Report of the

40th NATIONAL CONFERENCE ON WEIGHTS AND MEASURES 1955

U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

MISCELLANEOUS PUBLICATION 216

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Report of the 40th National Conference on Weights and Measures 1955

Attended by Representatives from Various States

Sponsored by the National Bureau of Standards

Washington, D. C., May 16, 17, 18, 19, 20, 1955

United States Department of Commerce • Sinclair Weeks, Secretary

National Bureau of Standards • A. V. Astin, Director

National Bureau of Standards Miscellaneous Publication 216

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Official photograph of delegates and guests attending the Fortieth National Conference on Weights and Measures, assembled in the grounds of the headquarters hotel

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OFFICERS

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Vice Presidents:
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G. L. Johnson, Director, Division of Weights and Measures, Department of Agriculture, State of Kentucky.
J. Roy Jones, Commissioner, Department of Agriculture, State of South Carolina.
C. A. Lyon, Director, Division of Markets and Standards, Department of Agriculture, State of New Hampshire.
A. O. Oslund, Superintendent, Department of Weights and Measures, Union City, New Jersey.
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Secretary: W. S. Bussey, Chief, Office of Weights and Measures, National Bureau of Standards.
Treasurer: G. F. Austin, Jr., Deputy Sealer of Weights and Measures, Detroit, Michigan.
Chaplain: R. W. Searles, Deputy Sealer of Weights and Measures, Medina County, Ohio.

(As elected by the Fortieth National Conference for the ensuing year)

President: A. V. Astin, Director, National Bureau of Standards.
Vice Presidents:
G. L. Johnson, Director, Division of Weights and Measures, Department of Agriculture, State of Kentucky.
W. A. Kerlin, Alameda County Sealer of Weights and Measures, Oakland, Calif.
C. A. Lyon, Director, Division of Markets and Standards, Department of Agriculture, State of New Hampshire.
J. E. Mahoney, Superintendent of Weights and Measures, Department of Markets, State of Maryland.
M. A. Nelson, Chief, Bureau of Foods and Standards, Department of Agriculture, State of Michigan.
W. K. Tripple, Chief, Bureau of Weights and Measures, Norfolk, Virginia.
Secretary: W. S. Bussey, Chief, Office of Weights and Measures, National Bureau of Standards.
Treasurer: G. F. Austin, Jr., Deputy Sealer of Weights and Measures, Detroit, Michigan.
Chaplain: R. W. Searles, Deputy Sealer of Weights and Measures, Medina County, Ohio.
Sergeant at Arms: Joseph Shaw, Assistant Superintendent of Weights and Measures, Passaic, New Jersey.

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(As elected by the Fortieth National Conference)

A. V. Astin
G. L. Johnson
W. A. Kerlin
C. A. Lyon
J. E. Mahoney
M. A. Nelson
W. K. Tripple
W. S. Bussey
G. F. Austin, Jr.
R. W. Searles
Joseph Shaw
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V. D. Rogers, of Memphis, Tennessee.
R. K. Slough, of Akron, Ohio.

STANDING COMMITTEES

(As constituted at the conclusion of the Fortieth National Conference, the personnel and organization of each of the standing committees of the Conference are as reported below. As reported, the membership of each committee reflects the appointments made by the President of the Conference, changes that have occurred from expiration of term or other cause, and the elections by the several committees of chairmen for the ensuing year. The remaining term of office for each committee member, in years, is shown by the figure in parentheses following each entry. Mr. W. S. Bussey, National Bureau of Standards, by his election to the office of Secretary of the Conference, is a nonvoting member of and secretary to each of the standing committees. At the recommendation of the Executive Committee the former Committees on Legislation and Methods of Sale of Commodities have been consolidated to form the Committee on Laws and Regulations and the name of the Committee on Weights and Measures Education has been changed to Committee on Education. The Executive Committee also recommended that the Committee on Trading by Weight be dissolved at the close of the Forty-first Conference and its duties absorbed by the Committee on Laws and Regulations.)

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H. E. Howard, of Miami, Florida. (3)
J. E. Brenton, of California. (4)
M. W. Jensen, National Bureau of Standards. (5)

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[1] W. S. Bussey, Secretary of the Conference, is *ex officio* a nonvoting member of and Secretary to the Committee.

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J. W. Reese, of Iowa.
A. J. Mayer, of Louisiana.
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Ladies' Committee: Mrs. W. S. Bussey, Mrs. J. M. Dietz, Mrs. M. W. Jensen, Mrs. R. E. Meek, Mrs. P. E. Nystrom, Mrs. R. D. Thompson.

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Mrs. F. T. Achenbach.

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Mrs. Mary A. Jorgensen.

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Committee Meetings, Monday, May 16, 1955

Monday was set aside for meetings, both open and executive, of the Conference committees. Announcements to this effect were carried in all invitations, all pre-Conference publicity, and in the tentative and printed programs.

Many delegates took full advantage of the committee meetings, which were well attended, and informative to all.

The Conference committees that met on Monday, May 16, were the Executive Committee, Committee on Legislation, Committee on Methods of Sale of Commodities, Committee on Specifications and Tolerances, Committee on Trading by Weight, Committee on Weights and Measures Education, and Special Flour Committee.

[1] W. S. Bussey, Secretary of the Conference, is *ex officio* a nonvoting member of and Secretary to the Committee.

REPORT OF THE FORTIETH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES

FIRST SESSION—MORNING OF TUESDAY, MAY 17, 1955

(A. V. Astin, President, and C. A. Lyon, Vice President, Presiding)

The invocation and the memorial service for departed members were delivered by the Conference Chaplain, Rev. R. W. Searles, Deputy County Sealer of Weights and Measures, Medina County, Ohio.

REMARKS OF R. W. SMITH, HONORARY LIFE MEMBER

When the 39th National Conference convened a year ago we were saddened by news of the death, only a few days before, of a beloved friend, Charles C. Neale.

Mr. Neale attended his first National Conference in 1912, as Commissioner of Weights and Measures of the State of Minnesota. From that time forward throughout his active life, first as a weights and measures official and later as an equipment manufacturer's representative, he established an enviable record of attendance at our meetings and participation in our affairs. The sincerity of his interest in the Conference and his readiness to lend a full measure of personal effort to its success, were ever apparent and were abundantly demonstrated.

His abilities were quickly recognized by the Conference in his election to membership on the Executive Committee in 1912. He was elected to the office of Treasurer in 1913 and again in 1914, and to the office of Vice President in 1920. He contributed to the formal programs of the Conference and was consistently helpful in debate.

From time to time many members of the Conference sought him out privately for information and counsel, and on more than one occasion he was called in as a consultant by the Conference Committee on Specifications and Tolerances.

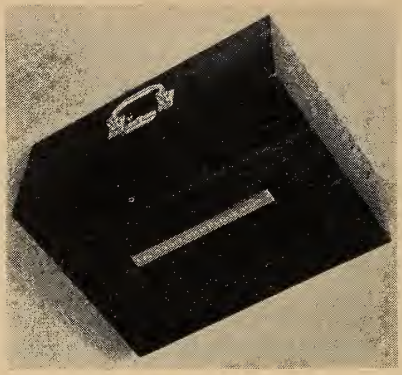
Before our meeting adjourned last year a group of Charlie's old friends decided to present to the National Conference a permanent memorial to him. This has now been prepared, in the form of a gavel and sounding board and a case in which they can be kept when not in use.

These pieces are made from African rosewood. The striking plate of the sounding board is a square of veined black marble. The board bears an engraved plate inscribed with these words:

IN MEMORY OF

CHARLES C. NEALE

Presented by a group of old friends
on May 17, 1955, to the
National Conference on Weights and Measures
in affectionate commemoration
of a lifetime of Weights and Measures service



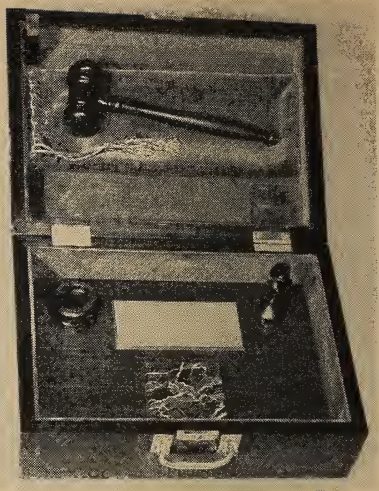


FIGURE 1. *Charles C. Neale memorial gavel and sounding board.*

The members of the group that planned this tribute to their departed friend have elected to remain individually anonymous. As their spokesman it is my privilege now to present this memorial to the National Conference on Weights and Measures.

It is our hope, Dr. Astin, that you, as President of the Conference, and your alternates and successors in office, will use this gavel in conducting the meetings of this organization. Thus shall we be happy in imagining that in the sound of the gavel the voice of Charlie Neale continues to speak and bring to us kindly guidance in our deliberations.

Dr. Astin: Thank you very much, Mr. Smith. It is with deep humility that I accept this gavel from the friends of Mr. Neale, on behalf of the National Conference on Weights and Measures. We shall see that it is used in accordance with the intentions of the donors.

ADDRESS BY HON. WALTER WILLIAMS, UNDER SECRETARY OF COMMERCE

(The following are excerpts from the remarks by Under Secretary Williams)

You probably noticed yesterday's headlines announcing that "Business Soars to All-time Peak." In the first quarter of this year Gross National Product—the total value of all goods and services—hit an annual rate of $370 billion, compared with $362 billion in the same period last year. This output noses out the previous record of $369.9 billion, set in the second quarter of 1953.

Underlying this booming situation is a resurgence of consumer expenditures for durable goods, led by automobiles and housing, but in all major areas of private demand the chart-lines are pointing up.

It is significant that this record-breaking performance of our economy springs primarily from private enterprise and the personal needs, desires, work and ambitions of the people. Government purchases of goods and services are $12 billion less than their peak in 1953.

From these figures we can see that we have an amazingly buoyant economy which promises a steady uplifting of our standard of living. Our economy's ability to provide more and more of the good life for the mass of Americans is, of course, based on mass production. Mass production would not be possible without standardization of products and their parts, and this standardization depends on exactitude of measurement.

Thus this Conference, and the work that you handle from day to day, represents a factor that I believe is a keystone of our great national progress. Like other aspects of national life, weights and measures are a cooperative effort, with responsibility properly divided among state and local governments, the Federal Government, and among American businessmen.

As you know, our National Bureau of Standards is constantly carrying on theoretical and experimental investigations to improve standards of measurement. This is necessary because advancements in technology, from which spring improvements in the standard of living, demand labor-saving devices of greater and greater precision—both on the production line and in the finished product. Thus, steady improvement of both our standards of measurement and our standard of living depend on research.

The importance of research may appear to be self-evident, but let me give you some facts and figures to support this statement.

Here is a good example: A Study, conducted over a fifteen-year period, disclosed that for every dollar of research that is conducted in this country, $36 in sales and $7.20 in profits before taxes result. This is something that should interest businessmen.

Another excellent illustration was given in a recent Fortune Magazine article, which stated that every dollar spent in research by the DuPont Company enables that great chemical firm to invest $3 in new plant. And of course, improvement of plant and equipment by industry means better capacity for production, more products and more jobs.

Another example comes from the National Bureau of Standards' own famous "MDE-Modular Design of Electrons," an entirely new concept of electronics design, utilizing the "building block" principle, which makes possible mechanized production.

A study made of the Wafer assembly line's actual production of an 8-tube radio frequency receiver for the armed forces revealed these impressive savings over conventional manufacture:

	CONVENTIONAL	*WAFER*
Overhead	$5. 44	$2. 86
Labor	5. 60	2. 83
Materials	35. 85	20. 56
Total	46. 89	26. 25=44% reduction in cost

Already one company has set up a plant, in Arlington, Virginia, to produce component parts for TV sets by the modular method, and we hear of plans by some of the brand-name manufacturers to redesign their sets and convert to mechanized production.

It is so easy to say that all this technological progress depends on machines. Of course, it doesn't. It depends on people—people who design the machines, tend them efficiently, and master-mind the whole production process.

PRESIDENT'S ADDRESS

By A. V. Astin, *Director, National Bureau of Standards*

I should like at this time to give a general status report on the National Bureau of Standards, covering the period since your last meeting. During this period the Bureau's management has been primarily concerned with trying to make the organization better able to carry out its unique scientific and technical services to the nation. A major element in this effort involves increased fiscal support for the National Bureau of Standards, and here I am very pleased to report that in these efforts we have had the hearty cooperation of the Secretary of Commerce and other officials of the Executive Branch of Government.

Another development in this Bureau management effort involves the mechanism for determining the most urgent needs of the specialized technical groups that the Bureau serves. For this purpose, we have set up twelve Technical Advisory Committees, representing the

major scientific and engineering associations of the country. Representing the weights and measures interests of the nation, there has been established a committee of six members appointed after nomination by this Conference. The committee includes representation from three groups, the weights and measures officials, the manufacturers of weights and measures equipment, and the users of weights and measures equipment. The individuals from these three groups, respectively, are Mr. John P. McBride of Massachusetts, Mr. Charles M. Fuller of California, Mr. W. H. Harks of Bowser, Inc., Mr. B. H. Dreese of the Hobart Manufacturing Company, Mr. A. V. Hokanson of the National Retail Grocers Association, and Mr. H. J. Kennedy of the Continental Oil Company.

This committee has held meetings during the past year and has made a number of important suggestions to us for strengthening the Bureau's program. They have told us of urgent needs in connection with measuring problems concerning liquefied petroleum gas, liquid ammonia, and axleloads of trucks. We are hoping that the program of the National Bureau of Standards before too long will be able to give appropriate recognition to these needs.

One of the common recommendations which our group of Advisory Committees has made involves methods of communication with the general public and with the pertinent technical groups throughout the country. As an element in improving general familiarity about the Bureau's work, we held, in early February, an Open House. We were successful in having several hundred key representatives of science, industry, and government attend this Open House, and we hope they devired from it a better knowledge of the ways in which the National Bureau of Standards serves the Nation.

About a year ago we completed a fine new $4,000,000 laboratory in Boulder, Colorado. We moved to this laboratory our Radio Propagation and Standards work, as well as most of the associated staff. The move to Boulder was completed at the end of the summer, and in September President Eisenhower formally dedicated the new building.

Last fall in Paris there occurred the Tenth General Conference on Weights and Measures. This Conference is participated in by approximately 30 nations of the world, and stems from the "Metric Convention" of 1875. It is the primary means by which we are assured that measurement techniques and standards for measurement are uniform on an international basis. This activity is important to the international aspect both of science and of commerce.

I was privileged to be a representative of the United States Government at this International Conference, and I should like to tell you briefly of two of its activities. First, a new thermodynamic temperature scale was adopted. This is a scale that concerns primarily scientific activity rather than industrial activity, but it is one which was sorely needed by scientific groups, particularly those concerned with investigations into the properties of materials at very low temperatures and at very high temperatures.

Another problem considered by the Conference was the possible redefinition of the international standard of length. (I have reported

at previous sessions of this Conference the inadequacies of the present standard and the work that we have been doing in attempting to develop a better fundamental standard for length measurements.) It was generally agreed that the international meter should be defined and referred to the properties of atoms rather than to a prototype bar of platinum-iridium, as is the present situation. It was not possible, however, to effect an agreement as to what particular atom, under what conditions, should be used for our fundamental length standard. So the recommendation of the General Conference was that the great national laboratories of the world give detailed attention and study to this problem during the succeeding years, in the hope that, by the time of the eleventh Conference, now scheduled for 1960, there will be sufficient technical information to make an intelligent and wise decision—one which we hope will last for years. Accordingly, the technical program at the National Bureau of Standards is being modified to study this problem, in the hope that we will make our fair share of technical contributions to the solution of the length-standard problem.

I should like to mention briefly just three important technical achievements at the National Bureau of Standards during the past year. One of these concerns a basic discovery in fluid dynamics, of particular importance to supersonic aircraft. It relates specifically to the mechanism of the transition from laminar flow to turbulent flow around aircraft structures. Our staff has studied this transition in detail and has developed fundamental and important contributions to understanding this complex but very important phenomenon.

Another achievement comes from our radiation laboratory, where we have been concerned with improved techniques for measuring high-energy X-rays. Using our Betatron, a facility for generating 50-million-volt X-rays, we have developed new equipment for detecting the presence and energy content of such X-rays and have been able to use this detection equipment in association with modern television equipment. This has enabled us to develop a system for looking at the internal parts of moving metallic objects. This technique has been applied specifically to looking at the inside of an operating gasoline engine; this is the first time this has been done, and we believe it represents a most important new tool for the mechanical engineers of the nation.

The third development involves the application of the techniques of the physical sciences to the medical sciences. The National Bureau of Standards, as you know, is fundamentally concerned with advancing the science of physical measurement, and in this connection we have found many instances where our competence can be brought to bear in solving problems of the medical scientists. Specifically, an instrument has been developed which will record automatically critical physiological characteristics of a patient during a surgical operation. We call this instrument a physiological monitor, and it will record and display automatically to the physician or surgeon the pattern of the patient's heartbeat, the irregularity of the heartbeat, the respiration rate, the respiration volume, and the blood pressure.

One of the best ways we have of indicating the quality of the contributions of the staff of the National Bureau of Standards to the

technical groups that it serves, is through the recognition that the professional societies give to the staff members of the Bureau. We are very proud that many of our staff members have been honored during the year by important professional groups of the nation. I should like to refer to just a few of these. Mr. H. S. Bean, who handles our fluid meter work at the Bureau, was given the Worcester Reed Warner Medal by the Society of Mechanical Engineers in recognition of his important contribution to the science of fluid mechanics. Dr. L. S. Taylor, Chief of the Atomic and Radiation Physics Division, has received recognition for his contributions to the solution of measurement problems concerning X-rays and other radioactive materials. Dr. I. C. Gardner, Chief of the Optics and Metrology Division, was given the Ives Medal of the Optical Society of America for his important contributions to the science of applied and geometric optics and to the general science of optical measurements.

Two very recent awards to more junior staff members are the Guggenheim Fellowship to Dr. Phillip Davis of our Applied Mathematics Division and the Rockefeller Public Service Award to Dr. Richard Trees of the Spectroscopy Section.

I should like to turn now more specifically to the liaison between our over-all program and the weights and measures officials of the Nation. The Office of Weights and Measures has continued the policy of being represented at all State and regional weights and measures meetings and participating in their activities. We attempt to take advantage of these meetings and conferences by scheduling travel so that representatives of our Weights and Measures Office can also visit other jurisdictions where there are current problems requiring, or indicating the usefulness of, the presence of either Mr. Bussey or Mr. Jensen, who carry most of this workload.

Two years ago the resolutions of this Conference urged that the National Bureau of Standards initiate a program of training films in the area of weights and measures. With the assistance of our technical staff throughout the Bureau and our experts in motion-picture techniques, the Office of Weights and Measures completed a film last fall called "A True Standard". The first showing of this picture was at the Baltimore meeting of the Southern Weights and Measures Association in October. Since then, the film has been shown at eight meetings of weights and measures officials, and prints have been loaned for showing before about 70 organizations, including scientific and professional societies, service clubs, high schools, colleges and universities, industrial concerns, and law enforcement agencies of cities, counties, and States. The film has also been shown at least three times on television programs. It is estimated that, exclusive of the television audience, about 8,500 people have seen the film by this time. It is scheduled to be shown to members of this Conference who have not already seen it on the program tomorrow morning in the auditorium of the National Bureau of Standards. Prints of this film are available for loan without cost except for carrying charges. We are planning additional films. This first one is a rather general one on the over-all subject of weights and measures. The future films are intended to be more specifically designed for training purposes. We hope that we can report additional progress on this subject at the next National Conference.

Another activity of the Office of Weights and Measures that has required much detailed work during the recent months has been its cooperation with the Conference Committee on Specifications and Tolerances. This Committee has been concerned with the preparation of a proposed revision of the Conference codes for commercial weighing and measuring devices, and the preparation of the proposed new edition of NBS Handbook 44. We plan to issue the new handbook, which will be known as "NBS Handbook 44—Second Edition—1955," in both bound and loose-leaf forms, so that those desiring the advantages of loose-leaf copies may purchase these for use in binders of their own selection. In addition to the codes of specifications, tolerances, and regulations adopted by the Conference, the new handbook will contain important introductory text, weights and measures tables and equivalents, and useful indexes. Arrangements have been made to expedite the actual printing of the handbook, and it is believed that copies will be ready for distribution within sixty days after adjournment of this Conference.

I am pleased to report that several additional States have taken official action with regard to the adoption of provisions of NBS Handbook 44. A number of other States are understood to be ready to take similar action as soon as the new handbook is ready. A map has been prepared that shows the current situation in each State. You will find copies of this map available to you on the table outside this meeting room.

During January we enjoyed having the Conference Committee on Specifications and Tolerances at the Bureau for a week, during which its members worked diligently on the proposed revision to Handbook 44. I can assure you that the Committee's recommendations come to you only after careful and studious consideration.

The acquisition of new testing equipment by State and local jurisdictions continues, sometimes to supplement or replace existing equipment, at other times to initiate testing programs. Most of these items are mentioned in the reports of the various States.

There have been several changes among personnel of the State weights and measures officers. Among the State administrators who have taken office during the past year are John J. Leonard of New York, T. C. Harris, Jr., of Virginia, W. P. Reed of Georgia, and Ralph Magoffin of South Carolina. These men, except Mr. Reed, who is ill, are present at this Conference. We welcome them to our ranks.

It is with deep regret that I announce the resignation of an old and trusted member of the Conference, Joseph F. Blickley of Pennsylvania. He resigned his position as State Director in Pennsylvania, effective May 2. Nevertheless, we are glad to know that he will be able to attend this Conference. He will arrive tomorrow morning.

I also regret reporting the illness of Joseph G. Rogers, State Superintendent of Weights and Measures in New Jersey. He has undergone rather serious surgery, and because of that is unable to be with us. It is a great disappointment that he is not here, because I understand he has one of the best attendance records among all of the participants in the Conference. Since 1922, when he attended his first Conference, he has missed only two meetings.

The Bureau's own weights and measures staff has been augmented through the appointment of H. F. Wollin, who will assist in the

various technical activities of the Office of Weights and Measures. In addition, we have continued to retain R. W. Smith as a consultant during the past year. He played a key role in the preparation of the weights and measures film.

Since so many of the things of interest to this Conference involve legal considerations, I am sure you will be pleased to hear that during the past year we have appointed an attorney to the staff of the National Bureau of Standards. Our attorney is Mr. Hirschie Johnson, and he is present at this meeting.

At the request of the Conference and its committees, we have, during the past year, concluded the approval-seal investigation, conducted a survey on packaged flour weights, studied the quantity control of paper containers for milk, and experimented with farm milk tank calibration. The results of our studies on these items will be reported to you later in the meeting.

Our calibration of State standards continues. During the past year we have had either mass or capacity standards submitted by about half the States, as well as the District of Columbia and Alaska. No length standards were submitted by the States; however, tests of two such standards were completed and the standards returned to a State.

We have embarked on a new program of providing essential repairs to standards when they come in to us for calibration. These repairs will not be made in competition with private groups. If there are private groups available and competent to do the work, we shall hope that they will do it. However, in some cases where we are in the best position to do it, we plan to make necessary adjustments to the standards when they come in for calibration.

At the request of weights and measures officials of three States, a member of our Capacity Section supervised the calibration, in the field, of a large volumetric meter prover belonging to an oil company. There had been some disagreement as to its true capacity.

Our Office of Weights and Measures has instituted a program of reminding the States to resubmit their standards at regular intervals, as required by State statutes. We hope that, by staggering the calibrations over a considerable period, we can maintain a uniform flow of this work to the Bureau. This will simplify things for us and enable us to do the work more efficiently.

Our railway track scale unit completed during the year its tests in the southeastern portion of the country. We have added a new scale inspector, Leonard J. Lambrecht, to the staff. He and Mr. Oakley will be operating our two cars during the coming year.

Mr. Russell has completed work on his 1,000-pound precision balance. He will describe it to you during this meeting, and it will be on display at the Bureau on Wednesday afternoon. Specifications for this balance are being made available to manufacturing groups, so that it can be produced and made available to anyone wishing to purchase one.

We have just completed a revision of our Miscellaneous Publication 121 dealing with tables and conversions of units of weights and measures. This revision of M121 is now at the Government Printing Office and should be available in a short time. In addition, Dr. Lewis V. Judson of our Length Section has completed the writing of a popular presentation on "Units and Systems of Weights and Meas-

ures"; it is expected that this will be available for general distribution within the next few months.

Before concluding, I want to pay my tribute to the members of the committees of this Conference. It is largely through these committees that the detailed work of the Conference gets accomplished, and I think all of us owe a great deal to the energy and general competence of the members of these various committees.

I am very pleased with the example of this Conference as an ideal relationship between the Federal and State and local governments. The Federal government provides assistance, but leaves the job of enforcement to the State and local groups. This has proved very effective, and we at the National Bureau of Standards are pleased to have participated in this technical program. I hope that the members of this Conference will continue to look to the National Bureau of Standards as a service institution. We are effective only insofar as we do the jobs which are needed by the technologists of the country, and by our scientists and engineers. The weights and measures groups represent one of the most effective means of bringing to the people the results of the activities of the National Bureau of Standards. So I am particularly pleased with the opportunity you give us to be of service to you, but at the same time I hope you will continue to tell us what your problems are and give us suggestions as to how we can do our work more effectively.

APPOINTMENT OF COMMITTEES

The President made the following committee appointments:

COMMITTEES TO SERVE DURING THE 40TH NATIONAL CONFERENCE

Committee on Nominations: J. F. True, Kansas, Chairman; C. D. Baucom, North Carolina; J. A. Boyle, Maine; F. M. Greene, Connecticut; G. H. Leithauser, Baltimore, Md.; D. G. Nelson, Morris County, N. J.; A. C. Samenfink, Rochester, N. Y.

Committee on Resolutions: P. E. Nystrom, Maryland, Chairman; J. H. Meek, Virginia; J. F. McCarthy, Boston, Mass.; H. J. McDade, San Diego County, Calif.; B. A. Pettit, District of Columbia; W. E. Sheehy, Fairfield County, Conn.; Clyde Spry, Iowa.

STANDING COMMITTEES

Committee on Legislation: J. T. Kennedy, District of Columbia, 5-year term, to succeed D. M. Turnbull, Seattle, Wash., whose term expired.

Committee on Methods of Sale of Commodities: J. Roy Jones, South Carolina, 5-year term, to succeed J. G. Rogers of New Jersey, whose term expired.

Committee on Specifications and Tolerances: M. W. Jensen, National Bureau of Standards, 5-year term, to succeed W. S. Bussey, National Bureau of Standards, whose term expired.

Committee on Trading by Weight: G. L. Johnson, Kentucky, 5-year term.

Dr. Astin: Mr. Johnson was appointed to this Committee only two years ago to fill an unexpired term. He has served with distinction as Chairman of this Committee since the 39th National Conference.

The current activity of this Committee dictates that Mr. Johnson should have an opportunity to follow through on the work which has been instituted during the current year.

Committee on Weights and Measures Education: W. A. Baerwolf, Pontiac, Mich., 2-year term, to succeed J. F. Blickley, Pa., who has resigned his position as Director, Bureau of Standard Weights and Measures, Commonwealth of Pennsylvania; I. M. Levy, Chicago, Ill., 5-year term, to succeed C. M. Fuller, Los Angeles County, Calif., whose term expired.

ROLL CALL OF STATES

The Secretary called the roll of States. Delegates from 36 States, the District of Columbia, and Puerto Rico responded. Delegates and their ladies were introduced individually.

(The Conference was recessed until 2 p. m.)

SECOND SESSION—AFTERNOON OF TUESDAY, MAY 17, 1955

(C. A. Lyon, Vice President, Presiding)

ROLL CALL OF STATE AND REGIONAL WEIGHTS AND MEASURES ASSOCIATIONS

The Secretary called the role of State and Regional Associations of Weights and Measures Officials. Representatives of all 16 active associations on record responded.

(Written reports from many States and Associations were supplied to the Secretary in advance of the Conference. These were duplicated and distributed at the Conference.)

REPORT FROM NATIONAL SCALE MEN'S ASSOCIATION

By V. C. Kennedy, Sr., *President, N. S. M. A., and President, Streeter-Amet Company, Chicago, Illinois;* Presented by C. C. Morgan, *Vice President, N. S. M. A., and City Sealer of Weights and Measures, Gary, Indiana.*

The National Scale Men's Association was created to increase the efficiency of weight and measures, and today that is still our principal reason for existence.

It might be said that our organization, in its over-all scope, encompasses the talents of a manifold membership to achieve this end. We are benefited by close association with members falling into several distinct categories—State and National weights and measures officials, manufacturers of weighing and measuring devices, the service fraternity, and industry's representatives. The National Scale Men's Association furnishes the opportunity to exchange information and problems leading to a thorough analysis and complete solution of important matters. Of course, the best interests of the general public always come first and foremost in all of our activities.

The 36th Annual Conference of the National Scale Men's Association has just passed into history, and with it came the realization that our group is now stronger than ever before for the promoting of a better understanding of the full importance of weights and measures activities in protecting the best interests of the individual.

Those who have attended many of our conferences in the past stated unanimously that our program thsi year excelled in the over-all content of informative variety offered, resulting from the pertinent subjects chosen, the methods of presentation used, and the top speakers on the agenda. The panel discussions especially brought to the attendance a wealth of views on timely subjects.

The more than usual number of State and National officials in attendance was indeed gratifying. These experienced people certainly contributed greatly to discussions—both formal and informal—and assisted the work of the National Scale Men's Association immeasurably.

Industry was also very well represented. Its members contributed much to the Conference, and it is safe to say benefited by association with manufacturers, the maintenance and service personnel, and public officials. In every respect, our 1955 conference should be considered excellent.

Membership is the life blood of any organization, and we are indeed fortunate for the ever increasing support of new and old members alike. Our membership is now at an all-time high, and I am happy to advise that we are quite confident of adding two enthusiastic new divisions to our roster in the near future.

The N. S. M. A. divisional activities illustrate the eagerness of these groups to strengthen the function of the national organization.

The year of 1954 saw the establishment of three new permanent committees which we feel will intensify the services of the National Scale Men's Association to weights and measures, namely, the Divisional Activities Committee, the Public Relations Committee, and the Technical Committee.

The importance of industry must not be overlooked. It is essential that division programs and activities as well as our national efforts be directed toward the creation of greater interest on the part of industry, as well as the other classes making up the unique group we represent. We certainly intend to place great emphasis on working toward this end. Whenever industry realizes that weights and measures are an important part of its operation and contribute materially to its success, it will at the same time recognize to a greater extent the services of the National Scale Men's Association.

Plans will soon be under way for our next annual conference, and the official organ of the National Scale Men's Association, the Scale Journal, will keep all of you advised of details as they become known. I would like to take this opportunity to issue to everyone a cordial invitation to attend our 1956 conference. It will be held in Chicago again in 1956, as it is every alternate year.

We consider it a privilege to present the report of the National Scale Men's Association before the National Conference on Weights and Measures as a part of your program, and wish to renew our pledge of maximum effort to support our mutual interests in the expanding field of weights and measures.

THE WEIGHTS AND MEASURES PROGRAM IN A STATE DEPARTMENT OF AGRICULTURE

By H. P. Hutton, *President, National Association of Commissioners, Directors and Secretaries of Agriculture, and President, State Board of Agriculture, State of Oklahoma;* Presented by F. G. Cesar, *Director, Marketing Division.*

The topic that has been assigned me gives rise to the questions as to why weights and measures programs have been placed in so many State Departments of Agriculture.

In reviewing the history of weights and measures we find that the first crude weighing balances had their origin for use in weighing agricultural commodities, before the dawn of history. By the time of the Pharaohs of ancient Egypt the device had been greatly improved and was still used principally for dealing in agricultural products. Even the Bible refers to dealing in corn and wheat by weights. This reference is in the eighth chapter of Amos in the controversy of the rights and wrongs of Israel which tells of the practice of falsifying the balances by deceit. The logical conclusion for the administration of weights and measures programs by so many

State Departments of Agriculture should therefore stem from the indubitable fact that in all countries, down through the ages, agriculture has always been the back bone of economy, as well as the industry for which weights and measures were originated.

Incidentally, I would like to point out that the Oklahoma Department of Agriculture has jurisdiction only over weights and measures of agriculture and agricultural products. Remaining weights and measures administration is performed by other State agencies. As is the case in several of the States that exercise control over agricultural products, devices for the measurement of petroleum products are tested by the Motor Vehicles Division of the Corporation Commission.

As proof of the fact that Agriculture Departments are usually the enforcement organization, it is significant that in 33 of the 45 States having weights and measures programs, a part or all of the program is administered by the various State Departments of Agriculture.

In our State it has been demonstrated beyond a question of a doubt that agriculture is vitally affected by weights and measures. At the inception of our program a little less than 6 years ago it was found that some large capacity scales were inaccurate to such extent that truck loads of some farm commodities weighed over them cost producers or dealers from 5 to 30 dollars. The first year of our program approximately 60 percent of the vehicle scales were condemned for repairs. Most producers of farm commodities do not have ways and means of accurately predetermining the weights of their produce and it is all too obvious that he should be afforded the best possible protection in this field. In this respect producers are not at all in the same category as other industries and their positions make them largely dependent upon adequate weights and measures administration.

This causes us to realize that in many instances the activity is given inadequate attention and support by State agricultural leaders and that most of our efforts are frequently expended in other channels. We believe that this discrepancy can quite logically be attributed to the fact that we are saddled with so many other duties that in most instances time does not permit us to devote the effort to the program that it rightly deserves.

It would seem that we should take stock of ourselves and try to find the answers concerning the proper procedure for heads of agriculture departments and weights and measures officials in order to bring about continued support and the achievement of a greater measure of success. In this respect I believe we should give more personal attention and interest, learn more about details of operation, assume responsibility in proportion to our authority and, above all, make a concerted effort to establish good public relations regarding the work. Of course we all know that one of the best ways to do this is to present properly to the general public the good that is being accomplished by these activities through the media of newspapers, radio and television. For any program to be successful and enjoy continued support it is of paramount importance for it to have public appreciation. It should be emphasized, however, that to long endure, the program must merit such appreciation.

Perhaps some of you are of the opinion that it is not possible to devote more time and energy to this worthy work and that efforts

should be made to transfer the activities to another agency. To this suggestion my vote is "No!" I believe it can be done, it should be done and I am of the very firm conviction that the Agriculture Department is the logical place for the service. It is an established fact that the farmers are really benefiting from good weights and measures administration and the better the administration the greater the benefit derived. Many farmers in my State have enthusiastically expressed their gratitude for the service. They are very definitely in a position to lose if administration is inadequate and it is my belief that the weights and measures program affords one of the greatest services to the farmer.

All of us are now fully aware of how right and farsighted was George Washington when he recommended uniformity of weights and measures in his first message to the American Congress in 1789 and we can feel further justified in proper weights and measures administration by authority of the first verse of chapter 11 of Proverbs which reads, "A false balance is abomination to the Lord: but a just weight is his delight."

In confirmation of my foregoing remarks my conclusions are, that as agricultural leaders, we should strive to formulate some plan of national scope whereby we can all pull together in a co-ordinated manner in order to bring about better administration of this worthy activity which it so richly merits.

BUILDING A STATE PROGRAM

By F. H. Wessels, *Special Assistant to Mr. P. C. Brinkley, Commissioner of Agriculture, Commonwealth of Virginia* [2]

My purpose is to tell you what we in Virginia have tried to do within the past few years. Our program has been overhauled primarily by Commissioner P. C. Brinkley, who has sympathy for the program and actively participated in it; by J. H. Meek, Chief of our Division of Markets; and last, but a long way from least, by R. D. Thompson who has just come up to the Stockyards Branch of the U. S. Department of Agriculture, after spending 20 years with us in weights and measures in Virginia.

It was Mr. Thompson who gradually, faithfully, against opposition at times, but persistently, brought us to a realization of the importance of weights and measures work. You know that the vast majority of things that we buy as consumers, or that farmers buy, are bought by weight or measure. The grain for our bread is weighed once when it is sold by the farmer. It is weighed several more times in commerce. The ingredients are weighed carefully to make the finished product right. The bread, itself, is weighed. Our milk is weighed on the farm and then put into packages and weighed again. The gas sold for our automobiles goes through a measuring pump. The paper that we write our reports on is sold by weight. Even the air in our tires has to go through a pressure gage.

Maybe because weights and measures is so close to our everyday lives, it is easy to take it for granted. How many of us as weights and measures men, have ever poured out the contents of a can of soup

[2] Mr. Wessels substituted for Mr. Brinkley who was scheduled on the program but could not be present.

and measured it in fluid ounces? How many of us have checked to see exactly whether our bottle of milk contains a quart? We take it for granted that the gasoline coming out of that pump is going to be the number of gallons registered.

It is easy to take for granted the weights and measures work by industry, by the people who work with scales, by the people who sell things by weight or by measure. Somehow it is easy for enforcement people to take weights and measures for granted. To show you how easy it is we sent our inspectors out recently to talk a little bit with spreaders of bulk fertilizer who were weighing their trucks maybe once a season. We pointed out to them that truck bodies change, dirt accumulates, gasoline loads vary, and that they were not being completely accurate in weighing their trucks that seldom. One man said, "All right, I will weigh my trucks just as often as you say, provided you practice what you preach at the State lime plant." We hurried out and checked the trucks there and found one truck had not been weighed for 3 years. It is easy to take weights and measures for granted.

On the other hand, weights and measures is easy to prove in its value to the consumer. We do not have to get theoretical about weights and measures. We do not have to talk about public welfare and public health. We can talk cold dollars and cents. We can get out our reports and prove beyond a shadow of a doubt that every dollar we spend for weights and measures saves somebody a conservative minimum of $10.00.

As I said, Mr. Thompson finally convinced all of us that weights and measures was a very valuable service. By being convinced ourselves, of course, we had taken only the first step. We saw we had at least three other groups we had to convince. The first, in terms of practical application, comprised the men who use the scales, the merchants, the manufacturers, the men who have the most direct dollars at stake in the adequacy of the scales. These are the men who have the most direct influence on the second group that we had to convince, our legislators who are vital to any program because they appropriate the money with which we do the work. Finally, there was the longer, tougher job of educating the consumer, the farmer, the housewife, to the importance of weights and measures work.

How did we go about that job? Let us start off with where we were several years ago. We had never had, as is the case with so many enforcement activities, enough men to really do a job of enforcing weights and measures law all the way across the board. But to stretch what appropriations we did have, our Division of Markets devised the plan of dividing the cost with certain localities that were to enter into an agreement with us that we would do the work and they would pay half of the cost. That stretched our money twice as far. Under that system we succeeded eventually in signing up about 40 counties and about 12 of our cities and towns. But we found that that system in many instances had certain drawbacks. Local government is supposed to be the soul of democracy, but somehow or other we found that in many instances after the agreement was signed and after our men had made a run through the county, tabulated the scales, condemned some and left notices on others, for some reason the board of supervisors were not so anxious to renew that agreement the next year.

We also found that word drifted across the line and the county board next door was not as anxious as they had been. There was a sudden change of heart. So we have been reducing that agreement system because we felt it was not ever going to get the job done completely.

Under that system we were checking small capacity scales in about a third of our counties every year. In another third we were checking scales periodically. Of course, we were checking gasoline pumps all the time. But in one-third of the counties in Virginia there was no small scale inspection, and so far as we knew there never had been any small scale inspection, so our weights and measures program was not getting the job done there. We used two approaches to get at these three groups that we thought we had to convince of the value of weights and measures. Neither of them is new to you. The first might be called a task force on weights and measures problems. As I have said, we did not have enough men. We could not spread ourselves thin enough to cover all the field and get any kind of a job done. Under Mr. Thompson's leadership we picked our problems and called our shots.

We took one man from weights and measures and one man from another section of the enforcement division. They would go together to work on a problem, and not only work on it but stay with it until the problem was cleared up. Not only that, but stay with it until the people directly concerned with that problem were sold in dollars-and-cents terms on the value of weights and measures work. Several years ago our grain man told us that in view of the fact that farmers had a disinclination to take discounts for moisture on grain or insect damage, because they did not like cash discounts, some of the buyers were using weight discounts. Instead of taking 70 pounds of ear corn to equal a bushel of shelled corn as the law said, they were taking 80 or 85 and sometimes 90 pounds, and so our task force from hay and grain and from weights and measures went out to work on that problem and stayed with it until it was solved.

Then our fertilizer people came to us and said, "We have reason to believe that all the fertilizer bags do not contain 100 pounds." We formed another task force to go around and weigh those bags of fertilizer and talk to the manufacturers and point out to them that the scales are not always short of weight and that they had a financial stake in their accuracy. We did the same thing on prepackaged goods when that tremendous change in agricultural and food marketing came into the picture. We realized there was always a chance of error, that individual stores were doing the packaging. So we sent a man out to check.

