to increase the capacity of computing scales by the addition of an added weight or weights shall operate properly irrespective of the speed with which they are manipulated.

15. All counter computing scales shall be maintained in level.

16. The specifications on a computing scale and on all parts of a computing scale, when not modified by the above, shall be the same as those of the type to which the scale under test belongs. Also, when not modified by the above, the specifications given under the heading "Scales: General specifications" shall apply to computing scales in so far as they are applicable.

Sensibility Reciprocal (SR).—When the scale is of such a type that the definition of SR is applicable, the maximum allowable SR shall be the same value as is permitted for a noncomputing scale of the appropriate type.

Tolerances.—Except on the special tests described above, the tolerances to be allowed in excess or deficiency on all spring computing scales equipped with a device intended to compensate for changes in the elasticity of the springs due to temperature effects, and also all those not operated by springs, shall be the values given in the appropriate column in the tolerance table under the heading "Counter scales." (See p. 97.)

Except on the special tests described above, the tolerances to be allowed in excess or deficiency on all spring computing scales not equipped with a device intended to compensate for changes in the elasticity of the springs due to temperature effects, shall be the values given in the appropriate column in the tolerance table under the heading "Spring scales." (See p. 102.)

Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on all new computing scales described herein shall be one-half of the values given: And provided further, That the tolerance on all computing scales equipped with a reading face or dial shall in no case be less than one-fourth of the minimum graduation on the reading face or dial, except that on new computing scales

it shall in no case be less than one-eighth of such minimum graduation.

CREAM-TEST AND BUTTERFAT-TEST SCALES

Definition.—A cream-test or butterfat-test scale is a scale especially designed and adapted for determining the fat content of cream or butter.

Specifications.—*1. All scales shall be provided with a graduated scale or arc divided into at least 10 equal spaces, over which the indicator shall play.*

2. The clear interval between the graduations on the graduated scale or arc shall not be less than 0.04 inch.

3. The indicator shall be of such length as to reach to the graduated divisions; or if the construction is such that the indicator and graduated scale are in the same plane, then there shall not be a separation of the ends of the graduations and the end of the indicator of more than 0.04 inch, this distance to be measured along the line of the graduations. The indicator shall terminate in a fine point to enable the readings to be made with precision.

4. All scales whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3° with the horizontal, shall be equipped with leveling screws and with a device which will indicate when the scale is level. The scale shall be rebalanced at zero each time its position is altered during the test contemplated by this specification.

5. All scales shall be so constructed and adjusted that when the pans are released or disturbed the pointer will return to its original position of equilibrium.

5a. All scales shall be so designed and constructed that when an 18-gram weight is shifted to any position on the

scale platform normally occupied by a cream-test bottle or to any position on the scale platform in which the 18-gram weight may reasonably be placed when samples are being weighed, the additional resulting error in the weight indication, due to this cause alone, shall not exceed 1 grain.

6. When not modified by the above, the specifications given under the heading "Scales: General specifications" (except specification No. 2) shall apply to cream-test and butterfat-test scales in so far as they are applicable.

Sensibility Reciprocal (SR).—The maximum SR allowable for these scales shall be 1 grain, or approximately 65 milligrams, when the scale is under maximum load: Provided, however, That the manufacturers' maximum SR or the maximum SR on all new scales shall be one-half of of this value. (The maximum load is defined as the weight of the sample used in each bottle multiplied by the number of bottles for which the scale is designed, plus the total tare of these bottles.)

(The term "sensibility reciprocal" or "SR" means the weight required to move the position of equilibrium of the beam, pan, pointer, or other indicating device of the scale a definite amount. In the case of scales provided with a single indicator and a graduated scale or arc, one of which oscillates with reference to the other to form a convenient means for determining the position of equilibrium of the beam, and which does not of itself directly indicate in terms of weight, the SR is the weight required to cause a change in the position of rest of the pointer equal to one division of the graduated scale or arc.

In the case of scales equipped with two indicators which move in opposite directions and oscillate with reference to each other to form a convenient means for determining the position of equilibrium of the beam, the SR is the weight re-

quired to cause a separation of the indicators of 0.04 inch, measured in the direction of their movement.

