

b. As Found Tests

All meters and/or associated metering devices shall be tested after they are removed from service. Such tests shall be made before the meters and/or associated metering devices are adjusted, repaired, or retired.

c. Leak Tests

Repaired meters, meters that have been removed from service, and new meters shall be leak tested prior to installation. Each meter tested shall be subjected to an internal pressure of at least 20" w.C. and checked for the presence of leaks by one of the following tests:

1. Immersion test.
2. Soap test.
3. Pressure drop test of a type acceptable to the Commission.

d. Meter Testing on Request of Customer

1. Each gas utility shall at any time when requested by a customer upon not less than five (5) days' notice, test the accuracy of any meter in use by him.

No deposit or payment shall be required from the customer for such meter test except when a customer, whose average monthly bill for gas service is less than fifty (50) dollars requests a meter test within six months after date of the installation of said meter or six months after the last previous test, in which case he may be required by the utility to deposit with it, to cover the reasonable cost of such test, an amount not to exceed the following, unless specifically authorized by the Commission:

- (a) For meters of rated capacities not exceeding 250 cubic feet per hour..... \$ 3.00
per meter
- (b) For meters of rated capacities exceeding 250 cubic feet per hour but not exceeding 400 cubic feet per hour..... \$ 5.00
per meter
- (c) For meters of rated capacities exceeding 400 cubic feet per hour but not exceeding 4,000 cubic feet per hour..... \$10.00
per meter
- (d) Fees for tests of meters of greater rated capacity than 4,000 cubic feet per hour or for testing meters under extraordinary conditions will be furnished upon application to the Commission.

The amount deposited with the utility shall be refunded to the customer if the meter is found to register more than two (2) per cent over or under the prover registration.

2. A customer shall have the right to require the utility to conduct the test on his meter in his presence, or if he so desires, in the presence of an expert or other representative appointed by him.
3. A report giving the name of the customer requesting the test, the date of the request, the location of the premises where the meter was installed, the meter reading at time of removal, the date tested, and the result of the test, the type, make, size and number of the meter, the date of removal and deductions drawn therefrom shall be supplied to such customer within a reasonable time after the completion of the test and a duplicate of such report shall be filed with the Commission.

e. Periodic Tests

Unless otherwise authorized by the Commission each utility shall make periodic tests of meters, associated devices and instruments, to assure their accuracy. Such tests shall be scheduled within the calendar year, or earlier, when the interval is stated in years; or within the calendar month, or earlier, when the interval is stated in months. The basic periodic test interval shall not be longer than provided for in the following schedule: (Note: Maintenance programs suggested by manufacturers of the following meters and devices should be carefully followed.)

1. Positive displacement meters
 - (a) Up to 250 c.f./hr. (except meters on space heating installations) 10 years
 - (b) 250 to 1500 c.f./hr. 7 years
 - (c) Up to 1500 c.f./hr. on space heating installations 7 years
 - (d) Over 1500 c.f./hr. 2 years
2. Orifice meters 6 months
3. Base pressure correcting devices 24 months
4. Base volume correcting devices 24 months
5. Secondary standards
 - (a) Test bottles, one cubic foot 10 years
 - (b) Dead weight testers 10 years

6. Working standards
 - (a) Bell provers 3 years
 - (b) Rotary displacement test meters 5 years
 - (c) Flow provers 5 years
 - (d) Laboratory quality indicating pressure gauges 6 months
7. If found inaccurate, each such meter shall, at the time of each test, be readjusted to be correct within the prescribed limits before again being installed.
8. If, during an inspection or the servicing of appliances or equipment on a customer's premises, a meter is observed to be in such a condition or so operating as to cause doubt of its accuracy or establish as a certainty that it is not recording within the limits of accuracy prescribed by these rules, it should be removed immediately without alteration of its condition, and tested, provided that in cases where removal is not feasible, same should be tested in place.

6.2 Test Procedures and Accuracies

Meters and/or associated metering devices shall be tested at the points and adjusted to the tolerances prescribed below. The test of any unit of metering equipment shall consist of a comparison of its accuracy with the accuracy of a standard. The Commission will use the applicable provisions of the standards listed in Rule 5.2 as criteria of accepted good practice in testing meters.

a. Positive Displacement Meters

1. Accuracy at test points

Flow	Adjusted to within
Check flow	+ 1% or - 2%
Not less than full rated flow	+ 1% or - 2%

2. Overall accuracy

The accuracy at check flow and the accuracy at not less than full rated flow shall agree within one percent.

b. Orifice Meters

Accuracy at test points must be within $\pm 2\%$.

c. Timing Devices

All recording type meters or associated instruments which have a timing element that serves to record the time at which the measurement occurs must be adjusted so that the timing element is not in error by more than plus or minus 4 minutes in 24 hours.

d. General

1. All meters and/or associated metering devices, when tested, shall be adjusted as closely as practicable to the condition of zero error.
2. All tolerances are to be interpreted as maximum permissible variations from the condition of zero error. In making adjustments no advantages of the prescribed tolerance limits shall be taken.