The first year we checked about 20,000 packages of all kinds, and found over one-fourth were short in weight. We are still working on that problem. These problems are not solved overnight, at least we have not found a way to do it, but we believe that real punitive action, court cases, is something of a last resort. Education, convincing this man and that man of the value of weights and measures, is the best approach to use.

Our second approach to convincing these three groups of ours was the use of publicity, and that is where I have come into the program. We use publicity in two ways. We used it first very, very sparingly, as the tremendously powerful weapon that it is and can be, a weapon

that can put a man out of business and ruin his business reputation. We used it only when we were convinced that the man in question was beyond doubt not willing to cooperate, and when he had been given every opportunity, the benefit of every doubt. We had one livestock weighing case in Virginia which went to court in recent years. We lost the case in the Circuit Court of our capitol city. Before the case went to court, after the Commissioner's hearing, we were able to squeeze out past court injunctions a simple story saying this man's license had been revoked, and why.

We lost the battle but won the war in that case. Although we lost the court case, the publicity that went with it probably did more to straighten out livestock auction market weighing in Virginia than any one thing we had ever done before.

The principal use of publicity, to my mind, should be, and in our case is, this business of educating folks to the value of weights and measures. When our task force comes back with preliminary but indicative results, we try, when we think more good than harm will be done, to turn out a press release on it, with pictures and facts, properly written, for as wide a distribution as possible.

One of the most effective uses we have ever made of publicity was again Mr. Thompson's idea. He came to me a couple of years ago and said he would like to do something about getting the results of our routine inspections before the people. So we worked something out. We fixed up a form requiring just a few blanks to be filled in, something like this: —— scales in ———— county were found to be inadequate; —— were small-capacity scales; —— were large-capacity scales; and so on. When an inspector made his round in a county and sent in his report a synopsis was sent to the Board of Supervisors of that county. At the same time a release was made out and sent to the local newspapers for release on the day after the Board of Supervisors was scheduled to meet. We found those little notices were carried extensively by our weekly newspapers and were widely read. One of the reasons for this is that when we go into a county for the first time we often find as many as 35 or 40 percent of the small-capacity scales weighing inaccurately, and by that strange coincidence with which we are all familiar, the vast majority of those inaccurate scales weigh short, so that it makes news and makes reading material.

What have been the results of this program of ours? The results have been that in our first group, our business men, many, many of them have come to realize the value of our weights and measures work and have told us so. One manufacturer told us that if one of his scales weighing 7-ounce packages of cereal was off ½ ounce it cost thousands of dollars a year. There was a laundry doing all its business by weight where we found a minus 10 percent error. That operator got his pencil out and did some figuring. He figured that scale was costing him $15,000 a year, 10 percent of his gross income. There was a man who was converted to the value of weights and measures work.

In our second group, our Legislature, I can not say that we have a great host of proponents of weights and measures, but at least we have nobody who violently objects. In our last Legislature we were successful in getting quite an increase in our appropriations. The thing we found most valuable was this prepackaged weighing, this

26 percent short. That was something they all understood, something against the little man—which is always bad—something they or their wives had experienced, and it was something that nobody had any serious argument against. We found that was our most effective argument with the legislature.

We did not have any tremendous amount of active support. A number of organizations passed resolutions favoring stronger weights and measures programs, largely resolutions against sin. But at least we found there was no objection to an adequate weights and measures program. We were successful in increasing appropriations for weights and measures by 30 percent over-all, nearly double our general fund appropriation for this activity. We were able to put in the field five new inspectors and an extra livestock-weighing inspector, and by the first of July we hope to put a prepackaged expert in the field.

The thing we are proudest of is that today we are able to check every small-capacity scale in Virginia where there is no local sealer, at least once a year. This is the first time, so far as we know, that this has been true in the history of Virginia, which goes back to 1606.

That is briefly what we have done in Virginia in building a State weights and measures program, and we are the first to admit that there is a lot more to be done. We have made mistakes, we have gone up blind alleys, but we have made progress, and we are convinced above all else that there is no way better than weights and measures work on which we in Virginia could be spending our time and the taxpayers' money.

REPORT OF THE OUTGOING EXECUTIVE COMMITTEE, PRESENTED BY G. F. AUSTIN, JR.

The Executive Committee has made a critical study of the entire matter of the Standing and Special Committees of the National Conference, with the objective of improving and strengthening the committee structure.

This study has convinced the Committee that certain weaknesses exist that can and should be corrected. These weaknesses may be enumerated as follows:

1. There appears to be a general feeling among the Conference membership that there are too many committees and consequently too many committee reports to be considered. The reason for this feeling is believed to be, in part, a lack of comprehensive programs and important agenda items, thus resulting in a lack of aggressive action by some committees.

2. The interests and activities of the several standing committees, as now constituted, overlap to a considerable degree. The reason for this is believed to be a lack of definition of the scope of each committee, and an actual duplication of objectives in the minds of committee members.

3. The degree of esteem in which the standing committees are held by outside agencies appears to be lessened by the duplication of effort that exists, by the lack of clear-cut definition of committee scope, and perhaps by too great diversification of committee activity at any one time.

4. The realization of committee objectives appears to be weakened by a lack of support of committee recommendations on the part of weights and measures officials in their own jurisdictions.

5. There appears to be a lack of proper coordination of the activities of the several standing committees.

Under the informal organizational plan of the Conference it is considered to be a proper function of the Executive Committee to propose for Conference adoption from time to time such organizational and procedural changes as, in the opinion of the Committee, will make for more effective and more constructive accomplishment. Accordingly, the Committee now recommends adoption by the Conference of the following plan with respect to its standing and select committees:

1. There shall be three standing committees of the Conference, to be known as (1) the Committee on Specifications and Tolerances, (2) the Committee on Laws and Regulations, and (3) the Committee on Education.

2. The field of the Committee on Specifications and Tolerances shall be all matters dealing with (a) specifications, tolerances, regulations, and requirements of any kind, relating to commercial scales, weights, measures, and weighing and measuring devices and accessories, including interpretation of such material whenever necessary, (b) standards and testing equipment for weights and measures officials, and (c) procedures for testing commercial equipment.

3. The field of the Committee on Laws and Regulations shall be all matters dealing with model laws, model regulations, bills introduced for legislative enactment, methods of sale of commodities, and general and administrative provisions, relating to weights and measures supervision in general, but exclusive of such matters as are within the jurisdiction of the Committee on Specifications and Tolerances.

4. The field of the Committee on Education shall be all matters dealing with the technical training and education of weights and measures officials, the education along weights and measures lines of the general public and of the users of weighing and measuring devices, and public relations programs and procedures for weights and measures organizations, but exclusive of such matters as are within the jurisdiction of the Committee on Specifications and Tolerances.

5. The normal voting membership of each standing committee shall consist of five active members of the National Conference, appointed by the President of the National Conference on a rotating basis, one such appointment to be made each year for a five-year term. Vacancies other than those caused by expiration of term shall be filled by appointment by the President for the unexpired terms. Each standing committee shall, at some time during each regular meeting of the National Conference, select its own chairman, to serve for the ensuing year and until a successor is chosen.

6. To provide for the desired coordination of the activities of the standing committees, the Secretary of the National Conference shall be, *ex officio*, a nonvoting member of each such committee, and shall serve in an advisory capacity and as secretary to the committee.

7. The following special arrangements shall prevail during the necessary transition period prior to a full change-over to the new plan for standing committees:

(a) The present Committee on Trading by Weight, which was created as a select committee by the 31st National Conference in 1941, and has been continued by the Conference on a year-to-year basis since that time, shall be continued until adjournment of the 41st National Conference, at which time this committee shall cease to exist and its functions shall be assumed by the Committee on Laws and Regulations.

(b) The present Committee on Methods of Sale of Commodities and the present Committee on Legislation shall be merged to form the new Committee on Laws and Regulations, the members of the present committees retaining membership on the new committee for the duration of the terms of their membership on the present committees. New appointments to membership shall be at the rate of one member per year, thus gradually reducing the membership of this committee to the normal number of five, in not more than five years.

8. When a select committee is set up, the membership shall be appointed and the committee chairman shall be named by the President of the Conference and the life of the committee shall be fixed as a definite period, not to exceed two years. At the expiration of the fixed period the committee shall automatically cease to exist, except that the life of a committee appointed to serve for only one year may, by action of the Conference, be extended for one year. If it is found necessary to establish a new select committee to carry on the activities of a committee so dissolved, the personnel of the new committee shall include at least two persons who did not serve on the precedent committee. At the option of the President, the Conference Secretary may be appointed to nonvoting membership on a select committee, to serve in an advisory capacity or to act as committee secretary, or both.

9. The Executive Committee shall annually review the committee structure and activities of the National Conference, making such recommendations as it deems proper to the Conference, to the Conference President, or direct to committee chairmen.

The Executive Committee wishes to record its conviction that membership on a standing or select committee of the National Conference carries with it the responsibility of participating in and contributing to the activities of the committee, and that a person accepting a committee appointment should be diligent and prompt in handling committee assignments and correspondence.

The Executive Committee strongly recommends to all members of the National Conference and to weights and measures officials throughout the United States that they cooperate wholeheartedly with the committees of the Conference and that they make an earnest effort within their own jurisdictions to implement the recommendations of these committees, as they are adopted by the Conference.

The Committee has discussed at some length the general question of attendance at meetings of the National Conference by our regular and associate members. It is agreed that the Conference can be successful only to the degree that the members support it by their presence at its meetings. In this relation it is felt that some formal recognition should be given to outstanding attendance records such as have been established by many officials and by associate members of the Conference, and as are in process of being established by those interested persons who attend and participate in our meetings year after year.

We have developed a plan that we believe will properly express appreciation of this valuable support and will encourage its continuance. This plan provides for the issuance of an attractive certificate

as an "Honor Award", which we think any recipient will be proud to display in his own office as evidence of his active association with the National Conference.

It is proposed that four basic classes of certificates be used, certifying to attendance at 10, 15, 20, and 25 meetings, respectively, a particular certificate to be awarded at the meeting next following the one at which the record in question was established. It would not be required that the attendance recognized be at consecutive meetings; we realize that many times consecutive attendance is interrupted for unavoidable causes beyond the control of the individual concerned. The minimum number of meetings for which a certificate would be issued would be 10.

It is proposed that this plan be put into effect as of 1955, and that in 1956 appropriate certificates be awarded for the first time, based on attendance through 1955. One difference would prevail on this first series of awards—the certificates would show the total number of meetings attended, but not less than 10. Thereafter, a certificate would be awarded on the basis of the 10th, 15th, 20th, and 25th meeting attended. Thus in 1956 a man might receive a certificate showing attendance at 13 meetings, for example. After he had attended two more meetings he would receive a 15-meeting certificate, and, after attending five more, he would receive a 20-meeting certificate.

It is further proposed that a colored seal be affixed to each certificate, and that an impression seal of the National Conference be procured to be used to impress the paper seal. The colors of the paper seals would differentiate certificates of the several categories—gold for 25 years, blue for 20 years, red for 15 years, and green for 10 years.

FIGURE 2. *Tentative draft of attendance award.*

The certificates would be 8 by 10½ inches in size, and each would be authenticated by autographed signatures of the President and the Secretary of the Conference. Each would be dated to show the month and year of the award.

A schematic sample of such a certificate as we propose has been prepared to show the general form. (See fig. 2.) This will be improved in appearance when the text is set in appropriate type sizes and designs. In all cases the name, the date, and the number indicating the period for which the certificate is issued would be hand lettered.

The Executive Committee recommends to the Conference the adoption of this award program, the details to be left to the discretion of the Secretary of the Conference.

Believing that better attendance and attention might be given to the many programs of our Conference, we are suggesting that all members be prompt and attentive. During the sessions your Executive Committee will appreciate the members keeping as quiet as possible while in the session room. To assist in this matter, we recommend that a Sergeant-at-arms be added to the list of officers and that the Nominating Committee offer such nomination at the proper time.

The Committee believes that it is best for the Conference and our program, that all entertainment in rooms be closed until the end of the sessions each day, and that all social activities wait each day until the business at hand is completed and we so recommend.

(The report of the outgoing Executive Committee was adopted by the Conference.)

A COOPERATIVE PROGRAM OF PUBLIC RELATIONS AND EDUCATION

By R. F. Straw, *President, National Association of Scale Manufacturers, and Vice President, Howe Scale Company, Rutland, Vermont*

At the National Conference on Weights and Measures last year, your Education Committee endorsed the idea of cooperation in publicity projects and the development of publicity aids as a joint project of your Education Committee and the National Association of Scale Manufacturers. Under this cooperative program, an encouraging start was made.

We have made available to interested sealers various publicity aids, which will help them obtain publicity and recognition in their own home towns. Sample news releases, examples of feature articles, and tips on how to obtain radio and television publicity were distributed to the heads of weights and measures jurisdictions around the nation. We hope to continue this cooperation and to increase its effectiveness in the future.

We would like to cite some of the publicity aids that have been developed and made available for weights and measures officials.

(1) Memorandum on ways and means of getting local publicity. This four-page memorandum was a brief on the reasons for and how to go about getting publicity through news releases, articles, radio, and television scripts, etc.

(2) A picture-illustrated article on the protection weights and measures gives to the public and merchants was prepared for King Features Syndicate and widely distributed for reproduction by hundreds of newspapers. The circulation of the newspaper subscribers to King Features Syndicate runs into the millions.

(3) A typical weights and measures article, with pictures, was prepared and published in the Sunday Magazine Section of the Washington Star. Reprints were sent out as idea provokers.

(4) Nationwide radio broadcasts.—Through the cooperation of the Chamber of Commerce of the United States, our Association Secretary participated in a nationwide radio broadcast discussing scales and weights and measures. The radio script of this broadcast was reproduced and distributed to weights and measures jurisdictions, and the broadcast itself was tape-recorded and the tape was offered for loan to local weights and measures jurisdictions. Both the script and the recording have been used in several areas.

(5) We made a start on a plan for exchanging among weights and measures jurisdictions the articles and radio and television scripts which are prepared and used for local publicity. Under this plan, we have reproduced and distributed several good articles and radio and television scripts.

We have received reports from many areas that the material provided under this joint project has actually been put to use in local news outlets. It certainly is encouraging to learn that officials are taking advantage of these opportunities to get publicity about the vital importance of their work.

While opportunities for publicity do occur on occasion, we like to emphasize that, with a little thought and aggressive attention, publicity opportunities can be created. Really, it is better that way, as you have more time to prepare copy or material. In our own publicity efforts, we have been amazed at the interest editors have shown in scales. I believe every weights and measures official in the nation can get excellent publicity by working up his own stories and offering them to news outlets.

For a long time we in the scale industry, and I am sure this includes weights and measures as well, did not consider it necessary to publicize the importance of scales. We supposed that the general public knew that weights and measures inspections save hundreds of millions of dollars a year in possible losses through short weight. We thought, too, that scale users would appreciate the fact that it is easily possible for them to give away all of their profits through inadvertent overweight.

We now realize we were wrong in believing that the public and business realized the critical importance of accurate weighing. One way we learned that scale owners and the public are not well informed about the dangers of inaccurate scales has been from correspondence and talks with editors of trade magazines. To our surprise, they have treated this subject as being almost brand new to them. The concept of the scale as a "money machine" is something that may seem old to us, but it is an idea that is now only very dimly making itself felt in commerce and industry.

We have come to realize the necessity for an aggressive program to educate the public about scales and weighing, and, since there is a remarkable parallel between our needs for publicity and your needs for a better public understanding of the importance of weights and measures, we believe you can realize great benefits for yourselves and for weights and measures by aggressive action in the field of publicity and other areas of public relations.

Our own modest program for publicity has amazed us with its accomplishments in the past two years. Our public relations department has obtained something over 100 pages of illustrated articles in national trade magazines. In addition, we know of dozens of articles prepared by the editorial staffs of such magazines which we believe have been inspired by the thoughts on scales expressed in our own prepared articles. Also, we know there has been a great deal printed about scales and weights and measures from our press releases. We have received many clippings, and we are sure wide distribution of good press releases brings many news articles.

The main objective of our publicity program is to inform the people in commerce and industry of the critical importance to themselves and to the buying public of accurate weights and the dangers of unreliable scales. In this program, we always point out the necessity for frequent tests and good maintenance and the fine protection afforded to business and the public by weights and measures enforcement.

To cite a few typical articles published in national trade magazines under the program, we mention:

"Which Scale for Your Weighing Job?"—Modern Materials Handling—This is an article we like to mention. It is a general discussion about the various types of what we call industrial scales, although most of them are commercial as well and include such as motor truck scales, portable platform scales, floor type scales, etc. This illustrated article was seventeen pages long, the longest article ever published by the magazine in a single issue. The magazine ran off several thousand reprints which were made available at 25 cents a copy, and the interest was so great, we understand, their supply was soon exhausted and they ran a second reprint.

In publicizing these types of scales, we have had some twenty-five articles published in national trade magazines.

"That's Money You're Weighing"—That was the title of a feature article on scales published in The Grocer's Digest. It was a typical illustrated article of some three pages, covering the story of the importance of scales in retail food stores. Scales are really "money machines" to retail stores. The merchant's dependence on good scales may be measured by the food store profit average of about 3 percent of sales. We know that an error of an ounce or less on each weighing can make a big cut in the merchant's profits, but does he?

We have had some twelve articles published in the various outstanding magazines in the retail food store field, and of course we expect to continue.

We have had numerous articles on various types of scales published in trade magazines covering miscellaneous fields, including such as the postal scale article in Shipping Management, an article on packaging scales in Candy Industry, two articles on scrap scales in Scrap Age, one on bakery scales in Bakers Weekly; portion scales in Institutions; metal warehouse scales in Copper and Brass News, etc.

While we have undertaken to classify the few articles mentioned above by types of scales, actually, in all of these articles we undertake to make business people conscious of all of their scales. This would include the commercial scales found in an industrial plant, as well as those found in a retail food store.

It is our purpose to continue to emphasize the important work you are doing in weights and measures enforcement. Also, we expect to work with your Committee on Education in preparing and distributing "aids" for weights and measures in obtaining local publicity.

We feel that we can count on weights and measures officials to do their part in getting publicity to awaken businessmen and the general public to the necessity for weights and measures enforcement to provide the accuracy needed in all phases of our economy. We in the scale industry have known and worked with weights and measures officers all through the years, and it is only natural that the two groups should continue to use teamwork to provide a better weighing service for the public.

REPORT OF THE SPECIAL COMMITTEE OF VICE PRESIDENTS OF THE CONFERENCE, PRESENTED BY W. L. DANIELS

During the 39th National Conference on Weights and Measures there was adopted a resolution reading in part as follows:

> *Resolved*, That proposals for nominations for replacement on the Weights and Measures Advisory Committee to the National Bureau of Standards shall be made annually to the National Conference on Weights and Measures by the vice presidents of the Conference then in office, sitting as a special committee for that purpose, under the chairmanship of a member selected by the committee, such proposals to include appropriate terms for each nominee according to the circumstances of the vacancies on the Advisory Committee either existing or anticipated; . . .

Pursuant to the terms of this directive, your vice presidents have met, have organized as a special committee under the chairmanship of J. Roy Jones, and have deliberated on the question of suitable replacements to fill vacancies on the Weights and Measures Advisory Committee to the Director, National Bureau of Standards.

For the information of the Conference, it may be said that the Advisory Committee, as constituted during the past year, has had as its members the following persons, appointed for the terms stated:

W. M. Harks, Chicago, Illinois, 1 year.
A. V. Hokanson, Porter, Indiana, 1 year.
C. M. Fuller, Los Angeles County, California, 2 years.
B. H. Dreese, Troy, Ohio, 2 years.
J. P. McBride, State of Massachusetts, 3 years.
H. J. Kennedy, Houston, Texas, 3 years.

By expiration of terms, Messrs. Harks and Hokanson retire from the Advisory Committee this year. We do not anticipate any further vacancies on this committee. Accordingly, the duty of the Committee of Vice Presidents will be discharged by proposing, for nomination by the National Conference, the names of two persons to serve 3-year terms on the Advisory Committee.

Before proposing these names for your consideration, we wish to report the unanimous recommendation of your vice presidents that the National Conference express its appreciation to each member of the Advisory Committee for his services during the year now ending, and that your receiving of this report stand as a formal expression of such appreciation.

It is now proposed that the National Conference nominate for 3-year memberships on the Weights and Measures Advisory Committee to the National Bureau of Standards, Mr. C. J. McCaffrey, Vice President, Ralph N. Brodie Company, Mount Vernon, New York, and Mr. Seth Shaw, Vice President, Safeway Stores, Inc., Washington, D. C.

(The report of the Special Committee of Vice Presidents was adopted by the Conference.)

REPORT OF THE COMMITTEE ON WEIGHTS AND MEASURES EDUCATION, PRESENTED BY C. M. FULLER, CHAIRMAN

The past year has shown a marked advancement in the use of good publicity and public relations for weights and measures. Illustrated feature articles have appeared in magazines and newspapers, exhibits have been widely displayed, and both radio and television have aroused the interest of the public. Many annual reports have been written and illustrated in a manner that holds the attention of the reader.

The motion picture, "A True Standard," produced by the National Bureau of Standards, is tops. In an interesting manner, it answers the question put up to us so many times, "How do you know that your weights are right?" This sound picture can be loaned, or purchased for a small sum, from the National Bureau of Standards. If you have not already availed yourself of this opportunity, do not neglect it. It provides a fine medium for release over your local stations, as well as for use in connection with speaking engagements.

The National Association of Scale Manufacturers is to be commended for its cooperation in preparing and making available to officials some excellent material for their use. The Association has also been instrumental in securing a radio broadcast over a national hookup, has produced a tape-recorded radio show for loan to officials, and has supplied facts and information for articles which have been syndicated to several hundred newspapers.

The Scale Journal is providing a useful medium for the exchange of information, keeps us posted with what is taking place among the weights and measures fraternity, and publishes articles and talks of educational value.

Altogether, we have good reason to feel optimistic over the fact that these efforts are obtaining public recognition, and that means better support for our departments.

Now, let us review some history that had an important bearing on weights and measures.

A joint resolution was adopted by Congress in 1836, providing that complete sets of standard weights and measures should be supplied to each State, so that uniformity would be established throughout the Union.

Two years later, another joint resolution directed the Secretary of the Treasury to furnish balances to all the States.

In due time these projects were completed. However, there was one weak spot in the plan. There were no weights and measures departments in existence to receive and adequately maintain, protect, and use the standards and balances. Consequently, many of them were lost or destroyed. Furthermore, the quality of the balances and standards would not measure up to the quality of those being made today.

It is certainly essential that the basic standards of the States should be uniform and of the highest quality. While it is true that some States have maintained the original equipment in good condition, and others have procured new standards and balances, it is also disturbing to know that a surprising number do not have adequate equipment.

A prime factor in our work is uniformity in all phases of supervision—weights and measures administration that is uniformly excellent.

The thought has been advanced that Congress might well repeat its early action and again provide the States with basic reference standards of mass, capacity, and length, and with balances. A project of this kind would undoubtedly supply complete sets to all States, which would mean identical standards and balances throughout the Union. It would also give a new and powerful impetus to better weights and measures enforcement.

In order to obtain the opinions of those who would be directly affected, questionnaires were mailed to the officials of the forty-eight States, the District of Columbia, and the territories of Alaska and Hawaii.

We received answers from all except one, which is an unusually high percentage and reflects the interest shown in the plan. Eighty-one percent were in favor of requesting Congress to repeat its former action.

Some of the officials were enthusiastic about the proposition. The Supervisor for one western State wrote, "I truly think this is the greatest idea of weights and measures times." From a Director in a southern State, "No one connected with our Department of Agriculture knows anything regarding the standards, if any ever were supplied the State. A secondhand balance and standards were purchased a number of years ago. I have sent them to the National Bureau of Standards and they have recommended that they be replaced with new ones. The new Commissioner of Agriculture is agreeable to buy new ones but funds are not available at this time. If this movement of the Committee on Education could develop in such a manner as to help us get good equipment, I would greatly appreciate it."

The only State official in one place is the Secretary of State, whose assistant writes as follows: "The Secretary of State does not have any scales to test weights. I have been here eighteen years with him and we have never had a call or demand to test scales. I understand that most cities and towns have ordinances regarding weights and measures."

From the Chief Inspector of Agriculture for another southern State, "At present our State does not have specific weights and measures laws. The location of original balances and standards furnished by the federal government is not known by our department. New primary standards would certainly be needed to initiate enforcement of weights and measures legislation when enacted."

Other comments received: "Your suggestion would co-ordinate the States and Territories, which would be very desirable." "It would be a splendid assist." "It is time for new ones." "I would be most favorable to the Congress providing the States with a new set of at least basic standards. Frankly, to have uniformity, that is the only way it can be done and I am optimistic enough to believe it would not be too much of a project to get this started in Congress. The cost of this would be a drop in the bucket."

While many of the States reported that they had good standards, with very few exceptions they expressed themselves in favor of the project.

We would suggest that the Resolutions Committee be instructed to draw up a resolution petitioning the Congress for favorable consideration of this request, and submit it at the next session of this Conference for a vote of the delegates.

In answer to many requests, we have made a compilation of job descriptions used for the several classes of positions established for Departments of Weights and Measures. This necessitated contacting city, county, and State merit system agencies in all parts of the country, and obtaining from them copies of the job descriptions used in their jurisdictions.

It has been interesting to study them. Some were so short that they conveyed little real information about the job, its responsibilities and relative importance. Others went into great detail, listing each individual item of work to such an extent that they were too involved and cumbersome.

Out of scores of job descriptions which were received, the following have been selected as good models. Please bear in mind that you will undoubtedly need to modify these by eliminating some of the provisions, or by adding others which apply to your own particular case.

The first description applies to the heads of State departments who may be known as any one of several titles, such as Commissioner, Superintendent, Director, or Chief.

> Directs and is responsible for the activities of the State Department of Weights and Measures; supervises the inspection of weighing and measuring devices throughout the State; establishes specifications and tolerances for commercial weighing and measuring devices; and makes rules and regulations for the purpose of making clear and effective the provisions of the law relative to weights and measures and weighing and measuring devices; certifies approved weighing and measuring devices for use in the State; and does other related work.

Does that seem rather long? Well, it is comprehensive all right. If you want a short description, how about this?

> Is responsible for planning, organizing, and directing the work of administering and enforcing laws regulating weights and measures and other related work.

That is short enough and at the same time covers the job, but it does not give much information to the person who does not have a copy of the laws.

In a case of this kind you could, if desired, follow the description with a detailed list under the heading, "Examples of Duties."

In States where weights and measures operates as a Bureau or subordinate to a larger department, such as the State Department of Agriculture, it will be necessary to preface the above description with the words, "Under the direction of the Director of Agriculture."

Cities and counties follow closely the above description except that they do not usually establish specifications and tolerances or certify and issue approvals of types of weighing and measuring devices. The heads of these departments are variously known as Sealers, Chief Inspectors, Commissioners, Superintendents, and Supervisors.

> Is the administrative head of the Department of Sealer of Weights and Measures with responsibility for the enforcement of all State laws and ordinances pertaining to weights and measures and performs other related duties as may be required. This class is that of department head with full responsibility for the operation of the department and its technical functions and activities.

A short description which is followed by a full page of duties, listed under "Work Performed," reads:

Administer all functions of Sealer of Weights and Measures as set forth in the State Business and Professions Code and the Administrative Code. Includes both administrative and technical functions.

Next to the head of the department, there is usually an Assistant or Chief Deputy—

Under the direction of the head of the department, to assist in formulating the policies, planning the work, directing the employees; and to do other related work as required.

Act as principal assistant to the Sealer in administering the functions of the department. (This brief description is followed by a page of duties listed under "Work Performed.")

Next we come to the deputies or inspectors who carry on the work in the field.

Under general supervision inspects and tests all commercial weighing and measuring devices used by wholesale and retail merchants; enforces laws and regulations in regard to packaging and labeling of commodities; and performs other related duties as required.

Here again, you may detail more of the work in the above, or you can follow with a list of duties under "Work Performed."

Larger departments may also have supervising deputies (similar to working foremen) and it should be noted that as the title implies, in addition to performing the duties of a deputy, they also supervise the work of others.

"Trainees" or juniors would apply to beginners who are learning the business, who work under the immediate direction of a deputy, and who are, in reality, apprentices or helpers, performing such duties as the deputy directs.

There are also other classifications, such as "complaint deputies," who receive complaints of violations and make investigations needed to correct the violation or to successfully prosecute offenders. They may be accompanied by "shopping investigators" who assist in the investigations of alleged violations by making test purchases and appearing at witnesses in court. In the case of these and other occasional positions, job descriptions should be drawn up with the assistance of the local Personnel Board or Civil Service.

We wish to express our appreciation to more than a hundred officials for their cooperation which supplied us with the opinions and information so necessary to this Report.

We also hope that you will find it useful.

(The Report of the Committee on Weights and Measures Education was adopted by the Conference.)

(The Conference adjourned, to reconvene at 10 a. m. Wednesday, May 18, 1955.)

THIRD SESSION—MORNING OF WEDNESDAY, MAY 18, 1955

(A. V. Astin, President, and G. L. Johnson, Vice President, Presiding)

(The first item on the program for this session was the showing of the National Bureau of Standards motion picture film, in color, and with sound, "A True Standard.")

THE NATIONAL BUREAU OF STANDARDS 1,000-POUND BALANCE

By H. H. Russell, *National Bureau of Standards*

The past two decades have seen very rapid growth of the highway freight transportation system. More and bigger highway freight carriers have been put in service carrying more freight, longer distances. Today the highway freight carrier is an extremely important link in the nation's economy.

The chief measures of the service rendered by highway transportation companies are weight and distance. To determine the weight, more highway vehicle scales, larger in both capacity and length, have been installed to keep pace with the expansion of highway transportation. These scales are used not only for determination of transportation charges, but also, in many instances, for fixing the amount of commodity involved in a sales transaction. Quite properly, the accuracy of these scales is a matter in which weights and measures regulatory agencies are directly concerned.

Because of the very rapid rate at which these large-capacity scales were being installed, it seemed at least possible that procurement of adequate testing equipment by State, county, and local weights and measures organizations had not kept pace. In order to develop the facts, and recognizing that the problem, being of national scope, could best be undertaken by a federal agency, the National Bureau of Standards inaugurated in 1936 an investigation of scales used for weighing highway vehicles.

This investigation, implemented with a specially constructed motor truck of sufficient size and capacity to transport effectively its main complement of test weights comprising fifteen 1,000-pound units, was continued for about four and one-half years and covered all sections of the country.

Tests and inspections made by Bureau representatives using this equipment graphically demonstrated that in many jurisdictions tests being made at that time on highway vehicle scales were not adequate. There were some exceptions, but, in the main, test loads employed, usually comprising a group of 50-pound weights, were not sufficiently large to disclose the true magnitude of ratio errors of scales in good condition and too small to reveal inaccuracies resulting from faulty conditions of scales in bad condition.

Annually, during the course of the investigation, the National Bureau of Standards presented reports to the National Conference on Weights and Measures regarding conditions found. Consequential to the important information contained in these reports, more and more 500-pound and 1,000-pound test weights were procured by various weights and measures organizations to provide means whereby highway scales could be effectively and more efficiently tested. In some jurisdictions, weights of like denominations have been procured by the particular State department charged with protection of the

highways from damage resulting from overloaded vehicles or from illegal distribution of vehicle loads. As knowledge of the availability of these larger weights spread, organizations other than regulatory agencies procured weights to replace groups of 50-pound units. There are literally many hundreds of these large weights in service already, and their number is growing continuously. Of course, these weights must be standardized before they are put in service and periodically thereafter.

The adjustment tolerance for a 1,000 pound Class C test weight is plus or minus one ounce. To a laboratory technician, equipped with a suitable standard and a reliable balance of adequate capacity, this tolerance seems generous. Currently, however, very few States have suitable equipment for standardizing weights larger than 50 pounds. Consequently, many States are depending on the National Bureau of Standards for calibration of their larger field standards.

At the National Bureau of Standards Master Scale Depot, located in the Clearing Industrial District of Chicago, there is a simple equal-arm balance built many years ago for the express purpose of calibrating four 2,500-pound weights required during the process of establishing a 10,000-pound shop standard. In the Bureau's Large-Mass Laboratory, Washington, D. C., there is a smaller balance of similar type. These have been put to considerable use during the past several years. With either of these balances, sufficiently precise weighings can be effected, but the accuracy of results depends too largely upon the skill and patience of the operator. In order to realize with surety results accurate within one-fifth of the tolerance (an objective of the Bureau when standardizing a weight to be used as a shop standard by some regulatory agency), the weighings have to be repeated several times. In many instances, the series of weighings becomes inordinately long. In a general way, but multiplied by the number of weights in the group, the same problem presents itself during the standardization of weights submitted by State weights and measures departments and other agencies.

In view of these difficulties, it was to be expected that Bureau personnel would investigate means for improving both the accuracy and over-all efficiency of the weighing equipment required for standardizing these larger weights. The balance pictured in figure 3 resulted.

At first glance, this device appears impressive in size and very intricate. It is rugged, and properly so. In addition to meeting the requirements for rigidity, reduced stresses, particularly in the pivots and bearings, are required in order to ensure accurate performance over a long period of time. Description of the various parts, many of which are merely duplicates of parts at the opposite end of the balance, will dispell the impression of intricacy.

When weighing relatively small weights, manipulation of the weights is not a serious problem. This is true whether the substitution or transposition method of weighing is employed. However, when the weights are too large to be handled manually, a special problem is presented.

Experience indicates that the simplest arrangement for meeting this problem is one that provides mechanical means for (1) lowering the entire balance until the suspension hooks can be engaged with the

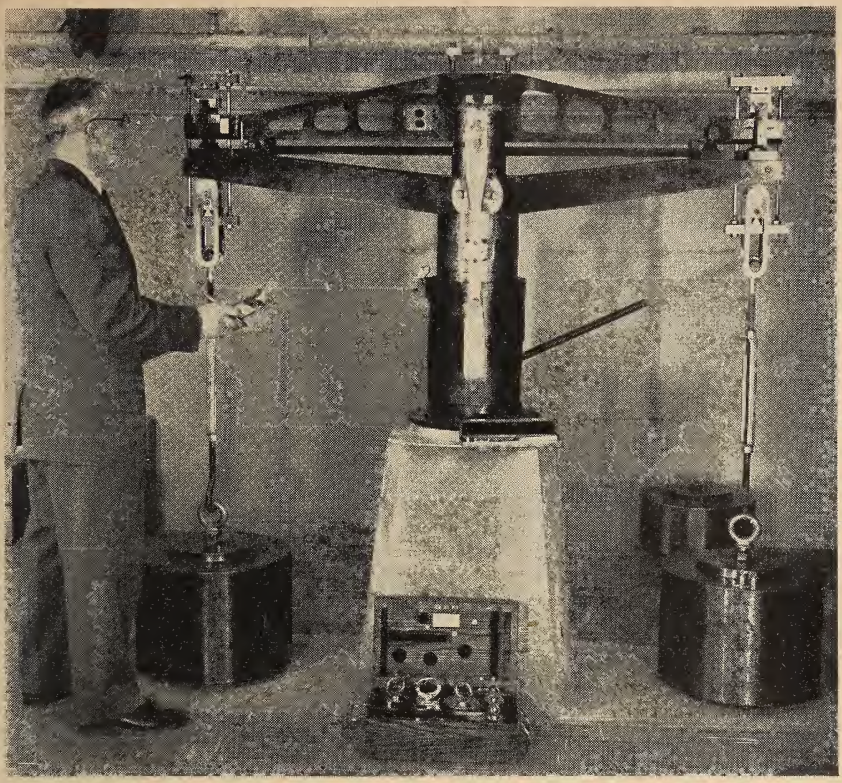


FIGURE 3. *New NBS 1,000-pound balance.*

(Shown in use during comparison of two 1,000-pound weights.)

weights, (2) raising the balance assembly, with the weights suspended, to provide clearance between the weights and the laboratory floor, and (3) permitting 360° rotation of the assembly. For this purpose the balance was provided with a simple piston-cylinder arrangement actuated by a hydraulic jack. The jack is not visible in the illustration, but there is an opening at one side of the cylinder through which the jack handle operates. Between this piston and the head of the jack, there is a ball bearing upon which the entire balance assembly may be rotated. The lower piston has been bored to provide a cylinder for the upper piston. The upper piston rests upon and is actuated by a hand-operated eccentric which is fully equipped with roller bearings.

In addition to housing the eccentric for the upper piston, the lower piston supports a bifurcated cantilever beam rigidly secured to the body of the piston. Near the ends of the cantilever are mounted arrestment pads which are adjustable in three directions. The top of each pad is V-shaped. The ends of the load bearings extend beyond the bearing surfaces and are in reality pivots with knife edges that coincide with the planes of the bearing surfaces. Cylindrical pins are securely fastened to the weighbeam directly above the shorter pads.

When the upper piston is lowered, the load bearings and the weighbeam arrestment pins engage the arrestment pads which are mounted on the cantilever and therefore stationary at the moment. The piston, continuing its downward motion, causes complete separation of all three pivots from their respective opposing bearings. Obviously, during this operation the entire weighbeam load is transferred from the beam to the cantilever. Also quite obvious is the fact that, because of the shape of the arrestment parts, positive duplication of pivot-bearing contact during the reverse operation is assured.

A transverse bar extending through the upper piston and terminating near the ends of the cantilever forms a key to prevent rotation of the upper piston in relation to the lower piston. This contributes much to maintaining proper position of relating parts separately supported.

Although the shape of the pads and other arrestment features are such that displacement of the load bearings in relation to their pivots is precluded, it was considered important to prevent rotation of the load bearing about the edge of the opposing pivot. In order to accomplish this, two pivot-bearing assemblies, mounted at 90 degrees to each other, are included in the design of the load suspension assemblies. These pivots are adjustable transversely and longitudinally and, when properly adjusted, assure that the line of suspension lies truly through the vertical axis of the terminal pivot, thus preventing improper rotation of the bearing and eliminating any tendency for the bearing to slip along or across the terminal pivot.

The balance is equipped with a conventional type of combined balance and sensitivity ball and an indicator and index scale. A latch mounted on the base cylinder engages, alternately, two long keyways milled in the body of the lower piston, thus ensuring rotation of 180° during transposition operations. The shape and manner of fixing the three pivots of the beam are important features contributing much to the practicality of the device. The body of each pivot has been ground to provide sides sloping at 75° in relation to the base. The pivot ways in the beam casting are milled in the form of a keyway of exaggerated width. Between each side of the pivot way and the pivot is inserted a wedge having one side perpendicular to its upper surface and one side ground to the angle corresponding to that of the pivot body. These wedges are of such dimensions that when in position they do not contact the bottom surface of the pivot way. Each wedge is provided with screws that engage the threads tapped in the weighbeam casting. When drawn down tight, these wedges prevent any movement of the pivots; moreover, they provide means whereby the distance between pivots and the alinement of each pivot in relation to others may be adjusted with precision and convenience.

In actual use, the balance has proved highly satisfactory. Although designed to be especially suited to transposition weighing, the method found to be more rapid, more convenient, and more precise, the balance is equally well suited to substitution weighing methods. Being susceptible of complete rotation, the entire assembly above the hydraulic jack can be rotated to a position that will not interfere with placement of the weights either by means of a powered hoist or with a two-wheeled dolly. In the recommended transposition weighing operation, once placed, neither weight is moved until the weighing has been completed.

Recently the Large-Mass Laboratory completed an evaluation and intercomparison of two weights submitted by one of the States. During this operation, two separately determined values were obtained for each weight by direct comparison with a shop standard, and two separately determined *differences* obtained by evaluating one in terms of the other. The computed and measured differences between these two weights were identical within less than one part in a million. We consider it very significant that this performance occurred during a routine weighing procedure accomplished without recourse to any special weighing techniques or operative skill. Other experiences, some of which were planned to develop the limitations of the balance, have proved that accuracy of this order is inherent in the design.

This balance was designed primarily to meet the requirements of the National Bureau of Standards. However, while the design was being developed, there was continuously in mind the fact that many States were potential users of a balance that could be procured without a too great outlay of money, particularly if the balance was so designed that special skills would not be required in order to obtain results accurate within the tolerance prescribed for Class C weights.

All parts of this balance were designed specifically to be adaptable to manufacture in any well-equipped machine shop. The prototype balance was manufactured in the Bureau's shops by machinists who, though highly skilled, are not familiar with scale and balance work. All tolerances specified were in agreement with customary good machine shop practice. No hand honing, lapping, or grinding operations were required. Assembling required only a few wrenches; final adjustments, following gravimetric testing, were effected quickly by simply loosening and tightening a few wedge screws.