Tolerances.—The tolerance to be allowed in excess or deficiency on all cream-test and butterfat-test scales shall be 1 grain or approximately 65 milligrams: Provided, however, That the manufacturers' tolerance or the tolerance to be allowed on all new scales shall be one-half of this value.

This tolerance shall be applied to loads of 18 grams each, one of which shall be added when the scale is under approximately the maximum load as defined above.

PRESCRIPTION SCALES AND BALANCES

Definition.—Prescription scales and balances are scales and balances designed for or adapted to weighing the ingredients of medicinal and other formulas prescribed by physicians and others and entering into the ordinary trade of pharmacists and chemists, and which are used or intended to be used for such purpose.

These scales shall be of two classes, class A and class B. A class A scale is one which meets all the requirements given under the heading "Class A" below. Such a scale may be used for all determinations of the character specified above. A class B scale is one which is somewhat less sensitive and accurate than a class A scale but which complies with all the requirements given under the heading "Class B" below. Such a scale may be used only for the weighing of loads of 10 grains or more.

CLASS A

Specifications.—1. All scales and balances shall be equipped with a device which will accurately indicate the position of equilibrium of the beam. If this device is provided with only one indicating edge, line, or point, then it shall also be

provided with a graduated scale or arc. If this device consists of a scale or arc and a single indicating edge, line, or point, or of two indicating edges, lines, or points, which move in opposite directions, these shall be so designed and constructed that when the beam vibrates one will oscillate with reference to the other.

2. Any graduated scale or arc similar to that referred to in specification 1 shall be divided into equal spaces with at least 0.04 inch clear interval between the graduations.

3. If the indicating device referred to in specification 1 is provided with a single indicating edge, line, or point, this shall reach to the graduated scale or arc; or if the construction is such that the indicator and graduated scale are in the same plane, then there shall not be a separation of the ends of the graduations and the end of the indicator of more than 0.04 inch, this distance to be measured along the line of the graduations. The indicator shall be so designed and constructed as to enable the readings to be made with precision. If provided with two indicating edges, lines, or points, these shall be sharply defined, *and shall in no case be more than 0.04 inch from each other when the scale is in balance, this space to be measured horizontally.*

4. The distance between the graduated scale and the indicator shall in no case exceed 0.04 inch: Provided, however, That this shall not be construed to prohibit the employment of an additional indicator at a greater distance from the graduated scale, designed and constructed so as to facilitate the correct positioning of the eye of the observer properly to read the indications of the scale and reduce parallax, when such additional indicator is clearly differentiated from the regular indicator so that it will not be mistaken therefor.

5. All knife-edges and bearings shall be made of hardened and tempered steel, or of agate.

6. The graduations on all graduated beams shall be clear and distinct, *and in no case shall their width be less than 0.008 inch.*

7. The clear space between graduations on all graduated beams shall not be less than 0.04 inch.

8. All scales and balances shall be provided with a device for arresting the vibration of the beam.

9. All scales and balances shall be so constructed and adjusted that when the beam is released or disturbed it will return to its original position of equilibrium.

10. All scales and balances whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3° with the horizontal, shall be equipped with a device which will indicate when the scale is level, and in no case shall any pendulum operating the scale be considered a leveling device. The scale shall be rebalanced at zero each time its position is altered during the test contemplated by this specification.

11. For the purpose of applying the SR and tolerances the capacity of all prescription scales and balances which are in the State, either in use or in the stock of manufacturers of or dealers in such apparatus, and which shall not have the nominal or rated capacity marked upon them, shall be taken to be 1 apothecaries' ounce (or 30 grams).

12. When not modified by the above, the specifications given under the heading "Scales: General specifications" shall apply to prescription scales and balances in so far as they are applicable.

Sensibility Reciprocal (SR).—The maximum SR allowable for prescription scales and balances of a capacity of one-half ounce (or 15 grams) or more shall be 0.2 grain (or 13 mg), at the capacity or at any lesser load, with the exception that

when this value is larger than that represented by two of the minimum graduations on any beam with which the scale may be equipped, the latter value shall be applied and used as the maximum SR, at the capacity or at any lesser load: Provided, however, That the manufacturers' SR or the maximum SR on all new prescription scales and balances shall be one-half of the value given unless this value is greater than one of the minimum graduations on the beam, in which case this latter value shall be applied and used as the maximum SR.