6.3 Facilities and Equipment for Meter Testing

- a. Each gas utility shall, unless otherwise specifically required by these rules, provide such laboratory equipment, meter testing equipment, and other testing facilities for each gas manufacturing or mixing plant, meter repair shop or testing station, as may be necessary to make the tests required of it by these rules or other orders of the Commission. The apparatus and equipment so provided shall be of a type and form approved by the Commission, and it shall be available at all times for the inspection or use of any authorized representative of the Commission.
- b. Each gas utility shall make such tests as are prescribed under these rules with such frequency and in such manner, and at such places as herein provided, or as may be approved or ordered by the Commission.
- c. Each gas utility shall file with the Commission a detailed statement showing the location of each laboratory, meter testing shop and testing station owned, controlled or operated by the utility, together with a full and complete description of each major testing or standardizing instrument or apparatus maintained therein. Any major change or addition to testing instruments and apparatus, or abandonment of testing instruments or apparatus shall be reported to the Commission within ten days after the change has become effective.
- d. The area within the meter shop used for the testing of meters shall be designed so that the meters and meter testing equipment are protected from drafts and excessive changes of temperature.
 1. The meters to be tested shall be stored in such manner that the temperature of the meters is substantially the same as the temperature of the prover.

e. Working Standards

1. Each utility shall own and maintain, or have access to, at least one approved bell type prover of 5 cubic foot capacity and all other equipment necessary to test meters, which shall be installed in the meter room.
 - (a) Means shall be provided to maintain the temperature of the liquid in the meter prover at substantially the same level as the ambient temperature in the prover room.
 - (b) The meter prover shall be maintained in good condition and correct adjustment so that it shall be capable of determining the accuracy of any service meter to within one-half of one percent.
2. Each utility having meters which are too large for testing on a 5 cubic foot bell prover may use a properly calibrated test meter or a properly designed flow prover for testing the large meters.

f. Working standards must be checked periodically (see Rule 6.1e) by comparison with a secondary standard.

1. Bell provers must be checked with a 1 cubic foot bottle which has been calibrated by the National Bureau of Standards.
2. Rotary displacement test meters must be checked with a bell prover of adequate capacity which has been calibrated by representatives of the National Bureau of Standards.

g. Extreme care must be exercised in the use and handling of standards to assure that their accuracy is not disturbed.

h. Each standard shall be accompanied at all times by a certificate or calibration card, duly signed and dated, on which are recorded the corrections required to compensate for errors found at the customary test points at the time of the last previous test.

i. Each utility must have properly calibrated orifices, as may be necessary, to achieve the rates of flow required to test the meters on its system.

6.4 Records of Meters and Associated Metering Devices

Each utility shall maintain records of the following data, where applicable, for each meter and/or associated metering device until retirement:

- a. The complete identification--manufacturer, number, type, capacity, multiplier, constants, and pressure rating.
- b. The dates of purchase, installation and removal from service, together with the location.

6.5 Meter Test Records

Each utility shall maintain records of at least the last two tests made of any meter. The record of the meter test made at the time of the meter's retirement shall be maintained for a minimum of 3 years. Test records shall include the following:

- a. The date and reason for the test.
- b. The reading of the meter before making any test.
- c. The accuracy "as found" at check and full rated flow.
- d. The accuracy "as left" at check and full rated flow.
- e. In the event test of the meter is made by using a standard meter or a flow prover, the utility shall retain all data taken at the time of the test in sufficiently complete form to permit the convenient checking of the test methods and the calculations.

PART VII STANDARDS OF QUALITY OF SERVICE

7.1 Purity Requirements

All gas supplied to customers shall be substantially free of impurities which may cause corrosion of mains or piping or form corrosive or harmful fumes when burned in a properly designed and adjusted burner.

a. Hydrogen sulphide

No gas supplied by any gas utility for domestic or commercial purposes in this State shall contain more than a trace of hydrogen sulphide. The gas shall be considered not to contain more than a trace of hydrogen sulphide if a strip of white filter paper moistened with a solution containing 5 per cent by weight of lead acetate is not distinctly darker than a second paper freshly moistened with the same solution after the first paper has been exposed to the gas for one minute in an apparatus of approved form through which the gas is flowing at rate of approximately five cubic feet per hour, the gas not impinging directly from a jet upon the test paper.

b. Total Sulphur and Ammonia

No gas supplied by any gas utility for domestic or commercial purposes shall contain more than thirty (30) grains of total sulphur, and more than five (5) grains of ammonia in each one hundred (100) cubic feet.

c. Test of Gas Purity

Each gas utility supplying manufactured gas for domestic, commercial or industrial purposes shall make daily tests of the gas leaving its manufacturing or purifying plants for the presence of hydrogen sulphide in the manner above specified. Each gas manufacturing or purifying plant having an annual output in excess of one hundred million (100,000,000) cubic feet of gas shall be equipped with, and shall maintain, such apparatus and facilities as are necessary for the determination of total sulphur and ammonia in gas; and each utility operation such as a plant shall make tests weekly or oftener as may be found necessary; and keep a continuous chronological record of the amount of total sulphur and ammonia in the gas distributed by it. In lieu of testing the sulphur content of the manufactured gas, Utilities supplying oil gas may make sulphur content tests of the oil stock by bomb calorimeter test. Sulphur content of the oil shall be determined when base stocks are known to be changed at two week intervals, provided the sulphur content of the oil does not exceed 1.5%. For oil stock with sulphur content in excess of 1.5% the manufactured gas shall be tested at least weekly as provided above. The records herein provided shall be kept at the station where made, provided, however, that such a utility supplying only water gas or oil gas shall not be required to provide apparatus for or make determinations of the amount of ammonia in gas.