Experience obtained during the construction of the prototype balance and through actual use of the device since completion proves that the design does meet all the requirements. Actual work with the balance indicated that, without appreciably affecting the performance of the balance, improvements in the design of the load bearings and arrestment pads and simplification of the load-suspension arrangement could be effected.

Although the design is by no means "frozen" we have prepared detailed drawings and specifications for the modified version of the balance. These drawings, though too expensive for general distribution, will be made available to any reputable concern called upon to submit bids for the construction of such a balance.

FACTORS CONTRIBUTING TO PACKAGE FILL VARIATION

By E. P. Lee, *Assistant to the Director of Manufacturing and Engineering, General Foods Corporation, White Plains, New York*

The point of this discussion can be stated in two short sentences. (1) It is impossible to produce packages without having some variation in fill. (2) No commercial packer can guarantee that all packages will be above the weight stated on the label.

I would like to explain some of the reasons why these two statements are true. But first, let us consider the place of the packager in the economic cycle. The packager's factory takes raw material obtained

from the farm or another factory. He adds to the value of this material in the process of mixing, grinding, cooking, or drying into a form that his customers will buy. To get the product to the customer, the packager must divide it into unit sizes that suit the use of the customer and place each unit in a container that will protect the product until the customer is ready to use it. The factory, then, is merely a step in the process of feeding and supplying the nation. In the food industry, this step of the process, processing and packaging, must be accomplished with the utmost economy.

The cost of raw materials is fixed in the open market, and the individual packager cannot influence them to any extent. The cost of packaging materials is likewise beyond the influence of the packager. High speed, efficient operation is the only solution to keeping costs down and staying in business. Packing speeds of 30 to 50 units per minute are considered slow; 50 to 80 per minute, normal; 80 to 150 are today's high speed, and already single units are operating in the 300 to 600 units per minute range. Volumes of one million packages per year are considered small. Volumes of one million packages per week are common. Volumes of one million per day are not unusual. These speeds and these volumes inevitably involve some variation of package fill. The packer cannot ignore these variations. His entire effort may be jeopardized if package fill is inadequate, or even appears to be inadequate because of slack fill. While I speak from a background in the food industry, I am sure that similar problems face all packagers. The difference between pharmaceuticals, foods, and fertilizers is only a matter of degree.

Enumeration of the factors causing package fill variation is easier by far than giving you the solutions. If we seek a complete and absolute control of fill, we will seek in vain. We must, therefore, be satisfied with a degree of control that is technically practical, economically reasonable, and in keeping with good manufacturing practices. Good manufacturing practice can be related to a balance.

A balance between causes and solutions and the control of causes and the control of solutions. These forces pivot on satisfaction to the consumer and profit to the manufacturer. Before solutions can be developed or controls applied causes must be identified. The following check list may be of some help.

FACTORS CAUSING VARIATION IN PACKAGE FILL

- Product Uniformity
  - a. Specific gravity and apparent density
  - b. Homogeneity
  - c. Flow characteristics
  - d. Compacting
- Basic Accuracy of Fillers
  - a. Volume fillers
    - 1. Container measure
    - 2. Cavity measure
    - 3. Time-flow
  - b. Weighers
    - 1. Net weighers
    - 2. Gross weighers
- Operating Conditions
  - a. Physical conditions
  - b. Human considerations
- Controls

First we have Product Uniformity and the subheading Specific Gravity and Apparent Density. It is readily apparent that, if you are measuring by volume and if at one time it takes 800 cm^3 to make a pound and if at another time it takes 1,000 cm^3, fill is going to vary unless a correction is made.

Figure 4 shows what happens to package weights if a correction is not made when the apparent density changes. You can see, as we connect the points together, that weight varies to a slightly greater extent than the apparent density. However, the correlation is −0.88, and that is mighty high.

We made a study of the volume of 12 ounces of green peas. Observations were taken every three hours for several days. We noted changes, test to test, and a trend as the season continued. The volume rose, and at the end of the period became less variable. A good sized packing plant will pack 500,000 packages, over 185 tons a day, and it takes exceptional skill and good fortune to keep package weights within reasonable limits at all times.

If the product is a liquid, the effect of temperature and/or air entrainment may change the specific gravity. A few degrees change in temperature may require a change of ⅛ inch in the fill height on a bottle. Air entrainment could make a ½ inch difference in the same bottle.

In the case of one product I know of, an allowance had been made for air and the bottles were regularly inspected for fill height. But then, as sometimes happens, the conditions changed. A new pump that did not mix in as much air as the old one gave away in overfill at the rate of $40,000 a year before it was discovered and the entrained air allowance reduced.

Thus far we have considered the effect of apparent density on volume fillers. If you net weigh, consider that accuracy is partially a function of the scale's ability to accurately stop the flow of product into the weigh bucket. Add to this the fact that the flow of product to the weigh bucket is usually a fixed volume. The rate of flow by weight will change with a change in aparent density. The scale has no automatic means of detecting such a change, and it has a relatively constant lag when it comes to stopping the flow. Thus, accuracy of scales is related to changes in apparent density.

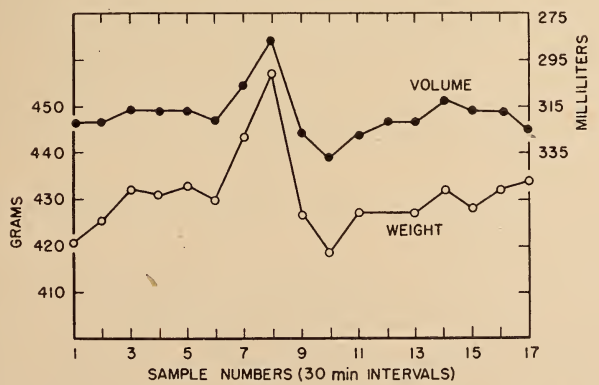


FIGURE 4. *Apparent density versus package weight of dry granular product.*

The homogeneity of a product is related in a way to the apparent density. It is primarily a problem associated with dry powders. Products that are mixtures are frequently blended in a mixer before packaging. Such blending may take five to thirty minutes, depending upon the product. Surprisingly enough, operation of the mixer for more than the standard time may reverse the blending action and actually unmix the product to a substantial degree. Now if one constituent of the product has a density appreciably greater than another, separation may seriously affect package fill. Such products, including those that have a common source but are not of uniform particle size, may also unmix in handling before they get to the filler. You have seen this effect in a gravel pile. The heavy stones have rolled to the bottom and to the side, while the smaller particles are concentrated toward the center.

The third aspect of product uniformity is its flow characteristic. For dry products and powders there are several factors inherent in the product that are important. One of these is the angle of repose. This is the angle made by the side of a pile with the horizontal. The angle of repose changes with moisture content, particle size, and other properties of the material. How does it affect the operation of a filler? The following are examples.

If we have a tall bin and fill it with a product having a high angle of repose, it will fill up in a sharp peak. The height of the pile, or the head over the dicharge point, we can mark "H". As the bin is emptied, the effective height of the pile drops and we can mark that level "h". The difference between these two levels will cause the rate of flow to change and thus change the package fill. It also, incidentally, gives another opportunity for the product to separate. As the angle of repose is exceeded in our bin, the sides of the pile will collapse and the effective height will increase. This occurs alternately as the bin is emptied, and is the cause of considerable trouble in many products.

The angle of repose will also affect the flow of product from auger type fillers. If the pitch of the auger is not flatter than the angle of repose, the product will not stop flowing when the auger stops, and the dribble will cause package fill to vary.

Products that compact, like snow into a snowball, must be handled with extreme care. Cake mixes are a good example of this type of product. Here, changes in pressure will change the degree of compacting. This, in turn, will change the flow characteristics and the apparent density. Both will cause package fill variation.

There also exist the extreme conditions where, like French cut beans, French fried potatoes, or shredded coconut, the pieces are interlaced like jackstraws and will flow only with the greatest difficulty or not at all.

The second heading on our list is the Basic Accuracy of Fillers. There are two basic types of fillers. Those that fill by volume and those that fill by weight.

Volume fillers are the more common because they are relatively simple, inexpensive, and are adaptable to high speed operation. Volume fillers can be further divided into three classes: (a) Those that use the container as the measuring element, (b) those that have a self-contained cavity for measuring, and (c) those that use a time-flow relationship.

The first of these that use the container itself as the measure are accurate only to the extent that the container is accurate at the time of filling. They may be subject to other problems, but certainly the container is one of the important ones. For example: A great number of the products you find in the grocery store are in glass containers. Glass is an excellent container for many products and the only practical one for others. However, for many reasons, it is not possible to make all glass containers alike. When we investigated the effect of container volume on weights in one situation, jars of maximum and minimum capacity were selected and run alternately through the filling machine.

After we had analyzed the results (see fig. 5) we found that the jar we had planned to put two ounces in varied 7.39 cm^3 and the weight of product varied 3.2 percent. The four-ounce jar varied 14.8 cm^3 and the product weight varied 3.1 percent. The large six-ounce jar varied 18.5 cm^3 and the fill weight varied 2.8 percent. This represents the best that can possibly be done with standard commercial glassware.

Containers of plastic, like the popular squeeze bottle, present even more difficult problems to contend with, for the container changes shape unless very carefully handled. Similarly, flat-sided containers that are easily flexed cannot be used for vacuum or pressure filling without incurring major changes in variations in package fill.

The second type of volume filler that has the self-contained measuring cavity as part of the machine is in very wide use. The cavity must be of the correct shape and contour. A cavity too flat will not fill properly. Neither will one that is too tall. A proper relationship between the diameter and depth of the measuring cavity is important to the product. If there is more than one cavity in the machine, it is, of course, necessary that all be exactly the same.

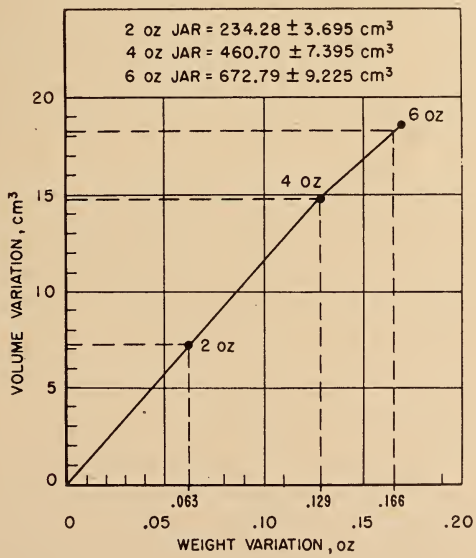


FIGURE 5. *Volume versus weight of product for wide-mouth glass jars.*

The third class, the time-flow equipment, is an important category of fillers. These depend upon creating a constant uniform flow of material and then controlling the amount of fill by regulating the time during which the flow occurs. Gravity or pressure devices are remarkably good so long as the pressure is constant and resistance to flow is uniform. Pumps for liquid or augers for dry products are also satisfactory so long as there is no slip in the pumping and the means of starting and stopping are accurate. Consider, however, that a clutch that slips one-quarter of a revolution in stopping an auger may cause a variation in package weight of 2 or 3 percent. In all of the time-flow devices, filling error increases as speed of operation is increased beyond reasonable limits.

A second major group of fillers are weighing devices. These are of two basic types. The first weighs the product and then puts it into the container. The second weighs the container and the product together and are known as gross weighers. Both types typically use a balance beam, though there are some new types that do not. Though we speak of these devices as scales, they have many of the characteristics of time-flow volume fillers, for many of them operate at speeds from twelve to twenty cycles per minute. Their basic accuracy depends upon the skill with which the scale was devised and the means provided to stop the flow of material when a balance has been reached. Pivots and bearings have to be good if they are to stand up under three million weighings a year. The mass of the beam must be kept low if it is to respond rapidly to small increments of weight. Electrical controls that require no more force than the magnetic damper on an analytical balance are available, and they have been used. Even these refinements, however, have their limitations and their variations. For example, suppose we have a solenoid that closes a gate to stop the flow of product, and that it is hooked up in approximately this fashion. If it operates on ordinary 60-cycle electric power, it will take up to $\frac{1}{120}$ second to close the gate. If we are weighing one pound in three seconds, the flow will be over five ounces per second, or more than 0.05 ounces in $\frac{1}{100}$ second. If this error seems small, consider that it is the best that can be done if everything else is perfect, and thus represents a minimum error. A minimum error averaging this much under or overweight on all packages will amount to 30,000 pounds in ten million packages.

Gross weighing is resorted to when the product is either sticky and cannot be depended upon to drop clean from the net weigh bucket, or is so dusty that the drop from a net weigh bucket would make such a mess as to gum up the scale and make working conditions unsatisfactory. A lack of uniformity in the tare weight of containers is a major cause of fill variation with this type of filler. Glass containers are poor in this respect; metal containers are not much better. Paper containers have their variation also. We have found as much as $\frac{1}{2}$ ounce variation in the plain cartons used for 12 ounces of cereal. Thus, tare weight is a source of fill variation.

Our third major heading is Operating Conditions. Probably less is known about the effect of operating conditions on package fill than any other cause. I think this is true because everyone expects things to go along as designed and planned, which is not necessarily true. Maintenance of equipment is extremely important, and the need is not always evident. In one plant we have been able to establish that the

wearing of the hard chrome plating on the inside of volume measuring cups affects the accuracy of fill. In another case we found the volume filler with a bent shaft had caused the size of the measuring cups to vary.

I could review many of the other physical effects such as constant head, uniform speed, spillage, packing room humidity, that affect package fill and should be included under operating conditions. More important than even these are people. Nothing gets done without people, and all too often we forget that people are human. The skills of people differ. We have found that it rarely takes less than six months and may take two years to train a skilled man in the operation of a multi-scale filler. Even the skilled operator is not infallible, for job routine has been known to blind them to the unusual. An inspector was actually hypnotized by the bright light reflected from the tops of metal cans she was supposed to be inspecting. When this happens, almost anything can happen—and does. The State of West Virginia recently held several hundred jars of one of our products. They were partially full. Investigation showed that between 3:00 and 4:00 a. m. a new crew, on the job for only two days, packed this product. Apparently, the volume filler, running at over 200 jars a minute, ran almost empty. The automatic switches failed and the jars went past four operators and an inspector without detection. We owe the State of West Virginia our thanks. We could have had a lot of unhappy customers and at least a couple of unhappy storekeepers on our hands. I know of no way of setting up complete and absolute barriers to prevent these accidents.

To guard against shifts in package fill, an alert management sets up a system of reports and controls. These are not automatic instruments, although they have some of the same characteristics. By the term "controls" I refer to both standard ways of doing the job so as to minimize fill variation, and to regular inspections and reports of inspections that serve to focus attention when something goes wrong. The manufacturer who makes no inspection of package fill has no control and must accept a very great chance that package fill will be in error without his knowledge. On the other extreme, the manufacturer who inspects 100 percent of his packages still does not have complete assurance that all packages are satisfactory, for people are human, and even machines are not infallible. As a result, most manufacturers compromise. They inspect a large percentage of the output visually or by machine, to detect, if possible, gross errors in fill. In addition, they inspect a small number of packages very carefully and estimate the true situation from what they learn. Actually what is done is to set up a patrol like that of the police department or a weights and measures department. This is a compromise between the cost of inspection and assurance that can never be complete. The greatest service such inspection can be is to help the manufacturer seek out and correct the causes of fill variation.

When such a cause is found, the detectives, production, engineering, and research departments are called in to trace it down and arrest the cause if possible. Without controls we would not be aware of the variation or its magnitude. Therefore, the degree to which effective controls are applied affects package fill. I may be stretching the point too far to list controls as a cause of fill variation; however, lack of controls certainly contributes to fill variation.

There is one additional consideration. Variation in weights does not stop when the package is sealed. Storage conditions may continue to affect weights. To test this effect on a grain product, we carefully weighed a number of cases, divided them into two equal groups, and stored them under different conditions. At the end of a few days we reversed the positions of the two lots and again watched what happened to their weights. Figure 6 shows the results for the two groups.

Offhand, it would seem easy to correct this condition by using a moisture barrier as a wrapping. Unfortunately, nature will not always cooperate, and sealing this product up tight spoils the flavor in a comparatively short time.

To sum up: The degree of package fill variation depends upon the product, the uniformity of the product with respect to apparent density and other physical properties that affect flow. The basic accuracy of measuring systems includes both fillers and containers. Operating conditions, both physical and those subject to human error, contribute to variation. The presence or absence of controls affects the information a manufacturer has available to use in developing means of counterbalancing other causes of fill variation. Not all packers have to contend with all these causes to the same degree. To a degree, there are solutions to most of the causes. Some of the solutions are practical, some are not. No solution or combination of solutions will eliminate all variations in package fill. No solution or system of control will give complete and economic assurance that underweights will not occur.

As I am sure you know, under the Federal Food, Drug, and Cosmetic Act and most State laws and regulations, the manufacturer is given the option of labeling his product as containing either a minimum quantity or an average quantity. If he elects to use average quantity, then tolerances are permitted consistent with good packing and distribution practices.

The manufacturer, when faced with this choice and the many causes of fill variation, almost always finds it necessary to think and act in terms of the average as he fills and labels.

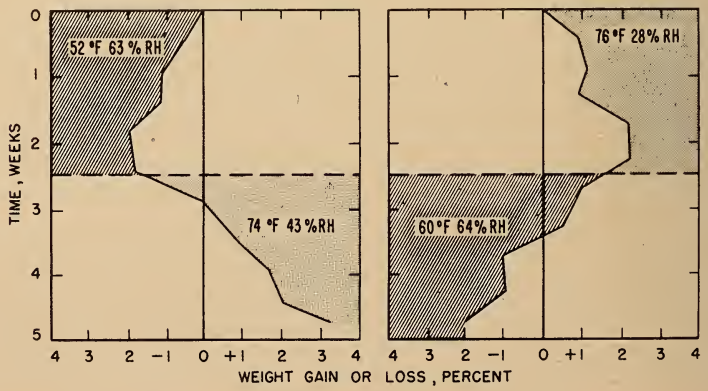


FIGURE 6. *Weight gain or loss during storage for plain printed cartons.*

Because of this situation, an inspection by an enforcement agency will find variation in fill from package to package. The larger the number of packages inspected, the more reliable will be the estimated average. The manufacturer asks only that the number of packages tested be large enough to be truly representative before any conclusions are drawn regarding the average or the tolerance.

DISCUSSION OF FOREGOING PAPER

MR. LYLES: I would like to know what percent of a lot of packages you would consider it necessary to check.

MR. LEE: The larger the group, the smaller the percentage. On a group of packages of less than 100, you should check practically all. It is seldom that an estimate based on less than 100 or 150 packages will be particularly accurate. If the deviation is slight, a larger number of packages is necessary to establish the deviation.

MR. MACURDY: Would you propose not to put any limit on allowable errors but merely to work from the average of a large number?

MR. LEE: It would not be fair to the consumer to work strictly from the average. There must be some limit on gross errors just as the law provides.

MR. MACURDY: Where would you place the limit on gross errors?

MR. LEE: You will agree that we are going to have variations. The manufacturer is faced with the problem of where he shall set his average with relation to the labeled weight. If he sets that average at a point where, say, 84 percent of his packages will be above labeled weight, under normal circumstances, he then will have 16 percent of his packages running underweight. The degree of underweight of the extreme packages will largely be a function of the particular system of operations he is using in filling. Some systems will cause variations where, of that 16 percent, the lowest package would probably not be more than 0.5 percent below the labeled weight. Other packages are likely to be 1 to 5 percent below, depending on the product and the system. There is no definite way of gaging it for all products.

However, should the manufacturer decide that some packages are going to be too low, and if he decides to move his average up so that 95 percent of his packages will be overweight, he will double his cost of over-fill. If he attempts to move his average still higher so that essentially he has 97 or 99 percent of his packages overweight, he will triple the cost of overweights, and he may run into an economic barrier as the result of setting his sights too high. He has to judge what his competitors are doing and how critical the nature of the product happens to be. Generally, we do not attempt to keep every package above label weight, because on some products the cost of overweight will run as high as $100,000 per 0.01 ounce overweight in the course of a year. One plant currently runs as high as $400,000 worth of overweights per year. I am sure that there still are some packages that are not full weight, but to materially reduce the percentage of short weights would be extremely expensive. And then there are, of course, the accidents that cause shortages. These are practically impossible to eliminate.

MR. KERLIN: Do you happen to know the actual target weight and the range for a 10-ounce package of frozen peas?

MR. LEE: I do not know precisely the target weight. The range would probably run 1 to 1.25 ounce, or more. The target might be

+0.25 to +0.3 ounce. Nonetheless, some are going to be ½ ounce underweight, and some will run 1¾ ounce overweight.

Mr. Watson: You have stated the impossibility of assuring full weight in all packages. I would inquire as to the possibility of 100 percent checkweighing. I realize that in certain types of products storage conditions will affect the weight, but in other types storage does not affect the product so severely. In the case of the latter, did you make the statement that you cannot assure weights up to the marked weight through the use of 100 percent checkweighing?

Mr. Lee: The question is whether a 100 percent checkweighing unit can eliminate all shortages. What happens if you begin to reject all shortweight packages; what are you going to do if you reject 10 or 20 percent of the packages each minute? You soon will have rejected packages beyond control or reason.

These packages are produced constantly and very rapidly by the nature of the system that is in use. Their weight depends upon the product as it comes from the field, the variation in treatment, and the normal fluctuation of the filler running at high speed. Many things contribute, and there is no way you can change the shape of the distribution curve unless you change the type of filling machine, your processing, and the source of raw materials. This is a question of economics.

The checkweighing machine cannot decide whether a package is minus 0.015 or 0.016 ounce. It also must have a little tolerance. A checkweigher will help to improve the curve. Automatic checkweighing sounds very good, but, when you start chopping off or rerouting great quantities of your production, you introduce an impossible situation. So instead, you deliverately let one in ten packages go underweight. To the consumer that means that on an individual package she is short once in ten times. But the chance of a consumer getting three or four of those in the course of three or four weeks of buying the product is remote.

In any event, the distribution curve is fundamental. We have made curves from weights of incoming raw materials that we purchase, so that we can estimate what sort of accuracy our supplier is maintaining. You can do the same thing to judge our quantity control.

Mr. Rhein: Is it the viewpoint of industry that, regardless of the net content stated, there are bound to be some shortages? Would it not be possible to change the label?

Mr. Lee: What you are suggesting is that, if we cannot keep this entire distribution curve above our label weight, we ought to change the label somehow? In that event we would get into the position of putting 21 ounces in a box marked 20. This might be considered a questionable practice under some State regulations. As long as such a requirement worked equal difficulty on all manufacturers, I suppose it would make very little difference.

Mr. Kerlin: You state that approximately 10 to 16 percent of your packages will be shortweight. That is a control factor, I presume. What would you say to a lot of various items of frozen food in which 24 to 67 percent were short of the declared quantity?

Mr. Lee: Although the 10 to 16 percent is not a pat figure, I think you will find it is used quite generally. Industry practices vary with respect to the percent of packages permitted to be underweight. If the law recognizes averages and tolerances, the percent underweight

could run as high as 50 percent. If a 16-ounce package could be held to 16 ounces ±0.01 ounce, there would be little question about having 40 or 45 percent of the packages that were between 15.99 ounces and 16.00 ounces. If this 16-ounce package were to vary several ounces, the question of underweight immediately arises as to what percentage of the packages can be permitted to be underweight, and how far underweight the extreme packages can legitimately be. I am no lawyer, but it would seem that this is a matter of definition of good manufacturing practice and just what constitutes a gross underweight. As a matter of practice, wide variation usually means that control is difficult. As a result, industry usually packs more on the average than the label weight and holds the percent of underweights reasonably low. When this is done, the percent underweight normally will stay below 50 percent, even though the control may not be perfect. I would sit still and watch the 24 percent; 67 percent is too much.

Mr. Miller (Passaic County, N. J.): Do you establish weights for specific areas of the country? As, for example, would you overpack more of a high moisture-content item going to a dry climate than when the same item is destined for a humid climate?

Mr. Lee: No. Our normal practice (rice grains, for example, come in somewhere around 13½ percent moisture content) is to pack the finished product at the same moisture content that the grain had when received. We have found that that is pretty close to equilibrium because it is the average at which the grain will hold moisture most normally. Our product is close to the equilibrium when packed. The average will vary from one area to another only as the result of local atmospheric conditions.

Mr. Nunn: According to your graph, there are a certain number of pieces that will come out shortweight. To what degree are they shortweight?

Mr. Lee: They will vary according to the product and to the general practices. I do not think you could say that there is a set amount that will apply to all packages or packaged foods. I think that is one of the good reasons the law has generally avoided stating tolerances and left them to regulations. On easy handling products like sugar, salt, and coffee, you can get remarkably good results. With cake mixes, shredded coconut, and things of that sort, there is much more difficulty. Even if you package by hand and set 100 people in a row with hand scales, you get the same type of variation. The degree of variation will depend upon the degree of attention to the adjustment of the equipment and how well the equipment will repeat. There is variation constantly.

SIMULATED ROAD TEST FOR TAXIMETERS

By C. H. Hartman, *The Durman Company, Seattle, Washington.*

(In the absence of Mr. Hartman, the Conference Secretary presented a motion picture film and commentary prepared by Mr. Hartman. The film pictured a device for making simulated road tests on taximeters. The device consisted of two cylindrical rollers, driven by the rear wheels of a taxicab while resting between them, a clock-type dial for registering mileage, and appropriate controls. Through the use of this device, a taximeter can be tested thoroughly while installed on a vehicle, in about fifteen minutes, with the vehicle remaining stationary. It is designed to take the place of a "measured course" and to eliminate the necessity for making "road tests".)

Mr. Wrenn: Has this testing device been approved by either or both the National Bureau of Standards and the National Conference on Weights and Measures?

Mr. Bussey: Neither the National Bureau of Standards nor the National Conference approves devices; however, the Conference did recognize this system of testing in amendments adopted to the taximeter code last year. These amendments included recognition of the simulated road test.

Mr. Hodgess I would like to know if there has been made a comparison between the indications of a taximeter on this device and during actual road tests.

Mr. Bussey: The City of Seattle has run numerous comparative tests over their carefully measured course. They also have accurately measured the circumference of the tires on rear wheels of taxicabs and have connected a counting device that counts the revolutions of the wheels. Thus, they have checked this machine against both a measured course, representing a road test, and a wheel test. According to the reports of the City of Seattle and The Durman Company, the different tests are in very close agreement. They also have made special tests to learn whether tire slippage is a factor. Water purposely has been run on the tires and rollers at the time tests were being conducted—no noticeable slippage was reported.

Mr. Hodges: What is the approximate cost of this test machine?

Mr. Bussey: I do not have that information; however, this is the only machine, so far as I know, that has been built. Mr. Hartman of The Durman Company informed me that he thought he could produce these machines to sell at about $2,500 each.

Mr. Prendergast: I was wondering about the wear on tires. Twenty years ago we had a machine similar to this, and an owner of a large taxicab fleet was going to sue the city. He claimed we damaged the rear tires on taxicabs. Will this machine damage the tires in any way?

Mr. Bussey: Apparently not. The officials in the City of Seattle have been using this machine for about two years and have noticed no tire damage. During my visit there, I did not see any evidence of loose rubber when I examined the machine. I do not believe that tire wear is a problem with this particular type of testing machine.

Mr. Howard: Inasmuch as a similar type machine is used to test speedometers up to 90 miles per hour, I do not believe tire wear would be a problem on taximeter tests running at about 25 miles per hour.

Mr. Kalechman: I did not see included in the film the special test for interference between the time and mileage mechanism. Is such special testing practical on this type machine?

Mr. Bussey: Because of time, that phase of the taximeter test was not shown on the film. However, it should be and is included in the regular testing procedure using this special device.

Mr. Wrenn: When do they determine the amount of wear on the tire tread?

Mr. Bussey. Tire wear is critical only in the application of tolerances. The inspector determines the depth of tread on the various makes of new tires used on taxicabs. Then, using either a graduated scale or a depth gage, he is able to measure the depth of tread at the time of test, and, if less than one-half of the tread remains on the rear tires of the taxicab, a special tolerance on overregistration is appli-

cable. With some experience, it is not too difficult to determine whether or not tires are worn to approximately one-half of their normal useful life.

ACCURATE LIVESTOCK WEIGHTS—IMPORTANT TO AGRICULTURE

By R. D. Thompson, *Supervisor of Scales and Weighing, Livestock Division, Packers and Stockyards Branch, U. S. Department of Agriculture*

Mr. Chairman, members of the 40th National Conference on Weights and Measures, I very much appreciate the opportunity which Mr. Bussey has afforded me to greet you briefly and tell you something about my new job with the U. S. Department of Agriculture.

As an active member of this organization since 1941 representing the Commonwealth of Virginia, I feel very much at home among you and wish to publicly acknowledge with thanks the many letters of congratulations received when it became known that Mr. C. L. Richard, who formerly held this position, had retired from Government service and that I had been appointed in his stead.

My interest in livestock scales and weighing goes back to my entrance in weights and measures work in 1938 and, in fact, prior to that date since I was reared on a livestock farm and correct weights on the products which we sold was of equal importance to the accurate weights of commodities which we bought. Since coming to my new job with the Packers and Stockyards Branch of the Livestock Division in the U. S. Department of Agriculture, I find that the problems with which I now have to deal are very similar to those encountered in this field on the State level except for the fact that they are multiplied by 48.

The fact that during the past four years American farmers have sold an average of 10 billion dollars worth of livestock which constitutes approximately one-third of their total farm income certainly establishes the relative importance of the livestock industry in the Nation's economy.

Since livestock is universally sold by weight, the accuracy of the scales and of the weighing becomes of paramount importance not only to the producer but also to the intermediate buyer, the packer and to the ultimate consumer.

While many of you may be familiar with the Packers and Stockyards Act enacted by Congress in 1921 and the functions of the Packers and Stockyards Branch through previous papers presented at this Conference, or through association with Branch personnel, I would like to tell you briefly some of the functions of the agency which I now represent.

The Packers and Stockyards Act was passed in 1921 after an investigation revealed that major packers maintained monopolistic control over operations at large terminal stockyards. This investigation disclosed that yardage charges, commission rates and feed costs at such markets were in many instances unreasonably high and were being applied on a discriminatory basis, that facilities and services being furnished at many markets were inadequate, and that consignors were not receiving complete and accurate accounting from their selling agents, and that stockyard companies, commission firms, dealers and packers operating at the markets were engaged in practices detri-

mental to the interests of livestock producers. Prior to the passage of the Act few States had legislation which provided for any form of regulation of public livestock markets.

The Act provides in substance that the facilities and services furnished to producers who ship livestock to public markets shall be adequate; that the charges assessed them for yardage, feed, and for selling and buying services shall be reasonable and nondiscriminatory; that all consigned livestock shall be sold on the basis of its merits under open competitive bidding conditions; that the weighing of such livestock shall be accurate; that full and correct accountings shall be furnished consignors and buyers for whom the commission firms act as selling or buying agents; and that the stockyard companies, market agencies, dealers, and packers subject to the Act shall not engage in unfair, deceptive, or discriminatory practices. The Act also requires that market agencies and dealers operating at supervised markets furnish bonds to assure performance of the financial obligations they incur. The reparation provision of the Act affords livestock producers and other patrons of public markets with a more expeditious and less expensive method of prosecuting claims against stockyard companies, market agencies, and dealers than remedies previously available to them at common law or by statute.

To carry out the provisions of the Act the Packers and Stockyards Branch now maintains 20 district offices at major livestock markets throughout the United States. Working from these offices, Branch personnel exercise general supervision over the operations of 2,200 commission firms, 2,800 dealers, and some 2,000 packers engaged in buying and selling at 67 terminal stockyards and 266 livestock auction markets posted as being subject to the Act. This supervision includes the investigation of numerous unfair trade practice complaints *including short weights*, the registration and bonding of stockyard companies, marketing agencies and dealers subject to the Act, the establishment of rates charged by stockyard companies and commission firms, and the supervision of the test and inspection of scales at posted livestock markets and packer buying stations.

A very natural question which will probably occur to you is—Just what auction markets are subject to supervision by the Packers and Stockyards Branch? Under the terms of the Act as it now stands, all stockyards with an area in excess of 20,000 square feet of actual pen space are subject to the Act. As previously stated, we now have some 266 auction markets in addition to the terminals posted and there are probably as many more which should be posted if the necessary funds were available to properly supervise their operations. Since funds for bringing additional markets under our supervision have not been available in recent years, we are at present pursuing a policy of posting only those markets located in cities where other yards are posted or in certain western States where all other eligible yards have been posted. This means that in many large livestock producing States there are numerous auction markets which are not Federally supervised and which are badly in need of closer State and local supervision.

In my own experience at the State level we found it desirable to slant much of our program toward the protection of the producer of agricultural products and obtained some excellent results in check-weighing livestock, tobacco and other commodities. As a result of

this we had the support of farm organizations who recognized the importance of this work and gave us much valuable support.

I would like to emphasize the need for full and active cooperation between Federal, State and local agencies in the testing of livestock scales and the supervision of livestock marketing and to assure you that the Packers and Stockyards Branch stands ready to assist you in any way possible to the extent that our facilities permit. Further, we recognize the need of your assistance in carrying out our program and hope to feel free to call on you for help as the occasion demands.

At this point I would like to express on behalf of my superiors in the Department of Agriculture appreciation for the excellent cooperation which we now enjoy with many States and local jurisdictions. Currently, we feel that the scale testing program on scales at public stockyards under Branch supervision is adequate.

However, we are not so optimistic in regard to our requirement that all scales used by packers for direct purchases of livestock at packing plants and buying stations receive adequate tests at regular intervals. This regulation, promulgated under authority of the Packers and Stockyards Act, adopted in July 1954, requires that all such scales be tested at least twice a year. While tests by competent commercial testing agencies are accepted by the Branch, we would much prefer that at least one test annually be made by an official agency and in this connection we solicit your assistance.

As a matter of interest to those States who may have in mind the enactment of more comprehensive legislation for the regulation of stockyards strictly under State supervision, I would mention that at the request of the Council of State Governors the Branch has drafted a model "Livestock Market Act" which may be of interest to you. Copies are available upon request.

Having so recently come from the administration of a State weights and measures program I feel that I am fully cognizant of the many calls upon your rather limited personnel and facilities and realize that most of you through necessity must concentrate on those problems which at the moment seem deserving of top priority. These decisions are often the most difficult part of administering a comprehensive program. This familiarity with your problems and ours leads me to leave the thought with you that from a dollars and cents standpoint the livestock scales in many States might be classed as your most important large capacity scales since livestock has a higher money value per pound than any other commodity commonly weighed for purchase or sale on scales of large capacity.

Time does not permit my elaborating on the necessity and value of weight supervision which to me is a basic part of any weights and measures program. While the testing of scales, meters, milk tanks, etc., is necessary and important, we have done less than half the job if we permit these accurate devices to be used to defraud the public. Checkweighing, weighmaster surveillance, test purchases and other means of dectection must be employed if we are to lay claim to protecting the public interest adequately.

Within recent months it has been my pleasure to visit quite a few of you in your State offices and learn at first hand of the excellent work which many of you are doing. This has been a most interesting experience and I hope to visit many more of you as the opportunity presents itself.

REMARKS OF A. T. McPHERSON, NATIONAL BUREAU OF STANDARDS

The general area of the Bureau work for which I am responsible includes the calibration of weights and measures, the preparation, testing and certification of the standard samples that the Bureau issues as a means of maintaining uniform standards of color, composition, purity, and temperature, and the development of test methods, specifications, and codes. Many of you are familiar with plumbing, electrical, safety and other codes through other regulatory officers of your respective jurisdictions. Many of these codes stem from work in which the National Bureau of Standards actively collaborates.

We learn from time to time that many of the States have regulations that call for testing by the Bureau. For example, one State requires that safety glass windshields for automobiles comply with certain specifications when tested at the Bureau. We like to know about such enactments before rather than after they are put on the statute books because we can often be helpful in drafting the legislation.

There are many fields of commercial measurement that lie outside the scope of weights and measures officials. For instance the electrical standards which are the basis of a multi-billion dollar electric power industry, usually come within the purview of public utilities commissions. The accuracy of the watt-hour meter in the basement is as important to the householder as the accuracy of the scales in the grocery store. They differ only in that different officials are responsible for their accuracy.

A new type of regulatory measurement that some of you may be concerned with in your States is the regulation of exposure to radiation from X-rays and radioactive materials that are coming into extensive industrial use. The Bureau in collaboration with others has anticipated the needs by preparing some model laws for the measurement and control of radiation to which workers and others may be exposed.

In extending my greetings, I wish to say that I shall be glad to try to be of assistance to you in problems that may come within the scope of the National Bureau of Standards.

(The Conference was recessed until 2:00 p. m.)

FOURTH SESSION—AFTERNOON OF WEDNESDAY, MAY 18, 1955

(G. L. Johnson, Vice President, Presiding)

SYMPOSIUM ON METHODS OF PROVING LIQUEFIED PETROLEUM GAS LIQUID METERING SYSTEMS

(R. E. Meek of Indiana, Moderator)

REMARKS OF R. E. MEEK, DIRECTOR, DIVISION OF WEIGHTS AND MEASURES, STATE OF INDIANA

The purpose of this symposium on methods of proving liquefied petroleum gas liquid-metering systems is to have all possible new data pertaining to the subject presented to and made a part of the record of the Conference.

The idea of a symposium first was advanced by W. S. Bussey, Secretary, National Conference on Weights and Measures, during a meeting of the Technical and Standards Sub-Committee on Weights and Measures of the Liquified Petroleum Gas Association, Inc., held in Chicago, Illinois, February 1, 1955. This group and others were of the opinion the plan had unquestioned merit.

Representatives of a number of organizations interested in proving LPG liquid-metering systems met in New York City on March 24 for the purpose of organizing a Program Planning Committee for the symposium. These organizations included the National Bureau of Standards, Gasoline Pump Manufacturers Association, Liquefied Petroleum Gas Association, American Petroleum Institute, Meter Manufacturers Association, and National Conference on Weights and Measures. Mr. Bussey was elected by those present as Chairman of the Planning Committee.

After the possible scope of the symposium was discussed, the following agreements were reached: (1) Material to be presented should be limited to the proving of LPG liquid-metering systems, (2) material previously presented on a National Conference program and appearing in printed reports of the Conference should not be repeated during the symposium, (3) formal presentations should be limited to new and additional information on proving LPG liquid-metering systems, or contain supporting data which should be considered in the development of a code of specifications and tolerances for these systems, (4) all organizations were to contact their members and obtain from them appropriate statements with respect to new developments, and (5) during the symposium the presentation of the formal statements would be followed with informal discussions during which all present would be given an opportunity to participate.

It is the sincere desire of everyone who has given serious thought to the problem of proving the accuracy of LPG liquid-metering systems that this meeting will prove successful and add considerably to our store of knowledge on this highly important subject. Finding the proper solution to the problem will require the untiring efforts of industry representatives and enforcement officials. Both groups have contributed considerable time and expense through the construction and operation of experimental proving equipment. The several groups have recognized the common objective and have worked together without any display of selfish interest. It is in that

spirit we meet this afternoon to hear and discuss all of the latest available information on the subject.

PHILLIPS LP-GAS LIQUID METER PROVER

By E. E. Reed, *Engineer, Phillips Petroleum Co., Bartlesville, Oklahoma.*

Liquefied petroleum gas (LP-Gas) is sold and distributed in many ways, and, as is the case with any commodity involved in a transaction, some means must be provided for measuring the amount of the commodity involved. LP-Gas is currently sold and measured principally by weight, vapor volume, and liquid volume. It is desirable from the LP-Gas industry's viewpoint, as well as the consumer's viewpoint, that the measurement used be as accurate as is reasonably possible.

The problem currently before the LP-Gas industry is the accurate measurement of liquid LP-Gas through positive displacement meters. The LP-Gas liquid meter, being a mechanical device, is subject to some wear and resultant inaccuracy over extended periods of use. These meters must also be properly installed in the dispensing system if they are to give accurate measurement. Thus, the problem is to provide some reliable means of periodically checking or proving the accuracy of the meter as installed—that is, not just the meter, but the entire metering system.

Phillips Petroleum Company instigated a meter prover development program early in 1954 with the following goal: Develop and build an LP-Gas liquid meter prover which would be (1) accurate, (2) simple to operate, (3) reasonable in cost, (4) low in time requirements for the meter proving operation, and (5) readily portable.

Since the unit to be built was to be a "field" or operating model rather than a laboratory model, detailed preliminary studies and calculations were the first steps in the program. These studies started with a comparison of the various methods which had been proposed and meter provers which had been built previously to determine the advantages and disadvantages of each.

