Consumer and Corporate Affairs
Consommation et Corporations

DEPARTMENTAL INSTRUCTIONS

FOR

INSPECTION

OF

ELECTRIC METERS

AND

AUXILIARY DEVICES

APRIL 1976

CONTENTS

INTRODUCTION

This document outlines in detail the rules and procedures which must be followed in the inspection of electric meters and electric metering devices used in revenue metering systems. Essentially, it is a description of what must be done and it is not too much concerned with how the inspection should be made. For technical details of the latter, reference should be made to Instructions to Inspectors regarding Methods of Electric Meter Inspections and Technical Electric Circulars.

It is not intended that these rules become immutable but rather that they form the basis for a continuous process of developing better and more effective means of inspection. Further, they do not preclude the Consumer Standards Directorate of the Department from making other arrangements with a specific utility or a group of utilities for the purpose of trying out new concepts or establishing a pilot project.

It should be noted, too, that the Department is prepared, on formal application from any industry organization representing either electric utilities, electric equipment manufacturers, or both, to meet the representatives of such organization to review the whole or any part of this document.

These rules are authorized under the Electricity Inspection Act and the Regulations thereto.

GENERAL REQUIREMENTS FOR INSPECTION AND TESTING

1. SCOPE

Part I outlines the general requirements which apply to the inspection and testing of all types of meters and devices used in the metering of electricity for revenue purposes.

2. APPROVAL OF METERS AND DEVICES

2.1 Basic Requirements

(i) No electric meter or device may be used in service for billing measurement until the type to which it belongs has received Approval of the Consumer Standards Directorate* of the Department.

(ii) No electric meter or device may be used in service for billing measurement until it has been verified by an inspector according to the rules pertaining to its kind in the subsequent parts of this document.

2.2 Type Approval

Approvals granted by the Standards generally fall into one of four categories viz:

(i) General Approval. This may be an approval covering a complete line of instruments or it may be restricted to definite forms or ratings of the type.

(ii) Approval of Modification. This category covers modifications or changes made to a type of meter already approved.

(iii) Special Approval. In cases where it is not necessary or perhaps even not desirable to grant general approval, Special Approval may be granted to an individual meter or a small group of meters for a specific purpose. Generally, such approvals will apply only to specified and identified meters owned by a particular utility. The Special Approval may also have other limitations such as being granted for a set period only.

* Henceforth called Standards. See definitions - Part X

(iv) Approval of Meter Shop Repair-Changes
Where a meter shop desires to make significant changes or modifications, to an approved type of meter or device, which are beyond the normal maintenance and servicing function, such procedure shall require the approval of Standards. See Section 2.4.

2.3 Approval Notices

The form of the Approval Notice issued by Standards varies with the kind of approval. The General Approval Notices are issued in two series: those with the identification number prefixed by the letter T apply to instrument transformers; those with the identification number prefixed by the letter E apply to electric meters and metering devices. See examples in Appendix I.

Special Approvals are in circular letter form with the original copy generally going to the equipment manufacturer and other copies going to the utility, district office and region. These circulars are serially numbered. See Appendix II for an example of a Special Approval letter.

Approvals for modifications to approved meters by a utility meter shop are by letter to the utility concerned and copies are sent to the Region and District concerned and sometimes to the original manufacturer of the equipment.

If approval for a device or type of device is withdrawn, the withdrawl notice shall be in the same format as the original approval. That is, for example, if a meter approved under the E series has its approval withdrawn, the Notice of Withdrawl of Approval will be promulgated under the E series.

2.4 Meter Shop Modifications

(i) If a utility wishes to modify or alter an approved type of meter, with the intention of using it in revenue metering service, it first must receive approval of the modification or change from Standards. The submission for approval shall clearly outline the details of the modification and the reasons for it.

(ii) Before approval is granted, the district office must satisfy itself, the Regional Office and the Standards that the contractor or utility has the proper equipment, staff and facilities to perform the work in a satisfactory manner. In general, where feasible, the modification shall be made using parts obtained from the original manufacturer of the device. A District Inspector may, at his discretion, or upon instructions from higher authority, select two or more such modified meters and forward them to the Standards Laboratory for testing.

2.5 Defects in Approved Devices

Any defect in a metering device, noted by an inspector or gleaned by him from information passed by a utility, shall be reported through the proper channels to Standards. Although it is of course quite proper to pass information regarding the defect to those concerned, under no circumstances shall the inspector, the District Office or the Region suggest or take any significant action pertaining to the defect or any other matter involving Approval of Type. Dealing with the manufacturer on such matters is strictly the perogative of the utility who purchased the meter or meters and Standards who granted the approval.

Defects shall be reported on the form shown in Appendix III.

3. RECORDS

3.1 Identification of Metering Devices

(i) Every meter and metering device (except instrument transformers) shall be given an inspection number before being presented for verification, such number to be indelibly stamped on a portion of the meter or device satisfactory to the District Inspector.

(ii) A code letter or number may be used with, or as part of any inspection number for meters or instrument transformers but no change in the code may be made without the prior consent of the District Inspector concerned.

(iii) A utility may assign an inspection number to its instrument transformers but in such case the utility shall advise the District Inspector regarding the system to be used. The utilities records shall show where transformers are located and identify them by type, rating, ratio, accuracy, serial number and inspection number if one is used.

(iv) Every shunt and multiplier, and every other device which uniquely affects the accuracy of the meter with which it is associated, shall be marked with an inspection number corresponding to the inspection number of the meter with which it has been calibrated.

3.2 Contractor or Utility Records

(i) Every contactor shall keep a complete and accurate record of all meters, instrument transformers and other metering devices used on his system (or held in stock for such purpose) and such record shall be available for inspection by an inspector at any reasonable time.

(ii) The record shall show details of type, ratings, multiplier, inspection number, serial number, location of installation and seal date or test date of each device.

(iii) For instrument transformers, the records shall also show whether an inspection number is attached to the transformer or is an assigned number and, details of any relays in the secondary circuit.

(iv) A record shall also be kept of all installations on commercial or power contracts with details of the equipment involved in each. Information may be provided by reference to inspection numbers only of meters or other devices, details of which are listed elsewhere in the records, except in the case of totalizing and telemetering systems which should be recorded on forms supplied by Standards.

3.3 District Office Records

(i) The District Office shall keep and maintain a complete and accurate record of all meters and metering devices over which it has jurisdiction. Where the utility meter record system, or any portion thereof is used and relied upon as part of the District Office record the district office must continuously and completely verify that such record is maintained essentially without error. Basically, the inspection field note shall be the source of this record and the means by which its accuracy is maintained.

(ii) The utility shall register, on forms supplied by the Department or other forms satisfactory to Standards, all installations involving power or commercial contracts. The District Office shall maintain this record in complete and good order. The details of what constitutes an installation which requires registration is given in Part VIIA.

4. SALE OR TRANSFER OF METERS

4.1 Notification

The utility shall notify the District Inspector without delay of any change of location of any meter from one inspection district to another and also of the number mark or other description of any meter that may be sold, scrapped, destroyed, burnt or lost.

4.2 Information Required

The District Inspector shall obtain from the utility a list of all meters involved in a sale or transfer and the name and address of the new owner.

4.3 Records

A meter is not to be recorded as scrapped or destroyed unless it has been rendered completely inoperative. Where the utility delivers the meters to some other party, for good and sufficient reason, for the purpose of dismantling and scrapping, the intent of this requirement shall be considered to have been complied with if the utility advises the District Office in writing that this is a standard procedure and supplies the name and address of the receiver of such meters.

5. TESTING EQUIPMENT

5.1 Test Board Requirements

Every meter test board shall be thoroughly checked and approved by a District Inspector before being used for verification of meters. It shall comply with the following minimum requirements:

(i) The design and construction of the board shall be such that any of the tests prescribed in the rules for any of the owner's meters can be conveniently and accurately made.

(ii) The board shall be equipped with a voltmeter of commercial accuracy i.e. 2% accuracy rating or better.

(iii) Satisfactory means shall be provided for adjusting the supply voltage to normal test voltage within the accuracy limits of the voltmeter.

(iv) Current values shall be adjustable and such as to provide any current required under these rules.

(v) Means shall be provided for indicating within an accuracy of 5%, the true or proportional current supplied to the meter current circuit.

(vi) The arrangement for providing a 50% power factor condition shall be such that the actual power factor of the test circuit shall be, as nearly as practicable, 50% lagging and must not be lower than 45% nor higher than 55% for any load condition within the capacity of the board.

(vii) Where the test board is intended for use in testing demand meters, means shall be provided for adjusting the load to the desired value and maintaining it essentially constant during the period of a test.

(viii) Means, satisfactory to the District Inspector, shall be provided for multiple dial testing of meters.

5.2 Inspection Standards

(i) Test standards used for inspection work shall be those supplied by the Department except as otherwise authorized under the Regulations to the Act.

(ii) Rotating standards shall be warmed up by application of normal voltage and current for a reasonable length of time before beginning the testing of meters. The length of time will depend upon conditions but in any case shall be long enough to allow the mechanism to reach room temperature.

(iii) Inspectors are responsible for the care and safety of government seals, instruments, field standards and other equipment placed in their charge and accordingly are not to allow them to pass out of their control or to be used for any unauthorized purpose.

(iv) Current taps on rotating standard switches must not be changed while current is flowing in the circuit.

(v) A current tap of a rotating standard must not be used for any current above or below the calibrated range of that coil as shown in the test certificate.

(vi) Inspectors are warned against applying voltages or currents to their instruments in excess of their rated capacities. Test circuits should be checked frequently and fuses of the proper size inserted when necessary.

(vii) As a check on maintained accuracy of standards, comparison tests shall be made periodically in each district office under the supervision of the District Inspector.

(viii) Periodically, test standards will be called in by the laboratory for inspection and calibration. These instruments must be shipped when called for in order to maintain a fixed schedule as nearly as possible.

(ix) Except for emergency repairs, which might be required in the field to complete a test schedule at location remote from District Headquarters, there shall be no tampering with rotating standards, stop watches or other test equipment. Defective instruments or those suspected of having defects should be shipped immediately to the Standards Laboratory with a letter of explanation.

(x) All departmental standards are to be shipped to the laboratory prepaid, carefully packed in the shipping boxes provided for the purpose.

(xi) Utilities and others concerned with tests or calibrations should be notified by District Inspectors that instruments shipped to the laboratory should be accompanied by a letter or document, signed by the purchasing agent or other responsible officer, authorizing the work. Special tests other than routine calibration should be detailed in the letter.

6. TEST CONDITIONS IN METER SHOP

6.1 Test Board Accuracy

Because the acceptance or rejection of a whole lot depends upon the results of the test made on the sample, tests must be made with particular care under well controlled conditions. The inspector must ensure by means of check tests that the test board itself does not introduce an error into the results at any of the prescribed test points. A carefully calibrated domestic meter maintained as a sub-standard could be useful for checking test boards.

6.2 Ambient Conditions

Ideally the sample meters should be tested under the average set of conditions which they will meet in service. However, for practical purposes it is considered that test conditions should approach, as far as possible, the conditions which pertained in the factory at the time of their calibration. To approximate these conditions the following requirements are stipulated:

6.2.1 Ambient Temperature

Accuracy tests should be made with a steady ambient room temperature of 23°C, ± 2°C. Significant deviations from this requirement shall be reported to Standards.

6.2.2 Other Temperature Factors

Although it is important to maintain good ambient temperatures in the meter shop, it should be noted that ambient temperatures produce second order effects compared to other temperature factors. The size of the cable, the tightness of the connections, the pressure on the jaws of the test socket etc. are all of greater importance and careful attention should be paid to them.

6.2.3 Applied Voltage

Normally the test voltage will be 120 or an integral multiple of 120. In some special cases the testing may be carried out at name-plate voltage or at the expected service voltage.

6.2.4 Frequency of Supply

The frequency of supply shall be the nominal system frequency ± 0.5%. It shall be considered that this condition is met in all major power systems.

6.2.5 Distortion Factor

It is considered that the distortion present in the voltage (and current) supplied to the meter under test should not be greater than 3%. This factor may normally be ignored unless there is evidence from the failure of a number of sample tests on a type of meter that errors are being introduced by the test conditions or test equipment.

6.2.6 Meter Suspension

The meter under test shall be so mounted that the shaft supporting the disc is within 1^{o} of being vertical.

6.2.7 Meter Registers

Particular attention must be paid in making tests on meters fitted with drum-type or cyclometer registers to ensure that no period of accuracy test embraces the time during which the most rapidly moving drum is actuating any of the slower drums.

6.3 Setting of Test Loads

Test loads shall be in accordance with the requirements for the particular type of meter. The test currents shall be accurately set and maintained within $\pm$ 5% of correct value on all loads.

7. REQUIREMENTS PRIOR TO VERIFICATION

Before an inspector accepts a meter or metering device for verification he shall satisfy himself that the following conditions have been met:

(i) The meter comes within the scope of a Notice of Approval issued by Standards.

(ii) The nameplate markings conform to those specified for the class of meter to which it belongs as outlined in Notice of Approval.

(iii) Correct indications for connecting the meter in service are supplied as specified in the Approval Specifications. For meters and devices approved before 1951 this requirement does not apply.

APPENDIX I PART I

Department of consumer and corporate affairs / Ministère de la consommation et des corporations

STANDARDS BRANCH - DIRECTION DES NORMES

NOTICE OF APPROVAL
AVIS D'APPROBATION

E-130

OTTAWA November 25, 1974

LANDIS & GYR TYPES "QFi" AND "QLi" A^2h LOSS METERS

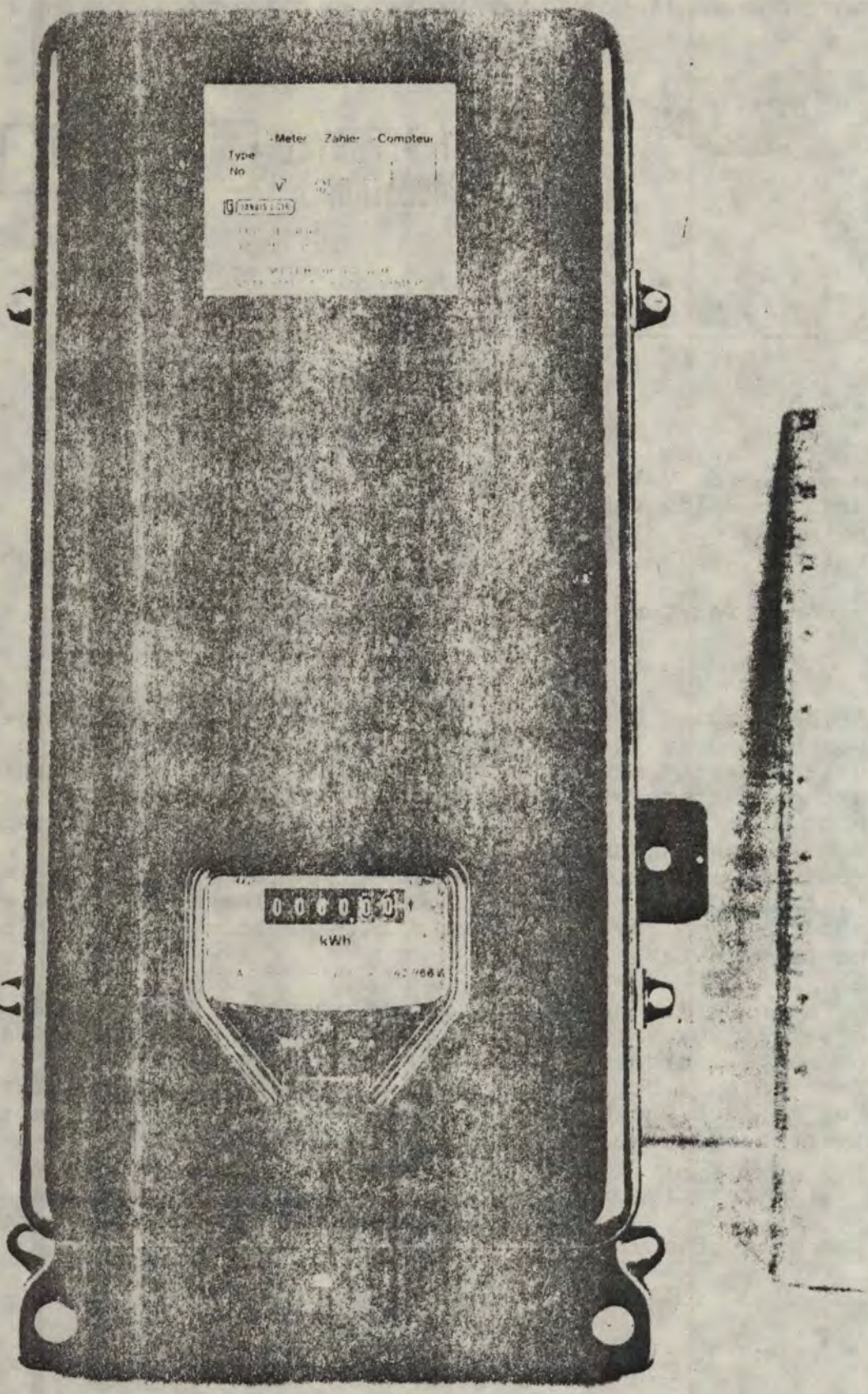
Elements	One, two or three denoted by type prefix
Current Rating	0.12-6.25 amperes
Compensation Voltage	115 volts
Register Relay Voltage	115 volts
Registration Units	Kwh, Wh or A^2h
Register Type	Any approved single or double tariff register
Transmitting Contacts:	Any approved Landis & Gyr type

Description

The purpose of the A^2h meter is to measure power line losses (copper losses) by integrating the square of the line current over time. Its physical appearance is similar to watthour meters of the "F" and "L" series, the basic difference being that the voltage coil of each element has been replaced by a second current coil. Furthermore an additional potential coil has been added to compensate for friction. This friction compensating element is supplied from an auxiliary 115 volt source via the bottom terminal block and is adjustable.

These meters may be fitted with double registers marked IMPORT-EXPORT, signified by type suffix "d". The register in use is indicated by an arrow. Register changeover is effected by a relay which must be controlled by an external SPDT contact whose position is determined according to the direction of power flow.

Disc rotation is always counterclockwise from above and the value per output pulse is the same regardless of the direction of energy flow.


Meter Zähler Compteur
Type
No
kWh

SPE - 219

Department of consumer and corporate affairs/ Ministère de la consommation et des corporations

G 1144-57/C2
GL 1144-57/C2
SL-100-SPE

Ottawa, Ontario
K1A 0C9

April 5, 1973.

SPECIAL APPROVAL

Granted to: Canadian General Electric Co. Ltd.,
Power Transmission and Distribution Dept.,
Power Transformer Section,
201 Woodlawn Road West,
Guelph, Ontario

Attention: Mr. W.H. Wardrope
Utility Sales Specialist

Subject: Three Only Canadian General Electric Bushing Type 2400/2000/1600/1200/800/400 - 5 Amperes, 60 Hz Current Transformers serial numbers 18798, 18799 and 18800

Special Approval has been granted by the Standards Branch for use in Canada for billing purposes to the above-named apparatus.

These transformers are bushing type with single tapped secondary windings with terminals identified as X1 - X4 and the 1200-5 ampere ratio from terminals X2 - X3.

The accuracy rating of both ratios is 0.3B1.8.

These transformers are mounted on the bushings of a 600 MVA Autotransformer serial number 288056 for use by Ontario Hydro at Lambton G.S.

They are identified as DD, EE and FF on the nameplate dwg. number 273088.