- d. In the case of those utilities supplying a mixed gas these standards of gas purity shall apply to the manufactured gas prior to mixture, excepting in emergencies or in special cases, by approval of the Commission.

7.2 Pressure Limits

a. Standard Gas Delivery Pressure

1. Each gas utility supplying gas for domestic or commercial purposes shall, subject to the approval of the Commission, adopt and maintain a standard pressure of gas as measured at the outlet of any customer's meter. In adopting such a standard pressure, each utility may divide its distributing system into districts and establish a separate standard pressure for each district, or the utility may establish a single standard pressure for its distributing system as a whole.
2. The Standard Pressure adopted as herein provided shall be filed with the Commission as a part of each gas utility's schedule of rates, rules and regulations, and shall be

clearly set forth in the schedules of rates, rules and regulations of the utility kept open to the public inspection at each office or location where applications for service are received.

3. No change shall be made in the standard pressure adopted by it for any district or system without the approval of the Commission.

b. Minimum and Maximum Gas Pressure

The standard pressure of gas supplied to domestic or commercial customers, as measured at the outlet of any such customer's meter, shall not be less than two inches nor more than twelve inches of water pressure. In the case of customers who require higher pressure than the standard established for domestic and commercial service, the gas utility may supply gas at the desired pressure.

c. Variations in Gas Pressure

The pressure of gas supplied at low pressure to domestic and commercial customers shall not vary more than fifty per cent (50%) above or below the standard pressure which the utility has adopted for a district or system, as herein provided, and no such variation in pressure shall be more than that equivalent to four inches of water column above or below the standard. No variation in pressure from the standard pressure of two inches or more of water column shall occur in a shorter time than fifteen (15) minutes excepting momentary fluctuations on individual services caused by the operations of customer's appliances or fluctuations caused by reasonable regulator buildups.

7.3 Pressure Surveys and Records

- a. Each utility shall make a sufficient number of pressure measurements on its mains and at the customer's meter so that it will have a substantially accurate knowledge of the pressures in the low, intermediate and high pressure systems in each district, division, or community served by its distribution mains.
- b. All pressure records obtained under Rule 7.3 shall be retained by the utility for at least 2 years and shall be available for inspection by the Commission's representatives. Notations on each record shall indicate the following:
 1. The location where the pressure check was made.
 2. The time and date of the check.

7.4 Standards For Pressure Measurements

a. Secondary Standards

Each utility shall own or have access to a dead weight tester. This instrument must be maintained in an accurate condition.

b. Working Standards

Each utility must have water manometers, mercury manometers, laboratory quality indicating pressure gauges and field type dead weight pressure gauges as necessary for the proper testing of the indicating and recording pressure gauges used in determining the pressure on the utility's system.

c. Working standards must be checked periodically (see Rule 6.2 e) by comparison with a secondary standard.

d. Extreme care must be exercised in the handling of standards to assure that their accuracy is not disturbed.

e. Each standard shall be accompanied at all times by a certificate or calibration card, duly signed and dated, on which are recorded the corrections required to compensate for errors found at the customary test points at the time of the last previous test.

f. Low-Pressure Distribution Systems

1. Each gas utility shall own and maintain at least one recording pressure gauge on each principal distribution main leaving each gas manufacturing plant, compressor, or holder station and no utility shall maintain less than two such gauges unless specifically relieved in writing by the Commission. Pressure charts taken from such gauges shall be preserved as a continuous record for a period of at least two years.

2. Each gas utility shall own and maintain at least one low pressure, portable recording pressure gauge for each one hundred (100) miles or fraction thereof of low pressure main in any district as may be ruled a separate distributing system by the Commission.

3. On low pressure distribution systems each gas utility shall during the six months of the peak season of the year make at least one twenty-four-hour record of pressure each week at the outlet of customer's meters for each one hundred (100) miles or less of distribution main in each district or separate distributing system. Such record shall bear the address of the customer where the pressure is taken and the dates, together with such other information as the Commission may from time to time direct and shall be filed and retained as a continuous

record for a period of at least two calendar years in the principal office of each district or division. In lieu of fifty per cent (50%) of the above required number of records from portable pressure gauges at customer's premises there may be substituted an equal number of twenty-four (24) hour records from recording pressure gauges permanently located at critical points on the distribution system.

g. High-Pressure Distribution Systems

1. On high pressure distribution systems, gas utilities shall maintain permanently located pressure gauges at critical points to measure the pressures on both sides of the pressure regulators. Recording pressure gauges shall be used in high pressure distribution systems with over 500 customers. In systems of under 500 customers, a log of pressure gauge readings shall be maintained with gauges read weekly and upon delivery into LPG holder stations. Charts from these gauges and the log of pressure gauge readings shall be preserved in the district or division offices as a continuous record for a period of at least two (2) years.
2. Pressure conditions on the customer's premises on high pressure distribution systems shall be determined by water column tests made during service calls in answer to complaints. A report on such tests shall be made on the complaint order, which report shall state the pressure observed when appliances were on and when all appliances (excepting pilot lights) were off, and it shall state whether the test was made at the outlet of the meter or at the customer's appliance. Pressure tests shall be made on one hundred per cent (100%) of the pressure complaints received.