From these studies it appeared that, of the previously proposed or built units, three of the volumetric type and one gravimetric type offered the best possibilities for a prover which would fulfill the requirements which had been established. Detailed calculations were made to determine the maximum possible errors of each of these four methods and cost estimates were prepared for each.

Based on expected accuracy, simplicity of operation and cost, the "hydrostatic" volumetric method was selected for testing. The terminology "hydrostatic" comes from the fact that in operation the prover tank is filled liquid full. Volumetric means, of course, that the proving is done on the basis of volume directly, rather than weight (which would subsequently be converted to volume).

Briefly, the method involves the use of a pressure vessel (prover tank) of known volume which is purged with LP-Gas vapors and "spray loaded" liquid full with LP-Gas pumped through the meter being tested. The accuracy of the meter is determined by comparing the known volume in the prover tank (corrected, from simple charts, for vapor in the tank at the start of the test and any thermal expansion of the liquid after it is metered), with the meter reading. The previously mentioned calculations showed that this prover would be accurate within ± 1 percent. It has the operational advantages of being simple and direct with no intermediate steps being necessary.

FIGURE 7. *Phillips LPG liquid meter prover unit.*

Such a meter prover, shown in figure 7, was designed and built using two ellipsoidal heads welded together as the prover tank. The tank is fitted with a relief valve, two pressure gages, a thermometer, a test connection (to verify that the tank is liquid full), and fill and withdrawal connections. The tank, liquid withdrawal pump (driven by an explosion-proof 110 volt electric motor), and tool box for the miscellaneous accessories are all mounted on a two-wheel trailer, so that the prover is a completely self-contained unit. The total weight of the unit is 1960 pounds, making it readily portable behind an ordinary passenger vehicle. It is estimated that additional provers of this design could be built at a cost of $1,200 to $1,500 per unit.

The prover tank was calibrated with water, using a "to deliver" test measure certified by the National Bureau of Standards. The volume of the prover was found to be 97.86 gallons.

It is necessary to make only two corrections for each run of the prover. These are: (1) a correction for any change in the liquid volume due to an increase or decrease in liquid temperature after it has been metered, and (2) a correction for the vapor in the prover tank at the start of the run. The correction factors for liquid expansion are shown in table 1. The condensed vapor volume correction factors are shown in figure 8. Note that these factors are shown in gallons in both instances in order to simplify the correction procedure as much as possible. These factors were calculated using average values of the properties of the components of LP-Gas. The maximum possible error which could be introduced by this use of average values

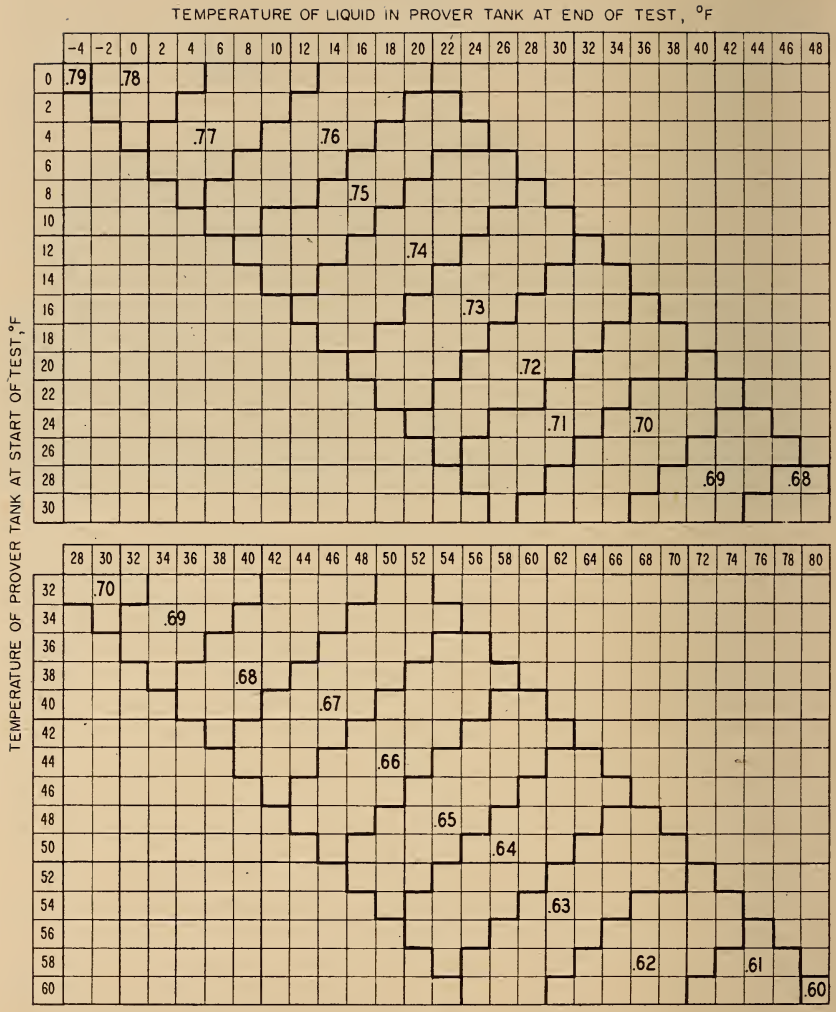


FIGURE 8. *Correction factor (in gallons) for condensed vapor volume.*

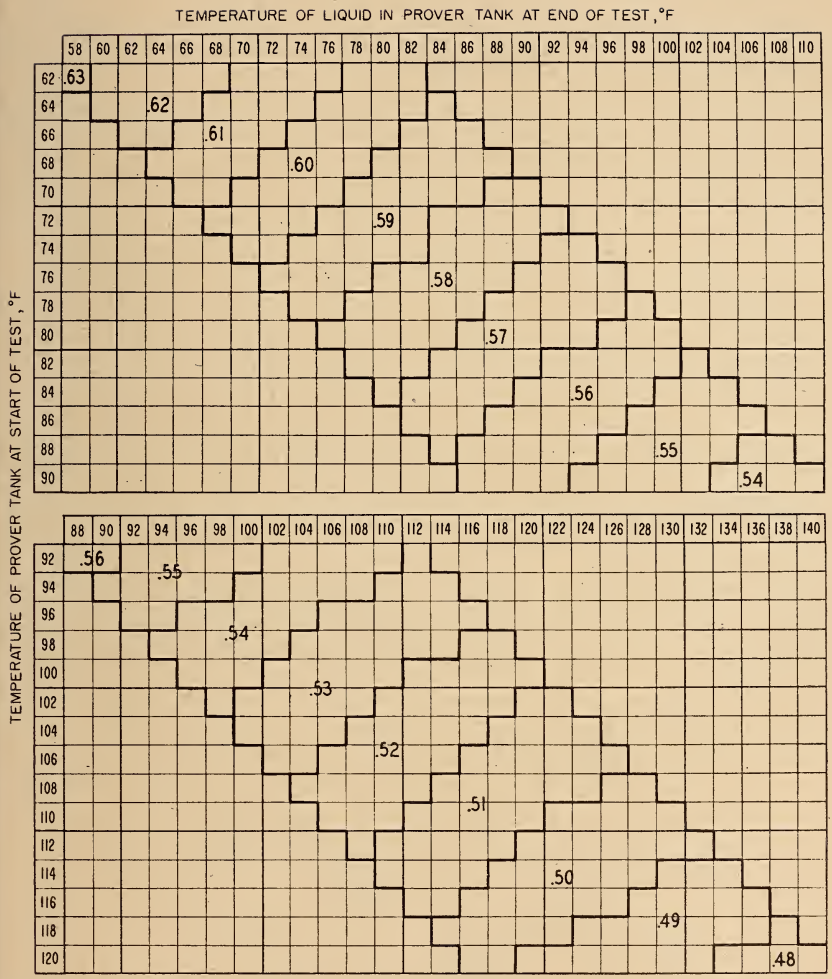


FIGURE 8. *Correction factor (in gallons) for condensed vapor volume.*—Con.

was considered in arriving at the expected accuracy of ±1 percent for the prover.

Figure 9 is a schematic drawing of the meter prover connected for use. Proving a meter is done in the following sequence:

1. Fill the prover tank through the delivery hose.
2. Pump the liquid back to the supply with the return pump. This will tend to equalize the temperature of the prover tank with that of the metering system.
3. Reduce the pressure in the prover tank to 10 psig by venting the vapor to a safe location through the vent hose.
4. Record the prover tank temperature.
5. Zero the meter and fill the prover tank, recording the liquid temperature at the meter three times during the fill (when approximately 15 gallons, 50 gallons, and 85 gallons have been delivered).
6. When the meter stops, record the meter reading and open the test valve on top of the prover tank long enough to verify that the tank is liquid full, and record the prover tank temperature. (If, due to adverse conditions, the tank is not liquid full, empty it and repeat the run.)
7. Pump the liquid from the prover tank back into the supply tank, using the prover return pump.
8. Determine the actual volume delivered into the prover tank as follows:

   (a) Average the liquid temperatures observed at the meter during the filling operation and compare this average with the prover tank temperature at the end of the fill. Use the difference of these temperatures and the average liquid temperature at the meter to determine the correction factor (in gallons) for thermal expansion from table 11. Subtract this factor from the prover tank volume if the prover tank temperature is higher than the liquid temperature at the meter; add it if the prover tank temperature is the lower.

   (b) Using the prover tank temperatures before and after filling, determine the correction factor (in gallons) for the vapor which was in the tank at the start of the test from figure 8. Subtract this factor from the volume which has been corrected for temperature change. This gives the actual volume delivered through the meter.

9. The meter error is easily determined by comparing this delivered volume with the meter reading.

Note that the proving operation involves only direct pressure and temperature readings and very simple correction calculations. This is extremely important in any field proving operation, since any com-

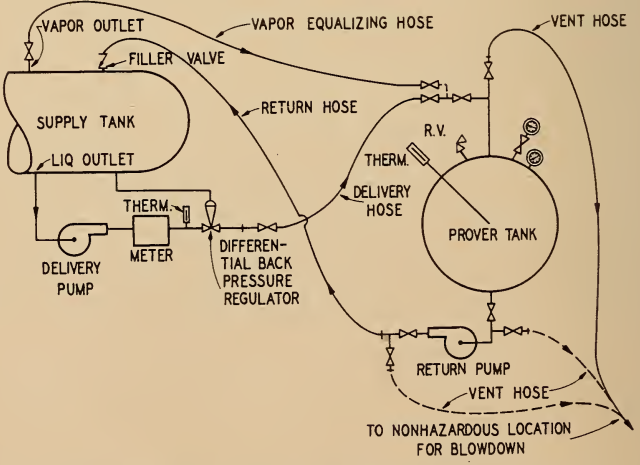


FIGURE 9. *Diagram of Phillips hydrostatic LPG liquid meter prover as connected for operation.*

plicated readings and involved calculations greatly increase the possibility of operator error.

Late in March 1955, some thirty-five "shake-down" runs were made with the meter prover at Phillips Petroleum Company's "66" Proving Station at Bartlesville, Oklahoma. These runs were made to check the operation of the unit and the detailed operating procedure which had been prepared. The results indicated that the prover would function as expected and that it could be filled liquid full at varying rates, if desired, without difficulty.

Actual field meter proving runs were started in April 1955, and although only a limited number of such runs have been made thus far, the results indicate that this meter prover is entirely satisfactory for proving the accuracy of LP-Gas liquid meter systems. It is accurate, simple to operate, reasonable in cost, and readily portable. The time required to make a complete proving run is approximately 30 minutes. Field proving runs with the prover will be continued for several months to obtain complete data on operation of the prover, including repeatability of results, under various conditions.

In addition, the "Jim-dandy" meter prover shown in figure 10 will be constructed in the near future. It will operate on the same principle as the one presently being tested. The primary difference in the provers will be the capacity of the prover tank. Note that the "Jim-dandy" unit uses a 100-pound (approximately 23 gallons) container, with the necessary fittings for gages and the thermometer well added, as the prover tank. It is currently planned to provide a hand pump rather than a power-operated pump for emptying the prover tank. It will be necessary to calculate an entire new set of correction factors for this unit, since the factors must be based on the actual capacity of the prover tank. The advantages of the "Jim-dandy" prover over the present unit are (1) the fact that it can be constructed at a lower cost (estimated at $300) and (2) it is more portable. Total weight of the unit will be 220 pounds, but it can be packed and shipped in two cases to facilitate handling.

We feel that this meter proving method offers a good solution to the LP-Gas industry's meter proving problem at a reasonable cost. The initial investment is relatively low and operating costs will be low, since it requires only a short amount of time for each proving operation, and does not require a highly skilled operator.

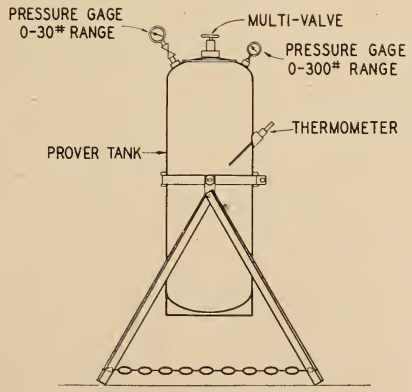


FIGURE 10. *"Jim Dandy" LPG liquid meter prover.*

TABLE 1. *Correction factor—liquid expansion in gallons*

Temperature difference between meter and prover tank, ° F	Temperature of liquid at meter, ° F															
	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
±1	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
±2	.22	.22	.22	.23	.23	.23	.23	.23	.23	.23	.23	.24	.24	.24	.24	.24
±3	.33	.33	.34	.34	.34	.34	.34	.35	.35	.35	.35	.35	.36	.36	.36	.36
±4	.44	.45	.45	.45	.45	.45	.46	.46	.46	.47	.47	.47	.47	.48	.48	.49
±5	.55	.56	.56	.56	.57	.57	.57	.58	.58	.58	.59	.59	.59	.60	.60	.60
±6	.67	.67	.67	.68	.68	.68	.69	.69	.69	.70	.70	.71	.71	.72	.72	.73
±7	.78	.78	.78	.79	.79	.80	.80	.81	.81	.82	.82	.83	.83	.84	.84	.85
±8	.89	.89	.90	.90	.90	.91	.92	.92	.93	.93	.94	.94	.95	.96	.96	.97
±9	1.00	1.00	1.01	1.01	1.02	1.02	1.03	1.04	1.04	1.05	1.05	1.06	1.07	1.08	1.08	1.09
±10	1.11	1.11	1.12	1.13	1.13	1.14	1.14	1.15	1.16	1.16	1.17	1.18	1.19	1.20	1.20	1.21

Temperature difference between meter and prover tank, ° F	Temperature of liquid at meter, ° F															
	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	
±1	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.14	
±2	.24	.25	.25	.25	.25	.25	.26	.26	.26	.26	.26	.27	.27	.27	.27	
±3	.37	.37	.37	.37	.38	.38	.38	.39	.39	.39	.40	.40	.40	.41	.41	
±4	.49	.49	.50	.50	.50	.51	.51	.52	.52	.53	.53	.53	.54	.54	.55	
±5	.61	.62	.62	.62	.63	.63	.64	.65	.65	.66	.66	.67	.67	.68	.69	
±6	.73	.74	.74	.75	.76	.76	.77	.77	.78	.79	.79	.80	.81	.82	.82	
±7	.85	.86	.87	.87	.88	.89	.90	.90	.91	.92	.93	.94	.94	.95	.96	
±8	.98	.98	.99	1.00	1.01	1.02	1.02	1.03	1.04	1.05	1.06	1.07	1.07	1.09	1.10	
±9	1.10	1.11	1.12	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	1.21	1.22	1.24	
±10	1.22	1.23	1.24	1.25	1.26	1.27	1.28	1.29	1.30	1.31	1.32	1.34	1.35	1.36	1.37	

Temperature difference between meter and prover tank, ° F	Temperature of liquid at meter, ° F															
	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	
±1	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16	
±2	.28	.28	.28	.29	.29	.29	.29	.29	.30	.30	.31	.31	.31	.32	.32	
±3	.42	.42	.42	.43	.43	.44	.44	.45	.45	.46	.46	.47	.47	.48	.48	
±4	.55	.56	.57	.57	.58	.58	.59	.59	.60	.61	.61	.62	.63	.63	.64	
±5	.69	.70	.71	.71	.72	.73	.74	.74	.75	.76	.77	.78	.78	.79	.80	
±6	.83	.84	.85	.86	.87	.87	.88	.89	.90	.91	.92	.93	.94	.95	.96	
±7	.97	.98	.99	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.07	1.09	1.10	1.11	1.12	
±8	1.11	1.12	1.13	1.14	1.15	1.17	1.18	1.19	1.20	1.21	1.23	1.24	1.26	1.27	1.28	
±9	1.25	1.26	1.27	1.28	1.30	1.31	1.32	1.34	1.35	1.37	1.38	1.40	1.41	1.43	1.44	
±10	1.39	1.40	1.41	1.43	1.44	1.46	1.47	1.49	1.50	1.52	1.54	1.55	1.57	1.59	1.60	

TABLE 1. *Correction factor—liquid expansion in gallons*—Continued

Temperature difference between meter and prover tank, ° F	Temperature of liquid at meter, ° F														
	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120
±1	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.19
±2	.32	.33	.33	.34	.34	.34	.35	.35	.36	.36	.37	.37	.38	.38	.39
±3	.49	.49	.50	.50	.51	.52	.52	.53	.54	.54	.55	.56	.56	.57	.58
±4	.65	.66	.66	.67	.68	.69	.70	.71	.71	.72	.73	.74	.75	.76	.77
±5	.81	.82	.83	.84	.85	.86	.87	.88	.89	.90	.91	.93	.94	.95	.96
±6	.97	.98	1.00	1.01	1.02	1.03	1.04	1.06	1.07	1.08	1.10	1.11	1.13	1.14	1.16
±7	1.14	1.15	1.16	1.18	1.19	1.20	1.22	1.23	1.25	1.26	1.28	1.30	1.31	1.33	1.35
±8	1.30	1.31	1.33	1.34	1.36	1.38	1.39	1.41	1.43	1.45	1.46	1.48	1.50	1.52	1.54
±9	1.46	1.48	1.49	1.51	1.53	1.55	1.57	1.59	1.61	1.63	1.65	1.67	1.69	1.71	1.73
±10	1.62	1.64	1.66	1.68	1.70	1.72	1.74	1.76	1.78	1.81	1.83	1.85	1.88	1.90	1.93

SUBURBAN RULANE LP-GAS LIQUID METER PROVER

By JOHN MACINTOSH, *Chief Engineer, Suburban Rulane Gas Co., Charlotte, North Carolina*

In the past fifteen years much has been written and much has been done in experimental methods on the measurement of liquefied petroleum gases. Liquefied petroleum gas being, as Mr. Weaver of the National Bureau of Standards once described it, "an awkward name as applied to hydrocarbon fuels which have boiling points below or at about the freezing point of water but which are not too volatile to be transported and stored in liquid form without using excessively heavy containers. These materials, therefore, combine the simplicity and ease of use and control which are characteristic of gaseous fuels for the economy of transportation in batches possible for a liquid, and it is in this combination of properties that gives the liquefied petroleum gases their place in commerce."

Much has been done in developing liquid meters to measure the amount of liquefied petroleum gas sold to consumers in the liquid phase, and the problem came up as to how to satisfactorily prove these meters under the conditions of temperature and pressure which were characteristic of the liquefied petroleum gases.

There is no difficulty in proving the individual meter itself as all of the manufacturers are able to prove their meters by one method or another with very close accuracy. The main problem lies in proving the meter as part of the entire system of delivery on a tank truck.

Back in 1941, the American Petroleum Institute and the American Society of Mechanical Engineers developed a project to study the results of volumetric research. This committee included representatives with special knowledge and experience in the technical phases of the meter measurement of petroleum, namely the design, research, testing and operation of positive displacement meters. The committee also included qualified representatives of all the major displacement meter manufacturers and the Liquefied Petroleum Gas Association; The research program was completed and the results

eventually published representing the combined efforts of all these people, and known as the A. P. I. Code No. 1101 for the installation, proving and operation of positive displacement meters in liquid hydrocarbon service.

This Code recognized the difference in technique between standard petroleum products and liquefied petroleum gases, and a schematic diagram of an LP-Gas metering system for a tank truck was shown as figure No. 5 in the publication of this Code. This diagram shown herein as figure 11, included all of the recommendations of both the meter manufacturers and the subcommittees, and the meter manufacturers adopted these techniques and recommendations of the A. P. I. Code No. 1101 and published in their own literature modifications of this particular layout. These layouts, shown herein as figures 12 and 13, are reproduced by courtesy of Rockwell Manufacturing Company and Neptune Meter Company.

Recognizing that it was a system including a meter that had to be proved rather than the individual meter itself, the type of provers to be used for such purpose was narrowed down to what might be classified as volumetric and gravimetric provers. Several of the weights and measures officials of different States recognized this fact and developed such provers in their own operating territory. For instance, Mr. Brenton of California preferred the volumetric method; Mr. Fuller in Los Angeles preferred the gravimetric method; Mr. Berryman in Florida has a volumetric unit; and Mr. Moulden of the Moulden Supply Company in Mississippi, with the cooperation of Mr. Dorman of the State of Mississippi, developed a commercial prover which is also volumetric. Mr. Harvey Howard of Miami County, Florida, developed the use of a so-called Gallon-Bottle method which was a modified gravimetric unit. Mr. C. D. Baucom of North Carolina combined his prover to be both volumetric and gravimetric. Mr. Fred True of Kansas developed his own gravimetric system.

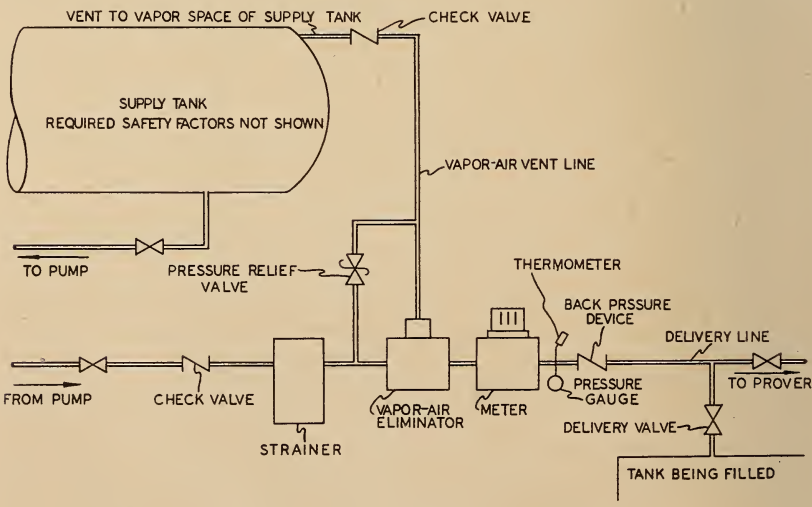


FIGURE 11. *Schematic installation diagram for LPG metering system.*

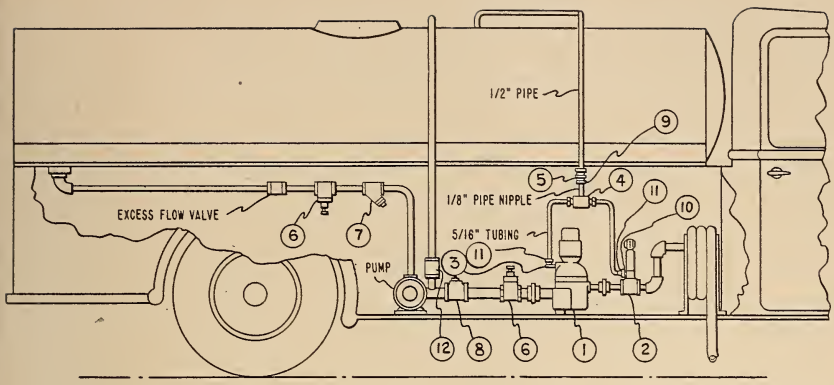


FIGURE 12. *Schemate diagram of Rockwell LPG tank-truck meter installation.*

1. Meter.
2. Differential valve.
3. Restricted flow elbow.
4. Tee.
5. ½-inch check valve.
6. Stop valve.
7. 1¼-inch strainer.
8. 1¼-inch check valve.
9. ½-inch × ⅛-inch bushing.
10. 5/16-inch × ¼-inch connector.
11. 5/16-inch tubing nut.
12. By-pass valve in return line to vapor section of tank.

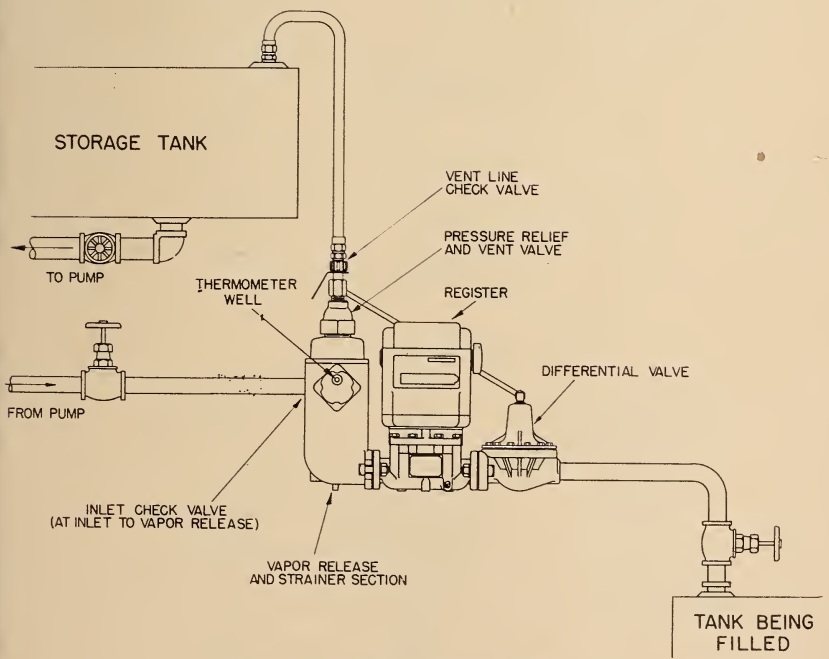


FIGURE 13. *Diagram of Neptune LPG tank-truck meter installation.*

Therefore, when the problem came to the Technical and Standards Committee of the Liquefied Petroleum Gas Association, it was decided to investigate and build both types of provers—gravimetric and volumetric—and if any other types of proving could be developed then the committee would also consider that as well.

The Suburban Propane Gas Corporation as an active member of the Liquefied Petroleum Gas Association, through its Rulane Division, undertook to build and check-test a volumetric prover as part of this research program. The first step in the Rulane development was to consult with Mr. C. D. Baucom, Superintendent of Weights and Measures, State of North Carolina, and get his valuable assistance in the initial stage of development of the prover to be utilized in the calibration station in Raleigh, North Carolina, whereby we could set up a standard check method and a procedure for the development. Mr. Baucom was very cooperative and put his personnel at our disposal in this matter. The object of our research into the proving method was to evaluate the volumetric and gravimetric methods of meter proving for meter systems used in liquefied petroleum gas first as to accuracy, second as to speed and convenience, third as to comparableness, and fourth as to adaptibility to field use.

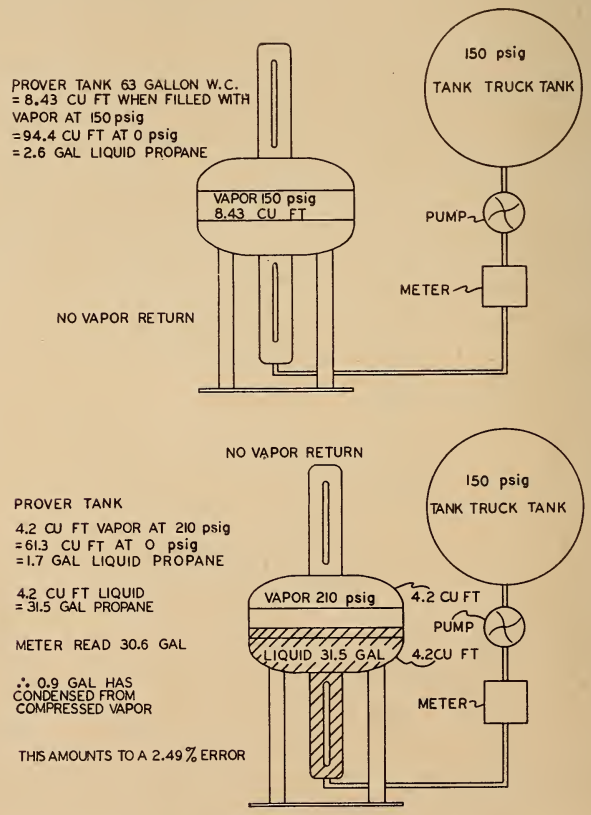


FIGURE 14. *Diagram of volumetric proving with no vapor return.*

In planning the meter proving system, the requirements of such a system needed to evaluate the volumetric and gravimetric methods of this proving as outlined were unknown. In order to cope with any unforeseen problems, a system was planned that could be readily changed from volumetric to gravimetric and vice versa, and that would furnish pressure and temperature data constantly throughout the tests. The basic requirements necessary for such a system were worked out between us.

It was recognized, however, that this was entirely a stationary unit and more or less a laboratory practice. Therefore, we needed to build another prover which could be adapted to field use. The Rulane Division of Suburban Propane Gas Corporation, therefore, instituted the building of another prover of the volumetric type mounted on a trailer so that it could be transported from plant to plant and could be used to check meters from a tank truck rather than from a laboratory bench. This prover (see figures 14 and 15) was built along the same lines as the prover which was installed in the calibrating laboratory in the State of North Carolina; however, the diameter of the prover body was increased in order to shorten

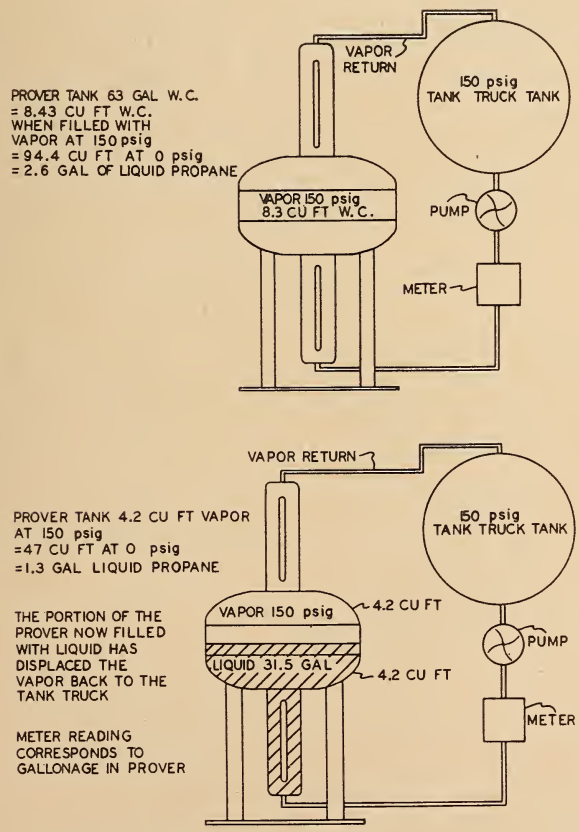


FIGURE 15. *Diagram of volumetric proving with vapor return.*

the height of the prover because it was found that when the prover is too tall there is difficulty in a man reading the gauge glass on the top seraphin neck. The prover was fitted with connections which would allow either top or bottom filling and would allow the use of a vapor return hose when required. It has a bottom outlet connected to a small pump for evacuation purposes. The prover is equipped with reflex gauges in order to show up the liquid level within very close measurement.

The procedure in testing is as follows:

The tank truck equalizing connections are connected directly to the top of the prover and the valves opened. This allows equalization of pressure between the prover and the tank truck storage tank.

METER PROVING DATA SHEET

TEST NO. 1

DATE: 4-20-55

TYPE TEST VOLUMETRIC

METER READINGS (GAL.):

Finish 50.1 gal.

Start 0 gal.

Net 50.1 gal.

Corr. to 60°F 48.647 gal.

PROVER READINGS (GAL.):

Finsh 50.2 gal.

Start 0 gal.

Net 50.2 gal.

Corr. to 60°F 48.543 gal.

SCALE READINGS:

Gross ____ lbs.

Tare ____ lbs.

Net ____ lbs.

Rate of Flow (gal/min) 19

Specific Gravity ____

Weight/Gallon @ ____°F = ____ lbs/gal.

Weight/Gallon @ 60 °F = ____ lbs/gal.

Calculated Weight Delivered ____ lbs.

METER TEMPERATURES: (°F at 5 gal. intervals)

0	5	10	15	20	25	30	35	40	45	50
		77		77				77		77

AVERAGE METER TEMP. 77°F

Volume Correction Factor for Average Meter Temperature .971

PROVER TEMPERATURE:

TOP 80 °F

BOTTOM 79 °F

AVERAGE 79.5 °F

Volume Correction Factor for Average Prover Temperature .967

% error (volumetric) .214 M.O.R.

% error (gravimetric) ____

(Meter Owner & Truck Number)

(Location)

(Signature)

FIGURE 16. *Meter-proving data sheet.*

The liquid line from the meter is then connected to the bottom inlet on the prover, and the prover filled and evacuated three times to bring the prover and the tank-truck storage tank to equal pressures and temperatures. A small amount of liquid is allowed to remain in the bottom seraphin neck of the prover slightly above the zero mark on the gauge on the bottom seraphin neck. This liquid is then bled down slowly with a small needle valve until it is exactly on the zero mark. The meter on the tank truck is then set back to zero, and the method of filling the prover is to pump fifty gallons through the meter in the same manner used in the actual delivery to a consumer tank. The pump is put in gear and the valve to the prover opened. When fifty gallons have registered on the meter, the valve on the liquid inlet and also the vapor return valve to the prover are closed and the pump is then stopped. As there is equalized pressure between tank truck and prover in the vapor phase of the prover, there is no evaporation of the liquid and only the vapor that has been displaced from the prover which is occupied by the liquid and forcing it out is the only transfer of vapor between prover and tank-truck storage tank.

Temperatures are read at the meter during several intervals of the pumping, and the pumping rate is checked at these same periodic intervals. Two thermometers installed in the main body of the prover provide temperature readings which are read and averaged. As temperatures and pumping rates are tabulated during the course of the pumping, it is simple to perform several check runs and do the calculations later. (See fig. 16.)

In the calculation of results, all volumes are brought back to a 60°F base, utilizing the standard volume correction factors as published by the ASTM-IP Petroleum Tables. Shown here in table 2 is the summary of tests run with the prover in groups of three.

TABLE 2. *Tabulated volumetric proving results*

Test No.	Meter reading corrected to 60° F.	Prover reading corrected to 60° F.	Percentage error
1	48.647	48.543	0.214 meter overregister.
2	48.547	48.441	0.218 meter overregister.
3	48.547	48.420	0.262 meter overregister.
4	49.425	49.005	0.85 meter overregister.
5	49.440	48.955	0.90 meter overregister.
6	49.597	49.152	0.897 meter overregister.
7	49.693	49.05	1.27 meter overregister.
8	49.693	49.075	1.24 meter overregister.
9	49.691	49.05	1.29 meter overregister.
10	47.90	48.04	0.292 meter underregister.
11	47.90	48.03	0.271 meter underregister.
12	47.269	47.402	0.281 meter underregister.

It was then decided that we might check the volumetric proving against the modified type of gravimetric proving. The gallon bottle was used and it was charged with gas and then bled down to atmospheric pressure. It was then weighed on a scale reading in one-hundredths of one pound. The net weight of the gallon bottle was determined, and the bottle was filled hydrostatically full. As this

bottle has a thermometer in it, the temperature could be obtained and the weight of the bottle hydrostatically full was determined at this temperature. From this, the weight of one gallon of the product at this temperature was determined, and by the use of correction tables the weight per gallon was corrected to 60° F. This procedure was repeated three times and as all three readings were within very close tolerance of each other, the average weight per gallon was established from these three readings. This weight was at 60° F. A one-hundred-gallon capacity container was set on a scale having quarter-pound graduations on the beam. A small amount of product was pumped into this container so that we had vapor pressure in the container. The tank truck was then connected to this container with no vapor return hose being used. The meter was set back to zero and the pump started and fifty gallons of product were pumped into this container. Temperatures were taken at the tank truck meter during the pumping operation, and the meter figure was then corrected to 60° F. The one-hundred-gallon container was weighed and the weights recorded, and the corrected gallonage in the truck meter was converted to pounds using the figure determined by the use of the gallon bottle. The tabulated figures are shown here in table 3.

TABLE 3. *Modified gravimetric test*

Weight of gallon bottle at atmospheric pressure	13.18 lb
Weight of gallon bottle hydrostatically full at 83° F	17.26
Weight of 1 gallon of product at 83° F	4.08
Weight of 1 gallon of product corrected to 60° F	4.242
Weight of gallon bottle at atmospheric pressure	13.18
Weight of gallon bottle hydrostatically full at 80° F	17.28
Weight of 1 gallon of product at 80° F	4.18
Weight of 1 gallon of product corrected to 60° F	4.2349
Weight of gallon bottle at atmospheric pressure	13.18
Weight of gallon bottle hydrostatically full at 90° F	17.21
Weight of 1 gallon of product at 90° F	4.03
Weight of 1 gallon of product corrected to 60° F	4.239
Average weight per gallon at 60° F	4.24

Weight of 100 gallon container with 123-lb vapor pressure	462.75 lb
Truck meter reading, start	0.0
Truck meter reading, finish	50.1 gal
Truck meter temperature	71° F
Weight of 100-gallon container with 50.1 gallons	672.25 lb
Truck meter reading corrected to 60° F	49.2 gal
Weight per gallon as determined by gallon bottle at 60° F	4.24 lb
Calculated weight of product delivered (49.2×4.24)	208.6 lb
Actual weight of product delivered (672.25−462.75)	209.5 lb
Percentage error of meter (underregistration)	0.43

It was decided to check a little further with the modified type of gravimetric by using a thousand-gallon tank and simulating customer delivery. So we placed a thousand-gallon tank on a platform scale and then connected a tank truck to this thousand-gallon tank, utilizing the same methods as we would use in filling a consumer's tank and not using any vapor return hose.

A sample of the product in the tank truck was first weighed in the gallon bottle, and from this weight it was calculated that the weight of a gallon of the product in the tank truck was equal to 4.1961 pounds at 60° F. A small quantity of the product in the tank truck was pumped into the thousand-gallon tank and the hose disconnected. This was done to simulate in every way possible what would happen with the filling of a consumer tank. We now had a thousand-gallon tank with a small amount of liquid in it which was equivalent to a

consumer's tank being practically empty but still had the back pressure or the vapor pressure of a small amount of liquid which was in the bottom of the tank. The tank was then weighed and the weights recorded, utilizing a 40,000-pound scale which had 5-pound graduations. The tank truck was then connected to this consumer tank, liquid line only, and the meter set back to zero. Then 25 gallons were pumped through the meter and the hose disconnected and the tank weighed. The meter was not set back to zero, but the hose from the tank truck was connected again to the storage tank and another 25 gallons were run, the tank weighed and recorded. This was repeated so that in the final tabulation we had put in three dumps of 25 gallons each, three dumps of 50 gallons each, and one dump of 100 gallons, making an actual total of 324.95 gallons put into the tank with the meter on an accumulative basis.

TABLE 4

Weight of gallon bottle at atmospheric pressure..... 23.97 lb
Weight of gallon bottle at hydrostatic full..... 28.10 lb at 69° F
Weight of 1 gallon (231 cu in.) of product..... 4.134 lb at 69° F
Weight of 1 gallon (231 cu in.) of product..... 4.1961 lb at 60° F

Weight of storage tank at start 2,760 lb with 123 lb vapor pressure

Tank weight	Truck meter reading	Gallons pumped	Gallons per minute	Meter temperature	Gallons pumped at 60° F	Net weight gas pumped	Calculated gallons pumped	Difference	Vapor pressure in tank
				° F		lb		%	
2,869	25.85	25.85	18.8	66	25.59	109	25.98	+1.25	125
2,970	50.225	24.375	17	66	24.13	101	24.07	+0.249	125
3,072	75.15	24.925	15.4	66	24.67	102	24.31	+1.46	130
3,281	125.05	49.9	14.7	66	49.4	209	49.81	+0.22	135
3,492	175.14	50.09	13.5	66	49.59	211	50.28	+1.39	140
3,702	225.0	49.86	12.1	66	49.36	210	50.04	+0.36	150
4,120	324.95	99.95	8.8	66	98.95	418	99.62	+0.68	165
Total					321.69	1,360	324.11	+0.84	

Table 4 shows a record of these amounts and the weights. It has to be remembered, however, that this scale was the 40,000-pound scale with 5-pound graduations; therefore, the close reading of the weights had to be within the 5-pound graduation error. The reason that the gallon bottle was used here to determine the weight per unit volume rather than using a pressure hydrometer was the fact that in previous experiments it was found that we could not depend upon the accuracy of the pressure hydrometer. However, we understand that a new type of pressure hydrometer is being developed which will overcome some of this difficulty so that this same type of gravimetric proving might be done with the use of a pressure hydrometer instead of a gallon bottle.