W.J.S. Fraser

W.J.S. Fraser
Chief,
Electricity and Gas Division.

cc. Mr. J. Fleming, D.I. of
E & G, London
Ontario Hydro (through Mr. Fleming)

Standards Branch
Direction des normes
SEP - 1975

The register and pulse output are in the same units. They may indicate ampere squared hours, or by a suitable combination of gear ratios and multipliers be converted to either primary or secondary watthours. In the latter cases, the effective line resistance must be marked on the nameplate either in ohms or watts at rated current, together with the current transformer ratio when applicable.

The value per output pulse must appear on the nameplate, and if in ampere squared hours, the register constant in associated summator devices must incorporate the value of effective line resistance.

Adjustments comprise balancing, full load and friction compensation and with the exception of the latter are similar to other "F" and "L" series meters.

A paper diagram glued to the underside of the terminal cover depicts the proper circuit connections. This approval is also applicable to A^2h meters when combined with other types of meters in a common case.

Approval granted to:

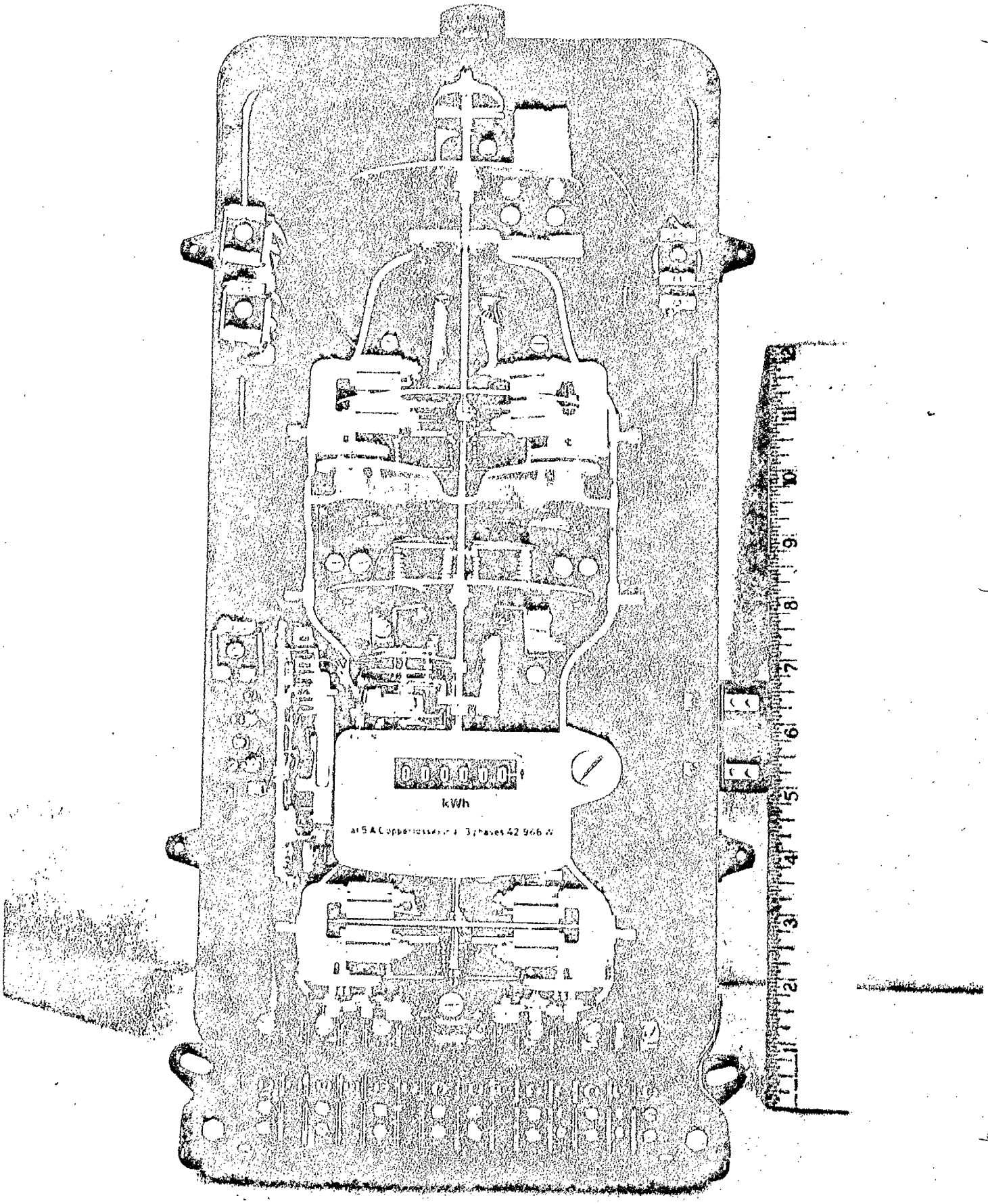
Landis & Gyr Ltd.,
2063 Chartier Street,
Dorval 760, Que.

J. L. Armstrong,
Chief, Standards Laboratory,

D. L. Smith,
Chief, Electricity & Gas Division
Metrology and Laboratory Services.

Re: GL 1145-57/L1-681

SEP - 1975


kWh

Consumer and Corporate Affairs | Consommation et corporations

Consumer Standards Directorate | Direction générale des normes

APPENDIX III

DEFECT REPORT
ELECTRICITY AND GAS INSPECTION

PART I

RAPPORT DE DÉFAUT
INSPECTION D'ELECTRICITÉ DU GAZ

STANDARD NO. *Référence de direction*
ELECTRIC *Électricité* 1145-9 ☐
GAS *Gaz* 1147-9 ☐

DISTRICT FILE NO. *Référence de district*

DISTRICT	D-J M Y-A	REPORT NO. *N° de rapport*	MANUFACTURER – *Manufacturier*	TYPE	RATING *Valeur rapport*	LOT SIZE *Grosseur du lot*

NO. OF SIMILAR DEFECTS FOUND *Nombre des défauts similaires*

SERIAL NUMBERS *Numéro de série*

DEVICE *Appareil*

- NEW *Nouveau* ☐
- REVERIFIED *Revérifié* ☐
- BECAME DEFECTIVE IN SERVICE *Devenu défectueux en service* ☐

DESCRIPTION OF DEFECT – *Description du défaut*

INSPECTOR'S COMMENTS – *Commentaires de l'inspecteur*

INSPECTOR – *Inspecteur*

ACTION BY LEGAL METROLOGY BRANCH – *Action par la direction de métrologie légale*

REPORT RECORDED *Rapport enregistré*	MANUFACTURER ADVISED *Manufacturier avisé*	LABORATORY TO INVESTIGATE *Investigation par laboratoire*	OTHER *Autre*
☐	☐	☐	☐

DISTRIBUTION

WHITE & BUFF – STANDARDS *Blanche et jaune – normes* | PINK – REGION *Rose – Région* | GREEN – DISTRICT *Vert – District*

CCA 1374

SEP - 1975

RULES FOR VERIFICATION OF NEW SINGLE PHASE WATTHOUR METERS AND SUBSEQUENT CONTROL OF ACCURACY

1. SCOPE

1.1 Authorization

These rules, cover the requirements for verification and subsequent control of accuracy of new single phase watthour meters entering service after January 1, 1976. This part includes two-wire, three-wire and transformer type versions of such meters but does not include those fitted with demand registers, or other auxiliary attachments. Meters fitted with pulse initiator and intended for use with remote registers are also included.

2. INSPECTION METHODS

2.1 Factory Calibration

While it is recognized that new meters have been calibrated and subjected to quality control procedures at the manufacturer's plant, for purposes of these rules "initial verification" means that verification of new single-phase watthour meters which takes place at the utility meter shops, independent meter shops, or District Offices under the direction of an inspector.

2.2 Lot of New Meters

For the purposes of initial verification the meters shall be separated into identified lots. A lot may embrace a whole shipment from one manufacturer or be part of a shipment but in no case shall a lot consist of more than 1000 meters. A lot shall be strictly homogeneous, that is to say it shall only include two-wire, or three-wire or transformer type or remote register meters not a mixture.

2.3 Lot Identification No.

Every lot submitted shall be assigned an identification number. This number is for departmental reference purposes and does not have any long term significance. However, the District Inspector must ensure that a designation completely and clearly distinguishes a lot from any other lot or group of the utility or those of other utilities in his area. (This is necessary to avoid confusion at Standards when reviewing and analyzing district reports.)

Every lot for which the $\bar{X}$ and s are not required shall be reported by the District Office as a SMALL LOT and the number of meters in it indicated on the report.

2.4 Initial Verification by Sampling Procedures

Except as provided under Sections 2.5 and 2.6, the normal procedure for initial inspection of new single-phase electric meters shall be by sampling methods. The inspector shall select a sample of meters from the lot presented for test, in accordance with Table I, Section 2.8, and verify their accuracy. The selection of the sample shall be strictly random. The method of presentation of the lot and the sample shall be determined by agreement with the District Office concerned. If the results of the test meet the requirements for the particular sample size and other criteria of Sections 3. and 4., the inspector shall accept and seal the lot.

2.5 Initial Verification by 100% Inspection

Where a lot size is too small or where the inspector considers it expedient within the limits outlined in Table I, the initial verification of the meters shall be by 100% inspection. (The choice of method may, in some cases, depend on circumstances, experience, utility preference and current directive. It should be noted also that the $\bar{X}$ and s shall be calculated, as shown in Table I, Section 2.8, for all lot sizes of 15 meters or more regardless of whether tested by sampling or 100% inspection.) See also Section 4.3.3.

2.6 Initial Verification by Witness Testing

Where a utility has fully automated test board equipment operating under suitable testing conditions, the inspector may, with the express approval of Standards and in lieu of the procedures under Sections 2.4 and 2.5, witness the initial verification tests made on lots of new meters by a utility meterman and accept and record the results as the official tests. The inspector must assure himself that the tests have been properly and accurately made and, as a part of this assurance, check according to a standard procedure the performance of the test board equipment on a scheduled basis. Provided that all the requirements of Sections 3. and 4. have been met, he shall seal the meters which have passed inspection by this method. The utility shall provide to the inspector the computer calculations for the parameters of the lot, viz. the mean and standard deviation.

2.7 Initial Verification by Witness Sampling

Where a utility has fully automated test board equipment operating under suitable testing conditions, the inspector may, with the express approval of Standards and in lieu of the procedures under Sections 2.4, 2.5, and 2.6 witness the initial verification of samples of new meters and accept and record the results as the official test. The inspector must choose the sample and assure himself that the tests have been properly and accurately made and, as a part of this assurance, check according to a standard procedure the performance of the test board equipment on a scheduled basis. Provided that all the requirements of Sections 3. and 4. have been met, he shall seal the meters which have passed inspection by this method. The utility shall provide to the inspector the computer calculations for the statistics of the sample, viz. the mean and standard deviation.

2.8 Sample Size

Table I below shows the authorized size of a sample in relation to the size of the lot.

TABLE I

Lot Size	Sample Size	$\bar{X}$ and s Required
1 to 14	100% inspection	No
15 to 40	15 or optional 100% inspection	Yes
41 to 110	15	Yes
111 to 180	20	Yes
181 to 300	25	Yes
301 to 500	30	Yes
501 to 700	35	Yes
701 to 1000	45	Yes

3. INITIAL VERIFICATION TESTS

(see page 15)

3.1 Dial Test and Mechanical Inspection

3.1.1 Basic Schedule

Regardless of the size of the utility, new meters shall receive the dial test and mechanical inspection on a periodic basis. The intent is that there will be some inspections being carried out in some part(s) of the country at all times. The schedule for such tests is shown below.

Area	Period during which dial testing is to be carried out
Atlantic Region	1st to 5th inclusive calendar days of month
Quebec	6th to 10th
Ontario	11th to 15th
Manitoba & Saskatchewan	16th to 20th
Alberta	21st to 25th
British Columbia	26th to last

Where, within the allotted period, a utility has presented 500 meters of one type for dial test and mechanical inspection, no further meters of that type need be presented during the period, provided that the results are satisfactory.

3.1.2 Dial Test and Mechanical Inspection

The dial test and mechanical inspection must be very carefully conducted by all Districts the aim being, of course, to find all the defects to which the meters may be subject.

In order to ascertain those errors which strictly pertain to the register itself the meter shall be run for a period sufficient to produce at least one revolution of the test dial hand. Other faults may show up during this run and it is essential that the reference and meters under test are measuring exactly the same load.

All meters shall be given a careful visual inspection as well, to seek out defects such as dirt in meters, loose screws, etc.

3.2 Creep Test

All meters submitted to load test must also be subjected to a "creep test". See Part XI for definition of creep.

3.3 Accuracy Tests

3.3.1 Test Loads

Each meter nominated for full tests shall be subjected to three accuracy tests at the loads specified on the current Test Table No. 1, Appendix I. These tests are:High Load, Unity Power Factor, (HL); High Load, 50% Power Factor, (PF); and Low Load, Unity Power Factor, (LL). The HL test is to be carried out first. Order of the remaining two tests is immaterial.

3.3.2 Tests on 3-Wire Meters

All tests on 3-wire meters shall be made with the current coils in series except as noted in Section 3.4.

3.3.3 Cyclometer Registers

Particular attention must be paid in making tests on meters fitted with drum-type or cyclometer registers to ensure that no period of accuracy test embraces the time during which its most rapidly moving drum is actuating any of the slower drums.

3.3.4 Meter Pre-conditioning

It should be emphasized that new meters should be tested under essentially the same conditions as pertained at the factory. The manufacturer does not energize the voltage

circuit for any length of time before making his test and therefore neither should we. However, it is very important that the meter be brought to meter room temperature before testing commences and it is the responsibility of the inspector to ensure that this is the case.

3.4 Balance Tests

Coil balance will not normally be checked. However, it should be checked if the inspector has reason to believe such a test is warranted.

4. CRITERIA FOR ACCEPTANCE OR REJECTION

4.1 Action Following Dial Test and Mechanical Inspection

At the end of the first six months of the dial test and mechanical inspection program, Standards shall examine the data to determine what action should be taken where a defect situation seems out of control with respect to any particular attribute. A proposal will be prepared by Standards for presentation to and discussion with AMEU, CEMA and CEA.

Until such time as a definite formula has been formally established, Standards shall consult with the manufacturer with a view to resolving the problem in each case where abnormal defect situations have developed with respect to his meter. It is hoped that the statistics from the dial test and mechanical inspection may help towards a general improvement in quality of meters.

The whole dial test and mechanical inspection program shall be reviewed from time to time and modified as deemed necessary.

4.2 Criteria with Regard to Creep

Any watthour meter whose disc creeps more than one revolution shall be rejected. If the meter is a member of a sample, it shall be replaced in the sample by another meter before the accuracy tests are made. Generally, a single creeping meter in a sample from a lot would not necessarily be cause for alarm but if more than one were found in a sample further testing should be stopped, the utility consulted and the matter fully investigated. See Section 4.5.

4.3 Criteria with Regard to Accuracy Tests

4.3.1 Lot Sizes of 41 to 1000 Meters

For lot sizes of 41 to 1000 meters the lot shall be verified by the sampling process and $\bar{X}$ and s shall be determined for each of the specified test loads for each sample. (The form shown in Appendix IV is a help in making the calculations.) Using the values of $\bar{X}$ and s obtained as co-ordinates, points shall be plotted on the appropriate truncated triangle chart provided in Appendix V. If all the plotted points fall within the bounds of the triangle specified for the particular sample size and test, the lot shall be considered fully acceptable with regard to accuracy requirements. If any point falls outside its designated triangle the lot has tentatively failed to meet the requirements. See Section 4.3.2.

It must be stressed here that the concept of an outlier does not apply to the sampling inspection for the initial verification of meters under these rules. An individual meter whose accuracy is, perhaps, open to question shall in no circumstances be removed from the sample. If the sample which includes it passes inspection then there is no valid reason to change the calibration or remove the meter from the sample - the meter must be left alone; if the sample fails on first test because of it, then a further sample shall be

drawn under Section 4.3.2; if the double sample fails then and only then may the meter by subject to re-calibration (along with possibly other meters of the lot). Quite obviously if a questionable meter is a long way out of calibration, the double sample is bound to fail and to take a second sample would be a waste of time. There is no simple way to determine where to draw the line so it is important that the second sample should be waived only if it is certain that the combined first and second sample will fail the lot.

A defective meter (i.e. one which has some apparent fault other than merely being out of calibration - for example a jammed disc or register) found in a sample shall be replaced by another meter drawn at random from the lot. A number of defective meters in a lot would be cause for investigation.

4.3.2 Double Sample

If the sample from a lot fails to meet the requirements of Sections 4.3.1, another sample shall be randomly chosen, of the same size as the first. New values for $\bar{X}$ and s shall be determined using the combined results of the first and second sample. If any point (HL, LL or PF) using the new $\bar{X}$ and s falls outside the appropriate triangle of Appendix V (for double sample size) the lot shall be rejected.

4.3.3 Lot Sizes of 15 to 40 Meters

For a lot size of 15 all the meters shall be tested: for a lot size of over 15 and up to 40 the verification may be performed by either sampling or 100% testing. In every case, under this section, however, the $\bar{X}$ and s shall be determined and reported, i.e. if 100% inspection has taken place the whole lot shall be treated as a sample and the $\bar{X}$ and s determined. Where inspection has been under the sampling procedure the criteria of Section 4.3.1 applies but if the sample fails to meet the criteria there is no recourse to a further sample and the lot shall be 100% inspected.

Where 100% inspection has taken place for a lot size of 15 to 40 meters, the lot shall be considered acceptable, if the points determined from the $\bar{X}$ and s of the test loads fall within the truncated triangle of Appendix V which corresponds to the lot size and appropriate test load.

A defective meter which has been rejected from a lot shall be reported regardless of whether of not it is later returned to the lot. The nature of the defect shall be indicated. See Forms, Appendix II.

4.3.4 Small Lots (14 meters or less)

For a lot size of fourteen meters or less, every meter shall be tested and any meter which falls outside any of the following tolerances shall be rejected. The remainder shall be accepted.

TABLE III

± .75% on High Load, Unity P.F.
± 1.1 % on Low Load, Unity P.F.
± 1.25% on High Load, 50% P.F.

4.3.5 Witness Testing

Where the witness testing procedure has been authorized, the lot shall be considered acceptable if the points determined from the $\bar{X}$ and s of the test loads fall within the designated triangle of Appendix V, which corresponds to the lot size (i.e. the lot size is treated as the sample size). Where an appropriate chart does not exist for the particular lot size, the one having its sample size nearest in value should be used.

If the errors of any meter of the lot fall outside the tolerances of Table III the utility is permitted to re-adjust the meter, otherwise it shall be rejected from the lot. The final values of $\bar{X}$ and s shall be determined using the new value of adjusted meters or, if certain meters are not returned to the lot by the utility, excluding such meters. A defective meter which has been rejected from a lot shall be reported regardless of whether or not it is later returned to the lot. The nature of the defect shall be indicated. See Forms, Appendix II.

4.3.6 Witness Sampling

Where the witness sampling procedure has been authorized, the criteria shall be exactly the same as if the initial verification had been carried out under Section 2.4, i.e. the criteria of Sections 4.3.1 and 4.3.2 shall apply.