NOTE.—If any prescription scale or balance has a smaller capacity than one-half ounce (or 15 grams), the maximum SR to be allowed at the capacity or at any lesser load shall be the same proportionate part of 0.2 grain (or 13 mg) that this capacity is of one-half ounce (or 15 grams).

(The term "sensibility reciprocal" or "SR" means the weight required to move the position of equilibrium of the beam, pan, pointer, or other indicating device of a scale or balance a definite amount. In the case of scales provided with a single indicator and a graduated scale or arc, one of which oscillates with reference to the other to form a convenient means for determining the position of equilibrium of the beam, and which does not of itself directly indicate in terms of weight, the SR is the weight required to cause a change in the position of rest of the pointer equal to one division of the graduated scale or arc.

In the case of scales equipped with two indicators which move in opposite directions and oscillate with reference to each other to form a convenient means for determining the position of equilibrium of the beam, the SR is the weight required to cause a separation of the indicators of 0.04 inch, measured in the direction of their movement.)

Tolerances.—The tolerances to be allowed in excess or deficiency on the ratio of arms of prescription scales and balances shall be the values shown in the following table:

Load		Tolerance on ratio	
Ounces, ap.	Grams	Grains	Milligrams
8	240	3. 2	208
4	120	1. 6	104
2	60	. 8	52
1	30	. 4	26
1/2	15	. 2	13

NOTE.—If any prescription scale or balance has a smaller capacity than one-half ounce (or 15 grams), the tolerance to be allowed shall be the same proportionate part of 0.2 grain (or 13 mg) that this capacity is of one-half ounce (or 15 grams).

If the scale is equipped with a graduated beam, the tolerance at any graduation on the beam shall be equal to the actual SR of the scale at the load in question.

CLASS B

NOTE.—In the case of a drug store doing prescription work, which is provided with a class A prescription scale or balance, then and in that case only an additional prescription scale or balance of class B may also be sealed, but only for the weighing of loads of 10 grains or more, and such scale shall not be used for weighing any load of less than 10 grains.

Specifications.—All class B scales and balances shall be conspicuously and clearly marked with the words "Class B. Not to be used in weighing loads of less than 10 grains,"

or with a similar and suitable wording conveying the same information.[10]

All class B scales and balances shall conform to all the specifications for class A scales and balances, but will be allowed the following sensibility reciprocals and tolerances:

Sensibility Reciprocal (SR).—The maximum SR allowable for class B prescription scales and balances shall be 0.5 grain, at the capacity or at any lesser load: Provided, however, That the manufacturers' maximum SR or the maximum SR on all new class B prescription scales and balances shall be one-half of the value given.

Tolerances.—The tolerances to be allowed in excess or deficiency on the ratio of arms of all class B prescription scales and balances shall be the values shown in the following table:

Load		Tolerance on ratio	
Ounces, ap.	Grams	Grains	Milligrams
8	240	8. 0	520
4	120	4. 0	260
2	60	2. 0	130
1	30	1. 0	65
1/2	15	. 5	30

NOTE.—If any class B prescription scale or balance has a smaller capacity than one-half ounce (or 15 grams), the tolerance to be allowed shall be the same proportionate part of 0.5 grain (or 30 mg) that this capacity is of one-half ounce (or 15 grams).

[10] In the case of class B prescription scales and balances, which are hereafter manufactured in the State or brought into the State, this requirement shall be fulfilled by the manufacturer. In all other cases the inscription shall be placed upon such scales and balances by the weights and measures official.

If a class B prescription scale or balance is equipped with a graduated beam, the tolerance to be allowed at any graduation on the beam shall be 0.3 grain (or 20 mg), unless this value is less than the actual SR of the scale at the load in question, in which case this actual SR shall be used as the tolerance at any graduation on the beam.

WEIGHTS

Specifications.—1. Weights shall be made of steel, iron, brass, or any other metal or alloy of metals not softer than brass: Provided, however, That weights below one-fourth ounce shall not be made of iron or steel, but may be made of aluminum.

2. Weights shall have smooth surfaces, and no weight of more than 1 gram, 1 pennyweight, or 1 scruple shall have sharp points or corners.