We feel that the use of a volumetric prover similar to what we have designed here on a trailer is a very accurate method of checking meters used in liquefied petroleum gas service in the field, and we believe that the accuracy of such meters, including the human element, can be determined within plus or minus one-percent accuracy. We believe that such a prover can be built including the trailer at a cost of between $1,200 to $1,500 per unit.

SKELLY OIL COMPANY LP-GAS LIQUID METER PROVER

By R. R. Wellington, *Assistant Engineer, Skelly Oil Co., Kansas City, Missouri*

You are all familiar with the ways in which LP-Gas is generally sold. The three ways it is normally sold are weight, vapor volume and liquid volume. One of the problems of the LP-Gas Industry, American Petroleum Institute and the weights and measures conference is the development of a positive displacement meter prover for an LP-Gas metering-system. We will all agree that it is a relatively simple procedure to prove an LP-Gas meter on a test bench using solvent with certain correction factors, but the problem of proving a meter installed in a truck with all necessary appurtenances for good operation has been difficult.

During 1954 Skelly Oil Company and two other companies decided to build meter system provers. After talking with people already using provers and acquiring data and information already available, Skelly decided to build a combination volumetric and/or gravimetric prover. The primary reason for deciding on the combination unit was to run prover tests utilizing both methods with the same gas and proving one against the other. We all know that there is a certain amount of error in either method but I am happy to say that many of the tests run were within one half of one percent (½ of 1%) of each other.

Our original consideration was to build a prover with the following aims:

1. Accuracy,
2. Simplicity of operation,
3. Low cost,
4. Time element in proving,
5. Portability,
6. Procedure.

The prover we built is not portable at this time because we wanted it large enough to handle a larger volume than would be required for truck metering systems, thinking primarily of metering systems used in LP-Gas bulk plants. Our prover holds 76 gallons and was calibrated by Mr. Fred True, State Sealer of Kansas, from the starting zero mark to the final calibration point. It was designed for a working pressure of 375 pounds and was built by welding two hemispherical heads together and flanging the top and bottom seraphins to the heads. The seraphins are made of 6-inch pipe. We have reflex gauges and three thermometer wells in the unit. The fittings are arranged so the unit can be spray loaded or bottom filled. A small 10-GPM pump is used to evacuate the prover.

We will briefly outline the two procedures used in our prover tests.

A. Using Bottom Filling with an Equalizing Line.
   1. Fill and empty prover tank to equalize the pressure and temperature.
   2. Record the pressures and temperatures of storage and prover tank.
   3. Start the pump and open the filling valve and vapor-equalizing line.
   4. During the filling process, record changes in temperature and pressure.
   5. When the prover tank has filled to the full calibration mark, shut off the filling valve, the vapor-equalizing valve and stop the pump.
   6. Allow prover contents to settle and record the pressure, temperature and the volume.

7. Record meter reading.
8. Empty prover tank with evacuating pump.
9. Make the necessary calculations and compare volume in gallons to the meter reading.

B. Using Spray Filling Without Vapor Equalizing Line.

1. Fill and empty prover tank to equalize the pressure and temperature.
2. Record temperatures and pressures of the storage and the prover tank.
3. Record the tare weight of the prover.
4. Connect the filling hose to the top filling valve.
5. Start the pump, then open the filling valve.
6. Record temperatures and pressures during the process.
7. When the prover tank has filled to the full calibration mark, shut off the filling valve then stop the pump.
8. Disconnect the hose.
9. Record the prover gross weight, meter reading, temperature and pressure of the storage and meter prover.
10. Take two or more specific gravity tests of the liquid in the prover until two readings are very close.
11. Empty the prover with the evacuating pump.
12. Make the necessary calculations and compare the meter prover content in gallons with the meter reading.

For field use, some of these steps could be eliminated but we needed them for information. We found both methods of proving satisfactory but think, for convenience in field use, the volumetric prover using an equalizing line would be easier to use. We also feel that we could eliminate a great deal of calculation as well as hydrometers, dry ice, scales and test weights. We feel that this would eliminate chance of error by the field operator as well as error in the equipment. These errors could be caused by incorrect specific-gravity tests, scales not checked properly and windage.

We might also suggest here that if gravimetric proving is contemplated the vessel should be spray loaded to eliminate calculations. The only objection we found in the volumetric prover was some bubbling in the reflex gauges on sunny days. We found that this could be retarded and sometimes eliminated by using heavier and better reflex gauges or by cooling the gauges with propane vapors.

From the information and data acquired in over two-hundred prover tests, we are considering the construction of a portable prover which we feel would be very reasonable and simple to operate in the field with a minimum of error. We are reasonably sure that a prover of about 30-gallons capacity would be large enough for most LP-Gas truck metering systems. We would use a very short bottom seraphin which would hold about one-half gallon and a top seraphin that would hold about one gallon. We would continue to use 6-inch pipe for seraphins. Lever-handle quick-action valves are very helpful in the prover operation. We also found very good mercury thermometers should be used and they should be checked often for accuracy.

In closing I would like to say that in the tests run, we used five different positive displacement pumps with different GPM which included two separate truck-metering systems and found that in practical field proving we can get repeatable tests within a plus or minus of 1 percent. This applies to gravimetric tests which we ran.

This paper could be prolonged indefinitely if we discussed the possible chances of error in the various methods of proving but I am sure that after the various companies run the tests they feel necessary and all data is evaluated, we will have a number of good workable field meter provers available with reasonably simple procedures.

EVALUATION OF THE VOLUMETRIC AND GRAVIMETRIC METHODS OF TESTING LP-GAS LIQUID METERS

By E. F. Wehmann, *Chief Development Engineer, Neptune Meter Co., New York, New York*

In 1940 the first paper on LPG liquid meter proving was presented at the National Conference on Weights and Measures.

Until about two years ago, relatively few had explored the subject of LPG liquid meter proving. However, in the last year or two many people have become actively engaged in conducting studies and tests.

In the early part of 1953, we, at Neptune, started building an experimental LPG meter-test installation with one purpose in mind, to compare, by actual test, all the various LPG liquid meter proving procedures which might be acceptable to you as weights and measures administrators. By the fall of that year we began conducting our tests.

Prior to 1953, the gravimetric method was considered more acceptable. Either of two hydrometer methods were used to determine the weight per gallon of the liquid—the low-pressure hydrometer or "dry-ice method" and the high-pressure-hydrometer method, usually referred to as the "pressure-hydrometer method." At first, we used the gravimetric method as our basis of comparison.

Permit me to describe only the pertinent parts of our LPG testing equipment. We have a combination, 49-gallon volumetric-gravimetric prover. This prover was originally designed to contain 50 gallons, but due to some error in fabrication, the finished prover contains only 49 gallons. This prover has upper and lower necks with sight gages, a pressure gage, two mercury-filled thermometer wells, one in the upper and one in the lower portion of the tank, and hose couplings at top and bottom for top and bottom filling, for draining, and vapor return. With this prover we are able to test meters using any one of the several methods, or in some instances using two methods simultaneously. The volumetric prover is suspended from a scale mechanism for the gravimetric tests.

So much for the meter-test equipment. Now let us consider the different testing methods which we compared. Three gravimetric test procedures were performed to compare the pressure-hydrometer method and dry-ice method and the one-gallon-sample method of obtaining the weight per gallon of the liquid.

Three volumetric methods also were compared. The first of these we refer to as the straight volumetric method, which makes use of a pressure-equalizing or vapor-return connection between prover and supply tank. The second of the volumetric types we refer to as the calculated-volumetric method. No pressure-equalizing line is used for this method, and the prover contains saturated vapor prior to each test. The third and newest of the suggested volumetric procedures is referred to as the hydrostatic method. Again no pressure-equalizing line is used, but, prior to each test, the pressure in the prover is reduced to 15 pounds per square inch, so that it contains only low pressure gas.

Time limitations today permit mentioning only a few of the points that must be considered when evaluating each of the six methods just described.

We feel that the method most acceptable to weights and measures should:

(1) Be accurate and consistent, regardless of temperature and wind velocity.
(2) Make use of a minimum number of proving devices, each of which must be calibrated using primary or secondary standards.
(3) Be portable, in order to test meters installed in fixed locations, as well as those on tank trucks.
(4) Be relatively inexpensive to build and maintain in top performance.
(5) Require a minimum amount of time and manpower to make and break test connections, to conduct tests, to observe and record data on prescribed forms, and to arrive at, and calculate if necessary, a final result.
(6) Be safe to operate in any area where a metered delivery is made without undue concern regarding temperature, wind velocity, or the releasing of gas into the atmosphere.

In addition, weights and measures officials generally require a procedure that: (1) makes use of uniform units of measure throughout—for example, an inch for an inch, a pound for a pound, a gallon for a gallon; (2) makes it possible to test a device "on the spot" without removing it from the installation, whether the installation is fixed or movable; (3) uses a standard of measure that is more accurate than the device being checked, that can be expected to maintain its accuracy over long periods of time and use and that can readily be rechecked by an even more precise standard. For example, the procedure of testing a meter with another meter (called a "master meter") and the procedure of isolating a meter from its installation (in order to use a substitute liquid and a standard "open type" prover) are not generally acceptable, since these methods do not conform with the fundamental concepts of a good testing method using adequate standards.

Keeping in mind these weights and measures fundamentals in testing procedure and the six desirable features of an LPG liquid meter proving method, let us try to see how the virtues of each of the six methods compare. Permit me to explain another point before proceeding. By discussing this material, we hope to broaden the outlook for those who have had neither the time nor the equipment to do so. It is *not* our purpose to infer that one testing method is not usable because another appears to be slightly better in some respects. All the methods, or any one method, mentioned previously could be adopted, but the purpose is to adopt a method that will be satisfactory to all.

To evaluate the six methods is not easy. In table 5 are tabulated comparisons of the six testing methods. I hope that, with the aid of this tabulation, you will be better able to visualize and understand the problem.

The following statements are made to emphasize some of the more outstanding factors that are not readily illustrated or recognized.

All gravimetric methods are less accurate when tests are conducted on windy days because of the aerodynamic effects on the prover tank when it is being weighed, before and after filling. In all gravimetric methods, the meter is checked by using a commercial weighing device rather than comparing with a fundamental standard. Thus, this method is based on an unacceptable procedure of testing one commercial device with another commercial device.

All three methods of determining the weight per gallon of an LPG sample, necessary in the gravimetric methods, leave much to be desired.

TABLE 5. *Comparison of LPG liquid meter proving methods*

CONSIDERED FACTORS	GRAVIMETRIC METHODS		
Is method apt to be less accurate with portable equipment?	Yes		
Units of measure	Gallons registered by meter measured as pounds delivered, then pounds delivered are converted by computation to gallons delivered to obtain final test results		
Six comparative methods	METHOD A Dry ice method of finding weight/gallon of liquid sample	METHOD B Pressure hydrometer method of finding weight/gallon of liquid	METHOD C 1-gallon standard and sensitive scale method of finding weight/gallon of liquid
Specific gravity determination	Low temperature—low pressure hydrometer	Atmospheric temperature—high pressure hydrometer	Net weight of a 1-gallon calibrated standard
Pressure equalizing line for testing	Not used		
Pressure equalizing line for draining prover	Preferable		
Weighing equipment	1 heavy scale	1 heavy scale	1 heavy scale 1 light scale
Equipment for finding weight/gallon of liquid	Special low temperature hydrometer equipment 1. Means of drying air in jar 2. Means of cooling sample liquid 3. Hydrometer 4. Thermometer	Special high pressure hydrometer 1. Special high pressure plexiglas jar 2. Special high pressure combination thermometer hydrometer 3. Means of cooling sample	Special high pressure 1-gallon calibrated standard equipped with thermometer Requires use of sensitive scale mentioned above
Tables or charts required	Specific gravity—temperature	Specific gravity—temperature	Specific gravity—temperature
Devices that require being checked for calibration and accuracy	1. Scale 2. (2) Thermometers 3. Hydrometer	1. Scale 2. Thermometer 3. Thermometer-hydrometer unit[a]	1. (2) Scales 2. (2) Thermometers 3. 1-gallon volumetric standard[a]
Effect of wind on test results	Less accurate	Less accurate	Less accurate (shelter for sensitive scale needed to protect it from wind and dirt)
Can test be run as quickly and accurately at high temperatures?	Not with propane	No	Yes
Does method permit meter to run at same gpm?	No	No	No
Number of hose connections made or broken to conduct consecutive tests with same meter	4. No vapor connection used when draining prover 6. Vapor connection used when draining	4. No vapor connection used when draining prover 6. Vapor connection used when draining	4. No vapor connection used when draining prover 6. Vapor connection used when draining
Accuracy in decreasing order (all equipment and human errors included)	2d	4th	3d
Relative speed with which test equipment can be set up and 3 tests run (estimated)	1 hr and 10 min	1 hr (cool weather)	45—50 min (more on windy days)
Relative time required for computations and recording data for final results (estimated)	10 min	10 min using calculator	10 min
Relative estimated cost for portable unit with prover, drain pump, and other related equipment, in increasing order	4th	2d	3d
Relative safety to operator of method under all conditions	4th	5th	3d

[a] Not easily done.

TABLE 5. *Comparison of LPG liquid meter proving methods* — Continued

CONSIDERED FACTORS	VOLUMETRIC METHODS		
Is method apt to be less accurate with portable equipment?	No		
Units of measure	Gallons registered by meter measured as gallons delivered to obtain final test results		
Six comparative methods	METHOD D Straight volumetric method Uses pressure equalizing connection	METHOD E Calculated volumetric method Prover contains saturated vapor prior to each test run	METHOD F Hydrostatic method Prover contains gas at 15 psi prior to each test run
Specific gravity determination	Not required		
Pressure equalizing line for testing	Required	Not used	Not used
Pressure equalizing line for draining prover	Required	Preferable	Not used
Weighing equipment	None required		
Equipment for finding weight/gallon of liquid	Not required		
Tables or charts required	1. Volume—temperature 2. Pressure—volume	1. Volume—temperature 2. Liquid/vapor ratio—temperature 3. Pressure--volume	1. Volume—temperature 2. Pressure—condensation[b] 3. Pressure-volume[b]
Devices that require being checked for calibration and accuracy	1. Volumetric prover 2. (2) Thermometers 3. Pressure gage[c]	1. Volumetric prover 2. (2) Thermometers 3. Pressure gage	1. Volumetric prover 2. (2) Thermometers 3. Pressure gage
Effect of wind on test results	No effect		
Can test be run as quickly and accurately at high temperatures?	Yes	No. May be difficult to use in hot weather	No. May not be possible (still to be determined)
Does method permit meter to run at same gpm?	Yes	No	No
Number of hose connections made or broken to conduct consecutive tests with same meter	None	None	None
Accuracy in decreasing order (all equipment and human errors included)	1st	5th	2d to 3d (still to be verified)
Relative speed with which test equipment can be set up and 3 tests run (estimated)	30 min	30 min (see hot weather note above)	35—40 min (see hot weather note above)
Relative time required for computations and recording data for final results (estimated)	5 min	10—30 min, depending on precision and use of a calculator	Variable: 10 min or more (still to be verified)
Relative estimated cost for portable unit with prover, drain pump, and other related equipment, in increasing order	1st	1st	1st or 2d depending on method of reducing prover pressure
Relative safety to operator of method under all conditions	Safest	2d	2d to 5th depending on method of reducing prover pressure

[b] May be combined for any one prover.

[c] Optional—sensitivity not important.

The weight determination of a one-gallon sample requires the use of a sensitive scale. If accuracy is to be achieved, this method would best be applied to stationary test equipment, so that the scale can be shielded from the wind. The small pipe size in the one-gallon standard reduces the normal operating flow rate of the meter, since this standard is generally connected in series between the meter and the gravimetric tank.

The pressure hydrometer is not the safest device to work with, and artificial cooling is necessary in hot weather to reduce pressures. The accuracy of the combination thermometer-hydrometer unit has always been in doubt.

The dry-ice method or low-temperature-hydrometer method has been used most generally in an area where butane is handled. The procedure provides reasonably accurate results, but to achieve this accuracy requires time, skill, and experience. The equipment itself is not inexpensive.

Any test method that requires dissipation of the LPG product into the atmosphere to conduct the test is not a safe method. All the methods of determining the weight per gallon of the product require that some product be so dissipated. Unless a vapor compressor is used to pull down the pressure of the prover using the hydrostatic method, the same criticism might be made of this procedure.

All the volumetric methods are based on using volumetric units; this is considered proper for testing a meter which is itself a volumetric device.

The volumetric methods make use of a prover than can be calibrated with water in the same manner as are all "open type" provers. If LPG pressures affect the volume of the prover, it is simple to determine and tabulate this effect.

Since the hydrostatic method is the one most recently proposed, more time will be required to obtain the additional data necessary for our comparison table. It will be interesting to learn if this method can be used successfully in hot weather without releasing safety valves. The validity and accuracy of the necessary charts required for this method will have a direct bearing on its accuracy.

The use of a pressure-equalizing line for the straight volumetric test always has aroused some questions in the past. We originally doubted the validity of the procedure ourselves. However, comparative tests have shown that, once the prover is properly attached to the supply tank and flushed with product, the prover is nothing more than an annex of the larger tank. During a test the liquid is moved by the pump through the meter and into the prover. As the prover fills, the vapor in it is displaced through the equalizing hose to the supply tank. It is because of this vapor transfer (and not because of any effect on meter performance) that we, as meter manufacturers, do not recommend the use of a vapor-return line when the sale of the product is involved. It is because of the pressure-equalizing line, however, that the straight volumetric method is so simplified. With the balanced pressure conditions between supply tank and prover, neither condensation nor evaporation of product takes place in the prover. Temperature differences between meter and prover seldom reach 2° F., a much smaller temperature consideration than with any other method.

In table 5 there is presented a comparison of the two liquid meter proving methods—gravimetric and volumetric. When studying the table, you will find that in most categories the straight volumetric method (with pressure-equalizing line) is as good as, if not better than, any of the other five methods. It tentatively appears that the straight volumetric method is the simplest, quickest, most inexpensive, and yet the most reliably accurate of the six methods discussed. A temperature-volume table is required with this method and is used occasionally to make the almost unnecessary volume corrections for 1° or 2° F. temperature changes. The method is safe because the procedure does not require dissipating LPG vapors into the atmosphere or the filling of closed tanks (having no vapor-return connection) to nearly 100 percent full at pressures which may, in hot weather, become high enough to cause safety valves to release.

REMARKS OF FRED LARSON, MARKETING ENGINEERING, SHELL OIL COMPANY

I was to have prepared a paper for this symposium, but the apparatus that we had constructed in our Chicago shops went into the field only about two weeks ago. It is a mobile volumetric unit weighing about 3,000 pounds, with a horizontal tank, and its cost was about $2,000. It is very easy to operate. At this time I am without photographs of it or data on its performance. In about a month we expect to have assembled some graphs and other information, which will be passed on to interested parties.

REMARKS OF C. D. BAUCOM, SUPERINTENDENT OF WEIGHTS AND MEASURES, STATE OF NORTH CAROLINA

We are now winding up thirteen months of research, at a cost of between $20,000 and $30,000, to determine the simplest, easiest, and most certain way of proving LPG meters. Now we are about ready to make a practical application of what we have developed. I did not prepare a paper because we are not yet through.

We have found that condensation in the prover is a big problem. It has been said that, if a system is balanced as to pressure, and if the liquid is introduced into the prover from the bottom, there will be no condensation. We do not wholly agree with that, but we have not determined the amount of the condensation that actually takes place.

We have plotted the results of gravimetric and volumetric 500-gallon tests on each of three meters. The total spread of the readings indicates to us that, whether tested gravimetrically or volumetrically, a mechanical meter tolerance of 0.4 percent is adequate. To this must be added something for the "human tolerance." We are satisfied that a 1 percent tolerance is ample to cover both the mechanical and the human elements.

When LPG is compressed it acts like a refrigerant. As it passes through a meter, there is a pressure drop equal to the resistance of the meter. With a pressure change there is an accompanying temperature change. A change of one degree represents 10 cubic inches in 50 gallons. Incidentally, we had to have our thermometers made and calibrated in pairs, in order to get comparable results.

MR. BERRYMAN: Have these gentlemen found it necessary to calibrate their provers at various pressures?

MR. REED: We actually calibrated our prover at atmospheric pressure and then checked it for possible pressure effects. Our prover is almost spherical, and pressure has very little effect on it; this effect is in the order of a fraction of a hundredth of 1 percent. The effect may be much greater depending on the shape of the prover and the degree to which it is stressed.

MR. BERRYMAN: In your method, Mr. Reed, did you observe a great rise in temperature in the last portion of liquid entering the prover? We have found a difference of as much as 5 degrees between bottom and top.

MR. REED: We did not find any great rise in temperature. We measured temperatures at the center of the prover, feeling that that gives an average that is close enough. Also, we checked temperature in the meter and just following the meter. For field use we have built insulated thermometer wells, one of which is to be clamped onto the pipe on each side of the meter.

MR. HOWARD: In my method I get the exact weight of one gallon at whatever temperature prevails at the meter, and then I determine by weight, regardless of the temperature in the tank, the exact number of gallons delivered into the tank.

MR. WEHMANN: If you weigh the 1-gallon sample at 70°, you get the weight of one gallon of product at 70°. But if the meter is measuring at 75°, for example, it is putting into the tank gallons that are lighter than the 70° sample, so it is necessary to make a weight correction, either from the meter reading down to the sample or from the sample up to the meter reading. If the temperatures at which the weight of the sample was determined and at which the meter is measuring are the same, then you are all right. We have run tests where the temperatures varied considerably throughout the test. One reason for taking temperature readings as close as possible to the meter is to minimize that variation. We seldom found variations of as much as 2 degrees. But in a gravimetric system, even with top filling, the variation will be considerably more than 2 degrees between the temperature of the sample and the temperature at the meter when it is operating.

MR. HOWARD: I take exception to what was said about the danger of dissipation. All I ever have to dissipate is one gallon, and I don't have to do that; the bottle can be turned upside down and the liquid poured back into the container.

MR. BERRYMAN: Mr. Wehmann, what size of prover do you recommend?

MR. WEHMANN: A minimum of 50 gallons. That is consistent with the ASME-API code for tank-truck meters. We feel that a meter should be operated on test for a minimum of one minute. Right now something smaller than a 50-gallon prover might suffice, but larger meters are coming and we should look ahead and provide for at least one-minute test drafts.

MR. COOLIDGE: We have been checking meters in Los Angeles County since 1940, using a 60-gallon gravimetric prover and determining specific gravities by the dry-ice method. We have rechecked

truck meters after 6 to 8 months of operation, during which they have measured perhaps 150,000 to 200,000 gallons, and results have agreed with original tests within less than one-half of 1 percent.

Mr. Brenton: The State of California has two 70-gallon volumetric units. Since 1940 we have made some 4,000 tests. On normal tests we apply a tolerance of 2 cubic inches per indicated gallon; on special tests our tolerance is 3 cubic inches. In 1952, out of 561 meters tested, 117 were sealed without correction, 355 were sealed after correction, and 89 were marked "Out of Order".

Mr. Baucom: There is an important point that we are still working on. A gravimetric prover cannot have a vapor return line. In top-filling such a prover, if the rate of flow drops to the point where there is no spraying of the liquid, a back pressure of as much as 325 pounds per square inch can be built up, and the vapor will not condense. It seems that the liquid must be sprayed in, or must be stirred or otherwise agitated, in order to produce condensation of vapor. We are experimenting with various mechanical means to solve this problem.

Mr. Batchelder: Outside of our plant in Pittsburgh, we have almost completed a rather elaborate LPG meter testing station, where we shall attempt to learn whatever we can about meter testing. At present we can add nothing to what has been presented to you, but from now on we shall do all that we can to help you and your committee in solving your LPG problems.

(In response to questions, it was brought out that: (1) A meter adjusted for one particular variety of LPG can be expected to give essentially the same performance with other varieties, because there is little difference in the viscosities of the several varieties. (2) The Committee on Specifications and Tolerances can make no close estimate as to when requirements specifically for LPG meters will be formulated. It will, however, make every effort to complete a tentative code or codes for presentation to the 41st National Conference in 1956. (3) Provers of the designs now contemplated can probably be sold complete at prices of from $1,200 to $1,500.)

(The Conference adjourned, to reconvene at 10:00 a. m. Thursday, May 19, 1955.)

FIFTH SESSION—MORNING OF THURSDAY, MAY 19, 1955

(A. O. Oslund, Vice President, Presiding)

REPORT OF THE COMMITTEE ON LEGISLATION, PRESENTED BY M. A. NELSON, CHAIRMAN

The Committee on Legislation submits this report with the following recommendations:

1. *Quantity Statements on Cans and Packages of Tobacco.*—A representative of the Internal Revenue Service, Mr. Norman T. Morsell, met with the Committee and stated that the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, now has authority to prescribe regulations to govern the payment of the tobacco tax. He stated that consideration was being given to the discontinuance of the use of stamps in the payment of the tax and the substitution of the return system. It was also stated that such a change might be made about January 1, 1956, and that the regulation making such a change in the collection of the tax would undoubtedly require a net weight declaration and a tax paid statement to be on each container of tobacco.

> It is the recommendation of this Committee that such a regulation as would require a net weight declaration on all tobacco containers be promulgated as soon as practical by the Commissioner of Internal Revenue.

2. *Amendment to the Model Law to Cover Special Labeling on Random-Size Packages.*—The Committee recommends that the Model Law be amended by adding a new section reading as follows:

> Sec. 19a. Same: Declarations on Random Packages.—That in addition to the declarations required by Sec. 19 of this act, any commodity in package form, the package being one of a lot containing random weights, measures, or counts of the same commodity and bearing the total selling price of the package, shall bear on the outside of the package a plain and conspicuous declaration of the price per single unit of weight, measure, or count.

3. *Standardization of Sizes of Prepackaged Commodities.*—The Committee still feels that standardization of the sizes of prepackaged commodities is desirable, but that the standardization program can best be worked out with the individual industries concerned rather than attempting an over-all standardization program by this Conference.

4. *Amendment to the Model Law to Provide for Adopting the Handbook 44 Codes by Statute Rather Than by Promulgation.*—There appears to be a rather wide sentiment among State and local officials for another amendment to the Model Law regarding the adoption of Conference-recommended specifications, tolerances, and regulations for commercial weighing and measuring devices. Therefore, this Committee recommends that the following amendment be inserted just before the final sentence of Section 7, Form 2:

> The specifications, tolerances, and regulations for commercial weighing and measuring devices, together with amendments thereto, as adopted by the National Conference on Weights and Measures, recommended by the National Bureau of Standards, and published in National Bureau of Standards Handbook 44 and supplements thereto, or in any publication revising or superseding Handbook 44, shall be the specifications, tolerances, and regulations for commercial weighing and measuring devices of the State of _____, except insofar as specifically modified, amended, or rejected by a regulation issued by the _____
>
> _____
>
> (Insert title of State official who issues promulgation)

(The report of the Committee on Legislation was adopted by the Conference.)

THE REQUIREMENT FOR SIGHT GLASSES ON RETAIL LIQUID FUEL DISPENSERS

REMARKS OF C. D. BAUCOM, SUPERINTENDENT OF WEIGHTS AND MEASURES, STATE OF NORTH CAROLINA

Basically, all weights and measures laws are for the purpose of providing standards of weight and measure and for the purpose of protecting the consumer. So far as I know, no State law incorporates details of enforcement; however, most State statutes provide for the adoption of rules and regulations consistent with the purpose of the law. These have the same effect as law. Thus, many rules and regulations have been promulgated and adopted by State and local jurisdictions under "State's rights" and "the right of local self government."

About 1905, cognizant of the lack of uniformity, the Director of the National Bureau of Standards called a conference of weights and measures officials in Washington. This meeting has become an annual affair known as the National Conference on Weights and Measures. The Director of the National Bureau of Standards appointed a committee known as the Committee on Specifications and Tolerances. This committee was instructed to review all of the rules and regulations then in existence and to draw up, as nearly as possible, a uniform code which would be acceptable to the majority of the jurisdictions affected. This procedure was endorsed by the Conference, and at a later date a code was promulgated by the Conference and recommended by the National Bureau of Standards as a model code for adoption by all weights and measures jurisdictions. I use the word "recommend" because neither the National Conference nor the Bureau has any authority by which they can enforce their recommendations; however, their recommendations have been accepted by all weights and measures officials at their face value, and, as a consequence, there is reasonable uniformity of rules and regulations throughout the United States.

In 1928 the Committee on Specifications and Tolerances recommended to the National Conference the adoption of the following specification: "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." I refer you to the report of the 21st National Conference on Weights and Measures, page 129. The committee consisted of F. S. Holbrook, National Bureau of Standards, Chairman; William F. Cluett, Chicago; Charles M. Fuller, Los Angeles; A. W. Schwartz, New York; and I. L. Miller, Indiana. This recommendation was held under consideration by the Conference until its meeting the following year, at which time it was unanimously adopted. I mention this in order that you may know that the recommendation was not a "flash" proposal and acceptance, but was given complete and deliberation consideration for a year after it had been recommended by the committee. The device herein referred to is the visigage or "see glass," and has been a vital part of any "blind" pump or liquid-measuring device ever since.

The fact that the National Conference unanimously approved such a specification, that the National Bureau of Standards recommended its adoption, and that the Bureau published said specification in its

handbook M85 in 1929, is positive proof of the need for such a specification. However, the importance of this specification justifies the mentioning of certain pertinent facts regarding the purposes of the visigage and why it still is in use.

It is generally conceded by every weights and measures official that any device which aids, or which can be made to aid, in the perpetration of fraud shall be condemned and its use prohibited. It is also conceded that a "blind" system of liquid delivery can, and therefore will, aid in the perpetration of fraud. Therefore, it is imperative that this specification remain in effect as long as "blind" systems of delivery are used. There is no substitute for this specification. To repeal or ignore the need of such a specification would constitute failure on the part of a weights and measures official to carry out his oath of office in the enforcement of the law and its purpose. No weights and measures official would dare be guilty of such negligence.

Now then, what is visigage? A visigage is any device which produces in the human mind, through vision, knowledge of a certain fact or facts, whether the device be a float gage or "see glass." The purpose of the visigage is to convey to the human mind the fact that the dispensing device—in this case the gasoline pump—is functioning as intended, that the system is full, that the air eliminator is functioning properly, and that the antidrain nozzle is holding. The visigage enables the operator of the pump and the purchaser of the gasoline to know, through observation of color, whether or not the gasoline being dispensed has been blended or is of a color contrary to the color advertised. It also enables the buyer and the seller to know for a fact that, if bubbles are passing through or if there is a drop of liquid level in the gage, the quantity registered as shown by the indicating elements is a false quantity. Either one of these constitutes fraud.

The visigage is the only means by which the operator of the pump has of knowing for a fact that he is delivering correct measure. Without it, he becomes liable, even though innocently, to the penalty of the law. Therefore, he cannot afford to take a chance. Furthermore, the visigage is the best advertisement a dealer can have on his pump, because a misrepresentation either of quality or of quantity will lose a customer more quickly than anything else. Therefore, it is good business to keep a visigage on a pump and to keep it clean, so that there wil be no question in the mind of the purchaser, the operator, or the casual observer, as to the desire of the owner of the pump to give value received, as advertised. In my opinion, to leave off the visigage would be business suicide, as well as illegal.

REMARKS OF C. F. BATEMAN, ASSISTANT GENERAL MANAGER, WAYNE PUMP COMPANY, SALISBURY, MARYLAND

Because of considerable discussion regarding the real need for a visigage on modern retail gasoline dispensing devices, it was indicated that some one should be selected to present the story against existing requirements for the use of a visigage to the National Conference on Weights and Measures. When asked if I would undertake this task, I willingly accepted, because the subject is so vital to both the petroleum industry and to equipment manufacturers. The oil industry,

through the American Petroleum Institute, has expressed a consolidated view which takes exception to the requirement for the visigage for reasons expressed in this report, and others too numerous to mention in the limited time available. It is also known that all manufacturers of motor fuel dispensing equipment for retail trade are in accord with the proposal that the visigage be eliminated as a component of such equipment.

More than six years ago, this question began to take definite form and answers were sought from equipment manufacturers, equipment users, and weights and measures officials. In nearly every instance, the answer has been the same, "It serves no useful purpose in a retail motor fuel dispensing device." On the other hand, some very few persons contend that the visigage is a true indicator of what is happening within the device. They believe that it indicates (a) if the device is full of liquid before a delivery is begun and (b) if liquid is flowing through the device when the discharge nozzle is opened.

Let us analyze these statements, first setting up the conditions which are supposed to make the indicator reliable. (See fig. 17.)

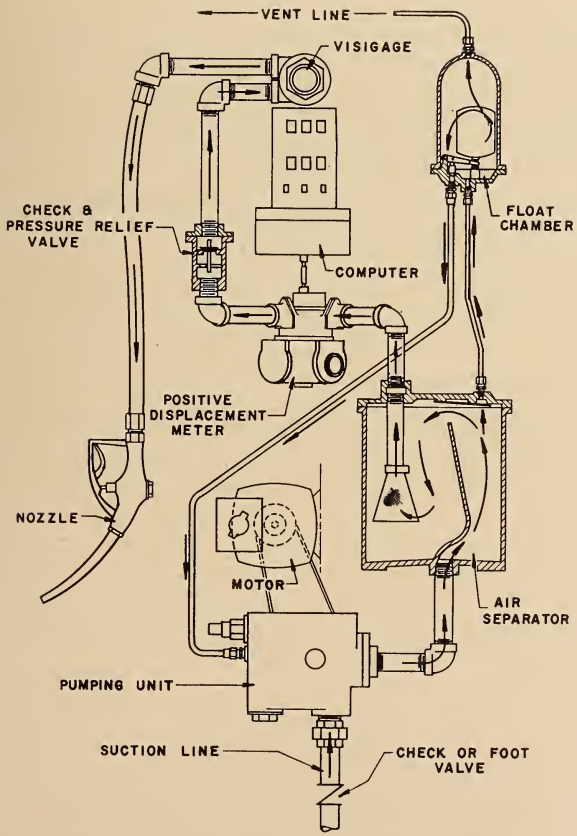


FIGURE 17. *Schematic diagram of retail meter-type liquid-measuring device.*

A. TO INDICATE A FULL SYSTEM

Conditions

1. There must be a check valve or foot valve in the suction line. Otherwise, when the pump is at rest, air will enter the system through the float chamber vent, displacing liquid as it flows back to the storage tank.

2. There must be another check valve between the air eliminator and the visigage to prevent liquid from flowing from the visigage into the float chamber during idle periods (should normal liquid level in float chamber be lower than visigage).

3. This check valve (see Item 2 above) must be by-passed by a relief valve to permit liquid beyond the check to expand and relieve into the float chamber. This is necessary to prevent excessive pressure caused by thermal expansion from cracking the glass visigage.

Analysis

1. The three conditions described above are necessary to help assure accurate measure. Since they are met in the design and manufacture of all dispensing devices, it then becomes apparent that it is impossible to indicate air by means of a visigage—because there can be no air present.

2. Before air can be pumped through a positive displacement meter such as is used in all modern dispensers, sufficient pressure must be developed to produce movement of the meter. The pressure required is not available because air will take the path of least resistance, which is through the air eliminator vent. Close observation of figure 17, which illustrates a typical air eliminator, will make this apparent. The connection between the air eliminator or coalescent chamber and the float chamber contains a controlled orifice which will permit free passage of air at a pressure lower than required to operate the meter. In an air eliminator chamber such as shown in figure 17, ebullition and coalescence are accomplished on the inlet side of the chamber, where the liquid flow is subject to a change in velocity coupled with a change in direction. Air accumulates in the upper part of the eliminator and passes off through to the float chamber, where final separation occurs. Sudden large volumes or slugs of air are safely handled by locating the fluid discharge point at or near the bottom of the eliminator. This permits a large volume of air to accumulate temporarily without any air being carried through the discharge and into the meter.

3. There are some unusual conditions which cause the appearance of air or vapor in the visigage. Prominent among these is the void produced by thermal contraction of liquid when the equipment stands idle for a long period spanning hot, then cold, atmospheres. A void in the visigage can sometimes be caused by a leaking check valve or relief valve, usually in combination with a leaking foot valve. Such failures are so infrequent that they may be considered negligible. If such a condition should exist, the computer will move ahead when the pump is started, while the nozzle is still closed. This reaction is much more apparent and is a more positive indication of air in the system than is the appearance of the visigage.

4. All newly designed motor fuel dispensers offered for use in retail trade are inspected and tested by weights and measures officials before

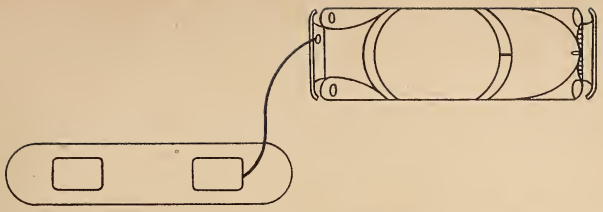


FIGURE 18. *Possible relationship between dispensing unit and receiving vehicle.*

they are first offered for sale. Each device thereafter produced is carefully checked for accuracy by the manufacturer before shipment. At the time of installation, it is checked by weights and measures personnel. During not one of these inspections does the appearance of the visigage have any influence on the test results. The two basic elements are the standard test measure and the computer readings.

5. In order to test public reaction to the elimination of the visigage, a large number of pumps throughout the country were treated by various means to make the visigage unreadable. During a thirty day period, there were no comments made to the dealers other than a few remarks such as, "That's unusual." In not one service station was a single customer complaint recorded. This test produced positive support to the belief that people do not watch the visigage. Numerous surveys have been made by oil marketeers in an effort to determine how to attract the attention of a service station customer while his vehicle is being fueled. An analysis of these surveys shows that only a very small percentage of customers watch the computer.

Figure 18 illustrates a somewhat typical service station island layout showing a possible relationship between the dispensing unit and the vehicle. There are obviously many other possible combinations; however, none of them produce the desired result of having the dispenser conveniently visible to the customer, with the car so positioned as to facilitate dispensing motor fuel.

6. The use of a glass cup as part of a fluid pressure system for handling hazardous liquids is risky; in fact, it makes light of the high value we normally place on human life and property. One single fire caused by a cracked visigage glass can cause far greater loss than any value which can possibly accrue to anything so vague in meaning as the visigage. Believing that the importance of good design to insure maximum possible fire prevention transcends any possible benefit which might be credited to the visigage, I contacted Underwriters' Laboratories, Inc., in Chicago, and received from Mr. W. W. Remer the following telegram.

Northbrook, Illinois, April 12, 1955—12 : 57 PM

C. F. Bateman
Wayne Pump Company
Salisbury Maryland

Confirming phone conversation Underwriters' Laboratories, Inc. is prepared to revise standard for power-operated discharge devices to delete requirement for visible discharge indicator. Glass indicators have been a constant source of trouble in past years. Believe that elimination of indicator will remove a potential hazard and contribute to a greater degree of safety.

(Signed) W. W. REMER, UNDERWRITERS' LABORATORIES, INC.

The importance that fire prevention people and equipment engineers place on the elimination of such a hazard as a visigage cannot be justifiably overlooked.

B. VISIBILITY OF FLUID FLOW

Conditions

1. The visibility requirement means that the visigage be made of glass.

2. Motion of fluid under glass is generally not apparent unless some artificial means is adopted to amplify the motion.

Analysis

1. The use of glass, with all the attendant risks previously described, is difficult because it must be mechanically joined to metal parts and sealed to prevent leakage. While this can be accomplished in most cases, there is no assurance that all parts produced will be absolutely tight to guard against the danger of fire.

2. How does the customer know that motor fuel and not some other fluid is being pumped through the visigage? Does he know by sight alone that he is buying motor fuel, kerosene, diesel fuel, or perhaps even water? He does not know; consequently, he must buy in good faith, as he does in many other instances when purchasing a commodity in a sealed, opaque container.

3. In order to make apparent the motion of a fluid under glass, the equipment manufacturers have incorporated in the visigage a mechanical device which is sensitive to the flow of fluids. This has taken the form of spinners or small multicolored balls. In many cases, the mechanical friction and the inertia of these devices prevent motion of the indicator when the fluid displacement is below three gallons per minute. Since such is the case, the device is definitely limited in scope and cannot be said to be a true indicator of fluid flow.