4.4 Other Factors

It is considered that conformity of a lot of meters to the requirements outlined in Sections 4.3.1, 4.3.2, 4.3.3 and 4.3.4 should be sufficient assurance that the manufacturer's quality control process is satisfactory. However, other contrary indications should not be ignored. While it is not possible to enumerate all the possible situations which might arise, some corrective action may be warranted in certain cases. For example, a single creeping meter in a sample would probably not be cause for alarm but if there were several such meters the following actions would be indicated:

(i) make absolutely certain that the test conditions, test boards and standards are satisfactory;

(ii) subject the deviate meters to critical examination to determine the cause;

(iii) consider the desirability of making 100% test on all meters in the lot in order to get a clear picture of the extent of the trouble;

(iv) report the findings to Standards, Ottawa.

5. PROCEDURES FOLLOWING ACCEPTANCE OF NEW METERS

5.1 Seal Validity

Except under the circumstances covered by Section 10.3, the seal on a new single phase electric meter is valid for eight years from the year of sealing, such validity being subject to extension on the basis of the results of sampling tests covered under Sections 11, 12 and 13. That is to say, for example, any meter sealed in 1976 may normally remain in legal use until December 31, 1984 and any meter sealed in 1977 may normally remain in legal service until December 31, 1985.

5.2 Formation of Proto-Groups

All new meters of one make, type and seal date presented for inspection by a utility meter shop and accepted under these rules shall be considered as a proto-group and shall be treated in the manner described below.

5.3 Identification of Proto-Groups

Standards will assign a designation to the proto-groups formed under Section 5.2 above e.g. the designation N75-I70 could be used to represent C.G.E. I-70 meters tested and sealed in 1975. Although the general designation would be common to all meters of the same type and seal date, differentiation as far as records are concerned would be made by naming the utility meter shop thus H.Q., Quebec, Proto-Group N75-I70. A utility or District Office may wish to use some other code to identify such proto-groups in its own records but correspondence between the two codes must be clear and unambiguous. In other words it must be possible to segregate and locate every meter in a proto-group.

6. PROCEDURE FOLLOWING REJECTION OF NEW METERS

6.1 Rejection of a Lot

If an inspector finds as a result of his tests that a lot of new meters fails to meet the acceptance criteria, he shall immediately take the following actions:

(i) re-check that the calculations have been correctly made;

(ii) check the test conditions, check the test board and make sure that the standard used is not responsible (see Technical Electric Circular for rules for checking out test boards);

(iii) advise the utility of the rejection.

It cannot be too strongly emphasized that in all cases of the rejection of new meters, the first responsibility of the inspector is to ensure that the test conditions and test equipment are not themselves at fault. In the case of small utilities or others which do not have frequent opportunities for check, the burden of proof falls even more heavily on the test facilities.

6.2 Rejection of Individual Meters

Where individual meters have been rejected from SMALL LOTS, or as a result of dial test and mechanical inspection or where meters are for any reason demonstrably renegades, such meters may be calibrated or otherwise serviced to bring them within the tolerances outlined in Section 4.3.4. The meters shall then be presented to the inspector for verification and sealing and if passed shall be considered the equal of other accepted meters under these rules.

6.3 Re-instatement of Rejected Lots

As already noted, where a lot has been rejected, all reasonable measures having been taken to ensure that there has been no error introduced by equipment or standards, all the meters of the lot may be re-calibrated, where necessary, and then re-presented to the inspector for verification. The inspector shall treat them as any other lot of new meters. It should be stressed, however, that not all the meters in a rejected lot should be re-adjusted, only those which are significantly out of line.

A lot of new meters which has been re-serviced and re-calibrated shall be assigned a new lot identification number. Such meters if passed shall be sealed by the inspector and shall be considered of equal status to other new meters accepted under these rules. Where possible, nevertheless, the district should endeavor to keep informed as to what happens to rejected lots. That is, there may be some value in the district and region knowing whether rejected lots are being returned to factory or re-serviced in utility meter shop, whether such lots when re-calibrated at factory are returned to same utility, etc.

CHECK TESTING OF METER TYPE/YEAR AFTER SHORT PERIOD OF SERVICE

7. CHECK TESTING PROCEDURE

7.1 Formation of Check Plan for Meter Types

Immediately after the end of each calendar year Standards shall examine the complete year's reports of new single phase meters inspected and shall set up a plan for check-sampling of the proto-groups formed in that year. A table will be prepared showing the type of meter to be check-sampled in each Field Operations Region. The general plan will be to have the various makes of meters checked by different Regions and for this purpose the Atlantic and Pacific Regions will check the same type, at least in the early years of the plan.

Normally, each utility will be allotted only one specific type to check test in any one year. In subsequent years, as far as possible, it will be arranged that the check tests for a particular type will be assigned to utilities in a different region.

The utilities and the district offices will be advised promptly of the type/region assignment as soon as possible after the end of the calendar year just completed.

7.2 Check Sample Selection

The second year after the year of formation of proto-groups as described in Section 5.2, check samples shall be selected for each type of meter and these shall be brought in for test in accordance with the plan outlined under Section 7.1. The sample in each case shall be selected by the District Office concerned and shall consist nominally of 100 meters or 1% of the meters of the proto-group, whichever is the lesser, for each utility in the district. The actual number called in may be increased to allow for meters, which for legitimate reasons cannot be presented. The increase must not exceed 10% and the number actually tested shall not be less than 95% of the nominal figure. Experience will determine if this is a sufficient sample.

If the nominal sample size is less than 5, the check sample will not be selected.

The reasons for the two year samples are: to get a good general indication of the initial performance of every type-year, to provide a reference against which future samplings may be compared, and to provide information as to the validity of the procedures.

Since the validity of the whole sampling process rests on the premise that the samples are random and truly representative of the populations, it is extremely important that all eligible meters be brought in for test. This is particularly true of the check sample because of its small size. The utility shall provide a complete explanation for all sample meters not brought in. The District Office shall pursue the matter further if it is not fully satisfied with the explanations given.

7.3 Tests to be Made on Sample

The inspector shall subject each meter of the sample to the standard high load, low load and power factor tests as described in Sections 3.3.1, 3.3.2, 3.3.3 and 3.3.4.

All meters of the sample shall be subjected to a "creep test".

Dial tests are not required, but the inspector shall note on the test sheet anything he observes which detracts from the condition of the meter, such as filings, dirt, bits of gasket, loose screws, etc.

It cannot be too strongly emphasized that the number of uncontrolled variables entering into the process of inspection and testing of a sample of meters should be kept at an absolute minimum since any additional variables increase the risk of failure of the group. It is, therefore, very important that the sample meters of a particular group be tested on a carefully checked test board, that the standard be known to be functioning properly, that the test should proceed without significant interruption, that the ambient conditions be good, that the pre-conditioning of the meters be satisfactory, that the same inspector makes all the tests on the sample, that the values for each test load are correct, etc. Any deviation from these concepts should be continually questioned and examined by the inspection staff, and the utility itself, regardless of how it may seem justified by the exigencies of the moment.

8. CALCULATIONS AND REPORTS

8.1 District Office Calculations

The District Office shall calculate the $\bar{X}$ and s of the sample from each utility except where the sample from a utility is less than 15 meters.

8.2 Outliers

The final calculation for $\bar{X}$ and s shall exclude sample meters which are outliers. An outlier shall be a meter for which the error is both:

(i) above +3% or below -3% i.e. $|x| > 3\%$;

(ii) more than three standard deviations from the sample mean, $\bar{X}$, at the particular test load, i.e. $|(x-\bar{X})| > 3s$.

In some cases when judging whether a particular meter is an outlier or not, it is necessary to calculate $\bar{X}$ and s with the error of the particular meter excluded. If the meter then conforms to the above criteria, it is an outlier.

Meters with the largest errors shall be judged and excluded, if necessary, before meters with smaller errors.

For the purposes of these rules "outliers" as defined above shall be considered to fall into two categories:

Class 1 Those meters which are aberrant as far as the norms of the proto-group are concerned because of defects in meter design, production deficiencies, incorrect factory calibration, etc. In other words, deficiencies which may be attributed to the manufacture of the type.

Class 2 Those meters which are aberrant because of accident, such as being dropped, maliciously damaged in service, etc.

The term "outlier" embraces both these categories but where it can be proven beyond doubt that the outlier belongs in Class 2 it need not be counted in determining the eligibility of a sample under the outlier criteria. However, both Classes shall be reported.

It is clear, therefore, that every outlier shall be carefully examined to determine, if possible, the cause of its deviation.

9. CRITERIA APPLICABLE TO CHECK SAMPLES

9.1 Accuracy Acceptability

Subject to the requirements of Section 9.2, if all three points obtained by plotting $\bar{X}$ and s for each test load fall within the inner triangle shown in Appendix IX the sample shall be considered acceptable.

If one or more points fall between the two triangles and the remaining points within the inner triangle the sample shall be considered conditionally acceptable.

If one or more points fall outside the outer triangle, the accuracy of the sample shall be considered unacceptable.

The criteria are applicalbe to the individual samples as well as the total combined sample.

For sample sizes of less than 15 meters, the sample shall be considered acceptable if the errors of the meters are all within 2%.

9.2 Outlier Acceptability

The following criteria shall govern the maximum, allowable number in proto-group samples:

Fast Outliers - not more than 1% of the nominal sample size (to the nearest higher whole number if the result contains a fraction) except that for a sample size of 25 or less no outliers are permitted;

Slow Outliers - not more than 2% of the nominal sample size (to the nearest higher whole number if the result contains a fraction).

10. ACTION FOLLOWING ACCEPTANCE OR REJECTION OF CHECK SAMPLES

10.1 Proto-Group Acceptance

If the samples are acceptable, both individually and collectively, under Sections 9.1 and 9.2 and the analysis under Section 10.2 shows no cause for alarm, the proto-group shall remain in service under the conditions established in Section 11. This acceptance shall apply equally to all other meters of the same type and seal date owned by other utilities in other Regions. Standards shall advise the districts, regions, utilities and manufacturers concerned immediately upon acceptance of a proto-group.

10.2 Non-Acceptability of Check Sample

The failure of a check sample under Sections 9.1 or 9.2 may not in itself warrant decisive action with respect to the particular meter type-year. Rather, it is a warning that something may be wrong either on a local, regional or national basis and a full investigation must then be launched to determine if there really is a problem and, if so, its nature and extent. Therefore, Standards shall be immediately informed of a sample failure and it shall consult with the manufacturer and Departmental Regional Office before further action is initiated. Various options shall be considered and the choice may rest upon the degree to which the sample fails to meet the criteria. Among the possible options are:

(i) taking another check sample in the same utilities or another region;

(ii) taking a full sized sample (see Table IV) in the same utilities or in another region;

(iii) if the proto-group is small, inspecting all the meters in the proto-group.

10.3 Rejection of a Proto-Group

If the actions taken under Section 10.2 clearly demonstrate that the performance of meters of the type-year is definitely unsatisfactory, with regard to the total population or with regard to a particular area, the Department reserves the right to call in all the meters or the offending portion thereof. The time period for recall will depend upon the seriousness of the defects and will be a matter for negotiation between the Department, the manufacturer and the utilities involved.

10.4 Inspection Fees

For check sampling of proto-groups, no fee is to be charged for these sample meters which are returned to the group with original seal intact.

For meters which are resealed with the new seal date, the usual fee is to be charged.

EXTENSION OF SEAL PERIOD OF ELIGIBLE METERS

11. SAMPLING FOR SEAL EXTENSION

11.1 Sampling Groups

11.1.1 Formation of Groups of New Meters

Acceptable proto-groups of new meters of two consecutive seal years may be combined to form a Sampling Group. However, a group may be formed from a single seal year if the utility so desires.

11.1.2 Formation of Groups of Mixed Background

Meters eligible under Section 11.1.1 above may be combined with the same type of meters eligible under Section 11.1.1, Part IIB to constitute a mixed group provided that:

(i) neither component of the group (i.e., new or re-serviced meters) exceeds 9,500 meters in number;

(ii) the mixed group includes meters of no more than two consecutive seal years;

(iii) a listing is submitted which segregates the new meters from the re-serviced ones;

(iv) the sample size is determined under Section 11.2.3.

11.1.3 Utilities with Groups Too Small to Sample

In order to provide viable groups, the formation of consortiums is encouraged. Such combinations may be formed by agreement between utilities or through the agency of an independent meter shop and the district inspector should assist in the formation of such groups.

The samples from groups formed under a consortium shall be randomly chosen from a composite list and the sample meters themselves should all be tested in one particular, selected shop. The sample size shall be in accord with Table IV and the rules for acceptance and rejection as already outlined shall apply. In the case of consortiums, mixed groups, as described under Sections 11.1.2 and 11.2.3, are not permitted.

11.1.4 Non-viable Utility Groups

Where a utility has meter populations which are too small to sample and where it is not feasible to form a consortium with others, the meters of such a population may, however, remain in service after their initial verification and sealing until the first Sample Group of the same type and seal date, in the same inspection district fails, provided that the failed group represents at least 10% of the total population of that type and seal-date in the same inspection district. If the failed group (or groups) represents less than 10% of the designated population, small scattered populations may continue to remain in service until the 10% criteria is, in fact, exceeded but the utilities concerned should nevertheless be alerted to the fact that re-call and re-inspection of the type and seal date is probably imminent. Groups from small populations which are called in under this rule are subject to the same requirements that apply to the particular sampling group or groups which precipitated their call-in.

11.2 Sample Sizes and Sampling Periods

11.2.1 Groups of New Meters

Each full group formed under 11.1.1 above should be sampled not later than early in the seventh year of the meters with the later seal date. If the group consists of meters of one seal year only the group should be sampled not later than early in the eighth year from the seal date. Groups must not be sampled too early; the intent should be to sample as late as possible without risking that if the group fails it will be difficult to bring all the meters in their due year. It is recognized, of course, that as the number of sampling groups increases it will become increasingly difficult to bring the meters in within the desirable time span.

11.2.2 Sample Size

The sample size shall be in accordance with Table IV below.

TABLE IV

Group Size	Nominal Sample Size
Up to 500 meters	25 meters
501 to 1,000 "	50 "
1,001 to 2,500 "	75 "
2,501 to 4,000 "	100 "
4,001 to 9,500 "	150 "
9,501 to 15,000 "	200 "
15,001 to 22,500 "	250 "
22,501 to 30,000 "	300 "
For every 15,000 or less above 30,000	add 100 "

Where a type of meter has never been sampled before by a given utility or where samplings have taken place but no group accepted the sample size shall be increased to that shown immediately below the normal size for the group.

11.2.3 Periods for Groups of Mixed Meters

Each mixed group, formed under 11.1.2 above, shall be sampled early in the seventh year of the meters with the later seal date. If the group consists of meters of one seal year only the group shall be sampled not later than early in the eighth year from the seal date.

Mixed groups shall be considered as being made up of two sub-groups viz: those that were new seven and eight years before and those that were re-serviced seven and eight years previously. The nominal sample size for each sub-group shall be determined from the graph in Appendix X. The total sample size for the group shall be the sum of the nominal sample sizes plus not more than 15% of the sum. The number of meters contributing to the final results shall not be less for either sub-group than the nominal sample sizes.

11.3 Tests to be Made on Sample

The inspector shall subject each meter of the sample to the standard high load and low load unity power factor tests maintaining, of course, the test conditions outlined in Section 6 of Part I. 50% power factor tests may be called for if there is evidence to indicate that significant changes in accuracy occur at this test point for a particular type over a period of time.

12. CRITERIA FOR ACCEPTANCE OR REJECTION

12.1 Accuracy Requirements

The $\bar{X}$ and s of the sample shall be determined for each of the two test points. The use of the form shown in Appendix XI will facilitate making these calculations.

Appendix IX shows the acceptance regions for various sample sizes. If both points obtained by plotting $\bar{X}$ and s for each test load fall within the inner triangle the accuracy of the group shall be considered fully acceptable. If one point falls within the inner triangle and the other falls between the two triangles the accuracy of the group shall be considered conditionally acceptable. If both points fall between the two triangles, the group shall be considered conditionally acceptable. If either point falls outside the outer triangle the group shall be rejected.

The final calculations for $\bar{X}$ and s shall exclude sample meters which are outliers. An outlier shall be a meter for which the error is both:

(i) above + 3% or below - 3% i.e. $|x| \geq 3\%$; and

(ii) more than three standard deviations from the sample mean, $\bar{X}$, at the particular test load, i.e. $|(x-\bar{X})| \geq 3s$.

In some cases when judging whether a particular meter is an outlier or not, it is necessary to calculate $\bar{X}$ and s with the error of the particular meter excluded. If the meter then conforms to the above criteria, it is an outlier. See Appendix XVII.

Meters with the largest errors shall be judged and excluded, if necessary, before meters with smaller errors.

12.2 Outlier Requirements

The following criteria shall govern the maximum, allowable number in group samples:

Fast Outliers - not more than 1% of the nominal sample size (to the nearest higher whole number if the result contains a fraction) except that for a sample size of 25 no outliers are permitted.

Slow Outliers - not more than 2% of the nominal sample size (to the nearest higher whole number if the result contains a fraction).

Where it can be clearly and conclusively established that an outlier's performance is due to an accident and is not due to an inherent defect or faulty calibration, such outlier will not be counted under this section. Such outliers shall, however, be separately reported and reasons for exclusion given.

13. ACTION FOLLOWING ACCEPTANCE OR REJECTION

13.1 Group Acceptance

If a sample is "fully" acceptable under Section 12.1 and meets the requirements of Section 12.2, the group from which it was taken shall be permitted to remain in service for a further six years.

If a sample meets the requirements of Section 12.2 but is only conditionally acceptable under Section 12.1, the group from which it was taken shall be permitted to remain in service for a further two years and a new sample shall be taken prior to the termination of this second year.

Group acceptance thus means that the seal validity date for any meter in the group has been moved ahead by the approved amount from the December 31 of the year previously assigned to it. See Section 5.1.

13.2 Re-sampling of Acceptance Groups

Any group accepted under Section 13.1 may be re-sampled towards the end of its new authorized period and, if again found satisfactory, its period further extended in accordance with the requirements of Section 13.1. The procedures for re-sampling, the criteria for acceptance or rejection, and the action to be taken following acceptance or rejection, shall be as outlined in Sections 11, 12 and 13 above.

13.3 Group Failure

If a sample fails to meet the requirements of either Section 13.1 or Section 13.2, the group, formed under either Section 11.1.1 or 11.1.2, shall be rejected and each meter of the group shall be brought in for re-servicing and re-calibration before the expiration of its valid seal date. If the group is made up of two seal years the call-in is for a period of two years except that some meters have to be brought in within the first year.

13.4 Treatment of Re-serviced Meters

13.4.1 Meters Which Fail Along the Way

Any meter of any group which for any reason requires to be serviced and re-calibrated before its due date shall, after re-calibration, be presented for re-inspection but it shall not return to its original group except if its re-inspection occurs in the same calendar year as its original inspection.

13.4.2 Meters Excluded from Above Rules

Except as provided under Sections 6.2, 11.2 and 13.4.1, the rules of Part IIA do not apply to meters serviced and calibrated in a utility shop or independent meter shop. Such meters are subject to the rules of Part IIB, Part IIC or Part IID as the case may be.

13.5 Disposal of Sample Meters

A sample meter from an accepted group may be returned to service as a member of the group provided that:

(i) it has not had its seal broken; *

(ii) the errors at high load and low load, as determined by the sample test, are within +2 and -2 percent;

(iii) there are no apparent reasons why the meter should be re-serviced and re-calibrated.

The remainder shall be re-serviced and re-calibrated and treated as meters under Section 13.4.

*NOTE: A meter with a broken seal which the inspector, as a result of examination and verification, is satisfied has not been tampered with may be re-sealed with the original seal date and returned to service as part of the group provided that the conditions under 13.5 (ii) and 13.5 (iii) have been met.