7.5 Heating Value

a. Heating Value Standard for Manufactured and Mixed Gas

1. Each gas utility supplying manufactured or mixed gas for domestic, commercial or industrial purposes, either directly or through a second utility, shall establish and maintain, with the approval of the Commission, a standard heating value for its product. The monthly average heating value of the gas measured in the manner and place as hereinafter provided shall meet the requirements of the standard established.
2. Each gas utility supplying manufactured or mixed gas shall file with the Commission as a part of its schedule of rates, rules and regulations, a statement of the standard heating value of the gas supplied by it:

- (a) At the outlet of its plant at low pressure delivery.
- (b) To its customers in each district as may be ruled a separate distribution system by the Commission.

A similar statement shall be inserted in its schedule of rates, rules and regulations, kept open to public inspection at each office or location where applications for service are received.

b. Daily Variation in Heating Value of Manufactured and Mixed Gas

The maximum variation of the heating value of manufactured or mixed gas leaving the plant shall be filed with the Commission.

c. Heating Value of Hydrocarbon Gas

Each gas utility supplying hydrocarbon gas for domestic, commercial or industrial purposes shall file with the Commission as a part of its schedule of rates, rules and regulations, the average total heating value of the hydrocarbon gas, together with the maximum fluctuation above and below the average total heating value which may be expected of the gas supplied by it in each district, division or community served.

d. Monthly Average Heating Value

1. The monthly average total heating value of manufactured or mixed gas at any given test station shall be an average of the daily determination as provided for in Rule 7.6.
2. The monthly average total heating value of hydrocarbon gas at any given test station shall be an average of all total heating value tests made during each month in fulfillment of the requirements of Rule 7.6.

7.6 Heating Value Determination and Records

a. Heating value tests shall conform to Chapter II "STANDARDS OF CALORIMETRY FOR GASEOUS FUELS" adopted by this Commission contained herein.

b. Calorimeter Equipment

1. Each gas utility supplying manufactured or mixed gas shall provide and maintain testing stations equipped with a calorimeter complete with all necessary accessories thereto, and of a type approved by the Commission, as follows:

- (a) One testing station at each gas manufacturing or mixing plant supplying each district, division or community, provided that such testing station may be installed at a point near the center of distribution, subject to the approval of the Commission.

(b) A gas utility distributing in any district, division or community manufactured or mixed gas purchased from a second utility shall be considered a manufactured or mixed gas utility and shall install testing stations in accordance with these rules.

2. A gas utility supplying any district, division or community with hydrocarbon gas, in which the annual sales exceed one hundred million (100,000,000) cubic feet, shall establish a testing station, or take samples indicative of the supplied gas, and shall make at least one determination per week of the total heating value of the gas delivered to customers.

c. Heating Value Tests

1. Manufactured or Mixed Gas

(a) Each utility supplying manufactured or mixed gas and maintaining a testing station at the manufacturing or mixing plant shall determine daily the heating value of the gas leaving the plant. This determination shall be as near a weighted average quality of gas sent out each day as practical limitations will permit, obtained either by averaging a series of tests taken at intervals in a manner approved by the Commission or by a test made upon a continuous sample taken and held by a device approved by the Commission.

(b) Each utility supplying manufactured or mixed gas and maintaining a testing station near the center of the distribution shall determine the heating value of the gas being delivered on at least six days per week in the manner prescribed above.

(c) Each gas utility supplying manufactured or mixed gas and maintaining a testing station shall determine the heating value of the gas in the mains at the outlet of each manufacturing or mixing plant at least three times each day, at intervals of not less than three and one-half ($3\frac{1}{2}$) hours, unless in the opinion of the Commission more frequent determination shall be made in which event determinations shall be made in the manner and at such times as may be approved by the Commission.

2. Manufactured or Mixed Gas Affected by Compression or Other Processes.

Each utility supplying manufactured or mixed gas, the operations of which involve compression or other processes affecting the heat content of all or any portion of its gas after the gas has been delivered from the manufacturing or mixing plant, shall maintain such equipment and make such tests as may be prescribed by the Commission.

3. Hydrocarbon Gas

Each gas utility supplying hydrocarbon gas for domestic, commercial or industrial purposes shall make tests of the gas delivered to its customers at such locations and with such frequency as may be prescribed by the Commission and shall keep a permanent chronological record of all tests of total heating value received or delivered to it; provided, that if heating value determinations of the same gas are satisfactorily made by an approved testing laboratory or another utility these determinations may be used for the purpose of the above record upon written approval of the Commission. In cases where unmixed hydrocarbon gas is served, the heating value may be calculated upon the basis of analysis of the shipment as received by the utility from the producer or manufacturer.

d. Heating Value Test Records

Each gas utility making heating value determinations as herein provided shall adopt, subject to the approval of the Commission, a standard form for recording the data and results of each such test. Each determination of heating value shall be recorded upon the form adopted for that purpose and such forms shall be retained as a chronological record at the station where made for a period of not less than two years.

7.7 Interruptions of Service

Any gas utility contemplating an interruption to service on its entire system or in any major district thereof shall first submit its plan to the Commission for approval.