DISCUSSION OF FOREGOING REMARKS

Mr. J. T. Kennedy (D. C.) : I would like to ask Mr. Bateman, if the visigage is eliminated, will the check valve between the visigage and the meter also be eliminated?

Mr. Bateman : There is no intention of eliminating the check valve or check pressure relief valve. This valve that Mr. Kennedy refers to is located on the discharge side of the meter. This valve serves a functional purpose in the equipment and, as such, there is no intention on the part of any manufacturer to remove this part.

Mr. J. T. Kennedy : But did you not state that that valve was placed there to keep the visigage from cracking?

Mr. Bateman : I said it was put there to keep the visigage full and to prevent cracking of the glass in the event of thermal expansion in the liquid.

Mr. J. T. Kennedy : You read a telegram from the Underwriters. Have you ever heard anything from any fire prevention unit of any local or State fire department protesting against the use of a visigage?

Mr. Bateman : I have it on the authority of Underwriters that such cases have occurred.

Mr. J. T. Kennedy: We work very closely with the Fire Prevention Division of the District of Columbia, which is recognized as efficient, and we have never heard one complaint from them about the visigage.

Mr. Bateman: I can recite a case that I know of personally where a gasoline pump caught on fire and the visigage broke and spread the fire by permitting gasoline to flow from the system.

Mr. J. T. Kennedy: That is admitted, but probably the fire started from a connection somewhere else, but not the visigage. If it gets hot enough, it will crack the visigage and add to the fire.

We admit, say 90 percent of the people do not know what a visigage is for. Maybe 10 percent do. Do you not think that it is some protection to maybe 10 percent of the people, to know that they are going to get gasoline, kerosine, or something else? Do you admit that 10 percent look at the visigage?

Mr. Bateman: I think that is beside the point. The point of the matter is that the equipment will give honest delivery regardless of the visigage. The visigage does not mean anything. If the pumps were not delivering any liquid but strictly air, the observer or customer would never know the difference, because gasoline in many cases is colorless and so is air.

Mr. J. T. Kennedy: You mean they could deliver pure air to you through the line and you would never know it?

Mr. Bateman: With the visigage you could not tell whether it was air.

Mr. J. T. Kennedy: You could not tell whether it was air or liquid? The part will still rotate.

Mr. Bateman: That is possible, but the equipment is designed to prevent such an occurrence.

Mr. J. T. Kennedy: That is all I have. I would like to bring up one point. We admit that maybe 90 percent of the people do not look at the visigage. I would say that 90 percent of the people do not look at the customer's side of the scale. So if we eliminate the visigage from the gas pump, why don't we eliminate the customer aperature on the scale?

Mr. Bateman: We actually see no correlation between a scale and a visigage on the gasoline pump. The corresponding information on a gas dispenser is shown by the computer wheel, the price wheels, gallon wheels, and the money wheels. There is actually no connection between a scale and a visigage on a gas pump.

Mr. Searles: Mr. Bateman, approximately how such cheaper will a gas pump be without the visigage?

Mr. Bateman: The question is how much money will the oil company save? There is no proposal to change the price of gasoline pumps because of elimination of the visigage. What we are trying to do is to eliminate an unnecessary part which contributes greatly to hazards and maintenance. Obviously, a visigage costs money, and we claim that it is a foolish extravagance, a waste of material, since it does not contribute anything. Consequently, we feel that the requirement should be deleted.

We know from our surveys that nowhere near 10 percent of the people look at the visigage. Approximately 5 years ago we set up in Salisbury, Maryland, a complete service station without visigages.

Over a 6-month period not one customer asked about the visigage. The same characteristic was found to be true in over 700 pumps that recently were fitted so that the visigage was not visible. There were so few comments made by the customers that it is obvious that well under 1 percent look at the visigage.

Mr. L. L. Kennedy (Esso Standard Oil Company): We have talked about seeing what you are getting and you must have a visigage on a pump to see what you are getting. I think it has been brought out here fairly clearly that a visigage does not in any way guarantee that you are getting what you are supposed to be receiving when you buy motor fuel at a service station. So if you are looking for that sort of thing, it seems to me that we must also demand that the people in the grocery business put into every package that they put out, for instance a package of powdered sugar, a glassine window, so that the customer would be more or less assured that he is getting sugar.

Mr. J. P. McBride: I think some of the analogies are incorrectly drawn, but it is particularly interesting from one standpoint. The equipment men, who have told us that they were complying with the specification by reason of the visigage, tell us now that that visigage does not do the thing it purports to do and that we have been led to believe that it does, and that one of the reasons is that, again by permission, valves have been permitted in a line and these valves are contributing factors to the failure of the visigage. I don't think that the analogy that the customer should not have the visibility because he does buy packaged goods which he does not see is right. There is a good deal of difference between a factory-filled package which is properly labeled and the sale of a product at a filling station where the control of delivery of the product is by an individual, sometimes an employee, sometimes an owner, and the product comes to the customer through a line and into a receptacle of the customer, so that he has no knowledge of what is happening except that he may read an indicator on the device. The purpose of the visigage was to give the customer the opportunity to see that a liquid was going through. In the passage of time, visigages have been reduced in size. Perhaps it is our fault that the sizes of the visigages have so deteriorated that they probably no longer serve their original purpose. I think perhaps there is some merit to the argument that the visigage may be contributory to hazard. This, I think, is worthy of consideration.

However, the device does have a useful purpose, whether or not the public may look at it. I think that, even though the public may not see the visigage, it is of some advantage to the inspector in going around and making casual inspections. He notices whether or not bubbles appear in the visigage.

There are other phases of it, too, that perhaps do not concern weights and measures, as, for example, gasoline enforcement laws. I think that we should not take any hasty action on this matter. I think it is worthy of further study.

Mr. Bateman: I do not think that we should judge what we have proposed here in the light of speculation. We should judge it on the basis of engineering knowledge. We all know that the reason the visigage was first adopted was to prevent inaccuracies because equipment was built with what we called dry-hose construction. The early pumps were not equipped with air eliminators. Since that time we have come a long way in developing the dispenser. We have equip-

ment today that insures accurate measurement. The visigage contributes in no way at all to the purpose. When you go out as weights and measures inspectors and run a test on a gasoline-dispensing pump, the only things you use are your test measure and computer reading. If the unit tests within the tolerance allowed, that is your criterion for the acceptance of the device—not whether the visigage appears to be full or the color of the liquid.

Mr. Kennedy (Esso Standard Oil Company) : I would like to suggest that a study be made by the weights and measures officials in the light of some of the things that have been brought out here this morning. We will be happy to supply you with as much data as we can.

REPORT OF THE COMMITTEE ON TRADING BY WEIGHT, PRESENTED BY G. L. JOHNSON, CHAIRMAN

During the year 1954–55, the Committee on Trading by Weight has investigated the feasibility of having more trading by weight instead of by measure, particularly in the grain trade. This was done through active correspondence with grain dealers, associations, brokers, and exchanges, and the response received by the Committee was very encouraging. Almost every reply indicated preference for trading by weight. However, the problem as to how and when the changeover should take place remains undecided. It is the sincere wish of the marketing interest that the National Conference on Weights and Measures will be able to stimulate interest and eventually solve this problem, which has been in existence since 1867.

The Committee called a meeting with representatives of the U. S. Department of Agriculture in October 1954 to discuss these problems.

The final meeting of the Committee was held in the Shoreham Hotel May 16, 1955, prior to the opening session of this Conference. This was an open meeting and included representatives of interested agencies and groups who expressed their approval of or opposition to the proposal. Informal discussion favored the practice of selling exclusively by weight, in order to establish a uniform practice in commercial transactions.

It is recommended that this Committee be continued and that the members of the Conference aid and assist this Committee during the ensuing year. The Committee also asks the Conference membership to recommend the appointment of one or more members to be selected from commercial enterprise, associations, or other interested parties.

The Committee wishes at this time to acknowledge the support and aid afforded by all those who cooperated with the Committee during the year.

(The report of the Committee on Trading by Weight was adopted by the Conference.)

REPORT OF THE SPECIAL FLOUR COMMITTEE, PRESENTED BY J. P. McBRIDE, CHAIRMAN

Your special Flour Committee has now completed its second year of study and herewith presents its final report. This Committee, as you will recall, grew out of a motion at the 38th National Conference on Weights and Measures, with representation on said Committee, of three Weights and Measures officials, three members of Flour Industry, and two consultant members, W. S. Bussey, Chief of the Office of

Weights and Measures of the National Bureau of Standards, and S. C. Rowe, of the Food and Drug Administration, U. S. Department of Health, Education and Welfare. Its first year of activity is recited in the tentative report submitted to the 39th Conference, which briefly included a visit to flour mills to witness actual operations and gathering test data from various weights and measures jurisdictions. This work was not completed to the satisfaction of the Committee and a further year of study was requested of the Conference and was granted.

Over the years, flour has offered a weights and measures problem due to variations in weight that occur in packaged flour and that are largely attributable to the hygroscopic nature of the commodity. Flour is of nationwide use, which gives it an interstate phase, and therefore, it originally comes under federal control. It is to be noted that, under this supervision, it is required that the commodity be equal to the marked weight on the package, irrespective of type of package, in relation to ability to arrest moisture loss, at the time it enters interstate commerce. The federal code further permits variations of two general types:

1. Variations from the stated weight or measure shall be permitted when caused by ordinary and customary exposure, after the food is introduced into interstate commerce, to conditions which normally occur in good distribution practice and which unavoidably result in change of weight or measure.
2. Variations from the stated weight, measure, or numerical count shall be permitted when caused by unavoidable deviations in weighing, measuring, or counting individual packages which occur in good packing practice; but, variations shall not be permitted to such extent that the average of the quantities in the packages comprising a shipment or other delivery of food is below the quantity stated, and no unreasonable shortage in any package shall be permitted, even though overages in other packages in the same shipment or delivery compensate for such shortage.

It is therefore recognized under the first of these permissive variations that, unless the package is air tight, variations will occur by reason of moisture loss or so-called shrinkage. The Federal Food and Drug Administration makes allowance for the shrinkage only after the product enters interstate commerce, dependent on factors such as type and size of package, temperature and humidity of atmosphere to which the commodity is subjected, the length of time in storage, and type of product. It does not, however, set up specific tolerances, as it is treated as a question of fact to be determined on the circumstance of a particular case. Moisture loss or shrinkage appears to be the principal difficulty with flour. The second of the permissible variations is more easily controlled, as this involves mechanical phases of proper quantity control, and needed improvements in this respect in some instances have been recommended by your Committee.

Insofar as this body is concerned, the problem which confronts it is the intrastate phase or when state laws become operative. State laws are not uniform however. Some states have a law requiring that all commodities in package form be marked as to quantity, others require that food in package form only be so marked, with provision in some of these latter states that variations similar to the federal code are permissible, while in other states no such provision is made. Again, in other states there is no law requiring packaged food to be marked,

and these states apparently operate solely on the so-called short weight law, while certain other states have a "net weight" law requiring that all commodities sold be of the represented weight. This presents a situation somewhat chaotic where some states may proceed under authority with varying degrees of success, with the probability that states having only a short weight law or net weight law have the most favorable position with relation to expectancy of successful prosecution insofar as the question of shrinkage is involved, although doubtlessly courts may take into consideration possibility of physical compliance with the law.

You will recall that, in the tentative report to the 39th Conference, mention was made of the fact that the 38th National Conference on Weights and Measures accepted a recommendation of the Conference Committee on Legislation on adoption of a Model State Regulation governing commodities in package form which contained, insofar as this immediate question of moisture content is concerned, the following language:

> Variations from the stated weight or measure shall be permitted when caused by ordinary and customary exposure, after the commodity is sold and delivered by the manufacturer, packer or distributor, to conditions which normally occur in good distribution practice and which unavoidably result in change of weight or measure.

It will be noted that, in the federal code, the permissive variation due to exposure is allowed "after the food is introduced into interstate commerce", whereas in the Model State Regulation the variation is permitted "after the commodity is sold and delivered by the manufacturer, packer or distributor".

The subject of moisture loss in flour has been treated time and time again both in National Weights and Measures Conferences and in State Weights and Measures Conferences and apparently will be a cause for discussion until some progress is made toward resolving the problem in a manner different from the present status.

It was pointed out in our report to the Conference last year that the Committee felt that it would be repetitious and would serve no useful purpose to gather further data specifically on moisture losses occurring in packaged flour; this phase of the general subject is believed already to be adequately documented. It was thought, however, that further information was needed about actual package weights. Accordingly there was sought and obtained, with the assistance of the Office of Weights and Measures of the National Bureau of Standards, the co-operation of 44 weights and measures jurisdictions in the collection of field data, of the Millers' National Federation, and about 30 milling companies in the furnishing of certain production data, and of National Bureau of Standards personnel in correlating, tabulating, and analyzing these data. The Committee wishes to express its appreciation to all of these co-operating agencies, and to each of the individuals involved for the valuable assistance rendered in gathering and summarizing these factual data. Without the co-operation of the individual weights and measures officials and the mills involved, the survey would not have been possible.

The survey covered all sections of the country. Data on sample packages were obtained in 34 States, representing contributions to our study by 29 State and 15 local weights and measures jurisdictions.

The products of large and small mills were included. The survey was limited to 5-pound packages of white flour, and a total of 430 identifiable samples of such packages were examined, all samples being obtained from retail stores. The plan of the survey called for determining, for each sample, the net weight and moisture content of each sample, and for recording, whenever obtainable, the identifying code number of the sample. From the code numbers there were later obtained from the mills the percentages of moisture, at time of packing at the mills, of the several lots of flour so identified. Using this information and the field weights, the net packing weights at the mills were computed.

The results of the survey may be summarized briefly as follows:

16.8 percent of 430 samples had net weights of 5 pounds or more when weighed at retail stores. The remainder of these samples weighed less than 5 pounds net.

The average net weight at retail stores was 4.96 pounds.

The average moisture content at time of weighing at the retail level was 12.09 percent.

There were 256 samples on which mill data were obtained and mill packing weights computed.

Of these 76.2 percent were calculated to have been packed at net weights of 5 pounds or more. The remainder of these samples were calculated to have been packed at less than 5 pounds net.

The average computed net mill packing weight was 5.04 pounds, i. e., 5/8 ounce over the stated net weight.

The average moisture content at time of packing at the mills was 13.79 percent.

It is recognized that actual numerical results obtained from some other survey, perhaps involving packages of other sizes or made at some other season of the year, might well differ from the results reported here. However, the general results developed by this year's survey are believed by the Committee to be indicative, and certain conclusions can be drawn therefrom. Two such conclusions are of special significance. First, weights of flour packages are unavoidably affected by differences in the conditions of handling and storage, by geographical location, and by weather conditions. Second, weights of flour packages as currently marketed are affected by differences in packing standards and procedures at the mills. That these conclusions are not new, does not detract from their importance to our present study. Our most recent survey is considered to have been helpful even if it did no more than confirm our earlier thinking on these phases of the problem of flour-package weights.

As you know, our Committee membership comprises weights and measures officers and representatives of the flour milling industry. We have discussed the opinions of members of the two groups we represent, and we know that among these groups are individuals who hold extreme views. On the one hand there is the weights and measures officer who maintains that a package of flour must always be of full net weight when delivered to the ultimate purchaser, regardless of what may have happened to it prior to that time and regardless of how long it has been since it left the mill where it was packed. On the other hand there is the miller who holds that, regardless of all else, he has discharged his full responsibility when he sees to it that packages of flour leaving his mill contain the weight of flour declared on the package. Your Committee, composed, we believe, of practical men, feels that a solution to the problem lies somewhere between these

viewpoints. Moreover, the Committee has agreed that nothing will be gained by prolonging the investigative phase of its discussions.

The flour industry representatives on this Committee obviously have no authority to make commitments for the milling industry at large. Accordingly, this entire problem was presented to the Board of Directors of the Millers' National Federation at its annual meeting in Minneapolis, Minn., on Thursday, May 12, 1955. Following full discussion of all aspects of the flour weight problem, the Board unanimously adopted a resolution outlining the manner in which the Federation can, and will, make constructive progress toward solution of the problem.

Following the adoption of the resolution, a complete report was made on May 13, 1955, to the full convention attending the meeting.

The complete text of the resolution adopted by the Board of Directors of the Millers' National Federation is as follows:

> Whereas federal statutes and regulations relating to label statements of weight of contents of packages of food moving in interstate commerce are applicable to packages of flour and other products of the milling industry, and in some cases state and local statutes, ordinances, regulations or enforcement policies vary from or are in conflict with the federal statutes and regulations, with resulting confusion; and
>
> Whereas this Board of Directors has heard the report presented at this meeting of the study and consideration that has been and is being given to these problems by the National Conference of Weights and Measures officials, and particularly by a special committee thereof appointed to consider said problems as related to flour, and has been informed of what appears to be a growing tendency on the part of certain state and local officials to require packaged flour to equal or exceed stated weights at time of sale within the particular jurisdiction, regardless of unavoidable loss of weight due to evaporation between date of packaging and date of sale at retail, compliance with which requirement would necessitate overpacking; and
>
> Whereas this Federation has no right to control, and does not attempt to control, the practices and policies of its members in matters relating to the manufacture, packaging, sale or pricing of their respective products, but is concerned with matters which affect the industry as a whole, and does attempt to keep its members informed of developments of importance to the industry; Now therefore be it
>
> *Resolved*, that the appropriate officers of the Federation be and they hereby are authorized:
>
> 1. To promptly inform the members of the industry of the developments above described;
>
> 2. To promptly advise the members of the industry of any recommendations which may be made or other action which may be taken by said Conference in respect to any of the aforesaid matters; and
>
> 3. To recommend to the members of the industry that renewed and continued effort be made to constantly improve weighing and packaging equipment and procedures, to the end that weight variations in flour packages be held to the lowest possible minimum and uniform accuracy of package weights be thus attained.

Your Special Flour Committee is heartened and encouraged by the attitude of the flour milling industry as expressed in the foregoing resolution. In it the industry has pledged its cooperation toward minimizing the flour weight problem.

As further evidence of this, the milling industry is presently conducting a survey of its current packing practices and weight checking procedures.

Also, your Committee is pleased to be informed that the Millers' National Federation will welcome the oportunity to cooperate fur-

ther with Weights and Measures officials and will make available the continued services of its representatives in any capacity.

The foregoing summarizes the action taken by the Millers' National Federation as the result of the report and recommendations of the flour milling members of your Committee.

The weights and measures members of your Committee now offer the following recommendations as a workable program which they believe is fair to the producers, marketers, and consumers of flour, and one that at the same time is practical from the standpoint of weights and measures enforcement.

1. It is recommended that this program be based on the principle that packaged flour shall be full weight when delivered to the retail outlet. This means that flour packages must be so packed that, while they are in transit and while they are in storage at any point other than the retail outlet from which sale is made to the ultimate consumer, the packages be of full net weight as defined in paragraph (j) (2) of the Model Regulation for Package Marking Requirements of the National Conference on Weights and Measures. (Here, and elsewhere in this report, in the case of a chain of stores, "retail outlet" shall mean a particular store outlet and shall not include the warehouse of the chain.)

2. It is recommended that weights and measures officers recognize as reasonable and proper the shortage from declared weight that results from the unavoidable loss of moisture from flour packages stored under reasonable conditions in the retail outlet. If an undue loss of moisture is caused by unreasonable storage in the retail outlet, the retailer is, of course, responsible.

3. It is recommended that, where possible, weights and measures officers, as a practical enforcement procedure, concentrate their check-weighing of flour packages largely at the distributor level—that is, at the warehouses of the mills, of jobbers and distributors, and of store chains—where full net weight is to be required and where the moisture content of the flour will not be a matter of consideration. When check-weighting at retail outlets, any shortages found are to be considered in relation to average warehouse weights for similar packages of the same brand of flour, and if the magnitudes of the shortages do not exceed what the officer determines to be a reasonable moisture loss, the packages are to be treated as satisfactory for sale. Moisture determinations can be resorted to if required, but usually should be unnecessary.

4. It is recommended that, if and when short-weight packages are discovered at warehouse level or when unreasonably large shortages are found at the retail level, the packages be ordered "off sale", the mill responsible for the packages shall immediately be notified of the facts, and an opportunity be granted for the mill to take the necessary remedial steps, thus taking into consideration that considerable difficulty will be involved for a mill to conform to this principle of packaging at all times. Many things can and do occur to packaged flour after it leaves the mill and before it reaches the ultimate consumer. Prosecution should be initiated only when suitable cooperation is not forthcoming and satisfactory adjustments are not promptly made, or when weight discrepancies are of such magnitude or frequency of occurrence as to indicate the need for drastic official measures. This recommendation is based on the conviction that, in the large majority of cases, better and more lasting results will be obtained from a program of education and cooperation than will be obtained from a plan of prosecution at every opportunity.

5. It is recommended that, for use in the checkweighing program, a series of average tare weights be determined for each brand and package size, and that these be checked from time to time. In setting up such a list of average tare weights, it is suggested that the mean of the actual tare weights of the lightest and heaviest packages of a group be used if these two tare weights are found to be in good agreement; otherwise a greater number of actual tare weights should determined to arrive at an acceptable average. (It will be understood, of course, that actual, not average, tare weights must be used if a prosecution is being made.)

6. It is recommended that weights and measures officers recognize that a reasonable period must be allowed for adjustment to the general program

herein outlined, particularly for putting into practice the basic principle of full-weight packages at all points up to and including delivery to retail outlets. Officials can further the program by discussing it at weights and measures meetings and schools and using it as a topic in their public relations activities. It is recommended that the milling industry also carry on similar educational activities among its members and customers, and otherwise help to implement the over-all program.

7. An associated recommendation is that in every weights and measures jurisdiction where it is practicable to do so by State or local promulgation or enactment, there be put into effect the Model Regulation for Package Marking Requirements as adopted by the National Conference in 1953. In some States this may necessitate a special promulgation under the special standard flour package section of the law.

8. The Committee strongly recommends that local officials work as closely as possible with their State office in effectuating this program. Also, all weights and measures officials and representatives of the milling industry are earnestly urged to give their wholehearted cooperation in putting this program into effect and carrying it out in the future.

While the industry members of this Committee are unable, on behalf of the milling industry, to subscribe to the foregoing recommendations of the weights and measures members, the industry members will transmit these recommendations to the Millers' National Federation for dissemination to its members, as contemplated by the resolution adopted by its Board of Directors.

In concluding this report the Committee wishes to remind the National Conference, that from the weights and measures standpoint, packages of flour and other commodities affected by moisture gain and loss present problems of particular difficulty. It seems impossible to devise enforcement programs for such packages that are wholly satisfactory to all parties at interest. In reaching any acceptable resolution of conflicting ideas in these cases, a spirit of give-and-take must prevail. The members of our Committee have made an earnest effort to be open-minded and objective as well as reasonable in handling our assignment.

Mr. Baucom: I want to say that that is one of the most thorough and comprehensive reports that I have ever heard at this Conference in 28 years. I move that we not only adopt this report, but that the committee be discharged with a rising vote of thanks for the thoroughness with which they have performed this task.

(The motion was adopted by the Conference.)
(The report of the Flour Committee was adopted by the Conference.)
(The Conference was recessed until 2 p. m.)

(A. O. Oslund, Vice President, Presiding)

REPORT OF THE COMMITTEE ON METHODS OF SALE OF COMMODITIES, PRESENTED BY G. H. LEITHAUSER, ACTING CHAIRMAN, AND DISCUSSION THEREON

Your Committee on Methods of Sale of Commodities submits its final report to this Conference. As has been stated before in our reports, uniform laws, uniform interpretation, and uniform inspection procedures are not only desirable, but they are essential in our weights and measures work. This can only be accomplished through the cooperation of industry as may be concerned, the public, and weights and measures officials. The cooperation of industry, and the understanding and realization on the part of the public concerning the important part weights and measures occupy in everyday life has been very good and is increasing each year. The tentative report of the Committee was discussed in both open and executive committee sessions. This final report replaces and supersedes the tentative report.

The following items are presented for your consideration and such action as the Conference may deem appropriate.

1. *Inert Liquid Fertilizers.* This is a holdover item from the National Conference of 1953. The Committee in its report at that time recommended the following: "Inert Liquid Fertilizers shall be sold by volume based on the United States standard gallon of 231 cubic inches, its multiples and binary submultiples, or by avoirdupois net weight." It developed from discussions when this item was presented for the consideration of the Conference that the item title was not sufficiently definitive and that a stipulation for temperature should be incorporated in consideration of pressure being a determining factor.

Due to extenuating circumstances, this subject was not pursued in the Conference of 1954 and is still subject to study. The Committee, after reviewing the original recommendations at its pre-Conference hearings, has nothing further to recommend regarding this subject at this time.

(Item 1 was adopted by the Conference.)

2. *Garlic Buds.*

Shall be sold by avoirdupois net weight; when in package form in quantities of one-*half* ounce or more, the net quantity shall be declared upon the container.

This recommendation is influenced by the disparity and variable sizes of garlic buds, and it is, therefore, deemed that sale by numerical count does not properly convey to the consumer accurate and determinative information on which to gage the value of his purchase and is, therefore, contrary to the principles of net weight labeling laws.

(Item 2 was adopted by the Conference.)

3. *Extratordinary Terms on Standard Containers for Ice Cream.*

It is recommended that the Conference go on record as condemning the use of such terms as "JUMBO", "GIANT", "KING SIZE", "TEXAS PINT", or any other misleading terms on standard containers for ice cream, and that containers incorporating such terms in their markings be denied approval for use as ice cream containers.

Such terms, no doubt, are subtle in their intent for what psychological effect they may have. Designations of this kind are quite in the same category as the use of such statements as "Full Pound," which often appears in advertisements of certain types of vendors merchandising such items as cakes and candy. Webster's Dictionary defines the adjective word "JUMBO" as "Huge of its kind." Obviously, you cannot have a "huge" standard measure container. Such containers either hold their declared rated capacities within the tolerances that our codes permit, or they are not correctly marked.

(Item 3 was adopted by the Conference.)

4. *Meats.*

It is recommended that this Conference go on record as condemning the sale of meats by the packing industry on the basis of gross weight and the methods of invoicing or billing their trade by such weight.

The practices of the meat packing industry in this connection have led to highly controversial situations due to the dissatisfaction of buyers in being billed for their meat supplies at gross weight whereas they in turn must vend by net weight. The industry has taken the position that the incorporation of the gross weight term in their invoices takes the form of a contract with their customers. It appears that buyers have little say in the matter and are, therefore, required to accept the terms of the invoice whether they like them or not.

From the standpoint of weights and measures principles, there would appear to be no justifiable reason why net weight requirements should not apply to the packers as it does to other segments of the meat trade, as well as the vast number of other enterprises dealing in food commodities. Merchants in the meat trade fear reprisals if they complain, and the situation, therefore, appears to be one in which coercion exists and which should not prevail in our American system of trading.

(Item 4 was adopted by the Conference.)

5. *Meats and Poultry in Plastic Wrappings and Casings.*—It is proposed that the recommendation adopted by the 36th National Conference in 1951 under this heading, and which appeared as Item No. 3 in the report of that year, now be amended to read as follows, and this Committee so recommends:

Meats and Poultry in Plastic Wrappings and Casings:—Shall be exempt from net quantity declarations at packing sources and shall be sold on the basis of actual avoirdupois net weight at time of sale; provided that each item of meat or poultry so wrapped or contained shall be plainly and conspicuously marked with the legend: "TO BE WEIGHED WHEN SOLD OR OFFERED FOR SALE" and, where the weight of the wrapping or casing exceeds 1/8 ounce per pound of the product contained therein, the tare weight shall also be plainly and conspicuously marked for deduction to determine the net weight; and provided, further, that when such products are sold at retail in establishments where the packages are not weighed in the presence of the buyer the net weight shall be declared by the retailer on the package or on a tag affixed thereto or on a sales slip rendered therewith to the purchaser.

For comparison, the original recommendation is quoted:

Meats and Poultry in Plastic Wrappings and Casings:—Shall be exempt from net quantity declarations at packing sources and shall be sold on the basis of actual net weight at time of sale; provided that each item of meat or poultry so wrapped or contained shall be plainly and conspicuously marked with the legend: "TO BE WEIGHED AT TIME OF SALE" and, where the weight of the wrapping or casing exceeds 1/8 ounce, the tare weight shall

also be plainly and conspicuously marked for deduction to determine the net weight.

The modification in the stipulation relating to tare weight will be noted. The 1/8 ounce limitation originally incorporated applied to each package regardless of its size. Through further exploration, the conclusion was reached that this is unreasonably restrictive and that the weight of the package should have consideration. In its original representations, the Committee primarily had in mind the one-pound packages of meat products, so highly prevalent in the trade, and we now feel that there is justification in having the 1/8 ounce stipulation apply to each pound of product rather than to the package unit, as this limitation would be within the scope of a tolerance we would normally allow on a food commodity, in the practical procedures of our work.

We believe that, besides remedying an unreasonable defect, the further amendments as now offered will clarify the intents and purposes of our original recommendation.

In the interest of brevity, the proposal is in basic form and, of course, subject to amplification in any regulations or rulings promulgated by the various jurisdictions to cover the issue. We do not deem it a prerogative of this Committee to specifically deal with the terms of regulations, as such matters properly repose in the Committee on Legislation. As the result of our exhaustive study of this entire matter, which seems to have assumed controversial aspects in certain channels of the packing industry, we would respectfully offer the following suggestions to that Committee and to any governmental agencies contemplating the adoption of a ruling:

(1) That the regulation or ruling be applied equally to all processed meat and poultry products encased in form-fitting cellophane or other cellulose or plastic material or in vacuum-sealed plastic adhering to the product.

(2) That such casings or materials of qualifying weight (not to exceed a maximum of ⅛ ounce per pound of product or fraction thereof), whether applied before or after processing, be regarded as a part of the net weight of the product.

(3) That sales of such products made at wholesale and accompanied by a written invoice covering the shipment, together with the marking of the net weight on cartons or boxes in which the product is shipped from the wholesaler to the retailer, be considered a guarantee of weight.

(4) That all such products, when sold at retail as a unit, must be weighed when offered for sale, and, if not weighed in the presence of the purchaser when sold, the net weight shall be marked on the package or on a tag or sales slip by the retailer.

(5) That on all individual units or packages of the comprehended product, the manufacturer or packer thereof shall place in a plain and conspicuous position the legend: TO BE WEIGHED WHEN SOLD or such suitable or equivalent wording as may finally be approved and adopted by the National Conference on Weights and Measures.

(A motion to adopt Item 5 of the committee report was defeated by a voice vote.)

6. *Tinting Base Color Systems for Paints.*

It is recommended that effective July 1, 1956, paint in package form, whether in the customary or base color system, be packaged and marked in standard sizes in accordance with the adopted Model Regulation for Package Marking Requirements—that is, in gallons, quarts, pints, ½ pints, and fluid ounces; and that, where additional head space is made necessary by the base color system, the cans be made over-size of the recognized units and the label contain some such statement as "This can is made over-size to permit the addition of the tinting colorant."

There have grown and developed in the paint manufacturing industry many misleading systems of packaging and labeling under the base color system. The attempt apparently has been to offer a "short-measure" package of base or vehicle with the assumption that the added colorant will bring the package near to full measure. This is completely contrary to the constant effort of weights and measures officials toward uniform packages of relatively few sizes, since it has brought such labeling on paint cans as 121 fluid ounces, 7/8 gallon, and 3 quarts-one pint-2 fluid ounces.

The Committee agrees that it is the responsibility of the paint industry to retain the gallon, quart, pint, etc., sizes for liquids, and can see no reason why the colorants cannot be added to these standard sizes.

Since the wide variances of labeling paints currently is the practice and since the Committee recognizes that supplies of cans and labels are on hand, our recommendation delays the effective date until July 1, 1956.

(After considerable discussion from the floor, the acting chairman of the committee moved that Item 6 be re-referred to the committee for further study. This motion was adopted by the Conference.)

7. *Precious Metal Alloys for Dental Purposes.*

This Committee recommends that no arbitrary numerical weight tolerances be stipulated or fixed for packages of precious metal alloys to be used as dental materials, and that the contents of such packages shall fully agree with the quantity declaration thereon.

Representations have been made that the American Dental Association is desirous of having specific tolerances stipulated because of certain production problems common in the industry. It has been pointed out that one federal specification, covering dental gold solder, permits a minus tolerance of 1.0 percent on individual packages and a minus tolerance of 0.1 percent on random lots of ten packages.

It is our considered opinion that, in dealing with metal products, we have an entirely different situation than with commodities that have considerable shrinkage propensities. The weight shrinkage factors in metals to the extent that any exist by reason of atomspheric conditions or changes, would at the most be appreciably small and certainly not sufficient as to warrant any such tolerance as 1.0 percent on individual packages.

Then too, in dealing with this issue, we must keep in mind that the commodities involved are of high intrinsic value and that even minute weight deviations from the declared contents on packages can be of serious consequence.

It has long been recognized that there are dangers inherent in fixing arbitrary tolerances, as they offer a temptation to the unethical to take full advantage of such tolerances at the source without consideration of the purpose for which they were intended—i. e., to comprehend conditions beyond the control of the packer. It does not appear that there should be any problem for the dental material industry to so pack their precious metals that there would be no loss through leakage, and further than this it seems they need not go, the presumption being, of course, that their weighing methods and practices are carefully and consistently accurate.

(Item 7 was adopted by the Conference.)

8. *Frozen Stuffed Turkeys.*—An article appeared in the December 20 issue of Time Magazine which read in part as follows: "The new frozen prestuffed turkey costs housewives a few cents more than the unstuffed one, but the Swansons soon hope to sell both birds at the same price, *make money on the added weight of the stuffing.*"

The Committee feels that it cannot sanction the incorporation of the stuffing as part of the net weight of the fowl. Your Committee proposes that, when fowl of any kind is put up in this manner, the net weight of the fowl, as well as the net weight of the stuffing, be required as a weight declaration on the package.

(Item 8 was adopted by the Conference.)

9. *Canned Oysters.*

Because the declarations of quantity as printed on the labels of various grades and brands of canned oysters vary considerably and do not reflect a true picture of the net contents of the packages, your Committee recommends that oysters in cans, or packages of a similar nature, be marked as to drained liquid measure or numerical count.

Mr. Wallace: The Oyster Institute of North America is a national trade association representing the oyster industry. We have canners located in every coastal State where oysters are canned, and I would like to speak on this particular topic for just a moment.

I am here at this time because our industry did not know and was not aware that the Committee on Methods of Sale of Commodities was to consider the type of information that should be on the label of canned oysters regarding the volume of oyster in the container. Possibly our failure to be informed was in some way tied in with the serious illness of the chairman of the Committee. The reason, therefore, that I am here is that we feel there should be some further consideration given to this particular matter. We are thoroughly in accord that there should be some uniformity as to the content declarations on canned oysters, but we feel that, from the standpoint of production efficiency, labeling by count is not a practical procedure.

Furthermore, there has been another factor that is involved in the matter of labeling canned oysters. On April 9, 1955, the U. S. Food and Drug Administration made an interpretation of the quantity of contents on labels for canned oysters which was printed in the Federal Register and therefore became an official regulation of that agency. At that time it was specified that the requirement regarding the quantity of contents statement will be met by an accurate total weight marking. You can see that, if this contrary provision is adopted by your organization and we have the other provision already adopted by the U. S. Food and Drug Administration, our industry is caught in the squeeze between the two enforcement agencies. For this reason we are hopeful that your Conference will be willing to refer this matter back to your Committee so that they can consider these further developments and a year from now come back to your Conference with a recommendation which will bring true uniformity, which I think we are all in agreement is most essential and desirous.

Mr. Lirio: I would like to mention at this time that about two weeks ago I notified a member of your organization, and also notified the Bristol Evening News about the same time, of this matter which is coming up here, and in both cases the Newcomb oyster men, who are members of your organization, told me they would probably take it up with you folks here in Washington.

MR. LEITHAUSER: Since the report was in printed form I had a telephone conversation with a representative of the Federal Food and Drug Administration and was told they did adopt a regulation on April 9. So, under the circumstances, I will withdraw this motion and move that it be referred back to the Committee for further study.

(The motion to re-refer Item 9 to the Committee was adopted by the Conference.)

10. *Rope and String.*—It has been called to the attention of this Committee that rope and string of various sizes and shapes are being distributed in many jurisdictions with no label of any description attached to same.

Your Committee recommends that these commodities when sold for 5 cents or more be marked as to net weight or linear measure.

(Item 10 was adopted by the Conference.)

11. *Turpentine.*—It has been called to the attention of this Committee that turpentine in drums is marked 56/7 pounds, which indicates 56 gallons at 7 pounds per gallon. The jobber or dealer receives the correct net weight as appears on the drums. These drums do not hold 56 gallons by volume, as the A. S. T. M. designation D–13–51 gives specific gravity of turpentine as 0.875 to 0.860 at 15. 5° C. or 60° F. This would make the weight of a gallon of turpentine vary from 7.16 pounds per gallon to 7.29 pounds per gallon according to the specific gravity of the turpentine.

As this marking is misleading, this Committee recommends that turpentine be sold by net weight or liquid measure; but when sold on a net weight basis, the gallonage marking be left off of the container and the billing done on a weight basis.

(Item 11 was adopted by the Conference.)

12. *Paper Wrapping Tissue Under 18 Pound Basis Weight.*—Tissue wrapping paper under 18 pound basis weight has wide use in industry for wrapping, stuffing, interleaving, converting, etc., and in packing of retail merchandise in stores and in the home, and the public interest in the proper labeling of delivery packages of this product has been recognized by the Commodity Standards Division of the United States Department of Commerce.

The Committee recommends that, on and after January 1, 1956, each delivery package of tissue wrapping paper of basis weights under 18 pounds shall be sold by grade number, sheet size, basis weight, quantity declaration, and manufacturer's name or approved identification mark.

The grade number declaration shall have reference to the grade designations set forth in revised Simplified Practice Recommendation R46–55 promulgated by the Commodity Standards Division of the United States Department of Commerce.

The quantity declarations as to Grades I, II, III, and IV shall be by sheet count of the delivery package.

The quantity declaration as to Grade V shall be by avoirdupois weight.

The manufacturer, in lieu of identifying each delivery package by imprinting his name thereon, may affix the copyright label of The Tissue Association as contained in the aforesaid revised Simplified Practice Recommendation R46–55, which incorporates for each user a code number which identifies the manufacturer and which is made readily available to the agency responsible for enforcement under this regulation.

(Item 12 was adopted by the Conference.)

13. *Rope, Twine, and Cordage.*

As previously recommended, we hereby reiterate that rope, twine, and cordage shall be sold by net weight or linear measure. When packaged in any manner, the package shall be marked with the net weight or linear measure.

The Committee is cognizant that representatives of the cordage industry have made representations to several States contrary to this previously-adopted action of the National Conference. The Committee feels that weights and measures officials and all representatives of the people who are making or enforcing weights and measures laws and regulations must take a firm stand on the sale of commodities by net weight or measure and that the affected industries should demonstrate their willingness toward honest representations and sales by sponsoring and supporting such requirements.

(Item 13 was adopted by the Conference.)

14. *Packaging of Fruits and Vegetables in Paper Cartons Marked by Volume.*—The Committee wishes to give this matter further study and, therefore, proposes it be held over till the next Conference meeting.

(Item 14 was adopted by the Conference.)

Mr. Baucom: This is the last year of Mr. Rogers' service as Chairman of this Committee. He has been a member of this Committee for some 12 or 15 years and has given it very faithful service. He has done his very best. In recognition of such service, I recommend that we give Mr. Rogers a rising vote of thanks, and have this action be entered as part of the permanent record.

(The motion was adopted by the Conference, and Mr. Rogers was given a rising vote of thanks.)

REPORT OF THE WEIGHTS AND MEASURES ADVISORY COMMITTEE, PRESENTED BY W. M. HARKS, COCHAIRMAN

The Weights and Measures Advisory Committee to the National Bureau of Standards held its first meeting in Washington on August 17, 1954. Organization of the committee was discussed and was completed by the election of John P. McBride as Chairman and Walter H. Harks as Cochairman. At this meeting, the program of the Office of Weights and Measures was reviewed by William S. Bussey, and the committee indicated general agreement with the aims of the program.

In the discussions of the activities of the National Bureau of Standards which followed, it was brought out that the various programs of the Bureau, such as testing and calibration services, have been greatly curtailed because of the lack of funds with which to carry on such activities. This financial restriction stems from two sources:

1. A substantial reduction in direct appropriations starting in the fiscal year 1950. In the fiscal year 1954, the Congress allowed only $6,250,000, even though the Bureau's request for $8,000,000 had strong administration support.
2. The Bureau, as one of its basic functions, performs calibration and testing services for industry, for which fees are charged, but moneys so received are paid into the General Treasury to the credit of miscellaneous receipts and thus the costs of these services deplete the Bureau appropriation without benefit of reimbursement.