14. RECORDS AND REPORTS

14.1 District Office Records

14.1.1 Field Notes and Test Sheets

(i) (a) Field Notes shall be written to cover every new meter inspected, whether by 100% inspection or by sampling procedures. The Field Note record shall contain the basic details of all the meters (i.e. make, type, capacity, inspection number, serial number etc.) and the errors of those which have been given the full accuracy tests.

(b) Field Notes shall be written to cover proto-groups checked by sample testing. The make, type and seal year shall be recorded for the proto-group as well as the statistical results of the check. Details of only those meters actually tested, together with their individual errors shall be recorded.

(c) Field Notes shall be written to cover groups sampled for seal extension. The make, type, seal years and number of meters in the group shall be recorded, as well as the statistical results of sampling. Details of only those meters actually tested, together with their individual errors, shall be recorded.

(ii) The present Field Note is not satisfactory for some purposes. It is considered that different Field Notes should be available for different situations and kinds of meters. Further, the possibility of making the Test Sheet replace the Field Note should be investigated. (A Field Note number could be applied from a roll of pre-numbered adhesive tape).

14.1.2 Record of Proto-Groups

The District Office shall keep a record of all proto-groups of new meters sample checked during the calendar year. This record shall show the type and make of the meters, the number of meters originally forming the proto-group, the seal date of the meters, the results of tests and the Field Note numbers of the Field Notes on which the test data was recorded.

14.1.3 Dial Test and Mechanical Inspection Period

District Offices are required to keep the data necessary to complete the monthly report to Standards (form shown in Appendix II).

14.1.4 Formation of Sampling Groups

When a utility has determined the composition of a group of meters intended for sampling for seal extension under Section 11.1.1, it shall prepare a list of all the meters comprising the group. A copy of this list shall be sent to the District Inspector of the local district who shall then draw a representative sample from the group in accordance with Section 11.2.2 and forward to the utility the details of the meters chosen.

If the group passes as a result of the sampling, the District Office shall check the group listing against its own records to ensure that the listing is essentially correct. The listing is retained by the District Office: meters may be deleted from it but no meter may be added.

14.2 Reports to Standards

14.2.1 Monthly Report of New Single-Phase Watthour Meters

At the end of each month each District Office shall forward to Standards a summary of all new single-phase watthour meters inspected during the month. The form shown in Appendix XII shall be used for this report.

14.2.2 Dial Test and Mechanical Inspection Report

At the end of each month the District Office shall complete the forms shown under Appendix II and forward them to Standards.

14.2.3 Check Test Report

The district offices shall report to Standards the following details pertaining to the check sample tests made on each utility proto-group. See Appendix VIII for draft of report form:

(i) name of utility;

(ii) type of meters in proto-group;

(iii) number of meters in utility proto-group;

(iv) number of meters selected for the sample;

(v) number of meters actually tested;

(vi) an explanation covering those meters not tested;

(vii) The $\bar{X}$ and s of the sample for each load test where the sample size is 15 or more. If it appears that a check sample has failed to meet the requirements of Section 9.1 or the outlier criteria, this shall be noted on the form. In such case, too, Standards shall be notified immediately. For sample sizes of less than 15 meters, the sample shall be considered acceptable if the errors of the meters are all within $\pm$ 2%

(viii) the complete test data for all samples shall be sent to Standards.

14.2.5 Sampling Group Notice

A District Office shall notify Standards when a group is about to be sampled or re-sampled. The following information shall be supplied:

- the make and type of meters in the Group;
- the seal date(s) of the meters;
- the number of meters currently in the group;
- the number of meters originally in the proto-groups from which the group was formed;
- the number of meters in the sample.

14.2.6 Results of the Sampling of a Group

After a sample from a Group has been tested, the District Office shall report its findings to Standards and offer its recommendations regarding acceptance or rejection of the group for seal extension. The report shall include:

(i) a summary showing full details pertaining to the group and sample (Appendix XIV);

(ii) a histogram if the results seem unusual;

(iii) such useful information as an explanation for outliers, or the reason for meters not being brought in.

14.3 Standards Summaries and Reports

14.3.1 Monthly Summary of New Single-Phase Meters Tested

When reports from all districts have been received, Standards shall summarize the statistics obtained for each make and type. The summary shall include a listing of all the lots tested during the month together with the mean and standard deviation for each test load of each lot. In addition, the National mean for the type ($\overline{X}$) shall be calculated and the average standard deviation indicated.

Copies of the summaries for all types shall be sent to the District Offices and the summaries which concern his own types shall be sent to each manufacturer.

14.3.2 Dial Test and Mechanical Inspection Summary

(i) At the end of each month the district shall complete the forms shown under Appendix II and return these to Standards, Ottawa.

(ii) Standards shall summarize the results obtained from the districts each month and send a copy to each manufacturer of those figures which pertain to his meter types. (Appendix III)

(iii) The E&G Division shall maintain a running plot or tabulation of the results for each type of meter for each of the four categories of faults shown on Report Form. (Appendix II)

14.3.3 Check Sampling of Proto-Groups

(i) A check sampling plan for proto-groups shall be prepared each year, as outlined in Section 7.1, and distributed to District Offices and utilities.

(ii) Not later than the end of the calendar year, after reports from all districts have been received, Standards shall calculate for each type:

(a) The $\overline{X}$ and s for each test load for the total of all the samples of the particular type.

(b) Determine correlation between the results obtained for individual utilities and the combined results. The $\overline{X}$ and s obtained for each utility can readily be compared with the $\overline{X}$ and s obtained under (a) by using standard techniques.

(c) Assess the results obtained under (b) and refer those utility figures for which there are discrepancies back to district concerned to determine, if possible, the reason.

(d) Apply the results obtained under (a) to the diagram for the appropriate sample size shown in Appendix IX.

(e) If the results are favorable for a particular type, the District Offices and the manufacturer concerned shall be so advised. If the results are not completely satisfactory the requirements of Section 10.2 and Section 10.3 apply and whatever action should be taken will depend on the result of the complete investigation.

14.3.4 Authorization of Sampling Group Status

Upon the receipt of a report from a district office concerning the sampling of a group for seal extension (see Section 14.2.6), Standards shall advise if it accepts the recommendation or wishes to discuss the matter further. The eventual decision and the consequent action necessary will be passed to the utility by the district office.

14.3.5 Summary of the Results of Group Sampling

(i) Standards shall maintain a cumulative summary of the results of sampling of each type of meter and shall report the latest statistics to the manufacturer concerned and to the district offices at least once a year.

(ii) Statistics shall be charted and analyzed to provide useful and necessary information for continuous monitoring of the inspection program.

RULES FOR VERIFICATION OF RE-SERVICED SINGLE-PHASE WATTHOUR METERS AND SUBSEQUENT CONTROL OF ACCURACY

1. SCOPE

1.1 Authorization

These rules shall apply to re-serviced single-phase watthour meters (without auxiliary attachments) which have been serviced and calibrated in the utility meter shop and which have been presented for inspection subsequent to January 1, 1976.

2. INSPECTION METHODS

2.1 Formation of Lots

Following meter shop calibration, the meters shall be formed into identified lots and then presented for inspection. Under these rules for verification of meter shop calibrated meters, a "lot" means a definite quantity of a specified kind of meter.

Generally speaking the meters are classified into two kinds viz: those with magnetic suspension of the disc and those not having magnetic suspension. A "lot" may include more than one make and rating of meter. Meters in a lot may have been serviced and calibrated by more than one meterman. However, it should be remembered that increasing the number of variablestends to increase the risk of failure of the sample and thus the lot. Therefore, as far as possible, the number of variables should be kept to a minimum.

2.2 Lot Identification No.

Every lot presented for test shall be assigned an identification number. This number is for departmental reference purposes and does not have any long term significance. However, the District Inspector must ensure that a designation completely and clearly distinguishes a lot from any other lot or group of the utility or those of other utilities in his area. (This is necessary to avoid confusion at Standards when reviewing and analyzing district reports).

Every lot for which the $\bar{X}$ and s are not required shall be reported by the District Office as a SMALL LOT and the number of meters in it indicated on the report.

2.3 Verification by Sampling Procedures

Except as provided under Sections 2.4, 2.5 and 2.6, the normal procedure for inspection of re-serviced single-phase watthour meters shall be by sampling methods. The inspector shall select a sample of meters from the lot presented for test, in accordance with Table I, Section 2.7 and verify their accuracy against the government standards. The selection of the sample shall be strictly random. The method of presentation of the lot and the sample shall be determined by agreement with the District Office concerned. If the results of test meet the requirements for the particular sample size and other criteria of Sections 3. and 4. the inspector shall accept and seal the lot.

2.4 Verification by 100% Inspection

Where a lot size is too small or where the inspector considers it expedient within the limits outlined in Table I, the verification of the meters shall be by 100% inspection. (The choice of method may, in some cases, depend on circumstances, experience, utility preference and current directive. It should be noted also that the $\bar{X}$ and s shall be calculated, as shown in Table I for all lot sizes of 15 meters or more regardless of whether tested by sampling or 100% inspection.) See also Sections 2.7 and 4.3.3.

2.5 Verification by Witness Testing

Where a utility has a fully automated test board operating under suitable testing conditions the inspector may, with the express approval of Standards, witness the verification by the utility meterman of a lot of meters calibrated by the utility. The inspector must assure himself that the tests have been properly and accurately made and, as a part of this assurance, check according to a standard procedure the performance of the test board equipment on a scheduled basis. Provided that all the requirements of Sections 3. and 4. have been met, he shall seal the meters which have passed inspection by this method. The utility shall provide to the inspector the calculations for the parameters of the lot viz: the mean and standard deviation.

2.6 Verification by Witness Sampling

Where a utility has fully automated test board equipment operating under suitable testing conditions, the inspector may, with the express approval of Standards and in lieu of the procedure under Sections 2.3, 2.4, and 2.5, witness the verification tests made

by the utility meterman on a sample from a lot of serviced meters and accept and record the results as the official tests. The inspector must choose the sample and assure himself that the tests have been properly and accurately made and, as a part of this assurance, check according to a standard procedure the performance of the test board equipment on a scheduled basis. Provided that all the requirements of Sections 3. and 4. have been met, he shall seal the meters which have passed inspection by this method. The utility shall provide to the inspector the calculations for the statistics of the sample, viz: the mean and standard deviation.

2.7 Sample Size

Table I below shows the authorized size of a sample in relation to the size of the lot.

TABLE I

Lot Size	Sample Size	$\bar{X}$ and s required
1 to 14	100% inspection	No
15 to 40	15 or optional 100% inspection	Yes
41 to 110	15	Yes
111 to 180	20	Yes
181 to 300	25	Yes
301 to 500	30	Yes
501 to 700	35	Yes
701 to 1000	45	Yes

3. VERIFICATION TESTS

3.1 Dial Test and Mechanical Inspection

3.1.1 Basic Schedule

A dial test and mechanical inspection shall be made on re-serviced meters in accordance with the following plan:

(i) every meter serviced by a utility having a meter inventory of 25,000 meters or less shall be subject to a dial test and mechanical inspection as detailed in Section 3.1.2;

(ii) meters serviced by utilities having more than 25,000 meters shall receive the dial test and mechanical inspection on a periodic basis. The intent is that such inspections will be made on a periodic basis and the period may be adjusted as the result of statistics obtained. This might well result in the schedules being different for different utilities depending upon the quality of the servicing procedure;

(iii) where, within the allotted period, a utility has presented for dial test and mechanical inspection 4,000 re-serviced meters, no further meters need be presented during the period, provided that the results of the inspection are satisfactory.

Table II shows the preliminary schedule with which the program will start:

TABLE II

Dial Test and Mechanical Inspection Schedule

Meters passing through meter shops in the indicated areas shall be inspected during the months shown:

Area	Months	
British Columbia (including Yukon)	April	Oct.
Alberta (including N.W. Territories)	Mar.	Sept.
Saskatchewan	Mar.	Sept.
Manitoba	Mar.	Sept.
Toronto District	Jan.	July
Ontario (other than Toronto District)	June	Dec.
Quebec	May	Nov.
Atlantic Provinces	Feb.	Aug.

3.1.2 Dial Test and Mechanical Inspection

The dial test and mechanical inspection must be very thoroughly and carefully done by all Districts, the aim being, of course, to find all the defects to which the meters may be subject.

In order to ascertain those errors which strictly pertain to the register itself, the meter shall be run for a period sufficient to produce at least one revolution of the test dial hand. Other faults may show up during this run and it is essential that the reference and meters under test are measuring exactly the same load.

All meters shall be given a careful visual inspection as well, to seek out defects such as dirt in meters, loose screws, etc.

3.2 Creep Test

All meters submitted to load tests must also be subjected to a "creep test". See Part X for definition of creep.

3.3 Accuracy Tests

3.3.1 Test Loads

Each sample meter shall be subjected to three accuracy tests at the loads specified in the current Test Table I, Appendix I, except as noted below. These tests are: High Load, Unity Power Factor,(HL); High Load, 50% Power Factor, (PF); and Low Load, Unity Power Factor, (LL). However, the 50% power factor test need not be made on single-phase meters having magnetic suspension. This rule shall apply whether the meters are to be inspected by sampling or 100% inspection. The HL test is to be carried out first. Order of the remaining two tests is immaterial.

3.3.2 Tests on 3-Wire Meters

All tests on 3-wire meters shall be made with the current coils in series.

3.3.3 Cyclometer Registers

Particular attention must be paid in making tests on meters fitted with drum-type or cyclometer registers to ensure that no period of accuracy test embraces the time during which its most rapidly moving drum is actuating any of the slower drums.

3.3.4 Meter Pre-conditioning

Ideally the sample meters should be tested under the average set of conditions which they will meet in service. However, for practical purposes, it is considered that soaking them at the meter shop room temperature for at least four hours before inspection should be sufficient provided that the stipulations covered by Section 6, Part I above, have been taken into account.

(A comprehensive study shall be undertaken by Standards to determine whether or not meters should have voltage applied to the voltage coils for a period prior to verification. The requirement in paragraph above may be modified as a result of the study.)

4. CRITERIA FOR ACCEPTANCE OR REJECTION

4.1 Dial Test and Mechanical Inspection

At the end of the first six months of the mechanical inspection program Standards shall examine the data to determine what action should be taken where a defect situation seems out of control with respect to any particular attribute.

The whole dial test and mechanical inspection program shall be reviewed from time to time and modified as deemed necessary.

4.2 Criteria with Regard to Creep

Any watthour meter whose disc creeps more than one revolution shall be rejected. If the meter is a member of a sample, it shall be replaced in the sample by another meter before the accuracy tests are made. Generally, a single creeping meter in a sample from a lot would not necessarily be cause for alarm but if more than one were found in a sample further testing should be stopped, the utility consulted and the matter fully investigated. See Section 4.4.

4.3 Accuracy Criteria

4.3.1 Lot Sizes of 41 to 1000 Meters

For lot sizes of 41 to 1000 meters the lot shall be verified by the sampling process and $\bar{X}$ and s shall be determined for each of the specified test loads for each sample. (The form in Appendix IV is a help in making the calculations.) Using the values of $\bar{X}$ and s obtained as co-ordinates, points shall be

plotted on the appropriate truncated triangle chart provided in Appendix XXI. If all the plotted points fall within the bounds of the triangle specified for the particular sample size and test the lot shall be considered fully acceptable with regard to accuracy requirements. If any point falls outside its designated triangle the lot is considered to have failed.

It must be stressed here that the concept of an outlier does not apply to the sampling inspection for the verification of meters under these rules. An individual meter whose accuracy is, perhaps, open to question shall in no circumstances be removed from the sample. If the sample which includes it passes inspection then there is no valid reason to change the calibration or remove the meter from the sample - the meter must be left alone; if the sample fails on first test because of it, then a further sample may, at the option of the utility, be drawn under Section 4.3.2; if the double sample fails then and only then may the meter be subject to re-calibration (along with possibly other meters of the lot). Quite obviously, if a questionable meter is a long way out of calibration, the double sample is bound to fail and taking a second sample would be a waste of time. There is no simple way to determine where to draw the line so it is important that the second sample should be waived only if it is certain that the combined first and second sample will fail the test.

If the utility does not elect a second sample after failure of the first, the lot shall be rejected and returned to the utility.

A defective meter (i.e. one which has some apparent fault other than merely being out of calibration - for example a jammed disc or register) found in a sample shall be replaced by another meter drawn at random from the lot. Such a meter shall be counted as defective and reported on forms shown in Appendix II. A number of defective meters in a lot would be cause for investigation.

4.3.2 Second Sample

If the sample from a lot fails to meet the requirements of Sections 4.3.1, another sample may, as indicated above, be randomly chosen, of the same size as the first. New values for $\bar{X}$ and s shall be determined using the combined results of the first and second sample. If any point (HL, LL, or PF) using the new $\bar{X}$ and s falls outside the appropriate triangle of Appendix XXI, the chart corresponding to the double sample size, the lot shall be rejected.

4.3.3 Lot Sizes of 15 to 40 Meters

For a lot size of 15 all the meters shall be tested: for a lot size of over 15 and up to 40 the verification may be performed by either sampling or 100% testing. In every case, under this section, however, the $\bar{X}$ and s shall be determined and reported, i.e. if 100% inspection has taken place the whole lot shall be treated as a sample and the $\bar{X}$ and s determined. Where inspection has been under the sampling procedure, the criteria of Section 4.3.1 apply but if the sample fails to meet the criteria there is no recourse to a further sample and the lot shall be 100% inspected.

Where 100% inspection has taken place for a lot size of 15 to 40 meters, the lot shall be considered fully acceptable, if the points determined from the $\bar{X}$ and s of the test loads fall within the truncated triangle of Appendix XXl which corresponds to the lot size and appropriate test load. However, if the errors of any meter of the lot fall outside the tolerance of Table III the utility is permitted to re-adjust the meter. The final values of $\bar{X}$ and s shall be determined using the new values of adjusted meters or, if certain meters are not returned to the lot by the utility, excluding such meters. The points determined by the final values of $\bar{X}$ and s must fall within the appropriate truncated triangles.

A defective meter which has been rejected from a lot shall be reported regardless of whether or not it was later returned to the lot. The nature of the defect shall be indicated. See Forms, Appendix II.

4.3.4 SMALL LOTS (14 meters or less)

For a lot size of fourteen meters or less, every meter shall be tested and any meter which falls outside any of the following tolerances shall be rejected. The remainder shall be accepted.

TABLE III

± .75% on High Load, Unity P.F.
± 1.1 % on Low Load, Unity P.F.
± 2.0 % on High Load, 50% P.F. - this test is not required on meters with magnetic suspension

4.3.5 Witness Testing

Where the witness testing procedure has been authorized, the lot shall be considered acceptable if the points determined from the $\bar{X}$ and s of the test loads fall within the designated triangle of Appendix V, which corresponds to the lot size (i.e. the lot size is treated as the sample size). Where an appropriate chart does not exist for the particular lot size, the one having its sample size nearest in value should be used.

If the errors of any meter of the lot fall outside the tolerances of Table III the utility is permitted to re-adjust the meter otherwise it shall be rejected from the lot. The final values of $\bar{X}$ and s shall be determined using the new values of adjusted meters or, if certain meters are not returned to the lot by the utility, excluding such meters. A defective meter which has been rejected from a lot shall be reported regardless of whether or not it is later returned to the lot. The nature of the defect shall be indicated. See forms, Appendix II.

4.3.6 Witness Sampling

Where the witness sampling procedure has been authorized, the criteria shall be exactly the same as if the verification had been carried out under Section 2.6, i.e. the criteria of Sections 4.3.1 and 4.3.2 shall apply.