- a. Each gas utility shall keep a record of all interruptions to service on its entire system, or in major divisions or operating districts thereof, including a statement of the time, duration and cause, if known, of the interruption. Any such interruption of over one (1) hour shall be reported to the Commission as soon as possible after its occurrence. Such records should include the following information concerning the interruptions:
 1. Cause
 2. Date and time
 3. Duration
- b. Planned interruptions shall be made at a time that will not cause unreasonable inconvenience to customers and shall be preceded by adequate notice to those who will be affected.

- c. Each utility shall notify the Commission by telephone of any interruption to the service of a major portion of its distribution system.

PART VIII - SAFETY

8.1 Acceptable Standards

As criteria of accepted good safety practice the Commission will use the applicable provisions of the standard listed in Rule 5.2.

8.2 Protective Measures

- a. Each gas utility, unless specifically relieved in any case by the Commission from such obligation, shall operate and maintain in safe, efficient and proper condition all of the facilities and instrumentalities used in connection with the furnishing, regulation, measurement and delivery of gas to any customer up to and including the point of delivery, which point, for the purpose of these rules, shall be deemed to be the outlet fitting of the meter installed by the utility.
- b. Each gas utility, unless specifically relieved in any case by the Commission from such obligation, upon request of any customer and without extra charge, shall make an inspection of appliances in use by that customer, in accordance with the rules and regulations of such utility filed with the Commission.
- c. Each utility shall exercise reasonable care to reduce the hazards to which its employees, its customers, and the general public may be subjected.
- d. The utility shall give reasonable assistance to the Commission in the investigation of the cause of accidents and in the determination of suitable means of preventing accidents.
- e. Each utility shall maintain a summary of all reportable accidents arising from its operations.

8.3 Safety Program

Each utility shall adopt and execute a safety program, fitted to the size and type of its operations. As a minimum, the safety program should:

- a. Require employees to use suitable tools and equipment in order that they may perform their work in a safe manner.
- b. Instruct employees in safe methods of performing their work.

- c. Instruct employees who, in the course of their work are subject to the hazard of electrical shock, asphyxiation or drowning, in accepted methods of artificial respiration.

8.4 Customers Piping

Each customer's piping system shall be tested for leaks before service is turned on.

- a. Pressure Test

If local authorities do not require a pressure test of customer's piping, as set forth in American Standard Installation of Gas Appliances and Gas Piping, ASA Z21.30, the utility shall advise the customer of the desirability of having his plumber conduct such a test.

- b. Leakage Test

Before permitting the use of gas at any location, the piping system shall be tested for leaks by a method at least equal to that described in Section "Leakage Check After Gas Turn On," in the latest edition of the American Standard Installation of Gas Appliances and Gas Piping, ASA Z21.30.

- c. Service Cocks

On and after the effective date of this order each and every gas service line installed or reconstructed shall include a suitable shut-off valve, or cock, properly housed or encased so as to be accessible at all times, located outside of the structure served and between said structure and the gas main from which said service is supplied.

8.5 Gas Leaks

A report of a gas leak shall be considered as an emergency requiring immediate attention.

8.6 Odorization

Any gas, distributed to customers through gas mains or gas services or used for domestic purposes in compressor plants, which does not naturally possess a distinctive odor to the extent that its presence in the atmosphere is readily detectable at all gas concentrations of one-fifth of the lower explosive limit and above, shall have an odorant added to it to make it so detectable. Odorization is not necessary, however, for such gas as is delivered for further processing or use where the odorant would serve no useful purpose as a warning agent. Suitable tests must be made to determine whether the odor meets the aforementioned standards.

CHAPTER II

STANDARDS OF CALORIMETRY FOR GASEOUS FUELS

PART I - GENERAL

1.1 Applicability of Rules

When a change is desired in the type of calorimeter to be used at a given calorimeter station, a request shall be made to the Commission by the utility, briefly stating the authorization sought, the type of calorimeter presently being used at the calorimeter station, the type of calorimeter desired to be used at the station in the future, and the major reason for making the change.

1.2 Deviations from Rules

In no case shall any public utility deviate from the methods herein set forth except with special written authorization from the Commission. If hardship results from the application of any rule herein prescribed because of special conditions, application may be made to the Commission for authorization to deviate therefrom. Such request for deviation authority shall set forth a complete justification of the proposed procedure.

1.3 Definitions

a. Fuel Gas

Any combustible gas or vapor, or combustible mixture of gaseous constituents, used to produce heat by burning.

b. Fuel Gas Calorimeter

An apparatus for determining the calorific (heating) values of fuel gases.

1. Recording Calorimeter

An automatic device that continuously makes a written record of the heating value of a fuel gas or mixture of fuel gases on a chart.