3. Weights shall not be covered with a soft or thick coat of paint or varnish.

4. All holes in which foreign material is to be placed for adjusting purposes shall be of such form that the material will be permanently and securely held in place. In no case shall this adjusting material project beyond the surface of the weight.

5. Rings on weights shall not be split or removable.

6. All weights shall be clearly marked with their nominal value, *and in addition weights intended for use on multiplying-lever scales shall be clearly marked with the value they represent when used upon the scale for which they are intended:* Provided, however, That the values of weights of less than 1 gram, 1 pennyweight, or 1 scruple may be designated by dots, lines, figures, distinctive shape, or other appropriate means.

Tolerances.—The tolerances to be allowed in excess or deficiency on commercial weights shall be the values shown in the following table: Provided, however, That the manufac-

turers' tolerances or the tolerances to be allowed on new commercial weights shall be one-half of the values given:

Avoirdupois System

Weight	Tolerance, weights for equal-arm scales, ratio 1:1	Tolerance, counterpoise weights for multiplying-lever scales		
		Ratio less than 100:1	Ratio 100:1 and less than 1,000:1	Ratio 1,000:1 and over
Pounds	*Grains*	*Grains*	*Grains*	*Grains*
50	100. 0	60. 0	40. 0	20. 0
25	60. 0	36. 0	24. 0	12. 0
20	60. 0	36. 0	24. 0	12. 0
15	40. 0	24. 0	16. 0	8. 0
10	40. 0	24. 0	16. 0	8. 0
8	30. 0	18. 0	12. 0	6. 0
5	30. 0	18. 0	12. 0	6. 0
4	20. 0	12. 0	8. 0	4. 0
3	20. 0	12. 0	8. 0	4. 0
2	15. 0	9. 0	6. 0	3. 0
1	10. 0	6. 0	4. 0	2. 0
Ounces				
10	10. 0	6. 0	4. 0	2. 0
8	5. 0	3. 0	2. 0	1. 0
5	5. 0	3. 0	2. 0	1. 0
4	5. 0	3. 0	2. 0	1. 0
2	3. 0	1. 8	1. 2	. 6
1	2. 0	1. 2	. 8	. 4
1/2	2. 0	1. 2	. 8	. 4
1/4	1. 0	. 6	. 4	. 2
1/8	. 5	. 3	. 2	. 1
1/16	. 5	. 3	. 2	. 1
1/32	. 5	. 3	. 2	. 1
1/64	. 2	. 12	. 08	. 04

The tolerances to be allowed in excess or deficiency on apothecaries' prescription weights shall be the values shown in the following table: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on new apothecaries' prescription weights shall be one-half of the values given:

Apothecaries' System

Weight	Tolerance	Weight	Tolerance
Ounces, ap.	*Grains*	*Scruples*	*Grains*
12	4. 0	3	0. 3
10	4. 0	2	. 25
8	3. 0	1	. 15
5	3. 0	*Grains*	
		20	. 15
4	2. 0	10	. 12
3	2. 0	5	. 08
2	2. 0	2	. 04
1	1. 0		
Drams		1	. 03
8	1. 0	. 5	. 02
6	1. 0	. 2	. 015
4	. 7	. 1	. 01
3	. 6		
2	. 5		
1	. 3		
. 5	. 2		

Metric System

Weight	Tolerance	Weight	Tolerance
Grams	*Milligrams*	*Milligrams*	*Milligrams*
500	350	500	7
200	200	200	4
100	150	100	3
50	100	50	2
20	50	20	1
10	40	10	1
5	25		
2	15		
1	10		

The tolerances to be allowed in excess or deficiency on weights to be used in connection with cream-test and butterfat-test scales and moisture-test scales shall be 20 milligrams on the 18-gram weight and 10 milligrams on the 9-gram and 10-gram weights: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on new weights shall be one-half the values given.

Part III.—CITATION TO CERTAIN CODES OF SPECIFICATIONS AND TOLERANCES FOR COMMERCIAL WEIGHING AND MEASURING DEVICES, OTHER THAN THOSE ADOPTED BY THE NATIONAL CONFERENCE ON WEIGHTS AND MEASURES

INTRODUCTION

Below are given references to and brief descriptions of certain codes of specifications and tolerances affecting a variety of groups of commercial weighing and measuring devices. With a few exceptions these codes relate to devices which are not covered by the codes adopted by the National Conference on Weights and Measures; the exceptions mentioned are cases in which there is a well-recognized code adopted or indorsed by some other organization, covering similar ground to that covered by a conference code. In the case of the codes for clinical thermometers and moisture-test scales the devices in question are noncommercial.