4.4 Other Factors

It is considered that conformity of a lot of meters to the requirements outlined in Sections 4.3.1, 4.3.2 and 4.3.3, should be sufficient assurance that the utilites quality control process is satisfactory. However, other contrary indications should not be ignored, While it is not possible to enumerate all the possible situations which might arise, some corrective action may be warranted in certain cases. For example, a single creeping meter in a sample would probably not be cause for alarm but if there were several such meters the following actions would be indicated:

(i) make absolutely certain that the test conditions, test boards and standards are satisfactory;

(ii) subject the deviate meters to critical examination to determine the cause;

(iii) consider the desirability of making 100% test on all meters in the lot in order to get a clear picture of the extent of the trouble;

(iv) report the findings to Standards.

5. PROCEDURES FOLLOWING ACCEPTANCE OF RE-SERVICED METERS

5.1 Seal Validity

5.1.1 Commencing January 1, 1979-
Basic seal periods to be:

For meters prior to A/S base:	4 years
A/S base meters, non-magnetic suspension:	6 years
Meters with magnetic suspension:	8 years

5.1.2 Commencing January 1, 1980-
3-wire meters prior to A/S base will not be accepted for re-verification.

5.1.3 Seal periods of meters now in service (re-verified prior to January 1, 1979) are to remain unchanged (even though there are some anomalies). For example, type OC meters re-sealed in 1978 will be due for re-verification in 1984 but the same type of meter re-sealed in 1979 will be due in 1983.

Notes:

(i) Re-verified lots which include meters having different seal periods: If the lot is accepted the appropriate basic seal period will apply to each individual meter. E.g., type OC would be valid for 4 years, type CFA for 6 years.

(ii) All meter types, regardless of age, are eligible for seal extension (if sample test results are good enough).

(iii) Seal extension periods are to be 2 or 4 years for non-magnetic suspension meters, and 2 or 6 years for meters with magnetic suspension, depending on acceptance triangle.

5.2 Formation of Proto-Groups

All re-serviced meters of one make, type and seal date accepted under the above rules and belonging to one utility shall be considered as a proto-group and shall be treated in the manner described below. Where it can be shown that meters of more than one type (or variations of a type) from the same manufacturer are essentially similar in performance, then such may be included together in one group.

5.3 Identification of Proto-Groups

Standards will assign a designation to the proto-groups formed under Section 5.2 above e.g. the designation R75-170 could be used to represent C.G.E. I-70 meters tested and sealed in 1975. Although the general designation would be common to all meters of the same type and seal date, differentiation as far as records are concerned would be made by naming the utility thus, Saskatchewan Power, Proto-Group R75-170. A utility may wish to use some other code to identify such proto-groups in its own records but correspondence between the two codes must be clear and unambiguous. In other words, it must be possible to segregate and locate every meter in a proto-group.

6. PROCEDURE FOLLOWING REJECTION OF RE-SERVICED METERS

6.1 Rejection of a Lot

If an inspector finds as a result of his tests that a lot of meters fail to meet the acceptance criteria, he shall immediately take the following actions:

(i) re-check that the calculations have been correctly made;

(ii) check the test conditions, check the test board and make sure that the standard used is not responsible. See Technical Electrical Circular of rules for checking out test boards;

(iii) advise the utility of the rejection.

It cannot be too strongly emphasized that in all cases of the rejection of re-serviced meters, the first responsibility of the inspector is to ensure that the test conditions and test equipment are not themselves at fault. In the case of small utilities or others which do not have frequent opportunities for checking, the burden of proof falls even more heavily on the test facilities.

6.2 Rejection of Individual Meters

Where individual meters have been rejected from SMALL LOTS, or as a result of dial test and mechanical inspection or where meters are for any reason demonstrably renegade, such meters may be calibrated or otherwise serviced to bring them within the tolerances outlined in Section 4.3.4. The meters shall then be presented to the inspector for verification and sealing and if passed shall be considered the equal of other accepted meters under these rules.

6.3 Re-Instatement of Rejected Lots

As already noted, where a lot has been rejected under Section 4.3.3, all reasonable measures having been taken to ensure that there has been no significant error introduced by equipment or standards, all the meters of the lot shall be returned to the utility for re-servicing and re-calibration. If the meters are again re-presented in the same lot, they shall then be treated as a new lot and the procedures under Section 4 apply.

CHECK TESTING OF METER TYPE/YEAR AFTER SHORT PERIOD OF SERVICE

7. CHECK TESTING PROCEDURE

7.1 Formation of Check Plan for Meter Types

Immediately after the end of each calendar year the District Office shall examine the complete year's records of meter shop serviced single-phase meters inspected and shall set up a plan for check sampling of the proto-groups formed in that year. The check sampling shall take place in the year which is two years after the seal date year of the proto-group. Normally, each utility will be allotted only one specific type to check test in any one year. The District Office designate the type to be tested by each utility in the plan and shall arrange as far as possible that:

(i) tests of each type are equally distributed;

(ii) each utility samples the various types equally over a period of years.

A utility which has no proto-group (i.e. of one type) of more than 300 meters in the particular year may opt out of the check sampling program but the meters so exempted shall then be on fixed seal status and shall be covered under the rules of Part IID. No proto-group of less than 50 meters shall be check sampled and such meters shall be on fixed seal status.

The District Office shall advise its utilities promptly regarding the details of the check test plan.

7.2 Check Sample Selection

The second year after the year of formation of proto-groups as described in Section 5.2, check samples shall be selected for each type of meter and these shall be brought in for test in accordance with the plan outlined under Section 7.1. The sample in each case shall be selected by the District Office concerned and shall consist of not less than 1% nor more than 2% of the meters of the type/year (except that no sample size shall be less than 25) for each utility in the District, to the nearest whole number.

The exact percentage figure shall be determined by the District Office so as to provide a sample size which approximates one of the standard nominal sample sizes. The actual number called in may be increased to allow for meters, which for legitimate reasons cannot be presented. The increase must not exceed 10% and the number actually tested shall not be less than the nominal figure. Experience will determine if this is a sufficient sample.

The reasons for the two year samples are: to get a good general indication of the initial performance of every type-year, to provide a reference against which future samplings may be compared, and to provide information as to the validity of the procedures.

Since the validity of the whole sampling process rests on the premise that the samples are random and truly representative of the population, it is extremely important that all eligible meters be brought in for test. This is particularly true of the check sample because of its small size. The utility shall provide a complete explanation for all sample meters not brought in. The District Office shall pursue the matter further if it is not fully satisfied with the explanations given.

7.3 Tests to be Made on Sample

The inspector shall subject each meter of the sample to the standard High Load, Low Load and Power Factor tests as described in Section 3.3.

All meters of the sample shall be subjected to a "creep test".

All tests on 3-wire meters shall be made with the current coils in series.

Dial tests are not required, but the inspector shall note on the test sheet anything he observes which detracts from the condition of the meter, such as filings, dirt, bits of gasket, loose screws, etc.

It cannot be too strongly emphasized that the number of uncontrolled variables entering into the process of inspection and testing of a sample of meters should be kept at an absolute minimum since any additional variables increase the risk of failure of the group. It is, therefore, very important that the sample meters of a particular group be tested on a

carefully checked test board, that the standard be known to be functioning properly, that the test should proceed without significant interruption, that the ambient conditions be good, that the pre-conditioning of the meters be satisfactory, that the same inspector makes all the tests on the sample, that all test loads are correct, etc. Any deviation from these concepts should be continually questioned and examined by the inspection staff, and the utility itself regardless of how it may seem justified by the exigencies of the moment.

8. CALCULATIONS AND REPORTS

8.1 District Office Calculations

The District Office shall calculate the $\bar{X}$ and s of the sample from each utility except where the sample from a utility is less than 15 meters.

8.2 Outliers

The final calculations for $\bar{X}$ and s shall exclude sample meters which are outliers. An outlier shall be a meter for which the error is both:

(i) above +3% or below -3% i.e. $|\bar{X}| > 3\%$ and

(ii) more than three standard deviations from the sample mean, $\bar{X}$, at the particular test load, i.e. $|(x-\bar{X})| > 3s$.

In some cases when judging whether a particular meter is an outlier or not, it is necessary to calculate $\bar{X}$ and s with the error of the particular meter excluded. If the meter then conforms to the above criteria, it is an outlier. See Appendix XVII.

Meters with the largest errors shall be judged and excluded, if necessary, before meters with smaller errors.

For the purposes of these rules "outliers" as defined above shall be considered to fall into two categories:

Class 1 Those meters which are aberrant as far as the norms of the proto-group are concerned because of defects in meter design, production deficiencies, incorrect factory calibration, etc. In other words, deficiencies which may be attributed to the manufacture of the type.

Class 2 Those meters which are aberrant because of accident, such as being dropped, damaged in service etc.

The term "outlier" embraces both these categories but where it can be proven beyond doubt that the outlier belongs in Class 2 it need not be counted in determining the eligibility of a sample under the outlier criteria. However, both Classes shall be reported.

It is clear, therefore, that every outlier shall be carefully examined to determine, if possible, the cause of its deviation.

9. CRITERIA APPLICABLE TO CHECK SAMPLE

9.1 Accuracy Acceptability

Subject to the requirements of Section 9.2 if all three points obtained by plotting $\bar{X}$ and s for each test load fall within the inner triangle shown in Appendix IX the sample shall be considered acceptable.

If one or more points fall between the two triangles and the remaining points within the inner triangle the sample shall be considered conditionally acceptable.

If one or more points fall outside the outer triangle, the accuracy of the sample shall be considered unacceptable.

9.2 Outlier Acceptability

The following criteria shall govern the maximum allowable number in proto-group samples:

Fast Outliers - not more than 1% of the nominal sample size (to the nearest higher whole number if the result contains a fraction) except that for a sample size of 25 no outliers are permitted;

Slow Outliers - not more than 2% of the nominal sample size (to the nearest higher whole number if the result contains a fraction).

10. ACTION FOLLOWING ACCEPTANCE OR REJECTION OF CHECK SAMPLES

10.1 Proto-Group Acceptance

If the sample is acceptable under Section 9, the proto-group shall remain in service under the conditions established in Sections 11, 12, and 13 and the utility so advised.

10.2 Non-Acceptability of Check Sample

If a check sample is unacceptable under Section 9, the District Inspector shall consult with the utility and attempt to ascertain the cause. Standards shall be immediately informed and consulted as to what further action should be taken.

At least two possible inferences may be drawn from the failure of the check sample:

(i) the sample is not representative of the group (for example the sample size might be too small);

(ii) the servicing procedure of the utility is faulty;

(iii) the meter type has a basic design defect.

Since the meters of the group are re-serviced meters there should be sufficient history of the meter type to determine whether or not some basic design defect exists.

It shall be the responsibility of the utility and District Office to fully examine any of the possibilities which cannot readily be eliminated.

It should be clear too that conditionally acceptable proto-groups may require investigation by the District Office as they may well be indicative of future difficulties.

10.3 Rejection of a Proto-Group

If the actions taken under Section 10.2 clearly demonstrate that the performance of meters of the type-year are unsatisfactory, with regard to the population of a particular utility, the Department reserves the right to call in all the meters of the utility proto-group. The time period for recall will depend upon the seriousness of the defects and will be a matter for negotiation between the Department and the utility involved.

EXTENSION OF SEAL PERIOD OF ELIGIBLE METERS

11. SAMPLING FOR SEAL EXTENSION

11.1 Sampling Groups

11.1.1 Formation of Sample Groups

Acceptable proto-groups or combined acceptable proto-groups of two consecutive seal years, shall be used to establish seal extension Sample Groups. It should be fully understood that the formation of very large groups is viewed with concern since the eventual failure of such groups may have a severe impact on District Office staffing as well as meter room staffing. Therefore, it would be better in some cases to establish the Sampling Group from a single proto-group or seal year.

11.1.2 Formation of Groups of Mixed Background Meters eligible under Section 11.1.1 above to form a group may be combined with meters eligible under Section 11.1.1, Part IIA to constitute a mixed group, provided that:

(i) neither component of the group (i.e., new or re-serviced meters) exceeds 9,500 meters in number;

(ii) the mixed group includes meters of no more than two consecutive seal years;

(iii) a listing is submitted which segregates the new meters from the re-serviced ones;

(iv) the sample size is determined under Section 11.2.

11.2 Sample Sizes and Sampling Periods

Each full group formed under 11.1.1 or 11.1.2 above shall be sampled not later than early in the seventh year of the meters with the later seal date. If the group consists of meters of one seal year only the group shall be sampled not later than early in the eighth year from the seal date. Groups must not be sampled too early; the intent should be to sample as late as possible without risking that if the group fails it will be difficult to bring in all the meters in their due year.

EXTENSION OF SEAL PERIOD OF ELIGIBLE METERS

11.1.3 Utilities with Groups Too Small to Sample

In order to provide viable groups, the formation of consortiums is encouraged. Such combinations may be formed by agreement between utilities or through the agency of an independent meter shop and the district inspector should assist in the formation of such groups.

The samples from groups formed under a consortium shall be randomly chosen from a composite list and the sample meters themselves should all be tested in one particular, selected shop. The sample size shall be in accord with Table IV and the rules for acceptance and rejection as already outlined shall apply. In the case of consortiums, mixed groups, as described under Sections 11.1.2 are not permitted.

The sample size shall be in accordance with Table IV below except in the case of Mixed Groups where the nominal sample size shall be determined from the graph in Appendix X.

TABLE IV

Group Size	Nominal Sample Size
Up to 500 meters	25 meters
501 to 1,000 "	50 "
1,001 to 2,500 "	75 "
2,501 to 4,000 "	100 "
4,001 to 9,500 "	150 "
9,501 to 15,000 "	200 "
15,001 to 22,500 "	250 "
22,501 to 30,000 "	300 "
For every 15,000 or less above 30,000 add	100 "

The actual number of meters selected for the sample shall approach but not exceed 115% of the nominal sample size. The number of meters contributing to the final result shall not be less than 95% of the nominal sample size.

11.3 Tests to be Made on Sample

The inspector shall subject each meter of the sample to the standard High Load and Low Load unity power factor tests maintaining, of course, the test conditions outlined in Section 3. If there is evidence to indicate that signficant change in accuracy occurs at 50% power factor for a particular type over a period of time, then a test at 50% power factor may be required.

12. CRITERIA FOR ACCEPTANCE OR REJECTION

12.1 Accuracy Requirements

The $\bar{X}$ and s of the sample shall be determined for each of the two test points. The use of the form shown in Appendix XI will facilitate making these calculations.

Appendix IX shows the acceptance regions for various sample sizes. If both points obtained by plotting $\bar{X}$ and s for each test load fall within the inner triangle the accuracy of the group shall be considered fully acceptable. If one point falls within the inner triangle and the other falls between

the two triangles the accuracy of the group shall be considered conditionally acceptable. If both points fall between the two triangles, the group shall be considered conditionally acceptable. If either point falls outside the outer triangle the group shall be rejected.

The final calculations for $\bar{X}$ and s shall exclude sample meters which are outliers. An outlier shall be a meter for which the error is both:

(i) above +3% or below -3% i.e. $|x| > 3\%$ and;

(ii) more than three standard deviations from the sample mean, $\bar{X}$, at the particular test load, i.e. $|(x-\bar{X})| > 3s$

In some cases when judging whether a particular meter is an outlier or not, it is necessary to calculate $\bar{X}$ and s with the error of the particular meter excluded. If the meter then conforms to the above criteria, it is an outlier. See Appendix XVII.

Meters with the largest errors shall be judged and excluded, if necessary, before meters with smaller errors.

NOTE: It is important that the sample for a particular group shall be tested on a carefully chosen test board. The test should proceed without significant break i.e. not some now and others several days later. If for some satisfactorily explained reason there is a break in the testing, the inspector must ensure that the test conditions are essentially the same and the test equipment is the same and functioning properly before proceeding with the interrupted portion of the test.

12.2 Outlier Requirements

The following criteria shall govern the maximum, allowable number in group samples:

Fast Outliers - not more than 1% of the nominal sample size (to the nearest higher whole number if the result contains a fraction) except that for a sample size of 25 or less no outliers are permitted.

Slow Outliers - not more than 2% of the nominal sample size (to the nearest higher whole number if the result contains a fraction).

Where it can be clearly and conclusively established that an outlier's performance is due to an accident and is not due to an inherent defect or faulty calibration, such outlier will not be counted under this section. Such outliers shall, however, be separately reported and reasons for exclusion given.

13. ACTION FOLLOWING ACCEPTANCE OR REJECTION

13.1 Group Acceptance

If a sample is "fully" acceptable under Section 12.1 and meets the requirements of Section 12.2 the group shall be permitted to remain in service for a further four or six years. The six year extension applies to meters with magnetic suspension. For others, the fully acceptable extension is four years.

If a sample meetsthe requirements of Section 12.2 but if only conditionally acceptable under Section 12.1 the group from which it was taken shall be permitted to remain in service for a further two years and a new sample shall be taken prior to the termination of this second year.

Group acceptance thus means that the seal validity date for any meter in the group has been moved ahead by the approved amount from the December 31st of the year previously assigned to it. See Section 5.1.

13.2 Re-Sampling of Acceptance Groups

Any group accepted under Section 13.1 may be re-sampled towards the end of its new authorized period and, if again found satisfactory, its period further extended in accordance with the requirements

of Section 13,1. The procedures for re-sampling, the criteria for acceptance or rejection, and the action to be taken following acceptance or rejection, shall be as outlined in Sections 11, 12 and 13 above.

13.3 Group Failure

If a sample fails to meet the requirements of either Section 12.1 or Section 12.2, the group formed under either Sections 11.1.1 or 11.1.2 shall be rejected and each meter of the group shall be brought in for re-servicing and re-calibration before the expiration of its valid seal date. If the group is made up of two seal years the call-in is for a period of two years except that some meters have to be brought in within the first year.

13.4 Meters which Fail Along the Way

Any meter of any group which for any reason requires to be re-serviced and re-calibrated shall, after calibration, be presented for re-inspection but it may not return to its original group.

13.5 Disposal of Sample Meters

A sample meter from an accepted group may be returned to service as a member of the group provided that:

(i) it has not had its seal broken;

(ii) the errors at High Load and Low Load, as determined by the sample tests, are within +2 and -2 percent;

(iii) there are no apparent reasons why the meter should be re-serviced and re-calibrated.

The remainder shall be re-serviced and re-calibrated and treated as meters under Section 13.4.

*NOTE: A meter with a broken seal which the inspector, as a result of examination and verification, is satisfied has not been tampered with may be re-sealed with the original seal date and returned to service as part of the group provided that the conditions under 13.5 (ii) and 13.5 (iii) have been met.

14. RECORDS AND REPORTS

14.1 District Office Records

14.1.1 Field Notes and Test Sheets

(i) (a) Field Notes shall be written to cover every meter inspected, whether by 100% inspection or by sampling procedures. The Field Note record shall contain the basic details of all the meters (i.e. make, type, capacity, inspection number, serial number etc.) and the errors of those which have been given the full accuracy tests.

(b) Field Notes shall be written to cover proto-groups checked by sample testing. The make, type and seal year shall be recorded for the proto-group as well as the statistical results of the check. Details of only those meters actually tested, together with their individual errors shall be recorded.

(c) Field Notes shall be written to cover groups sampled for seal extension. The make, type, seal year and number of meters in the group shall be recorded as well as the statistical results of sampling. Details of only those meters actually tested, together with their individual errors, shall be recorded.