2. Water-Flow Calorimeter

A laboratory device for measuring the total and/or net heating value of a fuel gas or mixture of fuel gases in which the heat evolved by the complete combustion of a measured quantity of gas burning at a uniform rate is absorbed by a quantity of water also flowing at a uniform rate. The weight and increase in temperature of the water flowing during the interval that the measured quantity of gas is being burned furnish the primary data necessary for calculating the heating value of the gas.

c. Calorimeter Station

The location at which a calorimeter is maintained for the purpose of determining the heating value of a fuel gas.

d. Standard Temperature

60° F., based on the international temperature scale.

e. Standard Pressure

The absolute pressure of a column of pure mercury 30 inches in height at 32° F., and under standard gravity (32.174 ft./sec²) or (980.665 cm/sec²)

f. Standard Cubic Foot of Gas

The quantity of gas which, when saturated with water vapor and at a temperature of 60° F. and under a pressure of 30 inches in height of mercury at 32° F. (density 13.5951 grams/cc and acceleration of gravity 980.665 cm/sec²) occupies one cubic foot.

g. Dry Cubic Foot of Gas

The quantity of gas which, when free of water vapor at standard temperature and under standard pressure will fill a space of one cubic foot. The total heating value of one dry cubic foot of gas is equal to the product of the total calorific value per standard cubic foot and the constant 1.0177.

h. British Thermal Unit (Btu)

The quantity of heat that must be added to one avoirdupois pound of pure water to raise its temperature from 58.5° F. to 59.5° F. under pressure.

i. Total Calorific Value

The number of British thermal units evolved by the complete combustion at constant pressure, of one standard cubic foot of gas with air, the temperature of the gas, air and products of combustion being 60° F. and all of the water formed by the combustion reaction being condensed to the liquid state.

j. Net Calorific Value

The number of British thermal units evolved by the complete combustion at constant pressure, of one standard cubic foot of gas with air, the temperature of the gas, air and products of combustion being 60° F. and all of the water formed by the combustion reaction remaining in

the vapor state. The net calorific value of a gas is its total calorific value minus the latent heat of vaporization at standard temperature of the water formed by the combustion reaction. Latent heat of vaporization of water at 60° F. = 1057.8 Btu per lb. or 50.37 Btu per standard cubic foot.

k. Theoretical Air

The volume of air that contains the quantity of oxygen, in addition to that in the gas itself, consumed the complete combustion of a given quantity of gas.

l. Excess Air

The quantity of air passing through the combustion space in excess of theoretical air.

m. Combustion Air

The air passing into the combustion space of the calorimeter (theoretical air plus excess air).

n. Products of Combustion

All substances resulting from the burning of gas with its theoretical air, including the inert constituents of the gas and the theoretical air, but excluding excess air.

o. Fuel Gases

The products of combustion remaining in the gaseous state, together with the excess air.

p. Certified Gas

A sample of gas of certified heating value. The sample must be of constant composition and heating value and contain no condensibles that will effect a change in its heating value with any temperature-pressure conditions to which the gas may be subjected.

q. Standard Hydrogen Gas

Hydrogen gas generated by the reaction of water on hydrone, an alloy of sodium and lead. (Purity approximates 99.94 per cent hydrogen.)

r. Reference Hydrogen Tank Gas

Hydrogen gas of commercial quality and purity stored in a tank or cylinder at high pressure, the heating value (theoretical scale reading) of which has been determined with standard hydrogen gas.

s. Reference Gas

Reference gas of constant composition and heating value, the heating value of which has been accurately determined by use of certified gas or standard hydrogen gas. Such gas shall contain no condensibles that will effect a change in its heating value with any temperature-pressure change to which the gas may be subjected.

t. Condensate

The water that is condensed to the liquid state within the body of the calorimeter.

PART II-CALORIMETERS

2.1 Types of Calorimeters

It is the intent of the Commission that this general order be applicable to all types of calorimeters; however, at the present time there are only two types of calorimeters in use of which the Commission approves. These are the recording and water-flow types. Each type is being manufactured only by a limited number of manufacturers. In the case of the recording calorimeter there is only one principal manufacturer, Cutler-Hammer, Inc., and in the case of the water-flow type there are only a few manufacturers. Under these circumstances standards are provided or specified that treat specifically with the equipment produced by these manufacturers.

PART III - CALORIMETRY STANDARDS

3.1 Standards for Water-Flow Calorimeters

- a. The "Standard Method of Test for Calorific Value of Gaseous Fuels by the Water-Flow Calorimeters," published by the American Society of Testing Materials, ASTM Designations: D900-48, Adopted 1948, is hereby prescribed as the approved method of the Commission for operation water-flow calorimeters by the gas utilities in the State of Hawaii.
- b. The humidity correction procedure and the humidity control procedure of the "Standard Method of Test for Calorific Value of Gaseous Fuels by the Water-Flow Calorimeters," are the approved standard procedures of the standard method and shall be adhered to in detail as each is described in publication ASTM Designation: D900-48, adopted 1948.

- c. Where a water-flow calorimeter is employed for making a heating value determination of a fuel gas no less than one set of duplicate heating value tests shall be made of that gas for each determination performed. The difference between the two heating value test results obtained shall not exceed 10 Btu per standard cubic foot. If a difference of 10 Btu per standard cubic foot is exceeded, additional heating value tests shall be run until two test results are obtained of a lesser difference than 10 Btu per standard cubic foot. The average of the first two test results having a lesser difference than 10 Btu per standard cubic foot shall be the accepted heating value test result for that determination.

3.2 Standards for Recording Calorimeters

The standard methods for installing and operating recording gas calorimeters for determining the heating value (calorific value) of fuel gases applicable to the utilities using the Cutler-Hammer type of equipment are set forth in Rule 3.4.