A short description is given in the case of each code cited, so that the general scope of these codes may be made clear. The source from which copies of each code may be secured is also stated. In some instances the group responsible for the development of a code is also described.

The list which is here given does not purport to represent every code which might be cited. Particularly in the specifications and tolerances of the several States there are numerous instances in which mention is made of items which might be considered to fall within the scope of this list but upon which no comment is made herein; moreover, no mention is made below of State codes based upon codes adopted by the National Conference on Weights and Measures, but differing in some respects therefrom.

It may also be mentioned that the several departments of the Federal Government have issued from time to time purchase specifications governing their purchases of weighing and measuring equipment, and that no mention of these is made below.

GENERAL SPECIFICATION FOR SCALES

Federal Specifications Board Specification No. 473

This specification was officially promulgated on March 5, 1927, for the use of the departments and independent establishments of the Government in the purchase of weighing scales.

This code is based upon and very closely follows the general specifications for scales as adopted by the National Conference on Weights and Measures. Some additional material has been included along the lines of design requirements, particularly some of the provisions of the "Specifications for the manufacture and installation of motor-truck, built-in, self-contained, and portable scales for railroad service" of the Americal Railway Engineering Association.

Copies of this specification may be secured upon application to the Federal Specifications Board, care of the Bureau of Standards, Washington, D. C.

RAILROAD TRACK SCALES

Specifications for the Manufacture and Installation of Railroad Track Scales—Circular of the Bureau of Standards No. 83, January, 1920—Publication of the American Railway Association Under the Foregoing Title

This code was prepared by a joint committee of the American Railway Association, the American Railway Engineering Association, the Railroad and Warehouse Commission of the State of Minnesota, the National Scale Men's Association,

the Scale and Balance Manufacturers' Association, and the National Bureau of Standards. It was approved by the American Railway Association November 19, 1919.

This code is intended to apply to knife-edge scales of the straight and torsion lever types for weighing scales in railroad service. It is a detailed code containing engineering and design requirements and also specifications as to foundations, scale-beam house, approach rails, dead rails, protection from weather effects, lighting, drainage, ventilation, etc., and general installation requirements.

Copies of Circular of the Bureau of Standards No. 83 may be secured through purchase from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents per copy.

Copies of "Specifications for the Manufacture and Installation of Railroad Track Scales," as published by the American Railway Association, may be secured through application to the secretary of that association, 75 Church Street, New York, N. Y.

Federal Specifications Board Specification No. 314

This specification was officially promulgated on August 8, 1925, for the use of the departments and independent establishments of the Government in the purchase of railroad track scales.

The "detail requirements" of this code are the same as those embraced in Circular of the Bureau of Standards No. 83 referred to above.

Copies of this specification may be secured upon application to the Federal Specifications Board, care of the Bureau of Standards, Washington, D. C.

Specifications and Tolerances for Railroad Track Scales—State of Minnesota

These requirements are similar to the code published in Circular of the Bureau of Standards No. 83.

Copies of the Minnesota specifications and tolerances may be secured through application to the State Department of Scales, Weights, and Measures, Corn Exchange Building, Minneapolis, Minn.

TWO-SECTION, KNIFE-EDGE RAILROAD TRACK SCALES

Circular of the Bureau of Standards No. 333, July, 1927

The detailed work of preparing this code was done by the yards and terminals committee of the American Railway Engineering Association, on which the transportation and manufacturing interests and the National Bureau of Standards were represented. The code bears the approval of the National Scale Men's Association and the Scale and Balance Manufacturers' Association.

This code is similar in its scope to the code given in Circular of the Bureau of Standards No. 83, but relates, of course, to two-section scales whereas the earlier code related to scales of four sections or more.

Copies of Circular of the Bureau of Standards No. 333 may be secured through purchase from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents per copy.

The code is also published in American Railway Engineering Bulletin No. 294, volume 28, pages 557 to 611, February, 1927.