(ii) The present Field Note is not satisfactory for some purposes. It is considered that different Field Notes should be available for different situations and kinds of meters. Further, the possibility of making the Test Sheet replace the Field Note should be investigated. (A Field Note number could be applied from a roll of pre-numbered adhesive tape.)

14.1.2 Record of Proto-Groups

The District Office shall keep a record of all proto-groups of meters sample checked during the calendar year. This record shall show the type and make of the meters, the number of meters originally forming the proto-group, the seal date of the meters, the results of tests and the Field Note numbers of the Field Notes on which the test data was recorded.

14.1.3 Formation of Sample Groups

When a utility has determined the composition of a group of meters intended for sampling for seal extension under Section 11.1.1, it shall prepare a list of all the meters comprising the group. A copy of this list shall be sent to the District Inspector of the local district who shall then draw a representative sample from the group in accordance with Section 11.2.2 and forward to the utility the details of the meters chosen.

If the group passes as a result of the sampling, the District Office shall check the group listing against its own records to ensure that the listing is essentially correct. The listing is retained by the District Office: meters may be deleted from it but no meter may be added.

14.2 Reports to Standards

14.2.1 Monthly Report of Single-Phase Watthour Meters

At the end of each month each District Office shall forward to Standards a summary of all single-phase watthour meters inspected during the month. The form shown in Appendix XII shall be used for this report.

14.2.2 Dial Test and Mechanical Inspection Report

At the end of each month the District Office shall complete the forms shown under Appendix II and forward them to Standards.

14.2.3 Check Test Report

The District Offices shall report to Standards the following details pertaining to the check sample tests made on each utility proto-group. See Appendix VIII for draft of report form:

(i) name of utility;

(ii) type of meters in proto-group;

(iii) number of meters in utility proto-group;

(iv) number of meters selected for the sample;

(v) number of meters actually tested;

(vi) an explanation covering those meters not tested;

(vii) The $\overline{X}$ and s of the sample for each load test.
If it appears that a check sample has failed to meet the requirements of Section 9.1 or the outlier criteria, this shall be noted on the form. In such case, too, Standards shall be notified immediately. For sample sizes of less than 25 meters, the sample shall be considered acceptable if the errors of the meters are all within ± 3%.

(viii) the complete test data for all samples shall be sent to Standards.

14.2.4 Sample Group Notice

A District Office shall notify Standards when a group is about to be sampled or re-sampled. The following information shall be supplied:

- the make and type of meters in the Group;
- the seal date(s) of the meters;
- the number of meters currently in the group;
- the number of meters originally in the proto-groups from which the group was formed;
- the number of meters in the sample.

14.2.5 Results of the Sampling of a Group for Seal Extension

After a sample from a group has been tested, the District Office shall report its findings to Standards and offer its recommendations regarding acceptance or rejection of the group for seal extension. The report shall include:

(i) copies of the calculation sheets (Appendix XI);

(ii) copies of histograms (this is not mandatory but particularly desirable if the results are unusual), Appendix XIII;

(iii) a summary showing full details pertaining to the lot and sample, Appendix XIV;

14.3 Summaries and Reports by Standards

14.3.1 Authorization of Sampling Group Status

Upon the receipt of a report from a District Office concerning the sampling of a group for seal extension (see Section 14.2.5), Standards shall advise if it accepts the recommendation or wishes to discuss the matter further. The eventual decision and the consequent action necessary will be passed to the utility by the District Office.

14.3.2 Summary of the Results of Group Sampling

(i) Standards shall maintain a cumulative summary of the results of sampling of each type of meter and shall report the latest statistics to the manufacturer concerned and to the District Offices at least once a year.

(ii) Statistics shall be charted and analyzed to provide useful and necessary information for continuous monitoring of the inspection program.

RULES FOR EXTENSION OF SEAL PERIOD OF SINGLE-PHASE WATTHOUR METERS BY STATISTICAL SAMPLING METHODS

1. SCOPE

1.1 Authorization

These rules cover the requirements of a statistical sampling program for single-phase watthour meters already sealed and in service as of January 1, 1976. They shall be applicable where the electric utility seeks an extension of the seal period of meters not already covered under Parts IIA and IIB. Meter groups already in existence on January 1, 1976, are of course included under these rules.

2. INSPECTION METHODS

2.1 Formation and Composition of Groups

(i) Subject to the approval of Standards, the meters that a utility chooses for the statistical sampling program shall be placed in homogeneous groups which will normally be formed according to type and seal vintage. Subsequently, groups may be modified or combined if warranted by the performance data.

(ii) A group shall be composed of either meters of the same make, type and seal year or subject to the restriction imposed by Section 2.2, meters of the same make, type and two consecutive seal years.

(iii) A group may include various ratings of the same type, that is, 2- and 3- wire meters, 100 and 200 ampere ratings, transformer types, etc.

(iv) The following types may be combined to form a group:

C.G.E.	I-50, I-55, I-60
Ferranti-Packard	B-3, B-4
Sangamo	K, K2
Westinghouse	D2, D3

This should be considered as a guideline rather than a hard and fast rule. If there are existing groups comprising more than one type such as D3 & D4, such groups should be allowed to remain even though not in accord with these guidelines.

There are some instances of a utility having more than one group of the same type and same seal date. These may be combined into one group if so desired.

2.2 Group Size

(i) Because of the heavy inspection load imposed when a very large group fails, it is considered that such groups are undesirable and should be avoided.

(ii) Groups which include overdue meters or meters where the expiration of the seal period is imminent will not be permitted.

2.3 Listing and Identification of Groups

(i) A utility wishing to have a group of meters approved for sample testing shall prepare a list of the meters in the group and shall submit a copy of this list to the District Inspector of the area in which the meters are located.

(ii) Each statistical sampling group shall be assigned an identity number. It has been the practice to use the initials of the utility with a numerical suffix e.g. Group CP-3 might identify the third group established by the Calgary Power Company. The utility's system of group identity numbers shall be arranged by mutual agreement between the utility and Standards to assure that each utility's identification system is unique.

(iii) The list of meters for the group shall be so arranged as to facilitate the selection of samples. The inspection numbers shall be arranged in vertical columns in ascending order of magnitude and the listing shall normally include a sequential number, the inspection number, serial number, type designation, and the rating of each meter if all meters are not of the same rating. The serial number, while generally very desirable, may be left off the list if the District Inspector is satisfied that the inspection number sufficiently identifies the meter and that there is no risk that the meter records will become impaired.

(iv) A heading at the top of the list or on a cover sheet shall give full details of the composition of the group e.g.

> Calgary Power Company
> Group CP-3
> consisting of 5324 meters
> Canadian General Electric Type I-55A and I-55S
> seal dates 1963 and 1964

(v) Typed lists should show fifty meters per page (or 100 per page if there is room on the sheet to place another 50 adjacent to the first 50). Computer listings are satisfactory since all the sheets are linked together and thus difficulties are not encountered in selecting the sample. Any listing which shows different numbers of meters on each sheet can be a source of error in selecting the sample and entail considerable extra man-hours.

A copy of a portion of a satisfactory listing is attached as Appendix XV.

(vi) It should be stressed that the list of meters submitted by a utility and designated by a group number explicitly defines and restricts the group if it is approved for sampling. A meter of the same type and seal vintage deliberately or inadvertently left out of the group shall remain outside the group and shall be treated in the same manner as any other meter not belonging to the group. No meters can be added to the group after the listing has been approved.

2.4 Re-Listing Prior to Re-Sampling

If, in due course, a utility wishes to re-sample a group already approved for seal period extension in order to further extend the seal period, it shall:

(i) submit a new listing of those meters still remaining in the original group but the new listing shall not include any meters not on the original list;

or

(ii) if the District Inspector approves, submit a list of meters to be deleted from the original list, for any valid reason.

The new sample shall be drawn from what remains of the group on the basis of the number of meters still left. While there is no objection to a few meters selected for the first sample being called for the second sample, it is considered undesirable that more than 10% of the sample should thus be chosen twice in a row. If this should happen the procedure for sampling should be repeated or the method of choice changed.

2.5 Selection of Samples

2.5.1 Method of Selection

For each established group of meters, a random sample shall be drawn by the District Office in sufficient time to allow tests to be made before any significant quantity of the meters is actually due for re-verification. As long as the results of the sample tests continue to conform to the requirements, further sampling may take place at intervals of two, four, or six years thereafter. A suggested sampling method is outlined in Appendix XVIII.

2.5.2 Timing of Tests

Where the group consists of a single seal vintage, the sample shall be drawn and the tests made before, but not too long before, the beginning of the year in which the meters are due. Where the group includes two seal vintages, the sample shall be drawn and the meters tested towards the end of the year preceding the earlier of the two due dates or shortly thereafter. In some circumstances sampling and testing may be permitted up to April of the earlier due date year but it is stressed that the intent should always be that, as far as practicable, the timing of the sample tests should be such that they represent the condition of the meters on the due date yet not so late as to cause difficulties in bringing in all of the due meters if the sample should fail.

2.6 Sample Size

Except as indicated in Section 2.2, the nominal sample size shall be in accordance with Table I below.

TABLE I

Group Size	Nominal Sample Size
Up to 500 meters	25 meters
501 to 1,000 "	50 "
1,001 to 2,500 "	75 "
2,501 to 4,000 "	100 "
4,001 to 9,500 "	150 "
9,501 to 15,000 "	200 "
15,001 to 22,500 "	250 "
22,501 to 30,000 "	300 "
For every 15,000 or less above 30,000 add	100 "

The actual number of meters selected for the sample shall approach but not exceed 115% of the nominal sample size. The number of meters contributing to the final result shall not be less than 95% of the nominal sample size.

2.7 Presentation of Sample for Test

Every meter selected for the sample shall be transported to one location for testing, except when it is determined that either:

(i) the meter does not belong to the group being sampled;

or

(ii) the meter has previously been removed or processed in a fashion to disqualify it from the sample.

In each case when a selected meter is not transported to the location for test the explanation shall be recorded by the utility and reported to the District Office.

3. VERIFICATION TESTS

3.1 Creep Test

All meters from the sample shall be submitted to a "creep test". A meter shall be considered to creep if on voltage alone the meter disc makes one full revolution within 10 minutes.

3.2 Accuracy Tests

3.2.1 Test Loads

Each meter nominated for full tests shall be subjected to two accuracy tests at the loads specified on the current Test Table No. 1, Appendix I. These tests are: High Load, Unity Power Factor, (HL); and Low Load, Unity Power Factor, (LL). The HL test is to be carried out first.

3.2.2 Cyclometer Registers

Particular attention must be paid in making tests on meters fitted with drum-type or cyclometer registers to ensure that no period of accuracy test embraces the time during which its most rapidly moving drum is actuating any of the slower drums.

3.2.3 Meter Pre-Conditioning

The voltage coil of each meter to be tested shall be energized for at least one hour before testing.

4. CALCULATIONS

4.1 Error of Meter

In this section the error x of a meter shall be defined as:

$$x = \frac{\text{LL Error} + \text{HL Error}}{2}$$

In all cases, the error shall be expressed algebraically. Since the error is normally calculated on the basis of the so-called "Field Note Error", meters which register zero at either HL or LL shall be recorded as having $-\infty$ error or marked "Stopped".

4.2 The Sample Mean

The sample mean, $\bar{X}$, shall be calculated from

$$\bar{X} = \frac{\Sigma x}{n_s}$$

where n_s = the number of meters in the selection that contributes to the final calculation

4.3 The Sample Standard Deviation

The sample standard deviation, s, shall be calculated from

$$s = \sqrt{\frac{n_s \Sigma x^2 - (\Sigma x)^2}{n_s (n_s - 1)}}$$

4.4 Outliers

The final calculation for $\bar{X}$ and s shall exclude sample meters which are outliers. An outlier shall be a meter for which the error is both:

(i) above +3% or below -3% i.e. $|x| > 3.0\%$ and

(ii) more than three standard deviations from the sample mean, $\bar{X}$, at the particular test load, i.e. $|(x-\bar{X})| > 3s$.

In some cases when judging whether a particular meter is an outlier or not, it is necessary to calculate $\bar{X}$ and s with the error of the particular meter excluded. If the meter then conforms to the above criteria, it is an outlier.

Meters with the largest errors shall be judged and excluded, if necessary, before meters with smaller errors.

5. CRITERIA FOR ACCEPTANCE OR REJECTION

5.1 Sample Acceptability

The number of meters, n', selected for the sample - less the number of meters, b, in the selection found not belonging to the group - less the number of meters, n_s, in the selection that contributes to the final calculation of $\bar{X}$ and s, shall not exceed 15% of the nominal sample size, n. That is:

where $n' - b - n_s \leq 0.15n$

$n_s \geq 0.95\,n$

5.2 Accuracy Acceptability

Appendix IX shows the acceptance regions for various sample sizes. If the point obtained, using the values of $\overline{X}$ and s calculated from the sample for $\frac{\text{LL Error + HL Error}}{2}$, falls within the inner triangle, the group is deemed to conform fully to the accuracy requirement of these rules. If the point falls between the two triangles, the group shall be considered conditionally acceptable. If the point falls outside the outer triangle the group shall be rejected.

The final calculations for $\overline{X}$ and s shall exclude sample meters which are outliers. The use of the form shown in Appendix XI will facilitate making the calculations.

Data for derivation of the acceptance triangles is given in Appendix XIX.

5.3 Outlier Acceptability

(i) The following criteria shall govern the maximum, allowable number in group samples:

Fast Outliers - not more than 1.4% of the nominal sample size (to the nearest higher whole number if the result contains a fraction) except that for a sample size of 25 no outliers are permitted.

Slow Outliers - not more than 2% of the nominal sample size (to the nearest higher whole number if the result contains a fraction).

Where it can be clearly established that the performance of an outlier is due to an accident (e.g. accidentally dropped), or to tampering, such outlier will not be counted under this section. They shall however, be separately reported and the reason for exclusion given.

(ii) If the number of outliers exceeds the allowable number by two then the group shall be rejected outright.

(iii) If the number of outliers exceed the maximum allowable number by, at most, one in either of the preceding categories for percent error, a second sample of meters (of the same nominal size as the first sample) may be taken if the utility so desires and it shall be subjected to all the provisions of these rules except that for the second sample, if the number of outliers for either category of percent error exceeds the allowable number in the schedule, the group shall be rejected, with no provision for the drawing of an additional sample.

(iv) Standards reserves the right to reject a group where there are definite indications that the sample is not representative of the group or where some significant defect in the type has been uncovered so that it would be undesirable for meters of that type to remain in service beyond their regular seal period.

6. PROCEDURE FOLLOWING ACCEPTANCE OF A GROUP

6.1 Full Acceptability

If a sample meets the requirements of Sections 5.1 and 5.3 and is fully acceptable under Section 5.2, the group from which it was taken shall be permitted to remain in service for a further four or six years.*

6.2 Conditional Acceptability

If a sample meets the requirements of Sections 5.1 and 5.3 but is only conditionally acceptable under Section 5.2, the group from which it was taken shall be permitted to remain in service for a further two years.

6.3 Re-Sampling of Acceptance Groups

Any group accepted under Section 6.1 or 6.2 may be re-sampled towards the end of its new authorized period and, if again found satisfactory, its period further extended in accordance with Sections 6.1 and 6.2. The procedures for re-sampling, the criteria for acceptance or rejection, and the action to be taken following acceptance or rejection, shall be as outlined in Sections 2.4, 5, 6 and 7.

* Meters with magnetic suspension 6 years
Others 4 years

Group acceptance thus means that the seal validity date for any meter in the group has been moved ahead by the approved number of years from December 31 of the year previously assigned to it. See Section 5.1, Part IIB.

7. PROCEDURE FOLLOWING REJECTION OF A GROUP

Failure to conform to any of the requirements of Sections 5.1, 5.2 and 5.3 shall cause rejection of the group. However, a group composed of more than 9500 meters with two seal years may be re-analyzed on the basis of each sub-group, i.e. of each seal date, and if it is found either sub-group meets the requirements then such sub-group shall be permitted to remain in service for the term which the analysis permits.

All the meters of a rejected group shall be returned to the meter shop to have their seals broken before expiration of their authorized seal period.

8. TREATMENT OF SAMPLES AND REJECTED METERS

8.1 Meters Which Fail Along the Way

Any meter of any group which for any reason requires to be re-serviced and re-calibrated shall, after calibration, be presented for re-inspection but it may not return to its original group.

8.2 Disposal of Sample Meters

A sample meter from an accepted group may be returned to service as a member of the group provided that:

(i) it has not had its seal broken;*

(ii) the errors at high load and low load, as determined by the sample tests, are within +2 and -2 percent;

(iii) there are no apparent reasons why the meter should be re-serviced and re-calibrated.

The remainder shall be re-serviced and re-calibrated and treated as meters under Section 8.1.

* NOTE: A meter with a broken seal which the inspector, as a result of examination and verification, is satisfied has not been tampered with may be re-sealed with the original seal date and returned to service as part of the group provided that the conditions under 8.2 (ii) and 8.2 (iii) have been met.

9. RECORDS AND REPORTS

9.1 District Office Procedure

(i) Upon receipt of group listing from utility, if everything is in order, sample meters shall be selected and the sample list prepared. Copies of the sample list shall be sent to the utility.

The following information shall also be supplied to Standards:

- the make and type of meters in the group;
- the seal date(s) of the meters;
- the number of meters currently in the group;
- the number of meters in the sample

(ii) When the sample meters have been brought in to the meter shop by the utility, tests shall be made on the meters in accordance with these "Rules" and the results recorded on test sheets, a sample of which is shown in Appendix XVI. The utility shall provide a detailed explanation for each sample meter not brought in for test (every effort shall be made to keep the number of such missing meters as near as possible to zero).

(iii) The results of tests shall be analyzed statistically and the acceptance criteria applied. Appendix XI shows the form which shall be used for the statistical analysis; Appendix IX portrays the acceptance regions for the $\bar{X}$ and s plot; and Appendix XIX gives an explanation of the derivation of the acceptance regions as well as further details regarding the boundaries.

(iv) Field Notes shall also be written to cover groups sampled for seal extension. The make, type, seal year and number of meters in the group shall be recorded as well as the statistical results of sampling. Details of only those meters actually tested, together with their individual errors, shall be recorded. See Appendix XX for a typical completed Field Note. If the required information is recorded in some other acceptable forms the Field Note will not be required.

(v) After a sample from a group has been tested, the District Office shall report its findings to Standards and offer its recommendations regarding acceptance or rejection of the group for seal extension. The report shall include:

- copies of histograms (this is not mandatory but particularly desirable if the results are unusual) (Appendix XIII);
- a summary showing full details pertaining to the lot and sample (Appendix XIV):

(vi) If the group passes as a result of the sampling, the District Office shall check the group listing against its own records to ensure that the listing is essentially correct.

9.2 Procedure to be Followed by Standards

(i) Standards shall acknowledge receipt of data from District Office when group is first formed or when it is about to be re-sampled. See Section 9.1 (i).

(ii) Upon the receipt of a report from a District Office concerning the sampling of a group for seal extension (see Section 9.1 (v)), Standards shall advise if it accepts the recommendation or wishes to discuss the matter further. The eventual decision and the consequent action necessary will be passed to the utility by the District Office.

(iii) Standards shall maintain a cumulative summary of the results of sampling of each type of meter and shall report the latest statistics to the manufacturer concerned and to the District Offices at least once a year.

(iv) Statistics shall be charted and analyzed to provide useful and necessary information for continuous monitoring of the inspection program.