It is the opinion of the committee that relief from these major restrictions must be obtained before a comprehensive program can be inaugurated which will keep pace with the growing needs of industry.

On August 25, 1954, the chairman and cochairman of the committee met with Under Secretary of Commerce Walter Williams at a general meeting of the chairmen of all advisory committees. At this session it was emphasized that our national economy and security are becoming increasingly dependent upon science and technology, and that the National Bureau of Standards is the focal point around which all industrial standards revolve. As such, the Bureau needs the support of the general public in its activities. Several constructive suggestions for acquainting the public with the work of the Bureau were offered, one of which resulted in the holding of an "open house" at the Bureau in February of this year. Many congressmen and other influential visitors learned for the first time the scope of the Bureau's activities in the field of science and technology, and were greatly impressed with its relationship to the industrial progress of the nation.

In furtherance of this demonstrated need for better public knowledge and acceptance of the Bureau's work, the individual members of the committee have been instrumental during the year in having the activities of the committee publicized in various trade journals in the oil industry, the retail food industry, and in technical publications covering the weighing and measuring equipment field. Certain of the committee members have also made it a point to contact their Congressmen and other members of the Appropriation Committees in support of the Bureau's appropriation request for fiscal year 1956. It is the belief of the committee members that similar support on the part of the industry associate members of the National Conference on Weights and Measures will be extremely helpful in assuring the necessary budget support in the years ahead so that the necessary programs relating to weights and measures can be progressively carried on.

On April 18 and 19, 1955, the committee met for a second time in Washington, and unanimously passed the following resolution:

> Whereas, The Weights and Measures Advisory Committee to the National Bureau of Standards has, at its meeting on April 18–19, 1955, in Washington, D. C., been giving study to the fiscal requirements of the National Bureau of Standards, and in particular to such requirements in the field of the Bureau's weights and measures activities; Therefore be it
>
> *Resolved*, That this Committee endorses the current budget requests of the National Bureau of Standards, as approved by the Bureau of the Budget and submitted by the President to the Eighty-fourth Congress of the United States, as being minimal for carrying out the duties and responsibilities of the National Bureau of Standards, and be it further
>
> *Resolved*, That this Committee earnestly recommends to the National Bureau of Standards, to the Bureau of the Budget, and to the Congress of the United States that continued adequate financial support be provided for the weights and measures program of the Bureau, which, in the opinion of this Committee, must give technical support to sound progress in this important economic area.

During this meeting the committee viewed the new educational film prepared by the Bureau, and recommends that additional films on similar subjects of interest in weights and measures be prepared as a continuing program.

Before adjournment of this meeting, the committee agreed upon a set of recommendations to be presented to Dr. A. V. Astin, Director of the Bureau. These suggestions, in the opinion of the committee, will facilitate the work of the Office of Weights and Measures, if carried out. They have largely to do with the internal workings of the Bureau as they relate to the research, development, and test programs on which weights and measures officials depend. They refer specifically to such activities as axle load weighing, liquefied petroleum gas, and to the liquid fertilizer and anhydrous ammonia field.

In concluding its first report to the National Conference, the committee wishes to thank Dr. A. V. Astin, William S. Bussey, M. W. Jensen, and the other members of the Bureau staff for their wholehearted cooperation in supplying the committee with the information and data necessary to its deliberations.

(The report of the Weights and Measures Advisory Committee was adopted by the Conference.)

REPORT OF THE NATIONAL CONFERENCE COMMITTEE ON NOMINATIONS, PRESENTED BY J. F. TRUE, CHAIRMAN, AND ELECTION OF OFFICERS

The Nominating Committee submitted the following nominations for office in the National Conference to serve during the ensuing year, or until such time as their successors are elected.

OFFICERS

For President: A. V. Astin, Director, National Bureau of Standards.
For Vice Presidents: G. L. Johnson, of Kentucky; W. A. Kerlin, of Alameda County, California; C. A. Lyon, of New Hampshire; J. E. Mahoney, of Maryland; M. A. Nelson, of Michigan; W. K. Tripple, of Norfolk, Virginia.
For Secretary: W. S. Bussey, National Bureau of Standards.
For Treasurer: G. F. Austin, Jr., of Detroit, Michigan.
For Chaplain: Rev. R. W. Searles, of Medina County, Ohio.
For Sergeant at Arms: Joseph Shaw, of Passaic, New Jersey.
For members of the Executive Committee: L. C. Carpenter, of Missouri; B. S. Cichowicz, of South Bend, Indiana; J. L. Clough, of Delaware; J. G. Gustafson, of Minneapolis, Minnesota; A. A. Haggart, of Topeka, Kansas; J. W. D. Harvey, of Georgia; Earl Hubble, of Monroe County, New York; Mrs. Beatrice Lanham, of Harrison County, West Virginia; Alfred Lirio, of Cumberland County, New Jersey; J. F. McCarthy, of Boston, Massachusetts; F. E. McKinney, of Hartford County, Connecticut; J. I. Moore, of North Carolina; J. G. Rogers, of New Jersey; V. D. Rogers, of Memphis, Tennessee; R. K. Slough, of Akron, Ohio.

(Signed) J. Fred True, *Chairman,*
C. D. Baucom,
J. A. Boyle,
F. M. Greene,
G. H. Leithauser,
D. G. Nelson,
A. C. Samenfink,
Committee on Nominations.

(The report of the Committee on Nominations was adopted and the officers were elected unanimously.)

PAPER MILK CONTAINERS

By M. W. Jensen, *National Bureau of Standards*

The purpose of this presentation is to discuss certain factors relating to the marketing of milk in paper containers. The observations and recommendations are based on surveys in the field, studies of the automatic filling machines, and discussions with weights and measures officials. The comments offered are not to be interpreted as being critical of this method of merchandising dairy products, nor should the results be in any way related to the delivery of milk in glass bottles.

The distribution of milk and other fluid dairy products in flat-sided paper containers began in this country about 15 years ago. Since that time, weights and measures officials have attempted in many different ways to effectuate such supervision as would offer reasonable assurance that cartons contained the declared quantities of product.

When first offered, these cartons were considered by some to be paper milk bottles within the meaning of the National Conference code for milk bottles, as were the conical paper containers already in limited use, and attempts were made to impose on them the code requirements for milk bottles. This was improper by definition and was found to be impractical, because the cartons are not used as measures and were and are insufficiently rigid to retain their designed shape. The conical paper milk containers, on the other hand, do satisfy the definitions for milk bottles.

Following the acknowledgment that flat-sided paper containers for milk could not be treated as milk bottles, supervision generally took either or both of two directions: (1) the filling machines were treated as liquid-measuring devices and some were refined to a degree, including automatic product supply controls and provision for sealing the adjusting means, or (2) the cartons were considered to be labeled packages of milk and were checked just as are other prepackaged commodities.

Although the latter method of supervision proved to be the more practical and effective in most instances, only a few jurisdictions gave the matter really adequate attention. It appears that, even in most of these jurisdictions, officials made only occasional checks, and, as a result, instituted only limited corrective measures.

In an effort to control effectively this system of milk merchandising, one large city jurisdiction that wishes to remain unidentified concentrated, from the beginning, on a program of supervision that has provided data valuable in the preparation of this report. Their method of quantity checking is one that can be recommended. As applied to one-quart cartons of sweet milk, this method may be described as follows:

(1) Determine precisely the weights (to the nearest $\frac{1}{32}$ ounce) of several accurately measured one-quart quantities of milk. The average of these will serve as the NET weight of one quart of milk. (This should be done at various times during the first year to determine whether weights differ during the several seasons of the year, and samples should be obtained from each dairy in order to learn if the milk varies in weight among the dairies.)

(2) Weigh a random selection of at least ten empty cartons of each different design to the nearest 1/32 ounce. The average for each design will serve as the TARE weight of one quart of milk in cartons of that design. These averages should be checked occasionally.

(3) The weight differences between gross weights in commercially filled cartons of a particular design and correct gross weights—that is, the sum of the average NET weight of milk and the average TARE weight for that design of carton—will represent the variances (over or under) from labeled measure, in terms of weight. These variances then may be converted to liquid measure by determining mathematically the weight of one fluid ounce of milk and dividing the weight difference by that figure. Thus, if one quart of milk (32 fluid ounces) weighs 34.4 ounces avoirdupois, one fluid ounce weighs 34.4 divided by 32, or 1.08 ounces avoirdupois. Then, if a carton is one-half (0.5) avoirdupois ounce short, it is 0.5 divided by 1.08, or 0.46 fluid ounce short.

With this method of checking quantity, the officials of the jurisdiction referred to above found wide differences between the declared quantities and delivered quantities of milk in paper cartons. These differences were found in spite of their first efforts, made even before the initial installation of a machine in the city, which required modifications to the milk-measuring machines to make them comply with the specifications for commercial liquid-measuring devices insofar as these were applicable. They also found a relatively high percentage of cartons leaking to an extent that caused many consumer complaints regarding shortages.

That the efforts toward machine improvement were not the ultimate answer was illustrated by the wide variances continually encountered in quantity checks. Because of the foaming characteristics of fluid dairy products, and for other reasons, it became apparent that "end of line" control over the filling process was desirable. A control system similar to those employed with butter-printing machines seemed worth investigating, and subsequently the dairies were asked to obtain small equal-arm scales, and dairy personnel were trained in their use. These scales were installed alongside the conveyor line and cartons were check-weighed by sampling just before they were packed into a carrying case. In this procedure an occasional carton, at more or less regular intervals in the run, is picked from the line and weighed. If the cartons are running heavy or light, the machine is adjusted accordingly.

After several years of close supervision, a major city-wide survey on milk cartons was made in this same city during 1950. At that time, about 5,000 quart paper cartons were checked, again by weighing. One hundred twelve were found leaking and were an average of 2.89 fluid ounces short; this represented a decided improvement over the earlier observations. Although on the remaining cartons there was a variation from the declared quantity ranging from $-1/2$ to $+3/4$ fluid ounce, the over-all picture (as represented by the solid line on the graph) was very good. The average carton contained 32.19 fluid ounces, indicating an over-fill of about 0.6 percent.

During this 1950 survey, 19.7 percent of the cartons were found to contain less than the quantity represented, 11.6 percent were correctly labeled, and 68.7 percent contained over-measure.

Regardless of the educational emphasis at the dairy plants, it was concluded that the best control from the enforcement standpoint could be maintained in the retail stores with results of tests being made known to the dairy management. This procedure provides for the

checking of a number of milk cartons almost every day. The effect of such supervision is apparent on the chart, nonetheless it must be noted that there was a tendency to over-fill the cartons. This might indicate that the dairies were being extremely cautious in order to avoid shortages.

Close supervision was continued, and a second general survey was conducted in 1954. This survey, during which 5,529 quart cartons were weighed in retail stores, demonstrated further improvement in filling procedures.

In figure 19, the dotted line represents the 1954 survey and shows that near perfection had been reached in error distribution or average quantity of contents—that is, there were just about equally as many plus as minus errors in filling. In this survey the mean was found to be only 0.002 fluid ounce from zero error. It may be noted that the 1950 and 1954 curves are nearly equal in width; thus it could be assumed that the magnitude of errors indicated represents the best attainable with current equipment.

At this point in the study, it seemed advisable to attempt to determine whether the quantity control noted in figure 19 resulted from the careful supervision by weights and measures officers of the jurisdiction under study or from what might be termed normal progress of the machinery manufacturer and refinement of packaging processes. As the place for another survey, a similarly large city jurisdiction was selected where there had been no control or supervision over the quantity of milk in paper cartons.

This latter city was surveyed in 1955 by first determining average tare and net weights and then weighing about 2,000 one-quart cartons of sweet milk. This survey is represented in figure 19 by the dashed-line curve. It can be observed that in the second city there existed a wide variance, both minus and plus, from the declared quantity.

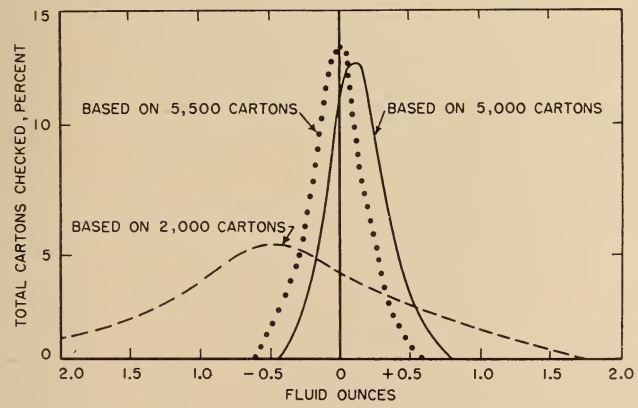


FIGURE 19. *Distribution of errors on surveys on quantities of milk in 1-quart paper cartons.*

———— 1950 survey---} Made in city where fill of cartons is closely supervised by
. . . . . 1954 survey---} weights and measures personnel.
– – – – – – 1955 survey--- Made in city where fill of cartons has no weights and measures supervision.

Nonleaking cartons, selected at random, contained from 29.20 to 33.75 fluid ounces, or from −8.75 percent to +5.47 percent of the declared one-quart quantity. The average contents of the one-quart (32 fluid ounces) cartons of milk was 31.23 fluid ounces, and thus the average shortage was 2.41 percent.

Although the "leakers" occurred quite frequently in the early history of flat-sided paper cartons for milk, experience and improvements in cartons and coating application have all but eliminated this problem. This was evident in both cities surveyed. Currently, only a very small percentage of paper cartons are found to leak, and these generally have been damaged by improper handling or packing.

The results obtained in the first city demonstrate that satisfactorily accurate quantities of milk in paper cartons can be realized under systematic weights and measures supervision. An analysis of the results obtained in the unsupervised jurisdiction forces the conclusion that, without weights and measures control, there is very apt to exist not only a wide scatter or distribution of errors, but perhaps even an average quantity of contents considerably less than that represented.

As a result of these studies made on the quantity aspect of the marketing of fluid dairy products in paper cartons, it now is possible to make certain recommendations.

(1) Filling machines should be so designed as to provide a "settling tank" of adequate capacity to control properly the amount of aeration of the product and to cause a reasonably air-free product at the time this is measured into the cartons.

(2) Automatic means should be incorporated in the filling machines to prevent the operation of the machines when the dairy product is foaming or is sufficiently short of supply to cause improperly filled cartons.

(3) A weight check, either automatic or manual, should be provided in the conveyor line after the cartons are filled and before they are placed in the carrying cases. The instrument employed in the check would then be the commercial device that actually controls the volume of milk in the containers. Of course, the best results would be obtained through a 100 percent check procedure; however, it is reasonable to assume that a sampling-type check would be satisfactory. The frequency of sample selection should be dictated by the indicated variances in machine operation.

It is possible that filling machines will be made that will conform to the requirements for commercial liquid-measuring devices and that will be sufficiently accurate and constant in their operation that the conveyor line check could be eliminated. It is questionable as to whether this degree of perfection has been achieved.

It must be noted that no machine or packaging line improvements will substitute adequately for comprehensive weights and measures supervision. In this, as in most other of the responsibilities of the enforcement official, the service he renders is to both the vendor and the consumer. Without weights and measures control, the unscrupulous dealer has the advantage, and the consumer is the prey of both carelessness and dishonesty.

In conclusion, it should be noted that if, in the course of his control procedures, the official finds it necessary to resort to prosecution for shortages in cartons of milk, the prosecution should be based on actual volumetric measurements of the contents of individual cartons and not on results obtained by the weighing method outlined for routine checking operations.

A NEW SYSTEM FOR PACKAGING MILK AND OTHER FLUIDS

By C. A. Southwick, Jr., *American Tetra Pak Corporation, Hope, New Jersey.*

(Mr. Southwick presented a motion picture film that showed the manufacturing process of and uses in the dairy industry for a new paper milk container called Tetra Pak (see figure 20).)

The Tetra Pak process and package have been in commerial use in Sweden for about 2½ years. Today there are about one hundred machines operating in Sweden and other parts of Europe primarily for packaging milk and cream.

The Tetra Pak system of packaging liquids is a continuous and integrated process of forming, filling, and sealing of a web of flexible heat-sealable material.

The material used for the milk container is a plastic-coated kraft board. The plastic coating is moistureproof and capable of strong seals at low heat-sealing temperatures. There are other materials available for different types of products and other uses.

The following will briefly describe the operation. The machine first forms the coated paper board into a tube by heat-sealing a back seam. As the tube is formed, it is filled with the liquid to be packed. As the filled tube passes down into the machine, pairs of heat-sealing jaws, acting with great pressure, make transverse seals (see fig. 21). Each transverse seal is at right angles to the previous seal. The result is a connected series of liquid-filled portions, each in the shape of a tetrahedron. The final operation is the cutting off of each tetrahedron and the counting and placing of it in a nested position in a

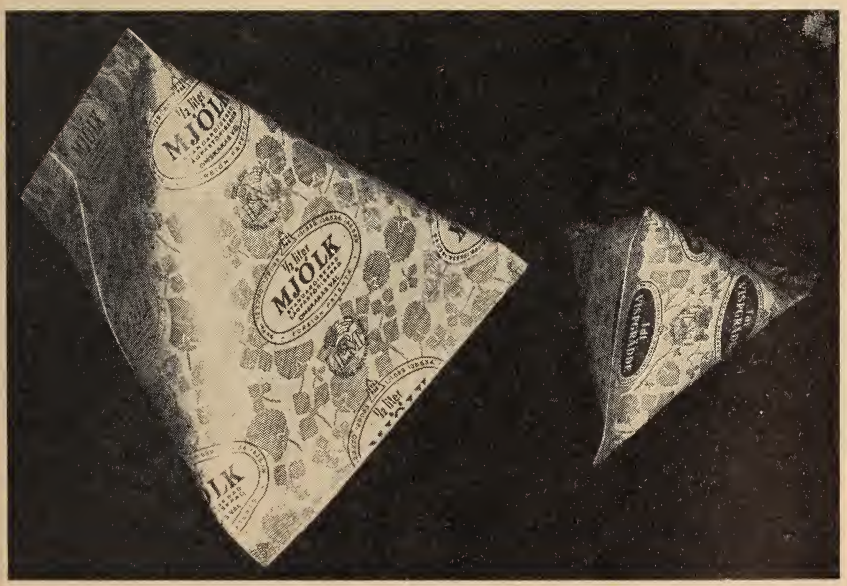


Figure 20. *"Tetra Pak" paper carton.*

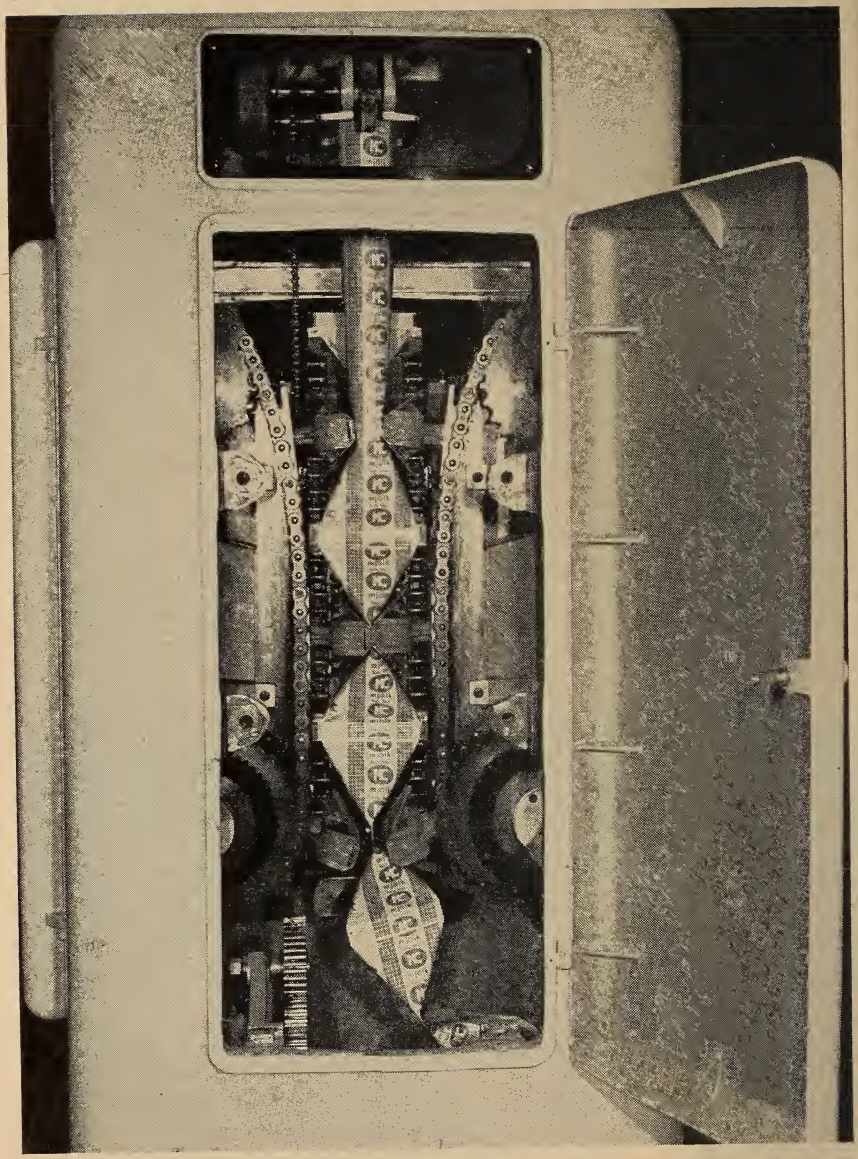


FIGURE 21. *"Tetra Pak" carton forming and filling machine.*

hexagonal-shaped container or loosely in a conventional shipping case.

The volume of the liquid contained in each tetra unit is determined by the cross setion of the tube, the spacing of the transverse sealer, and the side walls of the unit. Obviously, the walls of the cylinder being filled must be held under even and heavy tension if uniformity of the filler volume is to be obtained. Each tetra unit is made and completely filled in the course of a continuous operation. No air space remains in the container. After the manufacturing and filling process, the paper container stretches somewhat and, when a corner is cut for opening, air rushes in, the package sags, and the liquid level drops, so that not a single drop is spilled or lost.

Data has been developed showing the close distribution of the weights of series of one hundred consecutive packages of the various sizes from 25 to 500 cm^3. The machine is very simple to operate, is continuous in motion, and easy to clean and maintain. Because of its high rate of production, simplicity, low labor cost, and minimum use of packaging material, both by area and by weight, the Tetra Pak process can show large economies in the packaging of liquids.

Consumer acceptance has been shown by increasing number of machines being installed in Europe, and has been confirmed by many personal interviews and surveys. Today we are installing a few machines in this country for sampling purposes and to develop American data on machine performance. These machines are in the 8-, 4-, and 1-ounce sizes. We hope soon to be able to present data and to allow inspection by local, State, and federal authorities who have responsibility in this area.

WEIGHTS AND MEASURES APPROVAL SEALS

By M. W. Jensen, *National Bureau of Standards* (Presented by H. F. Wollin, *National Bureau of Standards*).

A tentative report was made to the 39th National Conference on Weights and Measures on the weights and measures approval seal investigation then being conducted by the National Bureau of Standards. As was stated in that report, the investigation was still under way with anticipated close during January, 1955.

The study was made to determine the adequacy of seals being offered for sale, and others, for the normal one-year exposure period considered minimal for satisfactory service.

In the tentative report it was stated:

> Concerning desirable qualities of the various materials and adhesives, it has become apparent that only the pressure sensitive seals will remain on an enamel surface when subjected to the conditions imposed by the extreme exposure test. In fact, at this point, there may be sufficient evidence to draw somewhat of a parallel between the special indoor steam and heat test and the outdoor exposure test. As yet no data from the outdoor exposures can be drawn to compare the uncoated with the coated samples. It appears, however, that the order of life expectancy outdoors probably will be from shortest to longest as follows:
>
> 1. Soft paper with water-soluble adhesive.
> 2. Gloss or varnished paper with water soluble adhesive.
> 3. Cloth with water soluble adhesive.
> 4. Composition coated cloth with water soluble adhesive.

5. Good quality hard finish paper with pressure sensitive adhesive.
6. Plastic impregnated paper with pressure sensitive adhesive.

It is significant that, thus far, there is no indication that the "special" samples (those prepared as a result of recommendations from manufacturers of adhesives and papers) are in any way superior to seals already on the market. Moreover, it is probable that the exposure test will indicate that some of the seals now available will remain adhered to the surfaces and hold their colors for the full year as required.

The order of permanence stated above was borne out in the year-long exposure test. Thus, it is reasonable to recommend the use of either plastic impregnated paper or good quality hard finish paper with pressure sensitive adhesive for approval seals that are expected to remain in place for one year of outside exposure.

The relative permanence of means for marking as described in the tentative report was confirmed by the full year of exposure. The two most satisfactory from that standpoint were a very soft graphite pencil and a good quality (waterproof) stamp pad ink.

As a result of the exposure test, it is possible to detail one problem that apparently is not solved by manufacturers of presently available seals. Both the paper dyes and the printing inks on the seals under test faded to illegibility. It appears, therefore, that, though there are available adequate materials and satisfactory adhesives, there still remains marked improvement in dyes and inks.

OPEN FORUM

Mr. Searles: The matter of selling meat to retailers by gross weight remains a problem to weights and measures officials. I would recommend that the proper committee of this Conference work with the meat industry and with enforcement officers to the end that this practice be ended. This Conference is on record as condemning such practice.

Mr. Lirio: I would like to refer to the Committee on Laws and Regulations a matter concerning the sale of lumber. In my jurisdiction the terms "board foot" and "square foot" are used more or less interchangeably when referring to lumber of the dimension $1\times1\times12$ inches, yet square measure theoretically has no depth. This is causing confusion and should be corrected.

(The Conference adjourned, to reconvene at 10 a. m. on Friday, May 20, 1955.)

BREAKFAST MEETING OF THE INCOMING EXECUTIVE COMMITTEE OF THE CONFERENCE, FRIDAY, MAY 20, 1955

On Friday morning, May 20, the newly elected Executive Committee and the chairmen of the standing committees met to discuss and reach decisions regarding the 41st National Conference. Present at this meeting were 10 of the 11 officers, 11 of the 15 Executive Committee members, and the chairmen of the three standing committees. The first part of the meeting was presided over by the Conference President, Dr. A. V. Astin, and the latter part by Mr. M. A. Nelson, Vice President. The following decisions were reached regarding the 41st National Conference on Weights and Measures, 1956:

Date: May 21 through 25, 1956.

Place: Willard Hotel, Washington, D. C.

Program: Program assignments left to the disretion of the Secretary.

Social Activities: Similar to previous years, to be arranged by the Secretary.

Ladies' Entertainment: To be arranged by the Secretary after consultation with a Ladies Committee to be designated.

Attendance Chairman: Mr. J. E. Mahoney of Maryland was elected Attendance Chairman.

Duplicating papers, etc.: A check list is to be prepared on which will be listed the papers available for distribution. This list will be handed to the delegates at the registration desk with the instruction that the list, properly checked, is to be returned to the desk prior to the close of the Conference. As soon as practicable after Conference adjournment, the papers, etc., indicated as desired on the check lists will be mailed to the delegates. Tentative and final committee reports will continue to be duplicated, distributed, and made available as in the past.

National Conference Letterheads: Authorized for limited use by the President and Secretary only, or by others under specific authorization of the President or Secretary. Use to be held to a minimum, and to be confined to situations in which Federal, State, county, or municipal letterheads would be objectionable or inappropriate.

General Suggestions: It was the decision of the Executive Committee that the roll call of associations be discontinued. The Committee voted to continue the breakfast meeting for the Executive Committee each year.

SEVENTH SESSION—MORNING OF FRIDAY, MAY 20, 1955

(W. L. Daniels, Vice President, Presiding)

AN EXPERIMENT IN FARM MILK TANK GAGING AND TESTING

By M. W. Jensen, *National Bureau of Standards*

At the request of the Conference Committee on Specifications and Tolerances, the staff of the Office of Weights and Measures, National Bureau of Standards, conducted a limited investigation on the calibration of farm milk tanks.

Briefly, the aims of the investigation may be listed as (1) a study of the various means for leveling tanks, (2) the effect on the level condition on a single tank of various degrees of lading, and (3) a comparison of independent gagings of a single tank by three skilled observers, using each of the three most common measuring means.

The loan of a 240-gallon tank was arranged by the National Association of Dairy Equipment Manufacturers. The selected manufacturer modified the tank according to the needs of the investigation and arranged for two independent gagings of the tank at the factory—before the tank was crated for shipment to Washington. The modifications included the installation of three types of leveling devices (plumb bob, circular level, and sixteen leveling lugs) and means for using three measuring gages (surface gage, graduated to $\frac{1}{32}$ inch, gage rod graduated to $\frac{1}{32}$ inch, and gage rod graduated to $\frac{1}{16}$ inch.)

At the factory the tank was leveled with plumb bob and gaged independently by two different men on succeeding days. Each man gaged the tank at 5-gallon intervals with each of the three measuring gages. The data sheets thus developed were retained by the manufacturer until after all gaging was completed by the Office of Weights and Measures observers.

After the tank was received in Washington, it was positioned on a concrete floor and leveled—again through the use of the plumb bob. The procedure at the Bureau was as follows:

1. The tank was thoroughly wetted and allowed to drain for 30 seconds after the main discharge ceased.
2. Using standard 5-gallon measure, water was poured into the tank through a funnel with the discharge end of the funnel below the surface of the water in the tank (after the first 5 gallons). Each time the 5-gallon measure was allowed to drain for a timed 10 seconds after the main discharge flow ceased.
3. After all surge had ended, independent readings were taken and recorded by each of the three observers, using successively each of the three gages. Both the reading and the recording were accomplished independently and without collaboration. (The gage rods had intentionally been numbered so that their readings would not be in agreement, in order that an observation on one would not influence the observer when reading the other.)

With the equipment and the procedures outlined above, 15 separate and complete gagings of the tank were accomplished by five observers, and the results were then studied.

Attention was given first to the figures obtained by the Office of Weights and Measures observers. "Majority" measurements for each 5-gallon increment were established in this way. If two readers agreed, this was the "majority" figure; if the three measurements were spread as 51, 52, 53 (this occurred only once on the 1/16-in. rod

and 1/32-in. surface gage and three times on the 1/32-in. rod), the middle or average figure was accepted. On no single measurement did the high reading differ from the low by more than two graduations.

The figures shown in table 6 indicate the number of times each of the observers varied from the "majority" reading. Each variation was by exactly one graduation. It should be pointed out that these readings represent precise observations by experienced personnel and should not be considered "average."

TABLE 6. *Incidence of variation from "majority" readings of three observers*

Observer	Gage rod 1/16-in. graduations			Gage rod 1/32-in. graduations			Surface gage 1/32-in. graduations		
	Times +	Times −	Total	Times +	Times −	Total	Times +	Times −	Total
A	1	3	4	1	9	10	3	1	4
B	6	1	7	13	0	13	2	5	7
C	1	0	1	2	3	5	1	3	4
Total	8	4	12	16	12	28	6	9	15

The significance of the data shown in table 6 seems to be that three experienced observers, exercising extreme care, will vary in their readings of a divided scale. It may be noted that the effects of personal tendencies of the observers are apparent in this data. Observer A obviously was often reading the lower of two figures when the indicating line was near the center between the two; likewise, Observer B was reading the higher figure.

It can be seen from the totals that "errors" occurred more than twice as often on the rod graduated in 1/32 inch than on the rod graduated in 1/16 inch.

The data shown in table 7 were developed from the calibration charts prepared at the factory by factory representatives. The numbers indicate the times the indicated variances occurred with the reading of gager B being subtracted from the reading of gager A for each 5-gallon increment.

TABLE 7. *Differences between readings of gager A and gager B*

Number of times differences occurred

Type measuring device	Graduations						
	−4	−3	−2	−1	0	+1	+2
Surface gage with 1/32-inch graduations					38	6	
Gage rod with 1/32-inch graduations	1	3	10	9	14	4	3
Gage rod with 1/16-inch graduations				1	12	21	10

The principal development of interest here is the divergence between the readings of two observers when using the 1/32-inch gage rod. The only reasonable explanation for the preponderance of plus readings on the 1/16-inch rod is that the tank was not in the same condition of level during the two independent gagings.

In table 8 there is shown a comparison of the mean values obtained at the factory for each 5-gallon increment versus the mean values for the same increments obtained in the laboratory at the National Bureau of Standards. Unfortunately the bridge to which is welded the surface-gage bracket was bent during shipment, so there existed a constant but undetermined difference between factory and NBS surface gage readings.

TABLE 8. *Differences between mean of factory gagers and mean of NBS observers*

Number of times differences occurred

Type measuring device	Graduations				
	0	+1	+2	+3	+4
Gage rod with 1/32-inch graduations	1	4	21	11	1
Gage rod with 1/16-inch graduations	30	8			

In this relation it might be pointed out that the position of the surface-gage bracket in relation to the bottom of the tank is critical. A factory calibration may be made incorrect by damage to the tank in transit. If such damage has occurred and if the factory-prepared chart is used without check of the position of the surface-gage bracket, all values recorded on the gallonage chart would be incorrect. Farm milk tank manufacturers might well devise some system whereby the position of the surface-gage bracket may be checked. One possible system may be for the factory to record the reading of the gage with a minimum of measured water in the tank and then include in the installation instructions a reference to this reading which then could be checked before the tank is placed in use and from time to time throughout its service.

To develop the table of differences of mean readings (mean of factory gagers for each 5-gallon increment minus mean of NBS observers for the same increments), it was necessary to round off the means.

Since the gage rod is at an extremity of the tank, and since the comparison of readings indicates a consistent difference, it may be assumed here, as before, that the tank was not leveled identically by the factory gagers and the NBS observers. Other than this consistent difference, it may be observed that variations occur more frequently with the rod having smaller graduations.

In an effort to determine the effect on the level of the tank of various degrees of lading, three sets of level determinations were made, first with the tank empty, next with the tank half full, and finally with the tank filled to capacity. A graduated spirit level, sensitive to 1 minute, was used on the leveling lugs provided on the tank, and each set of determinations involved eight observations, as indicated in figure 22. No readable change of level of the tank was found.

In an effort to learn the probability of repeating a level condition, the tank was leveled by one of the NBS observers, through the use of the plumb bob, and water was poured into the tank until the three observers agreed on a split-line reading on the 1/32-inch gage rod. In the absence of the person who leveled the tank, it was deliberately

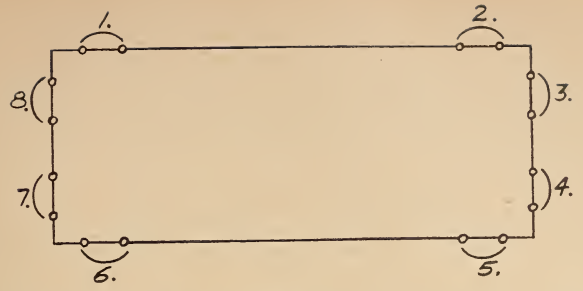


FIGURE 22. *Location of leveling lugs on experimental tank.*

thrown out of level. The observer attempted to restore the level position, again using the plumb bob. Once more, observations were taken on the gage rod (the water having remained in the tank), and it was agreed that the level had been restored within approximately one-fourth of the $\frac{1}{32}$-inch graduation.

When this same procedure was attempted with the circular level as the determining device, level was restored only to within about one of the $\frac{1}{32}$-inch graduations.

At this point it may be noted that the intersection of two perpendicular scribe marks (+) is much more satisfactory as an index for the plumb bob than is a punched or engraved point. Also, if a circular level is to be the level-indicating means, it must be very sensitive and the diameter of the bubble should be approximately equal to the diameter of the target.

Assuming that a sensitive spirit level of sufficient length is used both at the factory and during installation on the farm, leveling lugs are satisfactory. It is recommended that the lugs be installed in pairs, approximately 12 inches apart. On small tanks, a pair of leveling lugs on each of two adjacent top edges should be adequate, but on large tanks a pair of lugs should be installed on each of the four top edges. Leveling lugs are of little value if an insensitive level is used either during the setting of the lugs or during the leveling of the tank.

Obviously the effect of out-of-level condition varies inversely with the nearness of the measuring device to the center of the tank.

This farm milk tank experiment bears out the accepted conclusion that tolerance on a device that involves the reading of one graduation of a series must include an amount sufficient to allow for the variation of any two individuals in reading the scale. The original gager of the tank, for example, and the weights and measures official who checks the prepared chart will differ in their readings, this difference being additive to any error inherent in the device or caused by a difference in test procedures.

A critical study of the data developed by observers of the National Bureau of Standards indicates that it would be incorrect to expect graduations of $\frac{1}{32}$ inch to double the accuracy and precision afforded by $\frac{1}{16}$-inch graduations. Thus it would be improper to require smaller graduations and then decrease performance tolerances. In certain instances the actual measurements may be less accurate when $\frac{1}{32}$-inch graduations are employed than when $\frac{1}{16}$-inch graduations are used.

It must be acknowledged that the current system of measuring milk in farm milk tanks does not offer accuracy in the order of magnitude that normally is expected of commercial weighing and measuring devices. Nonetheless, the tremendous growth of the system indicates that it has met with wide acceptance. Efforts should be made to increase both the accuracy and the precision of this method of measuring milk.

DISCUSSION OF FOREGOING PAPER

Mr. Greene: I wish to mention some of the field problems in connection with farm milk tank testing. Many milk houses are very poorly lighted. Often the original cord of a plumb bob has been replaced with something quite unsuitable for precise indication. Many tanks are not equipped with level-indicating means, and the installer first has to do the best he can to level the tank. We find erratic differences between our results and the charts furnished by the tank manufacturers.

In our testing, one man from the producers' association and one State inspector work together, and each checks each gage-rod reading. We have records of retests on which original results have been exactly duplicated except on readings falling between graduations, where one reading might be taken at the upper line and the other at the lower line.

An improvement over pouring from the standard into a funnel is to use a standard with a spigot or other type of bottom outlet to which a hose is connected. We use 5-gallon and 10-gallon standards, and can draw off water from a tank at a rate of 300 gallons per hour. We have been averaging one and one-half tanks per day per inspector.

Mr. Marshall (Association of Dairy Equipment Manufacturers): Mr. Greene's difficulty with plumb bobs could be overcome by requiring replacement of improper cords—a matter of enforcement.

In some instances it appears that there is an effort to require a farm milk tank to be more accurate than a commercial scale. That does not seem to be reasonable. Again, some States insist that a tank cannot be gaged at the factory and that it must be gaged in the field; the latter is the more expensive procedure, and I think that, with reasonable care, tanks can properly be gaged at the factory and checked at the farm.

Mr. A. T. Smith: I have found plumb-bob reference "dots", as placed by the tank manufacturer, with diameters of one-eighth inch or more; it is impossible to level a tank with such a device. Also, some manufacturers of gage rods seem to persist in using unreasonably wide and deep-cut identification figures and placing these right in among the graduations in such a way as to interfere with accuracy of reading.

REPORT OF THE COMMITTEE ON SPECIFICATIONS AND TOLERANCES, PRESENTED BY R. E. MEEK, CHAIRMAN

Note.—The report of this Committee involved three documents, (1) a multilithed "Proposed Revision" of the H44 codes, distributed in February, 1955, (2) a "Tentative Report" proposing certain changes in the Proposed Revision, distributed on April 8, and (3) a "Final Report" embodying the proposed changes in the Proposed Revision as covered by the Tentative Report and other changes subsequently agreed upon.

Publication here of the text of the Proposed Revision is precluded by the size of that document; moreover, it is expected that the second edition of Handbook 44, presenting the codes as adopted by the Conference, will be available before this Report of the 40th National Conference is ready for distribution. Any presentation herein of the details of the amendments to and other changes in the Proposed Revision that were presented for action by the Conference, would be meaningless without a copy of that original document for reference. Accordingly, there are given in what follows, such pertinent extracts from the Tentative and Final Reports of the Committee and from the discussion that took place during Mr. Meek's presentation as will give all needed information regarding the development of the revision of the codes, the general nature of the revision, and certain details in relation thereto.

Your Committee on Specifications and Tolerances proposes for consideration by the 40th National Conference a complete revision of the codes of specifications, tolerances, and regulations for commercial weighing and measuring devices, as published in NBS Handbook 44 and subsequently amended by the Conference from time to time.