HAND-OPERATED GRAIN-HOPPER SCALES

Circular of the Bureau of Standards No. 199, March, 1925

This code was developed by a conference participated in by the Weighmasters'-Scale Men's Conference, Minnesota Track and Hopper Scale Department, National Scale Men's Association, Grain Dealers' Grain Conference Committee, Elevator Builders and Designers, Scale and Balance Manufacturers' Association, and the National Bureau of Standards, the last mentioned acting in an advisory capacity.

The code contains engineering and design requirements and requirements for installation, attachments, accessories, etc.

Copies of Circular of the Bureau of Standards No. 199 may be secured through purchase from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents per copy.

AUTOMATIC HOPPER, HAND-OPERATED HOPPER, AND RAILROAD TRACK SCALES USED FOR WEIGHING BULK GRAIN

American Railway Association, Grain Circular No. 1, January, 1922

This code contains requirements as to scale design, installation, operation, performance, and testing, for equipment of the character indicated. It was issued pursuant to the recommendation of the Interstate Commerce Commission, supplementary report, claims for loss and damage of grain, decided December 13, 1920, Docket 9009 (56 I. C. C. 347), and was published by the American Railway Association as effective January 1, 1922.

The character of the requirements of this code follow the lines of similar codes for scales in ordinary service with the exception that the requirements for grain-weighing service are, in general, more rigid.

Copies of the American Railway Association Grain Circular No. 1 may be secured through application to the secretary of that association, 75 Church Street, New York, N. Y.

Specifications and Tolerances for Hopper and Track Scales for the Handling of Bulk Grain—State of Minnesota

These requirements are similar to those of the American Railway Association cited above.

Copies of the Minnesota requirements may be secured upon application to the State Department of Scales, Weights, and Measures, Corn Exchange Building, Minneapolis, Minn.

MOTOR-TRUCK, BUILT-IN, SELF-CONTAINED, AND PORTABLE SCALES FOR RAILROAD SERVICE

Letter Circular of the Bureau of Standards No. 152, January, 1925—Circular of the American Railway Association IV–39

This code is intended for knife-edge scales of the straight and torsion lever types equipped with beams for weighing less-than-carload freight. The code contains detailed engineering and design requirements and also requirements for foundation, pit, beam house, lighting, drainage, ventilation, installation, etc.

Copies of Letter Circular of the Bureau of Standards No. 152 may be secured upon application to the Bureau of Standards. Copies of Circular of the American Railway Association IV–39 may be secured through application to the secretary of that association, 75 Church Street, New York, N. Y.

This code was also published in the July 23 number of the American Railway Engineering Association Bulletin, No. 257, volume 25.

WAGON AND MOTOR-TRUCK SCALES

General Requirements for the Construction and Installation of Wagon and Motor-Truck Scales—State of Minnesota

This code of specifications and tolerances is under consideration by the Department of Scales, Weights, and Measures of the State of Minnesota. Copies of this code, if and when adopted and issued, may be secured through application to the State Department of Scales, Weights, and Measures, Corn Exchange Building, Minneapolis, Minn.

MOISTURE-TEST SCALES

Specifications and Tolerances for Weighing and Measuring Devices—State of Wisconsin

These specifications relate to small scales used in determining the moisture content of cheese and butter, and have been in effect in Wisconsin for a number of years. While these scales are noncommercial, the Wisconsin specifications state that when tested they will be sealed only when they comply with the specifications and tolerances established.

Copies of these specifications may be secured upon request, from the State Division of Weights and Measures, Dairy and Food Department, Madison, Wis.

LIQUID-MEASURING DEVICES

Federal Specifications Board Specification No. 362

This specification was officially promulgated on December 24, 1925, for the use of departments and independent establishments of the Government in the purchase of liquid-measuring devices, retail type.

The "detail requirements" of this code are substantially the same as those embraced in the conference code for liquid-measuring devices.

Copies of this specification may be secured upon application to the Federal Specifications Board, care of the Bureau of Standards, Washington, D. C.

ELECTRICITY METERS

Circular of the Bureau of Standards No. 56, September, 1923

In Circular of the Bureau of Standards No. 56, second edition, issued September, 1923, electric light and power station operation, distribution, metering, utilization, and safety provisions are discussed, and a complete set of rules suitable for adoption by State public utilities commissions is presented. Existing regulations of the States are summarized.