RULES PERTAINING TO SINGLE PHASE WATTHOUR METERS REMAINING ON FIXED SEAL PERIOD

1. SCOPE

1.1 Authorization

Where for any reason a meter or meters cannot be covered by the rules in the preceding portions of Part II then the rules in Part IID shall apply. Principally, this means meters owned by small utilities which have been re-serviced by the utility or its agent.

2. INSPECTION METHODS

The verification of new single-phase watthour meters is completely covered in Part IIA. Where the rules under Part IIB cannot be applied to a utility's re-serviced meters, verification shall be by 100% inspection, following the utility calibration.

3. VERIFICATION TESTS

3.1 Dial Test and Mechanical Inspection

All meters shall be subjected to a dial test by an inspector. The meters shall be run on dial test for sufficient time to produce at least one complete revolution of the test dial or lowest reading dial of the register. Wherever feasible longer dial test runs should be made. If the dial test is made in advance of the load tests, sufficient time must elapse between dial tests and load tests to ensure that meters have returned to ambient temperature.

At the time of making the dial test, all meters should be examined to ensure that there are no obvious defects, that the meters are clean and without enclosed loose screws, etc. and that all conform to the approval requirements.

3.2 Creep Test

All meters shall be subjected to a creep test. For definition of creep see Part XI.

3.3 Accuracy Tests

3.3.1 Test Loads

Each meter shall be subjected to three accuracy tests at the loads specified in the current Test Table I of Appendix I except as noted below. These are: Light Load, Unity Power Factor (LL); High Load, Unity Power Factor (HL); and High Load, 50% Power Factor (PF). However, the 50% power factor test need not be made on single-phase meters having magnetic bearings

which are presented for re-verification.

3.3.2 Tests on 3-Wire Meters

Tests on 3-wire meters may be made with current coils in series or with each coil separately. When testing on each coil separately, the average of the errors on each coil at the particular load shall be taken as the error for that load.

3.3.3 Meter Registers

Care should be taken with meters fitted with drum-type or cyclometer registers to ensure that tests are made with only the lowest reading drum or dial turning.

3.3.4 Test Facilities

While it is recognized that a small utility may not be able to furnish the kind and sophistication of test equipment which it would be reasonable for the larger utility to provide, nevertheless the facilities of the former must be such that accurate inspections can be made. The inspector must ensure by tests and checks of the equipment that errors which can be attributed to the test equipment are either negligible or can be accurately ascertained and allowed for.

4. CRITERIA FOR ACCEPTANCE OR REJECTION

Any meter shall be rejected if:

(i) it fails on dial test;

(ii) it has obvious defects such as dirt or, loose screws within the case;

(iii) it creeps;

(iv) the errors on the stipulated load tests fall outside the following tolerances

±.75% on High Load, Unity P.F.
±1.1% on Low Load, Unity P.F.
±2.0% on High Load, 50% P.F.

5. SEAL PERIOD

Basic seal periods are as given in Section 5.1 of Part IIB.

6. RECORDS AND REPORTS

6.1 Field Notes

Field Notes shall be written to cover every meter inspected and this record shall contain the basic details of the meters (i.e. make, type, capacity, inspection number, serial number, etc.) and the errors found on test.

TEST TABLE No. 1. - Watthour Meters

Meter Type	Required Tests	Type of Meter Rating					
		Range Rated			All Others		
		High Load	50% PF	Low Load	High Load	50% PF	Low Load
		Test Amps % of Maximum			Test Amps % of Nominal		
1-phase, 2-wire		25	25	2.5	100	100	10
1-phase, 3-wire	Single Coil	50	50	5	200	200	20
	Current Coils in Series	25	25	2.5	100	100	10
Polyphase 2 & 3 Element	Each Current Coil	25	25		100	100	
	Series	25		2.5	100		10
Polyphase 2½-Element Y	Each Single Current Coil	50	50		200	200	
	Split Coil (New meters only)	50			200		
	Series	25		2.5	100		10
Polyphase 2½-Element Delta	2-Wire Element Alone	25	25	2.5	100	100	10
	3-Wire Element (Coils in series)	25	25	2.5	100	100	10
	All Current Coils in Series	25			100		
HORIZONTAL METERS							
2 Element	Each Current Coil	25	25	2.5	100	100	10
2½-Element Y	Each Single Coil	50	50	5	200	200	20
	Split Coil (New meters only)	50			200		
2½-Element Delta	2-Wire Element Alone	25	25	2.5	100	100	10
	3-Wire Element (series)	25	25	2.5	100	100	10

APPENDIX II PART II

MECHANICAL CHECK INSPECTION REPORT

CATEGORY OF METER[1]: _____ DISTRICT: _____

TYPE OF METER: _____ DATE: _____

TOTAL NO. OF METERS ACTUALLY INSPECTED: _____ TOTAL NO. PASSED[2]: _____

DEFECTS		
I	WRONG REGISTERS: FAST : SLOW	
II	REGISTER MESHING:	
III	FOREIGN MATTER IN METER:	
IV	OTHER FAULTS (STIPULATE) _____ _____ _____ _____	
		TOTAL: _____ % DEFECTS: _____

COMMENTS OR RECOMMENDATIONS: _____

1. NEW SINGLE PHASE
   OLD SINGLE PHASE
   NEW NETWORK
   ETC.
2. APPLICABLE TO SINGLE PHASE METERS ONLY

_____
DISTRICT INSPECTOR

SEP - 1975

PART I

Supplement to Appendix II

MECHANICAL-CHECK REPORT

Meter Type _____ Month _____ 19___

		Total No.	100% Insp.	Sampling	Nil	Effect on Registration: Fast	Slow	Stopped	Errati
I	WRONG REGISTERS								
	(a) Wrong no. of teeth in gears								
	(b) Wrong no. of teeth in worm								
	(c) Wrong multiplier marked on register								
	(d) Wrong Rr on register								
	(e) Teeth missing on gear								
	Totals	____	____	_____	___	____	____	_____	_____
II	REGISTER MESHING								
	(a) Meshing too deep in take off								
	(b) Meshing too light in take off								
	(c) Meshing too deep in gears								
	(d) Meshing too light in gears								
	Totals	____	____	_____	___	____	____	_____	_____
III	FOREIGN MATTER IN METER								
	(a) Dirt or steel on disc								
	(b) Dirt or steel on magnet								
	(c) Chips of glass (tight covers)								
	(d) Loose parts of solder on disc and magnets								
	(e) Loose screws securing parts								
	(1) name plate								
	(2) shunt coils								
	(3) grid								
	(4) pot lead clips								
	(5) register								
	(f) Extra meter parts (screws, etc.)								
	Totals	____	____	_____	___	____	____	_____	_____

Note: The District Office may find these forms, devised by the Toronto Office, very useful in keeping track of the whole picture of mechanical defects.

SEP - 1975

Supplement to Appendix II — Part II

MECHANICAL-CHECK REPORT

Meter Type _____ Month _____ 19___

IV OTHER FAULTS	Total No.	100% Insp.	Sampling	Nil	Effect on Registration: Fast	Slow	Stopped	Errati
(a) shaft our of bearing								
(b) loose pot leads								
(c) pot leads touching disc								
(d) open coils in meter								
(e) cover jammed on register								
(f) bearings loose								
(g) guide pins bent								
(h) bent spindle								
(i) bent take off wheel								
(j) bent worm or gear register								
(k) disc not centred in air gap, hitting magnet								
(l) loose terminal screws								
(m) steel in disc								
(n) meter running backwards, pot leads reversed								
(o) pot leads on wrong terminals								
(p) noisy meter, loose laminations in coils								
(q) broken magnet								
(r) loose register screws								
(s) loose parts								
(t) pointers off zero								
(u) bent disc								
(v) shorted turns in current coil								
(w) leads not soldered								
(x) loose pot jumpers								
(y) bottom bearing too high or low								
(z) wrong number of turns on coil								
(aa) top pins, sleeves dirty, uncleaned parts mixed with clean parts								
(bb) overload bridge material faulty								
(cc) jewel missing in register								
(dd) meter creeps								
(ee) calibration error								
(ff) other faults (describe)								
(i) _____								
(ii) _____								
(iii) _____								
(iv) _____								
Totals	____	____	_____	___	____	____	_____	_____

Note: District Office may find these forms, devised the Toronto Office, very useful in keeping trac the whole picture of mechanical defects.

SEP - 1975

APPENDIX III

(Form letter to be sent each month to each meter manufacturer)

Your file Votre référence

Our file Notre référence

This is to advise that of your type single-phase meters were subjected to our Dial Test and Mechanical Inspection during the month of 197 and the following summarizes the results of this inspection:

	Number Defective
1. Wrong Registers	
2. Register Meshing	
3. Foreign Matter in Meter	
4. Other Faults	

Comments:

Further details regarding the faulty meters are available on request.

Chief, Electricity & Gas
Consumer Standards Directorate

SEP - 1975

STATISTICAL ANALYSIS OF ____ ELECTRIC METERS

UTILITY _____ LOT SIZE "N" _____

LOT No. SAMPLE SIZE "n" _____

METER MAKE and TYPE _____ TEST First ☐ Second ☐ H.L. ☐ L.L. ☐ P.F. ☐

Frequency of $X_i +$ f_i^+	Frequency of $X_i -$ f_i^-	Algebraic value of $(f_i^+ + f_i^-)$ or $f_i^+ + f_i^-$	Cells X_i	$f_i X_i$	Absolute value or $\lvert f_i^+ \rvert + \lvert f_i^- \rvert$	X_i^2	$f_i X_i^2$
			1.8			3.24	
			1.7			2.89	
			1.6			2.56	
			1.5			2.25	
			1.4			1.96	
			1.3			1.69	
			1.2			1.44	
			1.1			1.21	
			1.0			1.00	
			0.9			0.81	
			0.8			0.64	
			0.7			0.49	
			0.6			0.36	
			0.5			0.25	
			0.4			0.16	
			0.3			0.09	
			0.2			0.04	
			0.1			0.01	
			0			0	
$\sum f_i^+ =$	$\sum f_i^- =$		$\sum f_i X_i =$				$\sum f_i X_i^2 =$

$\sum f_i^+ + \sum f_i^- = \sum f_i = n =$ ☐

$n - 1 =$ $\bar{X} = \frac{\sum f_i X_i}{n} =$

$$s = \sqrt{\frac{\boxed{\sum f_i X_i^2} - \left(\boxed{\bar{X}} \times \boxed{\sum f_i X_i} \right)}{\boxed{n-1}}} = \sqrt{\frac{\boxed{\quad} - \left(\boxed{\quad} \times \boxed{\quad} \right)}{\boxed{\quad}}}$$

THIS TEST :

ACCEPTED ☐ REJECTED ☐ ACCORDING TO ACC. REG. FIG. ☐ DATE _____

FN No. _____ to _____ SIGNATURE : _____

ACCEPTANCE REGION

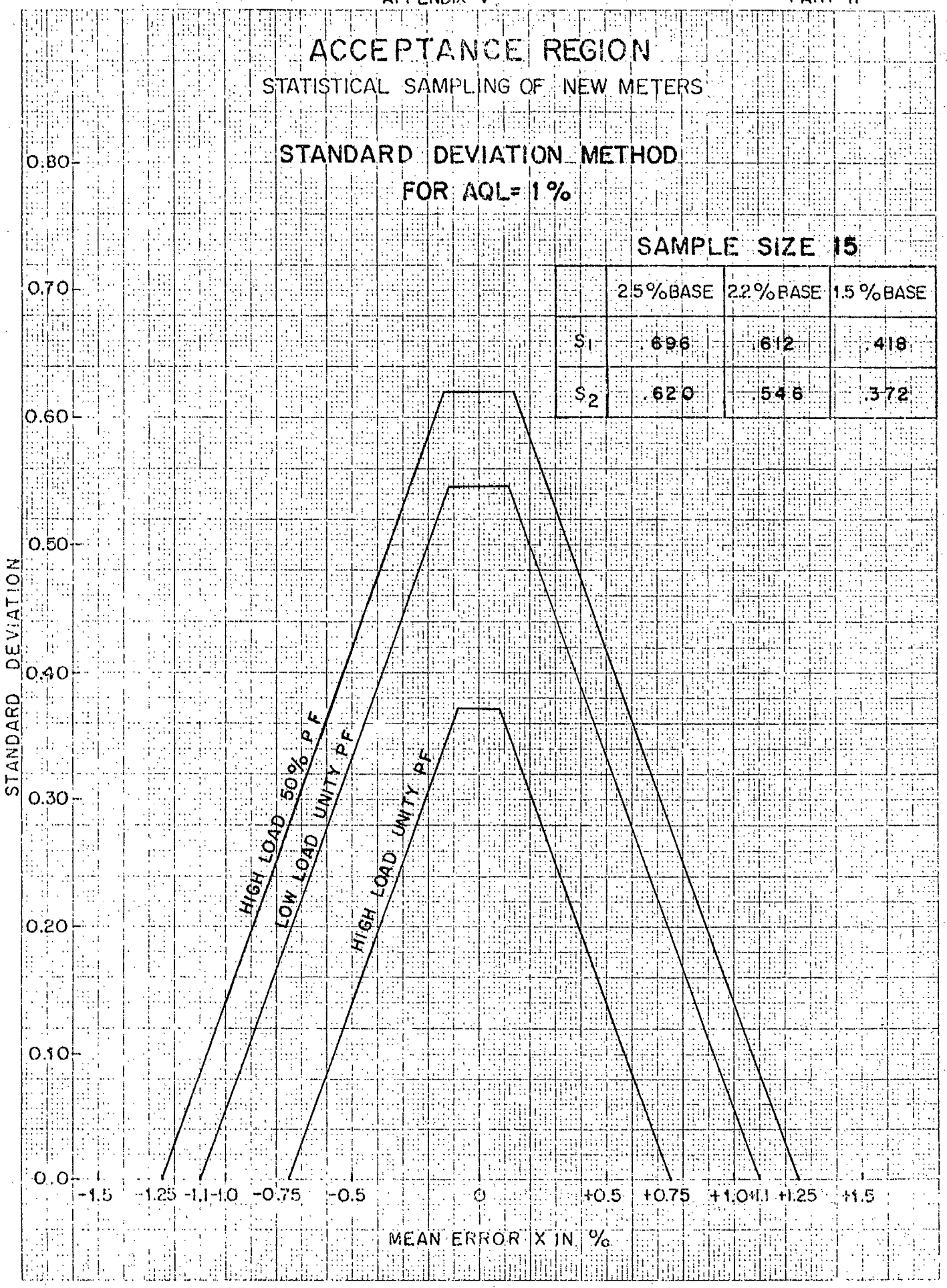
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL= 1 %

SAMPLE SIZE 15

	2.5 % BASE	2.2 % BASE	1.5 % BASE
S_1	.696	.612	.418
S_2	.620	.546	.372



ACCEPTANCE REGION

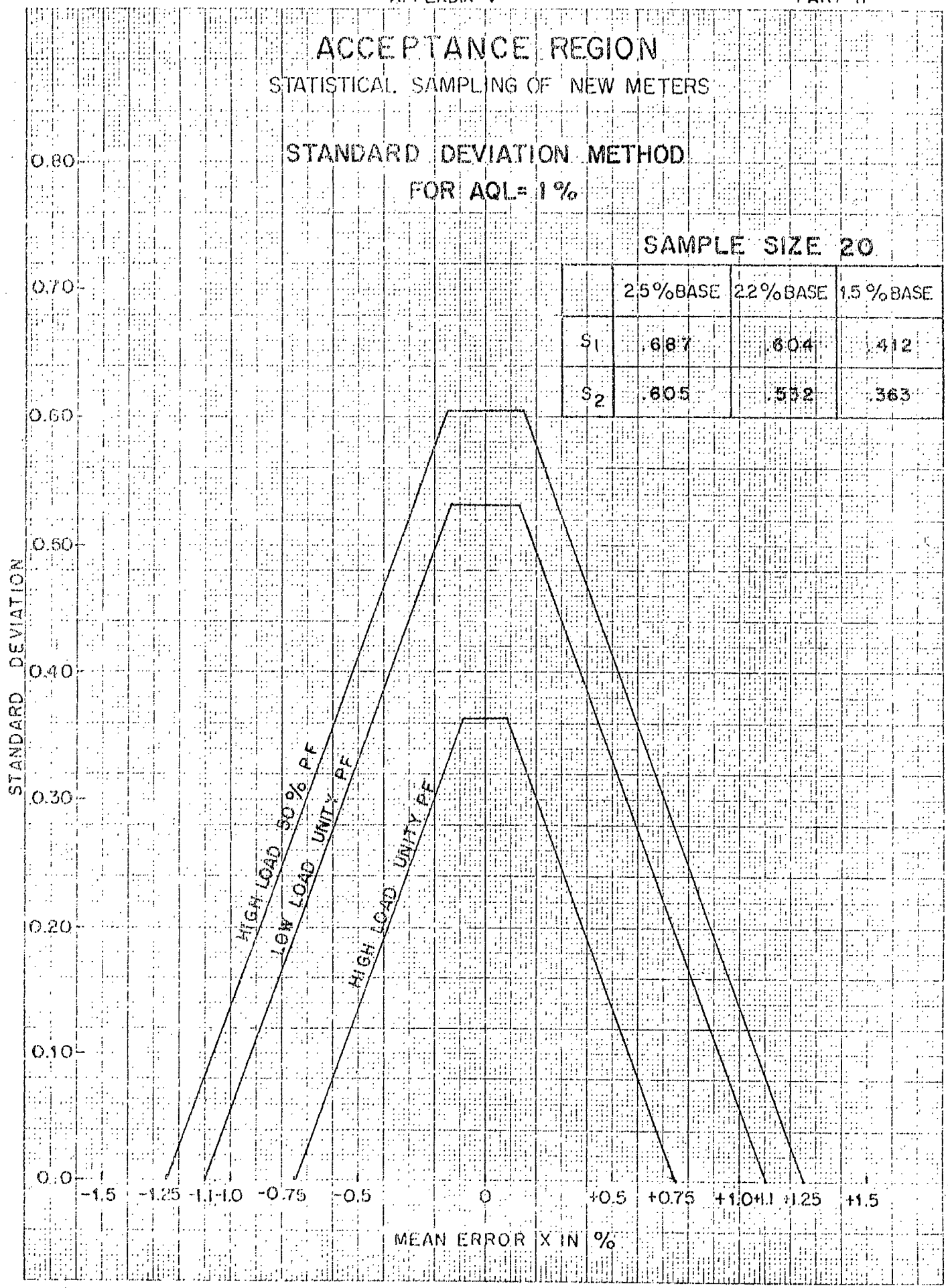
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL = 1%