In February of this year there was distributed, for study and comment, a Proposed Revision of the codes; this was sent to a large group of weights and measures officials, equipment manufacturers, and other interested parties. Many comments were received and studied by the Committee, and on April 8 we distributed our Tentative Report. Now we have had the benefit of additional comments made by mail, and of oral comments made during the open hearings held immediately prior to the convening of this Conference.

Your Committee has been diligent. Preliminary Committee work was carried on by correspondence. This was followed by a meeting of the Committee in Washington, D. C., lasting the entire week of January 24, during which all changes then under consideration were carefully reviewed. The Committee met again in Washington for three days immediately prior to the opening of the 40th National Conference. Comments from all sources on the proposed revision have been given detailed study.

The proposals of the Committee were and are designed to improve the codes and bring them up to date. Changes have been dictated by mechanical developments in commercial equipment, by comments and suggestions from weights and measures officials, representatives of equipment manufacturers, and others, and by the studies of the Committee itself, assisted by the staff of the Office of Weights and Measures of the National Bureau of Standards, and by several groups of representatives of manufacturers, tax officials, and affected industries with whom individual Committee members have had opportunities for oral discussion.

A consistent effort has been made to simplify and clarify the language of the codes. In many instances, sentences have been shortened, paragraphs have been divided, and text has been rearranged. Where definitions were found in specification paragraphs, these have been transferred to the "Definitions" section of the proper code. A considerable number of new definitions have been added, particularly in the general code and the scale code. For the purpose of clarification, distinction is introduced between "graduation" and "graduated interval", and appropriate changes in text have been made.

All nonretroactive material has been scrutinized in an effort to reduce the amount of such material wherever practicable. All requirements have been studied for possible obsolescence, and as a result a number of deletions are now proposed.

An important addition to each code except the general code is a listing of the general-code paragraphs that are particularly applicable to the specific code in question. This is done in a paragraph titled "General Code References", which is the first item of each specific code. A somewhat related new general requirement is that the general code applies to all classes of equipment unless "specifically suspended, modified, or limited by the terms of the general code or of some specific code."

In four cases important changes of form have been made. (1) The code for taximeters and the code for odometers have been consolidated into a single new code, the new code designated "Mileage-Measuring Devices". (2) The code for pre-packaged-ice-cream measuring-containers has been incorporated into the code for measure-containers. (3) The code for grease-measuring devices has been eliminated, and appropriate requirements for "lubricant-measuring devices" have been added to the code for liquid-measuring devices. (4) All appropriate meter requirements of the code for liquid-measuring devices have been duplicated in the code for vehicle tanks, making the latter code complete except for the applicable requirements of the general code.

In specific reference to the code for scales, the Committee wishes to make a clarifying statement to clear up any doubt that may exist relative to the Committee's recommendation regarding the attitude of enforcing officials toward that general category of weighing devices popularly known as "load-cell scales." This statement is as follows:

The Committee is aware of the fact that developments are taking place in the general field of load-cell weighing, involving components operating on electrical, electronic, hydraulic, pneumatic, and other principles. It has taken cognizance of the fact that scales employing such components are already in commercial use. The Committee feels, however, that since developments in this field are taking place rapidly and the situation still is in a fluid state, it would not be practical at this time to recommend the incorporation into the scale code of requirements specifically directed to the types of components and scales in question. Were this now to be done, the coverage could not hope to be complete. Moreover, in the absence of more technical information than is presently available to the Committee, such recommendations might later be found to be inappropriate, or possibly restrictive to progress.

It was suggested to the Committee by representatives of the National Association of Scale Manufacturers and the Scientific Apparatus Makers Association that definitions of the terms "Load Cell" and "Load-Cell Scale" be included in the code. After careful consideration the Committee decided that it would be inappropriate to define terms not occurring in the code.

The Committee wishes, however, to emphasize that it is not the intent of the scale code to permit the use only of those types of scales embodying pivots and bearings. Scales embodying other types of construction are also permissible. To insure that the scale code will not contain requirements prohibiting the use of such other types of scales, the Committee has reviewed the code and made certain minor modifications intended to avoid any conflicts with the new design principles mentioned earlier herein. These modifications relate primarily to pivots and bearings.

The Committee therefore recommends that weights and measures officials apply to load-cell scales existing code requirements, insofar as these are clearly applicable, as specified in Paragraph G–A.4. of the revised General Code, until such time as the formulation of specific requirements for such scales becomes feasible.

It should be noted that the proposed addition to paragraph A.1. of the code for liquid-measuring devices, to the effect that this code does not, in its present form, apply to devices for dispensing liquefied petroleum gases, is not to be construed as indicating any slackening of Committee efforts to develop proper requirements for such devices, for incorporation into this code at the earliest practicable date. To this end, the Committee cooperated in Conference program arrangements for the symposium held on Wednesday afternoon, dealing with the latest developments in equipment for proving LPG liquid-metering systems. Also, members of the Committee have, on several occasions, met with authorized representatives of interested industrial associations. These representatives have now proposed that they, instead of an independent agency as originally suggested by the Committee on Specifications and Tolerances, evaluate all information presently available, and they have offered to provide the Committee with a comprehensive report no later than December 1, 1955. Upon receipt of that report, and assuming that further study and evaluation will not be required, the Committee hopes that it will be in a position to draft a proposed tentative code for LPG liquid-metering systems for consideration by the 41st National Conference in 1956.

In further relation to the code for liquid-measuring devices, the Committee wishes to emphasize that this code does not necessarily require a mechanical air eliminator on a meter device or metering system. It should be noted that the manufacturer has the option of providing either an "effective air eliminator" *or* "other effective means" to prevent the passage of air or vapor through the meter.

In relation to farm milk tanks, the Committee urges that all manufacturers of such tanks make serious attempts to locate all gage rods and surface gages as near as practicable to the vertical axis with respect to the tank walls.

The Office of Weights and Measures of the National Bureau of Standards has recommended, and the Committee concurs, that when the second edition of NBS Handbook 44 is reprinted this year it be issued in both bound and loose-leaf forms, that there be added a cross-referenced index of all terms formally defined in the several codes, and that the new Handbook contain useful weights and measures tables. It has also been recommended that the several codes be arranged in the new Handbook on the broad basis of the frequency of their probable use by weights and measures officials and others, with the general code first, followed by (1) the codes for scales and weights, (2) the liquid measurement group of codes, (3) the linear measurement group of codes, and (4) the codes for dry measures and berry baskets and boxes.

As information, the Committee desires to report two endorsements of its proposed code revisions, as follows:

With respect to the code for vehicle tanks, endorsement was expressed by a representative of the West Central Region of the North American Gasoline Tax Conference with the reservation that member tax bodies will supplement the code (1) by requiring that, if a compartment has more than one indicator, only the top indicator shall be used for taxable motor fuel, (2) by fixing a maximum permissible ex-

pansion space above the top indicator, and (3) by requiring that a tank be marked to show the number of the State test certificate and the total capacity of the tank.

With respect to the code for farm milk tanks, the task committee on farm milk tanks of the Dairy Industry Supply Association recommended adoption of the code by the Committee on 3A Sanitary Standards and its inclusion, by citation, in the "3A Sanitary Code". When this is done, farm milk tanks will be required by sanitarians to meet both sanitary and weights and measures requirements.

(The General Code was presented and was adopted as proposed by the Committee.)

(The Scale Code was presented. Objection was raised to Regulation R. 19., which requires the single-draft weighing of highway vehicles and coupled highway-vehicle combinations or elements thereof. The following discussion took place.)

Mr. Todd: I am speaking for a group of men representing the railroads and the Association of American Railroads. There can be no disagreement on principle between two-draft and one-draft weighing. But with the advent of hauling semi-trailers on flat cars, we are getting into the business of weighing highway vehicles, and we are concerned about the hardship this regulation will work on railroads, and particularly on shippers contiguous to railway lines. Many shippers have obsolete types of scales, and today they can weigh in two drafts, subject, however, to later reweighing.

The practice of weighing in two drafts originated a great many years ago and is practiced today by the railroads and is recognized in their rules and regulations. Also, there are others besides railroad people who are affected. We ask, therefore, that you give this regulation careful consideration before adopting it. If it cannot now be amended to soften the effect of arbitrarily outlawing a large portion of the scales now in use, can not action be postponed to another session for a change of language that would be more acceptable to a large portion of this audience?

Some of the States that have promulgated Handbook 44 have in official use scales that carry out this principle of separate draft weighing by adding together the weights of several separate scales. I ask, therefore, for your consideration in postponing action on this paragraph.

Mr. Meek: The proposed effective date of this regulation is July 1, 1957. Experience has shown that the problem of two-draft weighing will not correct itself. We shall never accomplish our objective if we do not make a start, and in my opinion we should make that start now.

Mr. Christie: In New Jersey a regulation similar to R. 19. has been in effect for years. Compliance has been obtained with no adverse effects whatsoever. If only short scales are available, elements of a coupled combination can be uncoupled and weighed separately.

(A separate vote was taken on R. 19. and the regulation was adopted. The scale code as a whole was then adopted as proposed by the Committee.)

(The remaining 15 codes were presented and adopted in turn. Following this, a formal vote was taken on the adoption of the Proposed Revision of February 10, 1955, amended as proposed by the Committee; the motion prevailed, and the material was so adopted.)

Interpretations by the Committee on Specifications and Tolerances

From time to time the Committee is called upon, by weights and measures officials or other interested parties, to make "interpretations" of specification requirements. When a misunderstanding of the meaning of a specification occurs and the Committee feels that the specification language is inadequate or faulty and can and should be improved, a recommendation for a new definition or for an appropriate change in the language of the specification in question is made to the National Conference at the first opportunity. An example of such a situation is found in the new definition for "nominal", proposed at this time to be added to the general code. This new definition is based upon an interpretation issued by the Committee when it was asked to define this term.

In other cases the Committee feels that no change in or addition to a code is needed, but that a formal clarifying interpretation or explanation of the meaning or application of a requirement is called for. Such interpretations are normally made a matter of record, for future reference, without delay. It appears, however, that one such Committee interpretation is not yet in the printed record, although it was issued in 1950. Since it relates to a situation that might arise in any jurisdiction, it is quoted in full below; it will become of record with the publication of the Report of the 40th National Conference.

Tolerances to be applied following intra-test adjustment of a scale. The Committee on Specifications and Tolerances of the National Conference on Weights and Measures has been asked for an interpretation of paragraph G–T.1. of the General Code of the National Conference with respect to the following situation:

> A weights and measures officer is testing a scale to which the maintenance tolerance is applicable. An error in excess of the tolerance is found, but before the officer has officially rejected the scale, a scale mechanic offers to make adjustments to reduce the scale error. This offer being accepted, adjustments are undertaken but no actual repairs are made.

The question is asked, "Shall the officer now require performance within acceptance tolerances, under sub-paragraph (d) of paragraph G–T.1.?" It is asked, further, whether or not the answer to the first question would be the same if the adjustment were undertaken by the officer instead of by a scale mechanic.

In the opinion of the Committee, the sub-paragraph language which governs under both of the circumstances cited is "following official rejection". "Official rejection" is a prerequisite to the application of acceptance tolerances under G–T.1.(d). Therefore, if the officer, at the time that adjustment is undertaken, has not officially rejected the scale, he can properly approve and seal the scale if the adjustment in question merely brings the performance within the maintenance tolerances, whether this adjustment is made by himself or by a scale mechanic.

The Committee wishes to point out, however, that when adjustment of a device is undertaken, every proper effort should be made to reduce the errors as nearly as practicable to zero value. In this relation the Committee announces its intention to recommend to the 35th National Conference the adoption of a new general regulation carrying, among others, a requirement that "Whenever equipment is adjusted, the adjustments shall be so made as to bring performance errors as close as practicable to zero value." [Adopted by 35th National Conference.] The foregoing interpretation of G–T.1.(d) should not, therefore, be construed as justification to any degree of hasty or careless adjustments designed merely to get a piece of equipment into a "good enough" condition to "get by" the tolerances, when the expenditure of more time and effort would bring about much more nearly errorless performance. The interpretation does, however, meet

the practical situation where good adjustment may make rejection unnecessary for the time being, even though performance within acceptance tolerances can only be obtained by *repair* in addition to adjustment.

Mr. Meek. The Committee wishes to record its appreciation of the cooperation rendered by all those who studied its proposals and made constructive suggestions thereon. The Committee adopted many of those suggestions. In those cases where suggestions were not adopted, this was because, in the best judgment of the Committee membership, there were good and sufficient reasons for the decisions represented by the Committee's proposals to the Conference. Thank you all, very much.

REPORT OF THE NATIONAL CONFERENCE COMMITTEE ON RESOLUTIONS, PRESENTED BY P. E. NYSTROM, CHAIRMAN

APPRECIATION TO HONORABLE WALTER WILLIAMS, UNDER SECRETARY OF COMMERCE

Whereas, the Conference this year and in 1954 has been honored by the presence and our knowledge has been increased by the words of the Under Secretary of Commerce, Honorable Walter Williams; and

Whereas, the success of the Conference is enhanced by the interest of the U. S. Department of Commerce so capably discussed by Mr. Williams; Therefore, be it

Resolved, That this 40th National Conference on Weights and Measures record its appreciation and gratitude to Mr. Williams and through him to the U. S. Department of Commerce.

APPRECIATION TO THE STAFF OF THE NATIONAL BUREAU OF STANDARDS

Whereas, the success of the 40th National Conference on Weights and Measures has been due in large part to the sympathetic leadership of Dr. A. V. Astin, Director of the National Bureau of Standards, to the wholehearted cooperation of the staff of the Bureau, and especially to thoughtful planning and diligent efforts of Mr. W. S. Bussey, Chief of the Office of Weights and Measures, Mr. M. W. Jensen, Assistant Chief of that office, and their immediate assistants, Therefore be it

Resolved, That this 40th National Conference on Weights and Measures record its sincere appreciation of the services rendered to the Conference by Dr. Astin, Mr. Bussey, Mr. Jensen, and other members of the staff of the National Bureau of Standards.

APPRECIATION TO THOSE PARTICIPATING IN PROGRAM

Whereas, the 40th National Conference on Weights and Measures is mindful of the valuable contributions to its success made by the speakers on the program, by those who have exhibited and demonstrated devices of interest to weights and measures officials, and by its standing and special committees; Therefore be it

Resolved, That this 40th National Conference on Weights and Measures express and record its sincere thanks to all individuals and agencies that have participated in the formal program and the auxiliary events of its meeting.

APPRECIATION TO COOPERATING OFFICIALS

Whereas, it is recognized that attendance at the meetings of the National Conference on Weights and Measures by weights and measures officers and other persons directly concerned with weights and measures administration in the States, counties, and cities, is made possible in large degree by the interest and cooperation of the governing officials of those jurisdictions; Therefore be it

Resolved, That this 40th National Conference on Weights and Measures record its gratitude for such interest and cooperation by these governing officials and for this evidence of their support of constructive weights and measures supervision throughout the United States.

APPRECIATION TO MANAGEMENT OF HEADQUARTERS HOTEL

Whereas, the management of the Shoreham Hotel has done everything within its power to make our Conference a success; Therefore, be it

Resolved, That this, the 40th National Conference on Weights and Measures does express its warmest appreciation and thanks to the management of said hotel for their cordial hospitality and cooperation during our meetings; and be it further

Resolved, That the Secretary of this Conference transmit a copy of this resolution to the management of The Shoreham Hotel.

APPRECIATION TO THE SCALE JOURNAL

Whereas, the Scale Journal has consistently made most valuable contributions to the promotion of weights and measures administration in the United States by the publication of a wide variety of material related to that important activity; and

Whereas, the Scale Journal has been particularly helpful in connection with the meetings of the National Conference on Weights and Measures by carrying advance publicity and by publishing accounts of the proceedings; Therefore be it

Resolved, That this 40th National Conference on Weights and Measures record its thanks to the management of the Scale Journal for its sustained policy of cooperation with the Conference and its consistent support of the Conference program for sound weights and measures supervision.

APPRECIATION TO WASHINGTON BASEBALL CLUB

Whereas, the Management of the Washington Baseball Club of the American League did furnish tickets for the baseball game to the members of this Conference; Therefore, be it

Resolved, That this 40th National Conference on Weights and Measures go on record showing our appreciation for this fine gesture; and, be it further

Resolved, That our Secretary send the Washington Baseball Club a letter of appreciation from this Conference.

APPRECIATION TO INDUSTRY

Whereas, the representatives of industry by their support of the National Conference contribute materially to the accomplishments of the Conference, and

Whereas, the support from industry also expedites understanding and clarification of mutual problems; Therefore be it

Resolved, That this, the 40th National Conference on Weights and Measures, expresses its recognition of and appreciation for the cooperation of industry and its manifest interest in developing adequate weights and measures administration.

THE FILM—"A TRUE STANDARD"

Whereas, in response to official action of the 38th National Conference on Weights and Measures the National Bureau of Standards has developed a motion picture film in color portraying the need for and the development of accurate standards of weight and measure; and

Whereas, this film has been viewed by this and other audiences; and

Whereas, such educational efforts as this film represents can make noteworthy contribution to public education as to the need for and value of weights and measures administration; Therefore, be it

Resolved, That the staff of the National Bureau of Standards be and hereby is commended for the preparation of the film "A True Standard"; and be it further

Resolved, That weights and measures officials of State and local jurisdictions make every effort to schedule showings of the film before groups of consumers, merchants, legislators, etc.

STATE STANDARDS

Whereas, the Congress of the United States is authorized by the Constitution of the United States to "fix the standards of weight and measure"; and

Whereas, the Congress, by joint resolutions of June 14, 1836, and July 7, 1866, and the Act of July 7, 1838, did provide the States with the first basic standards and instruments and thus initiated the effort for nationwide uniformity in weights and measures; and

Whereas, these original standards have been made obsolete by the demands of business, industry, and science for greater accuracy and precision; and

Whereas, there currently is no source for standards of the precision required: and

Whereas, the development of specifications for and the manufacture of such precision standards and instruments is so highly specialized and technical that development and procurement on an individual State-by-State basis would be prohibitively expensive; and

Whereas, the only direct road to Nationwide uniformity is through the Federal government; and,

Whereas, it is reasonable to interpret that the Constitutional authority of the Federal government for establishment of standards encompasses the making available of the physical standards themselves, and

Whereas, the National Bureau of Standards is uniquely equipped to undertake the development of specifications, the placing of orders, the acceptance testing, the certification, and the disbursement of such basic standards and instruments: Therefore, be it

Resolved, That this 40th National Conference on Weights and Measures, in assembly this twentieth day of May, 1955, does record its unanimous request to the Congress of the United States that the Congress make available the necessary funds and direct the National Bureau of Standards to establish a project that will result in the providing to each State and Territory of basic standards of mass, volume, and length and suitable instruments and accessories as in its best judgment are required to establish the necessary foundation for precision and accuracy in the determination of weight and measure in business and industry of America.

INVESTIGATION OF AXLE-LOAD WEIGHTS

Whereas, the National Conference has, on two previous occasions, requested the National Bureau of Standards to undertake an investigation into the causes and extent of variations in the weights of axles of highway vehicles; and

Whereas, such information still is vitally important to the State weights and measures agencies and highway departments; Therefore, be it

Resolved, That this 40th National Conference on Weights and Measures reiterate its request to the National Bureau of Standards for technical assistance and advice on this essential project.

LIQUEFIED PETROLEUM GASES

Whereas, the development of adequate testing equipment and test methods for liquid meters dispensing liquefied petroleum gases is of great importance to the economy of the nation; and

Whereas, the weights and measures officials of the United States depend on the National Bureau of Standards for such technical aid; Therefore, be it

Resolved, That this 40th National Conference on Weights and Measures record its request to the National Bureau of Standards for development and dissemination of information regarding such equipment and methods.

(Signed) PAUL E. NYSTROM, *Chairman*,
J. H. MEEK,
J. F. MCCARTHY,
H. J. MCDADE,
B. A. PETTIT,
W. E. SHEEHY,
CLYDE SPRY,
Committee on Resolutions.

(The report of the Resolutions Committee was adopted by the Conference.)

MR. BUSSEY: I desire to read into the record a letter from the Department of the Navy. (Reading:)

DEPARTMENT OF THE NAVY
BUREAU OF SUPPLIES AND ACCOUNTS
Washington 25, D. C.

13 May 1955

Dr. A. V. Astin, Director
National Bureau of Standards
Department of Commerce
Washington, D. C.

Dear Dr. Astin:

Under date of 11 August 1954, the Bureau of Supplies and Accounts requested assistance of the Office of Weights and Measures in the development of a proposed uniform weight certificate for use by the Military Departments in connection with the shipment of household goods by motor van carriers.

Staff members of the Office of Weights and Measures conferred with members of the Household Goods Subcommittee of the Office of the Assistant Secretary of Defense and developed a uniform weight certificate form.

However, at a recent meeting held between a committee of household goods van carriers and the Department of Defense it was agreed that the adoption of the uniform weight certificate would not be feasible at this time and the project has been terminated.

The Military Departments have noticed a considerable improvement in the type of weight certificates being furnished by carriers to support motor van shipments of household goods. No doubt credit for this is due to the interest evidenced by your committee members at the time of your Thirty-Ninth National Conference of Weights and Measures in 1954.

The Movers Conference of America has published an article in its publication "In The Van" of 15 March 1955 reiterating the importance of legible and accurate weight certificates. The Conference was advised by the Military Departments that all future weight certificates must contain the following information:

a. Carrier's name
b. Date
c. Location of scale
d. Property owner's name
e. Weight summary
f. Signature of weighmaster

The assistance rendered the Military Departments by your staff members in connection with this very important weight problem is most sincerely appreciated.

Sincerely yours,

(Signed) F. J. Haerlin,
F. J. HAERLIN,
Captain, SC, USN,
Assistant Chief for Transportation.

REPORT OF THE NATIONAL CONFERENCE TREASURER

May 1, 1955.

Balance on hand May 1, 1954		$1,495.06
RECEIPTS:		
May 21—		
Registration fees—1954 Conference 377 at $5.00	$1,885.00	
Interest accrued, July 15–Dec. 1, 1954	3.17	
		1,888.17
Total		3,383.23
DISBURSEMENTS:		
May 17–21, 1954—		
Expenses of 39th National Conference		2,010.35
Balance on hand May 1, 1955		1,372.88

(Signed) GEORGE F. AUSTIN, Jr.,
Treasurer.

(The report of the Treasurer was adopted by the Conference.)

(The Fortieth National Conference on Weights and Measures adjourned *sine die* at 12:10 p. m.)

PERSONS ATTENDING THE CONFERENCE

Delegates—State, City, and County Officials

ALABAMA

State	T. H. Giles, State Inspector of Weights and Measures, 1008 East Clinton Street, Huntsville.

CALIFORNIA

State	James E. Brenton, Chief, Bureau of Weights and Measures Department of Agriculture, Mull Building, 1125 Tenth Street, Sacramento.
County:	
Alameda	William A. Kerlin, County Sealer of Weights and Measures, 333 Fifth Street, Oakland.
Los Angeles	Charles Morris Fuller, County Sealer of Weights and Measures 3200 North Main Street, Los Angeles.
	Edward L. Coolidge, Senior Assistant Sealer of Weights and Measures.
San Diego	Herbert J. McDade, County Sealer of Weights and Measures, 1480 F Street, San Diego.

COLORADO

City: Denver	Robert W. Conway, City Sealer of Weights and Measures, Room 207 Police Building, 13th and Champa Streets.

CONNECTICUT

State	Attilio R. Frasinelli, Commissioner, Food and Drug Commission, State Office Building, Hartford.
	Frank M. Greene, Chief, Division of Weights and Measures.
	Frank J. Delaney, State Inspector of Weights and Measures.
County:	
Fairfield	William E. Sheehy, Jr., County Sealer of Weights and Measures, County Court Building, Bridgeport.
	Alvin Coger, Assistant County Sealer of Weights and Measures.
	Ernest Wilson, Assistant County Sealer of Weights and Measures.
Hartford	Fred E. McKinney, County Sealer of Weights and Measures, County Building, 95 Washington Street, Hartford.
Tolland	William F. Masinda, County Sealer of Weights and Measures, West Willington.
City:	
Bridgeport	Louis Snow, City Sealer of Weights and Measures, 925 Main Street.
Hartford	Nathan Kalechman, City Sealer of Weights and Measures, 550 Main Street.
Middletown	Peter Grassi, City Sealer of Weights and Measures, P. O. Box 223.

DELAWARE

State	John L. Clough, Acting Secretary, State Board of Agriculture, Dover.
	Ralph W. Wine, Director, Bureau of Markets.

DISTRICT OF COLUMBIA

Weights, Measures, and Markets

300 Indiana Avenue, N. W.

Washington

District — J. Thomas Kennedy, Chief.
J. M. Boucher, Supervisor.
B. A. Pettit, Supervisor.
J. T. Bennick, Inspector and Investigator.
W. W. Brandt, Inspector and Investigator.
L. F. Brooks, Inspector and Investigator.
W. J. Chesser, Inspector and Investigator.
W. R. Cornelius, Inspector and Investigator.
L. F. Gnotta, Inspector and Investigator.
F. C. Harbour, Inspector and Investigator.
K. G. Hayden, Inspector and Investigator.
W. H. Jennings, Inspector and Investigator.
T. B. Middleton, Inspector and Investigator.
F. M. Warner, Inspector and Investigator.
W. W. Wells, Inspector and Investigator.

FLORIDA

State — Nalls Berryman, Director, Weights and Measures Division, Department of Agriculture, Nathan Mayo Building, Tallahassee.

City:
Jacksonville — Howard E. Crawford, Inspector of Weights and Measures, 431 West Eighth Street.
Miami — Harvey E. Howard, Supervisor of Weights and Measures, Coconut Grove Station, P. O. Box 708.

GEORGIA

State — Boyce L. Dyer, Liaison Officer, Department of Agriculture, State Capitol, Atlanta.
J. W. D. Harvey, Assistant Chemist, Department of Revenue, State Office Building, Atlanta.

ILLINOIS

State — Merrill M. Emerick, Assistant Superintendent, Division of Foods, Dairies, and Standards, Emmerson Building, State Fairgrounds, Springfield.

City: Chicago — Irvine M. Levy, City Sealer of Weights and Measures, Room 608, City Hall.
Frank J. Fitzgerald, Chief Deputy Sealer of Weights and Measures.*
Luke Prendergast, Chief Taximeter Inspector, Public Vehicle License Commission, Room 702, 1121 South State Street.

INDIANA

State — Rollin E. Meek, Director, Division of Weights and Measures, State Board of Health, 1330 West Michigan Street, Indianapolis.

County:
Grant — Reuben C. Parks, County Inspector of Weights and Measures, Court House, Marion.
Vigo — Robert J. Silcock, County Inspector of Weights and Measures, Room 5, Court House, Terre Haute.

*Registered in absentia.

City:
Fort Wayne — James A. Hilgemann, Deputy State Inspector of Weights and Measures, 301 South Clinton Street.
Gary — Cleo C. Morgan, Sealer of Weights and Measures, Room 204 City Hall.
South Bend — Bert S. Cichowicz, Inspector of Weights and Measures, City Hall.
Terre Haute — John T. Harper, Inspector of Weights and Measures, Room 205, City Hall.

IOWA

State — Clyde Spry, Secretary, Department of Agriculture, Capitol Building, Des Moines.

KANSAS

State — J. Fred True, State Sealer, Weights and Measures Division, State Board of Agriculture, 420 West Ninth Street, Topeka.
City: Topeka — A. A. Haggart, City Sealer of Weights and Measures, 1632 Clay Street.

KENTUCKY

State — George L. Johnson, Director, Division of Weights and Measures, Department of Agriculture, State Office Building, Frankfort.
City: Louisville — Vernon C. Herbert, Investigator of Weights and Measures, Division of Weights and Measures, Department of Public Safety, City Hall.
Thomas Hester, Investigator of Weights and Measures.

LOUISIANA

State — Alois J. Mayer, Director, Division of Weights and Measures, Department of Agriculture and Immigration, P. O. Box 4292, Capitol Station, Baton Rouge.

MAINE

State — James A. Boyle, Deputy State Sealer of Weights and Measures, Department of Agriculture, State House, Augusta.
City: Portland — Charles J. Wills, Jr., Sealer of Weights and Measures, 389 Congress Street, Room 10.

MARYLAND

State — Paul E. Nystrom, Chief, State Department of Markets, Board of Agriculture, University of Maryland, College Park.
John E. Mahoney, Superintendent of Weights and Measures.
W. S. Arbuckle, Chief, Dairy Department.
Harold A. Newlander, Assistant Inspector, Dairy Department.
County:
Baltimore — Frank J. Vittek, Chief Inspector of Weights and Measures, 25 Susquehanna Avenue, Towson.
George A. Klein, Assistant Inspector of Weights and Measures.
Montgomery — A. Morton Thomas, Director, Department of Inspection and Licenses, County Office Building, Rockville.
Erwin W. Bucklin, Chief, Division of Zoning Permits and Licenses, County Office Building, Rockville.

City: Baltimore	George H. Leithauser, Senior Assistant Superintendent, Division of Weights and Measures, Department of Public Works, 1106 Municipal Building.
	Morris Bratman, Inspector of Weights and Measures.
	Albert Golden, Inspector of Weights and Measures.

MASSACHUSETTS

State	John P. McBride, Director of Standards and Necessaries of Life, Department of Labor and Industries, 194 State House, Boston.
City:	
Boston	John F. McCarthy, Sealer of Weights and Measures, Room 105 City Hall Annex.
Brookline	Norman A. Sacknoff, Deputy Sealer of Weights and Measures, c/o Health Department, 11 Prospect Street.
Cambridge	Anders T. Anderson, Sealer of Weights and Measures, Municipal Building.
Chelsea	John J. Hanlon, Deputy Sealer of Weights and Measures, 59 Library Street.
Gardner	Frank Hirons, Sealer of Weights and Measures, City Hall.
Newton	J. Ellis Bowen, Sealer of Weights and Measures, City Hall, Newton Centre.
Worcester	Edward L. McAuliffe, Deputy Sealer of Weights and Measures, 108 City Hall.

MICHIGAN

State	G. S. McIntyre, Director, State Department of Agriculture, Lansing.
	Miles A. Nelson, Chief, Bureau of Foods and Standards, Department of Agriculture, Lewis Cass Building, Lansing.
	Clyde O. Cottom, Supervising Inspector of Weights and Measures.
	Leo J. Bauer, State Inspector of Weights and Measures.
	Lee K. Rice, State Inspector of Weights and Measures, P. O. Box 43, St. Johns.
	Rex J. Tuttle, State Inspector of Weights and Measures, 321 East Street, South, Morenci.
County:	
Chippewa	Otto Wallis, Sealer of Weights and Measures, Court House, Sault St. Marie.
Washtenaw	George P. Smith, County Sealer of Weights and Measures, Court House, Ann Arbor.
City:	
Dearborn	Charles H. Waller, Supervising Inspector, Department of Licenses, Weights, and Measures, 13030 Hemlock Avenue.
Detroit	Hazen L. Funk, Sealer of Weights and Measures, 909 Water Board Building.
	George F. Austin, Jr., Deputy Sealer, Bureau of Weights and Measures, 740 Elmwood Avenue.
Pontiac	Walter A. Baerwolf, City Sealer of Weights and Measures, Police Department.

MINNESOTA

State	Erling Hansen, Supervisor, Department of Weights and Measures, Railroad and Warehouse Commission, One Flour Exchange, Minneapolis.
	George A. Fazendin, State Inspector of Weights and Measures.

City: Minneapolis	Russell S. Ackerman, Superintendent, Department of Licenses, Weights, and Measures, Room 3 City Hall.
	John G. Gustafson, Inspector of Weights and Measures.

MISSOURI

State	L. C. Carpenter, Commissioner, Department of Agriculture, Jefferson City.
	Rollo E. Singleton, Director, Weights and Measures Division.
City: St. Louis	Joseph A. Bernard, Commissioner of Weights and Measures, Room 12 City Hall.

NEVADA

State	P. A. Ferretto, State Inspector of Weights and Measures, P. O. Box 719, Reno.

NEW HAMPSHIRE

State	Clement A. Lyon, Director, Bureau of Weights and Measures, Division of Markets and Standards, Department of Agriculture, State Office Building, Concord.
	Alfred H. Dittrich, Chief Inspector.
	Harold E. Haley, State Inspector.
City: Keene	Ronald M. Seaver, City Sealer of Weights and Measures, 72 Pine Avenue.

NEW JERSEY

State	Joseph G. Rogers, Superintendent, Division of Weights and Measures, Department of Law and Public Safety, 187 West Hanover Street, Trenton.*
	Archie T. Smith, Assistant Superintendent.
	Samuel H. Christie, Jr., Senior Inspector.
County:	
Atlantic	James E. Myers, Superintendent of Weights and Measures, 350 South Egg Harbor Road, Hammonton.
Bergen	Michael J. Santimauro, County Superintendent of Weights and Measures, 66 Zabriskie Street, Hackensack.
	Ernest E. Dawson, Assistant County Superintendent of Weights and Measures.
Burlington	Paul F. Nunn, County Superintendent of Weights and Measures, 236 Hooker Street, Riverside.
Camden	Albert C. Becker, County Superintendent of Weights and Measures, City Hall, Camden.
Cumberland	Alfred Lirio, County Superintendent of Weights and Measures, P. O. Box 369, Vineland.
	Winfield K. Thompson, Assistant County Superintendent of Weights and Measures, Court House, Bridgeton.
Essex	William H. Schneidewind, County Superintendent of Weights and Measures, Hall of Records, Newark.
Gloucester	Martin J. Caulfield, County Superintendent of Weights and Measures, Westville Road, Almonesson.
Mercer	Ralph M. Bodenweiser, County Superintendent of Weights and Measures, Court House, Trenton.
Monmouth	Glenn L. Berry, County Superintendent of Weights and Measures, 706 Eighth Avenue, Asbury Park.

*Registered in absentia.

	JOHN A. J. BOVIE, Assistant County Superintendent of Weights and Measures, 82 West Wall Street, Neptune City.
	WILLIAM I. THOMPSON, Assistant County Superintendent of Weights and Measures, Lake and Grassmere Avenue, Wanamassa.
Morris	DEL G. NELSON, County Superintendent of Weights and Measures, Court House, Morristown.
Passaic	WILLIAM MILLER, County Superintendent of Weights and Measures, Administration Building, Paterson.
Salem	J. KENNARD CRISPIN, County Superintendent of Weights and Measures, 60 North Main Street, Woodstown.
Union	JAMES M. DIETZ, County Superintendent of Weights and Measures, Court House, Elizabeth.
City:	
Englewood	LEONARD DERIENZO, Municipal Superintendent of Weights and Measures, City Hall.
Fair Lawn	ALPHONSE J. BEGYN, Municipal Superintendent of Weights and Measures, Borough Hall.
Hoboken	ANTHONY A. GROSSI, Municipal Superintendent of Weights and Measures, City Hall.
Linden	LAWRENCE T. REAGAN, Municipal Superintendent of Weights and Measures, City Hall.
Passaic	PAUL DEVRIES, Municipal Superintendent of Weights and Measures, Municipal Building.
	JOSEPH SHAW, Assistant Municipal Superintendent of Weights and Measures.
Paterson	JOSEPH P. LEONARD, Municipal Superintendent of Weights and Measures, 115 Van Houten Street.
	WILLIAM J. KEHOE, Assistant Municipal Superintendent of Weights and Measures.
Union City	ALFRED O. OSLUND, Municipal Superintendent of Weights and Measures, City Hall.
	NEW YORK
State	JOHN J. LEONARD, Director, Bureau of Weights and Measures, Department of Agriculture and Markets, State Office Building, Albany.
County:	
Genesee	GLENN A. PULLMAN, County Sealer of Weights and Measures, 19 Buffalo Street, Bergen.
Monroe	EARL D. HUBBLE, County Sealer of Weights and Measures, 1400 South Avenue, Rochester.
Nassau	ROBERT WILLIAMS, County Sealer of Weights and Measures, Old County Court House Annex, Mineola.
	WILLIAM KIRK, JR., Assistant County Sealer of Weights and Measures.
Niagara	HENRY C. HULSHOFF, County Sealer of Weights and Measures, 17 High Street, Lockport.
Ontario	RALPH F. BENHAM, County Sealer of Weights and Measures, Court House, Canandaigua.
City:	
Binghamton	HARRY A. LASON, City Sealer of Weights and Measures, 60 Robinson Street.
Elmira	JOHN F. MADDEN, City Sealer of Weights and Measures, City Hall.
Ithaca	E. PAUL NEDROW, City Sealer of Weights and Measures, 318 Columbia Street.
Lackawanna	JOHN J. SERES, City Sealer of Weights and Measures, 84 Rosary Avenue.
Long Beach	MRS. VERONICA R. ROCHE, City Sealer of Weights and Measures, 562 East Market Street.

Niagara Falls	THEODORA J. PAONESSA, Assistant City Sealer of Weights and Measures, Public Service Building, Walnut Avenue and Sixth Street.
Rochester	ANTHONY C. SAMENFINK, City Sealer of Weights and Measures, Rochester Food Terminal, Administration Building.
Yonkers	JOHN DIMASE, City Sealer of Weights and Measures, City Hall.

NORTH CAROLINA

State	C. D. BAUCOM, Superintendent, Weights and Measures Division, Department of Agriculture, Agricultural Building, Raleigh. JOHN I. MOORE, Field Supervisor. WILLIAM T. CRAWFORD, State Inspector of Weights and Measures, 304 Academy Street, Williamston. MARION L. KINLAW, State Inspector of Weights and Measures, Cross Street, Hope Mills. LATTA W. COOK, Liquid Fertilizer Specialist, Department of Agriculture, 110 Russ Street, Raleigh.

NORTH DAKOTA

State	J. C. GOLL, Chief Inspector, Weights and Measures Department, Public Service Commission, Capitol Building, Bismarck. JOHN KAUFFMANN, JR., State Inspector.

OHIO

State	V. D. CAMPBELL, Supervisor, Weights and Measures Section, Division of Food and Dairies, Department of Agriculture, 710 State Office Building, Columbus.*
County:	
Cuyahoga	JOE LAURIE, Deputy County Sealer of Weights and Measures, New Court House, Cleveland.
Medina	ROBERT W. SEARLES, Deputy County Sealer of Weights and Measures, Court House, Medina.
Ottawa	RUDOLPH STARKLOFF, Deputy County Sealer of Weights and Measures, 224 West Third Street, P. O. Box 208, Port Clinton.
Shelby	JOE L. BURKE, Deputy County Sealer of Weights and Measures, 710 Michigan Street, Sidney.
City:	
Akron	ROBERT K. SLOUGH, City Sealer of Weights and Measures, Municipal Building.
Cincinnati	WILLIAM E. G. RHEIN, Superintendent, Markets, Weights, and Measures, Department of Safety, 2nd Floor Market House.

OKLAHOMA

State	FAIN G. CESAR, Director, Marketing Division, State Board of Agriculture, 122 Capitol Building, Oklahoma City.

PENNSYLVANIA

County:	
Dauphin	SPENCER H. SEIGHMAN, County Inspector of Weights and Measures, Court House, Harrisburg.*
Philadelphia	JAMES J. POWERS, Supervisor, Bureau of Weights and Measures, 305 City Hall, Philadelphia.

*Registered in absentia.

*Registered in absentia.

PUERTO RICO

Commonwealth	J. Diaz y Hernandez, Head, Bureau of Operation, Economic Stabilization Administration, Box 4183, San Juan.

RHODE ISLAND

State	Edward R. Fisher, Sealer of Weights and Measures, Department of Labor, Veterans Memorial Building, 83 Park Street, Providence.
City:	
Providence	Edward F. Moran, Superintendent of Weights and Measures, 141 Fountain Street.
Warwick	Joseph A. Bruen, Sealer of Weights and Measures, 20 Omaha Boulevard, Hoxsie.

SOUTH CAROLINA

State	J. Roy Jones, Commissioner, Department of Agriculture, Wade Hampton Office Building, P. O. Box 1080, Columbia. Carl H. Stender, Assistant Commissioner. Ralph Magoffin, Director, Bureau of Inspection. Dexter C. Martin, State Inspector of Weights and Measures.

TENNESSEE

City:	
Memphis	V. D. Rogers, City Inspector of Weights and Measures, 590 Washington Avenue.
Nashville	Tom Webb, Sealer of Weights and Measures, 300 Demonbreun Street.

TEXAS

State	O. A. Kirkland, State Inspector, Weights and Measures, 3422 West Jefferson Boulevard, Dallas.
City:	
Dallas	George M. Hodges, Inspector, Weights, Measures, and Markets, 311 City Hall.
Houston	A. F. Gips, Inspector, Division of Weights and Measures, Department of Public Works, City Hall.

VIRGINIA

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