Copies of Circular of the Bureau of Standards No. 56 may be secured through purchase from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 60 cents per copy.

Code for Electricity Meters, Third Edition, National Electric Light Association, Publication No. 267–70

The present revision of this code has been made under the joint sponsorship of the Association of Edison Illuminating Companies, the National Electric Light Association, and the National Bureau of Standards by a sectional committee representing all interested organizations, in accordance with the procedure established by the American Engineering Standards Committee for the revision of American standards. This code is approved as American standard by the American Engineering Standards Committee as of February 20, 1928, designated as A. E. S. C. standard No. C12—1928.

The code contains sections on definitions, standards, metering, acceptance specifications, installation methods, test methods, laboratory and service tests, and demand meters.

Copies of this code may be secured through purchase from the National Electric Light Association, 420 Lexington Avenue, New York, N. Y., at $2 per copy.

GAS METERS

Circular of the Bureau of Standards No. 32, December, 1920—Circular of the Bureau of Standards No. 309, December, 1926

In Circular of the Bureau of Standards No. 32 a form is proposed for a model city gas ordinance, and rules are suggested for adoption of State public-service commissions. The technical matters involved are fully discussed and a summary is given of regulations in effect in numerous large cities.

Circular of the Bureau of Standards No. 309 contains a description of the construction and operation of a variety of gas-measuring instruments and methods of testing and adjusting such instruments.

Copies of these circulars of the Bureau of Standards may be secured through purchase from the Superintendent of Documents, Government Printing Office, Washington, D. C., No. 32 at 20 cents per copy, and No. 309 at 40 cents per copy.

WATER METERS

Standard Specifications for Cold-Water Meters, Disk Type

This code was developed by a group comprising the joint committee of the American Water Works Association and the New England Water Works Association, and the Committee of Water Meter Manufacturers. The code was adopted by the American Water Works Association June 9, 1921, and by the New England Water Works Association September 14, 1921.

The code contains manufacturing and performance requirements and, as published, includes an outline of the equipment necessary for conducting tests and an outline of test methods.

Copies of this specification may be secured upon application to the secretary, American Water Works Association, 170 Broadway, New York, N. Y., or to the secretary, New England Water Works Association, 715 Tremont Temple, Boston, Mass.

LEATHER-MEASURING DEVICES

Specifications and Tolerances for Weighing and Measuring Devices—State of Massachusetts; Specifications and Tolerances for Weighing and Measuring Devices—State of Ohio

Requirements for leather-measuring machines have been in effect in Massachusetts for a number of years. A short code based upon the Massachusetts requirements has recently been promulgated in Ohio.

Copies of the Massachusetts requirements may be secured by addressing the State Division of Standards, Department of Labor and Industries, Boston, Mass. Copies of the Ohio requirements may be secured by addressing the State Division of Foods and Dairies, Department of Agriculture, Columbus, Ohio.

CLINICAL THERMOMETERS

Clinical Thermometers, Commercial Standard CS1–28

This specification was formulated by the producers in cooperation with the National Bureau of Standards and later approved by representative conference of manufacturers, distributors, and users of clinical thermometers, final action being taken by this group on March 30, 1928. The plan followed in the development of this specification was the regular procedure set up by the Bureau of Standards for the establish-

ment of "Commercial Standards," the Bureau of Standards acting in an advisory and coordinating capacity only. The requirements of this code will be made the basis for the testing of clinical thermometers by the Bureau of Standards. Although clinical thermometers are not commercial measuring devices, reference to this code is included here because of the interest of weights and measures departments in such regulations.

This code contains requirements of the following character: Preliminary inspection, character of pigment, test for entrapped gas, hard shaker test, retreat test, accuracy, adjusting, and certificate.

Copies of Clinical Thermometers, Commercial Standard CS1–28, may be secured through purchase from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents per copy.

State and City Specifications and Tolerances

Specifications and tolerances for clinical thermometers are in effect in Massachusetts, Connecticut, Michigan, and New York City. Copies of these requirements may be secured, respectively, from the following: State Division of Standards, Department of Labor and Industries, Boston, Mass.; State Department of Health, Hartford, Conn.; State Board of Pharmacy, Lansing, Mich.; and the Department of Health, 505 Pearl Street, New York, N. Y.