3.3 Minimum Requirements

The requirements contained herein should be considered as minimum and any utility may adopt additional rules and practices provided they are not inconsistent with the provisions of this order.

3.4 Standard Method for Installing, Operating, Testing and Maintaining Recording Calorimeters Manufactured by Cutler-Hammer, Inc.

a. Location, Housing and Installation

1. General Location

Calorimeters shall be located in a place where the possibility of contamination of the combustion air by heat producing constituents is negligible. Where contamination of the air in the room occurs uncontaminated air shall be delivered to the calorimeter or calorimeter room at room pressure. The building or room for housing a recording calorimeter shall be constructed of such material and in such a manner as to eliminate the possibility of drafts and wide or rapid changes in temperature. The calorimeter room or enclosure shall not be used for any purpose that may cause contamination of the atmosphere or interfere with the proper maintenance and operation of the calorimeter or calorimeters.

2. Housing

The minimum clearance shall be 12 inches from the back and the sides of the tank unit and the hinged side and back of the recorder unit, and 36 inches from the front of both units. The minimum floor area suitable for one recording calorimeter and auxiliary equipment shall be approximately 70 sq. feet. Additional units may be installed in the calorimeter room provided

auxiliary equipment shall be approximately 70 sq. feet. Additional units may be installed in the calorimeter room provided the foregoing specified clearances are maintained. The tank and recorder unit or units may be installed in separate rooms but should not be separated by more than 100 feet. The room in which the calorimeter tank or recorder unit is located shall have a foundation reasonably free from vibration and floor shock and shall be capable of withstanding without deflection the weight of the tank unit and recorder unit, together with normal traffic and operations.

3. Installation

(a) Wiring

The calorimeter wiring to be installed shall be in accordance with the manufacturer's applicable instructions and applicable national and local codes.

(b) Gas Connections

A suitable piping system for conveying line and calibrating gases to each recording calorimeter that will enable the shifting from one gas to another, without extinguishing the burner flame and prevent the contamination of one gas supply with another, shall be provided at each recording calorimeter station. One quarter-inch needle valves and iron pipe size (I.P.S.) piping are recommended. Such a system is outlined in Figure A attached. In making the connections to the gas supply, the small orifice in the end of the nipple connected to the 1/4-inch union shall not be damaged or removed. A suitable pressure regulator shall be used with each calorimeter to provide proper pressure of the gas at the calorimeter when line pressures exist up to 30 inches of water. For line pressures above 30 inches of water, an additional or substitute pressure regulator must be used. The gas sampling or supply pipe to each recording calorimeter installed after the effective date of this order shall follow a direct route and be of the smallest practical internal diameter possible to enable the amount of gas required to properly operate the calorimeter to reach the instrument. Reduce to an absolute minimum the length of "dead" sample line connected at any time to the pipeline through which gas is conveyed to the calorimeter. For all hydrogen tests eliminate the passage of hydrogen through lines and regulators which have been in contact with other fuel gas.

(c) Gas Condition

The gas supplied to the calorimeter shall be practically free from hydrogen sulphide and other impurities which may interfere with its operation.*

(d) Installation of Tank and Recorder Units

Install the tank and recorder units and place them in readiness to operate as directed by the manufacturer's applicable book of instructions.

(e) Installation Report

- (1) Each gas utility shall file with the Commission at the time of the installation of each recording calorimeter or as soon thereafter as practical, a complete installation report, together with such other data or facts as may be pertinent to a suitable record of the equipment and facilities comprising a recording calorimeter station.
- (2) To the "Installation Report" for each calorimeter shall be attached a "Ground Plan for the Recording Calorimeter Stations," setting forth the outline of the building, the location of the calorimeter or calorimeters within the building, the size, length, gas pressure and general route of the gas sample pipe from the supply main to each calorimeter and the relative location of all secondary equipment necessary for the operation of the recording calorimeter.

b. General Care, Operation, Maintenance and Testing

The provisions of this section shall apply to the practices to be followed by gas utilities for operating, maintaining and testing recording calorimeters.

*Hydrogen sulphide concentrations in the order of 0.25 grains per 100 cubic feet may cause difficulty with the operation of a recording calorimeter. It is recommended that the hydrogen sulphide concentration of the gas supplied to a calorimeter be kept below a trace which approximates 0.25 grains per 100 cubic feet.

1. Calorimeter Station Records

Each gas utility shall keep a chronological record of weekly tests performed on each recording calorimeter for a period of not less than two years. In the record shall be entered the dates and results of operation to restore sensitivity and accuracy, including results of air-gas ratio tests, baffle tube changes, gas meter level adjustments, renewals of parts and other pertinent operations not otherwise specified in this order but included in the manufacturer's applicable book of instructions.

2. Gases Used For Testing

The calorimeters must be tested at periodic intervals on a gas of known heating value as defined in Rule 1.3 p through s.

3. Placing Calorimeter in Operation

Following the installation of a recording calorimeter as prescribed in Rule 3.4 a 3, it shall be run for a breaking-in period of not less than 24 hours and shall then be checked and adjusted for sensitivity and over-all accuracy in accordance with the following "weekly routine tests," starting with Rule 3.4 b 5 (b). ("As found test")

The 24-hour breaking-in run shall be made with the gas meter operating with air-gas ratio gears as specified in the manufacturer's applicable book of instructions and the heat absorbing air meter operating at normal speed. This run shall be made under normal ambient room temperature conditions.

4. Temperature Control Facilities

Suitable air conditioning facilities shall be provided at calorimeter stations existing as of the effective date of this General Order where tank water temperature has exceeded 90° Fahrenheit during more than 15 days of the year. Suitable air conditioning equipment shall be installed at new calorimeter stations or in connection with the relocation of existing air calorimeter stations subsequent to the effective date of this order where tank water temperatures will exceed 90° Fahrenheit at any time. Suitable provisions shall be made at all calorimeter stations to insure a minimum tank water temperature of 70° Fahrenheit at any time.

5. Weekly Routine Tests

The following routine weekly operating accuracy tests shall be performed on each calorimeter.

(a) Selection of Test Days

One day of each week shall be selected for the performance of an "As Found" accuracy test, mechanical tests, adjustments, and an "As Left" accuracy test of each recording calorimeter, and thereafter the specified accuracy tests, adjustments and maintenance work shall be performed on the same day of each week insofar as practicable.

(b) "As Found" Test

Operate the calorimeter using reference (or certified) gas before cleaning parts or making any adjustments to either the tank unit or the recorder mechanism. Make the change from line gas to the reference gas so as to have continuous chart reading by avoiding extinguishment of the calorimeter burner.

After the recorder pen has assumed its new position and has drawn a line at constant value for at least 20 minutes, make an over-all sensitivity test as described in Section C. Record the Upper and Lower Sensitivity readings on the face of the chart using a stamp, the print of which is illustrated by Figure D attached hereto. Calculate the mean of the two sensitivity readings and record the result as the average chart reading. Complete the "As Found" record showing the Btu of the reference gas and the correction to chart readings.

(c) "As Left" Test

If the "As Found" correction to the chart readings is 1 per cent or less of the heating value of the reference gas and the sensitivity difference is 2 Btu or less, no adjustment need be made and the instrument may be returned to service in which event fill in the "As Left" column of the form stamped on the recorder chart. The sensitivity difference of 2 Btu applies to a recording calorimeter of the split-scale type. For uniform scale instruments the sensitivity difference shall not exceed 0.5 per cent of full scale reading.

6. Maintenance and Recalibration Procedure

If the sensitivity or the correction to the chart reading is not within the limits specified in Rule 3.4 b 5 (c), follow the instructions set forth in Rules 3.4 d & e. to the extent necessary. If the sensitivity and accuracy have been restored, enter the final results in the "As Left" column of the weekly test record.

If the accuracy still is not within the prescribed limits, perform to the extent necessary the operations prescribed in Rule 3.4 f.

7. Reading Charts and Applying Corrections

The average heating value shall be determined from the chart for hourly periods and shall correspond to an imaginary line at the center of the inked line on the chart record.

When the chart record varies to such an extent that it is evident that an exact average heating value for an hourly period cannot be determined by one observation covering the chart record, the average for the hour shall be the average of four readings each covering a 15-minute chart interval. The corrections to compensate for the total error in the chart record, determined in Rule 3.4 b and recorded as "Correction to Chart Readings as Left," shall be applied to all subsequent chart readings until the correction has been again determined.

c. Sensitivity Tests

The sensitivity test of the recording mechanism shall be made by one of the following methods with the instrument operating on a gas of constant heating value.

1. Rheostat Method

Open the recorder door so as not to cause a deflection of the galvanometer. Rotate the rheostat from the operating setting in a counter-clockwise direction to cause the recorder pen to move toward scale zero approximately 10 Btu. Then reset the rheostat to the operating setting. Close the recorder door. Observe and record the chart reading when it shows no further increase.

Again open the recorder door and rotate the rheostat from the operating setting in a clockwise direction to cause the recorder pen to move toward the upper end of the scale approximately 10 Btu. Then reset the rheostat to the operating setting. Close the recorder door. Observe and record the chart reading when it shows no further decrease. The numerical difference between the two readings is the sensitivity of the recorder.

2. Alternate Method

Open the recorder door, slowly lower and unlatch the chart assembly. Then pull forward on the latch to swing the assembly out exposing the slide wire. Grasp the metal shaft extension from the slide wire and rotate in a clockwise direction so that the scale indicator has moved toward scale zero approximately

10 Btu. Latch the chart assembly and carefully close the recorder door. When there is no further increase, observe and record the chart reading.

Repeat the procedure, except rotate the slide wire in a counter-clockwise direction so that the scale indicator moves toward the upper end of the scale approximately 10 Btu. When there is no further decrease, observe and record the chart reading. The numerical difference between the two readings is the sensitivity of the recorder.

d. Restoration of Sensitivity

If the sensitivity difference of a recording calorimeter of the split-scale type is more than 2 Btu or the sensitivity difference of a recording calorimeter having a uniform scale is greater than 0.5 per cent of the full scale reading of the instrument, take the following procedure to restore the sensitivity of the calorimeter to acceptable limits.

1. Check all electrical connections of the recorder for corroded or loose contacts.
2. Check the clearance between the galvanometer pointer and the upper and lower clamping bar.
3. Note the play between the slide wire and the pen tip to make certain that it is not excessive.