SAMPLE SIZE 20

	2.5% BASE	2.2% BASE	1.5% BASE
S_1	.687	.604	.412
S_2	.605	.532	.363



ACCEPTANCE REGION

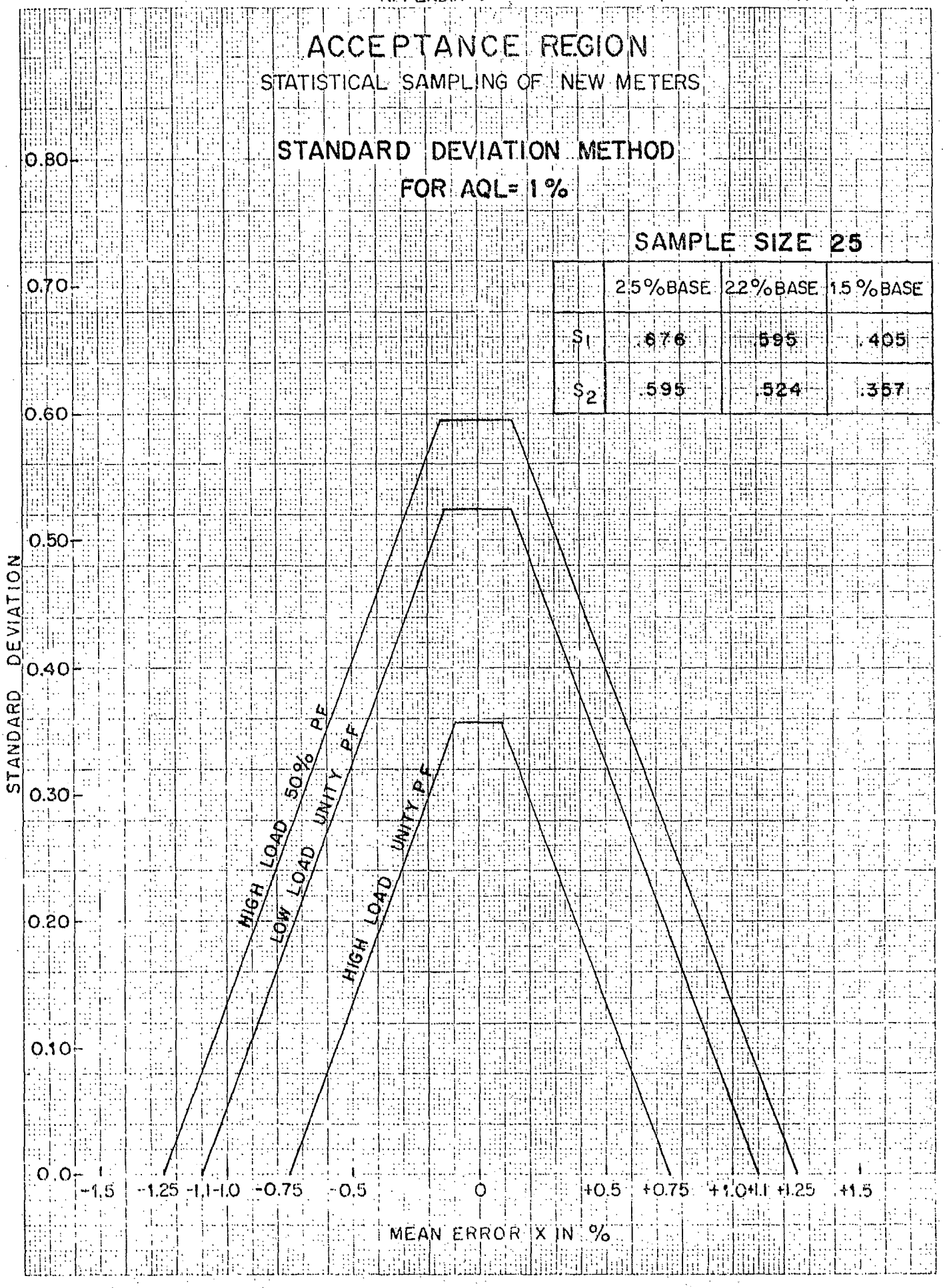
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL= 1%

SAMPLE SIZE 25

	2.5% BASE	2.2% BASE	1.5% BASE
S_1	.676	.595	.405
S_2	.595	.524	.357



SEP - 1975

ACCEPTANCE REGION

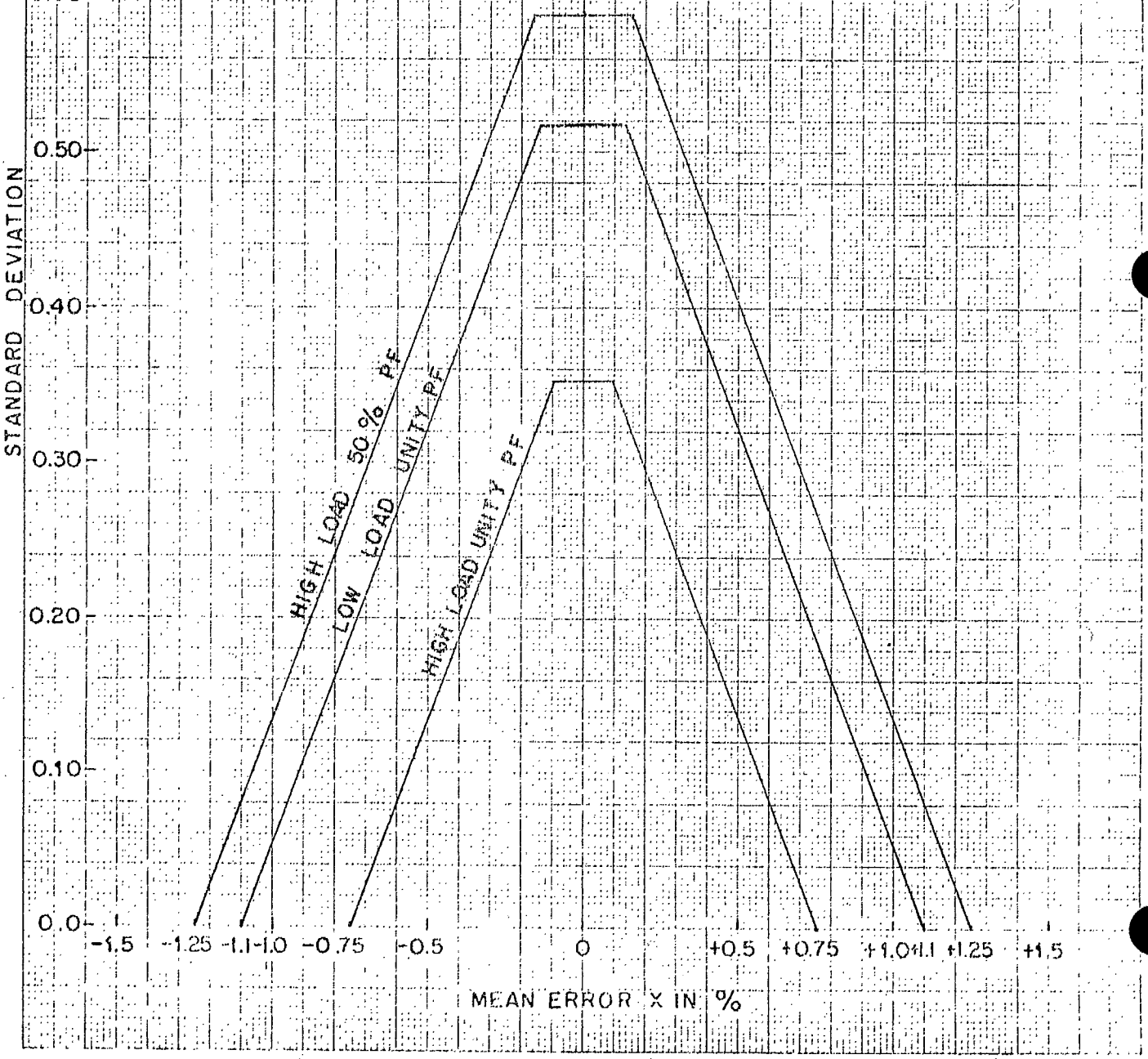
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL= 1 %

SAMPLE SIZE 30

	2.5 % BASE	2.2 % BASE	1.5 % BASE
S_1	.672	.591	.403
S_2	.588	.517	.353



46 1510

10 X 10 TO THE CENTIMETER 25 X 25 CM.
KEUFFEL & ESSER CO

ACCEPTANCE REGION

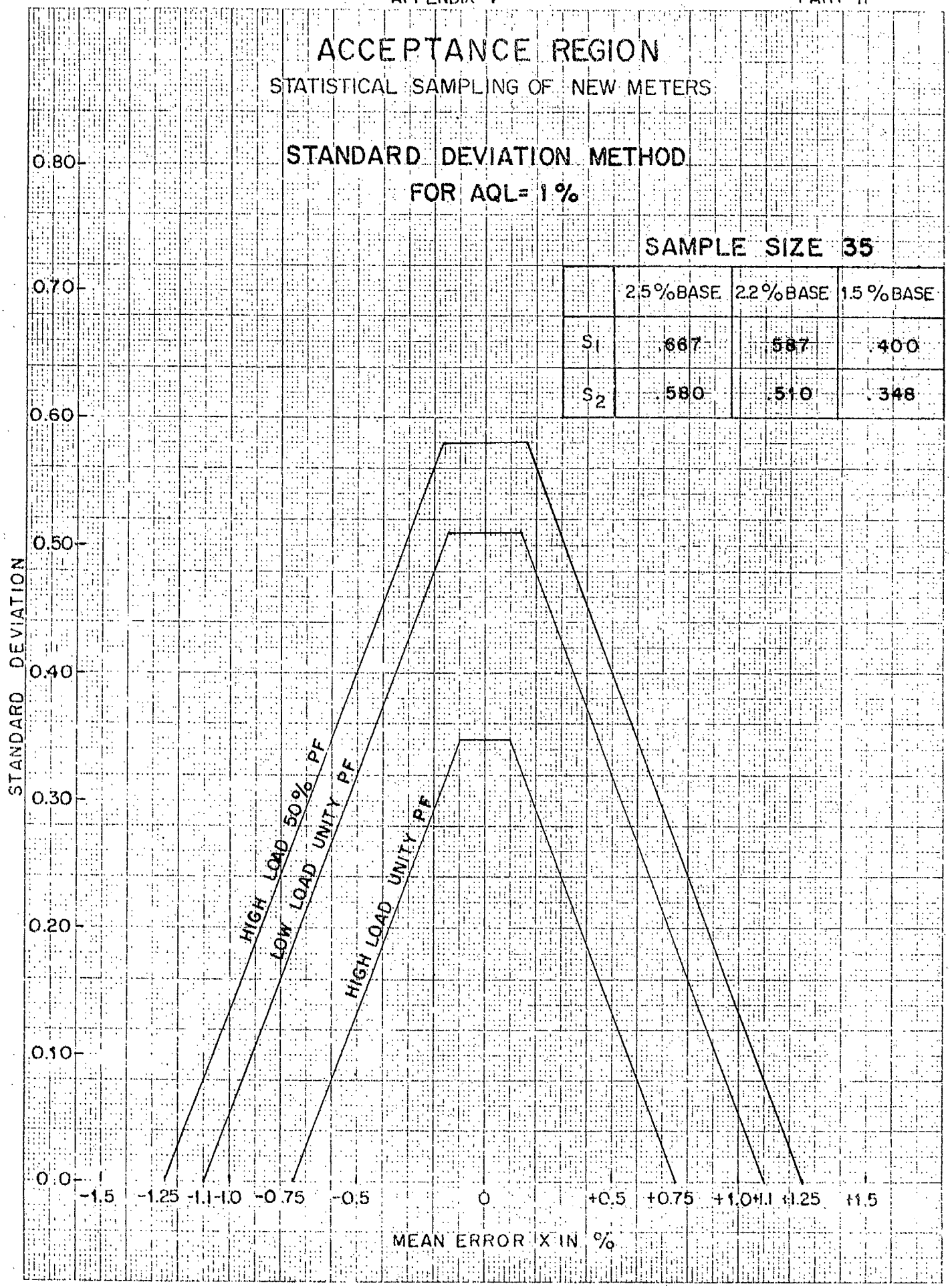
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL = 1 %

SAMPLE SIZE 35

	2.5 % BASE	2.2 % BASE	1.5 % BASE
S_1	.667	.587	.400
S_2	.580	.510	.348



46 1510

SEP - 1975

ACCEPTANCE REGION

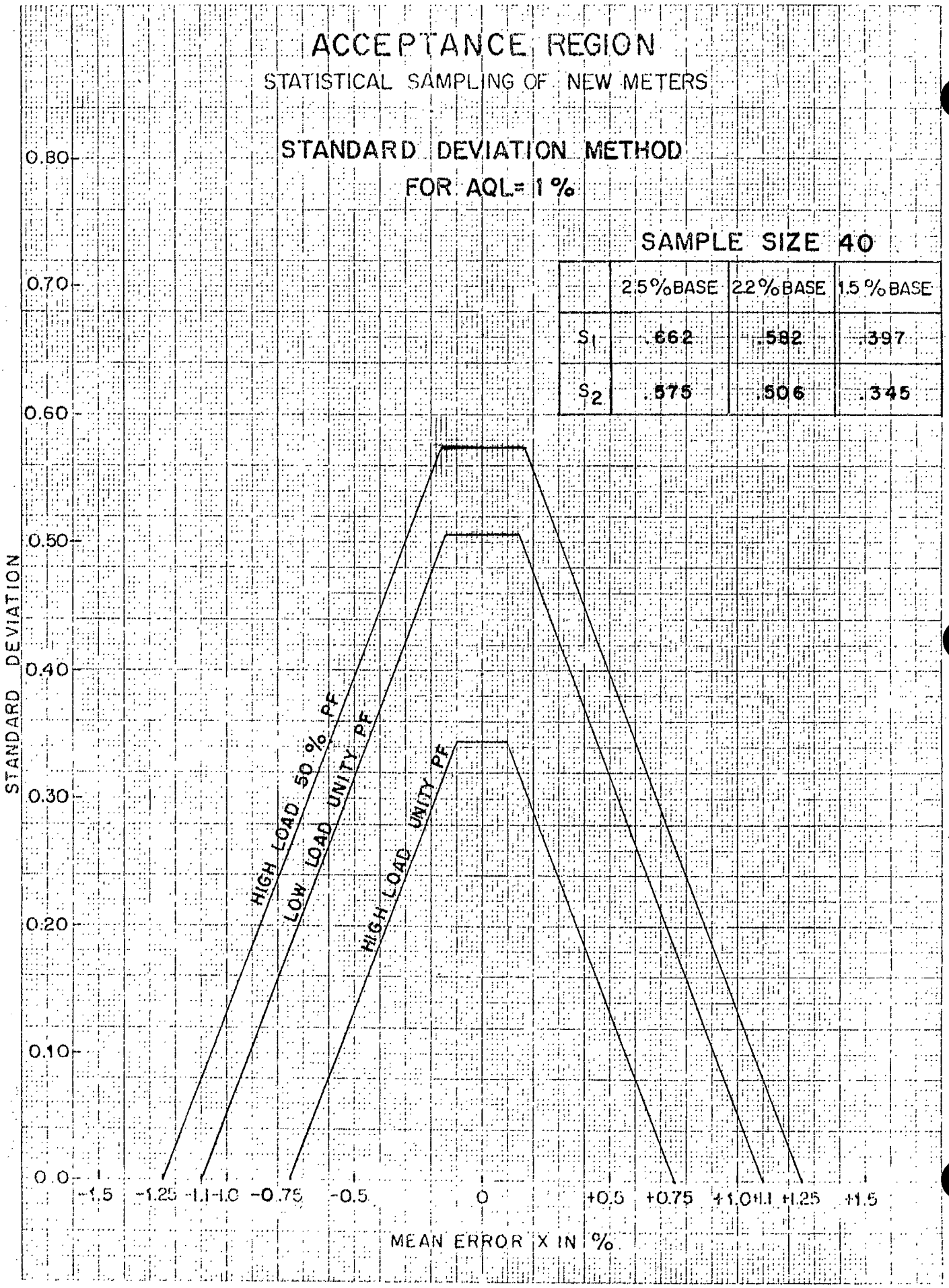
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL = 1 %

SAMPLE SIZE 40

	2.5 % BASE	2.2 % BASE	1.5 % BASE
S_1	.662	.582	.397
S_2	.575	.506	.345



ACCEPTANCE REGION

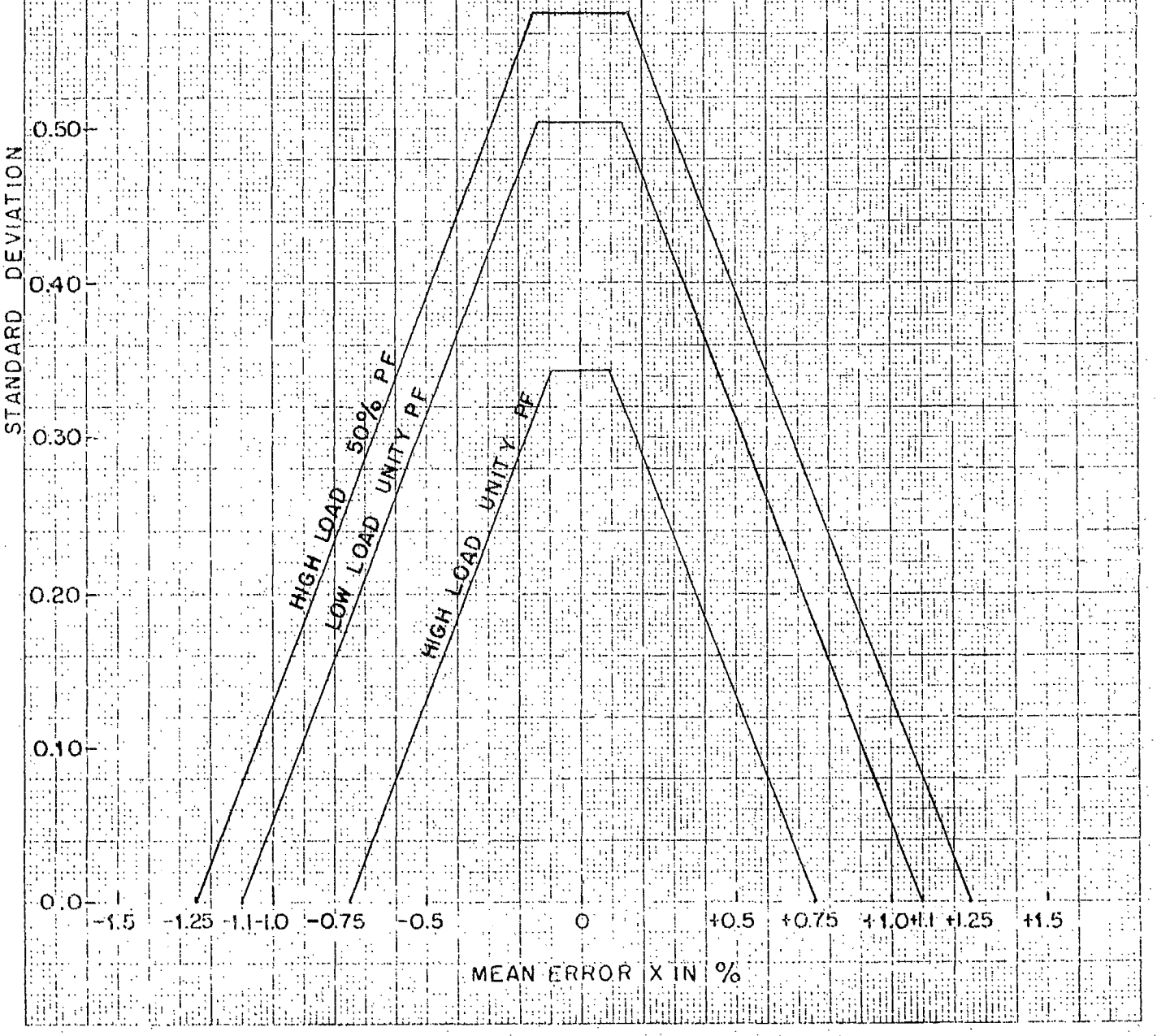
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL= 1%

SAMPLE SIZE 45

	2.5% BASE	2.2% BASE	1.5% BASE
S_1	.653	.574	.392
S_2	.573	.504	.344



SEP - 1975

ACCEPTANCE REGION

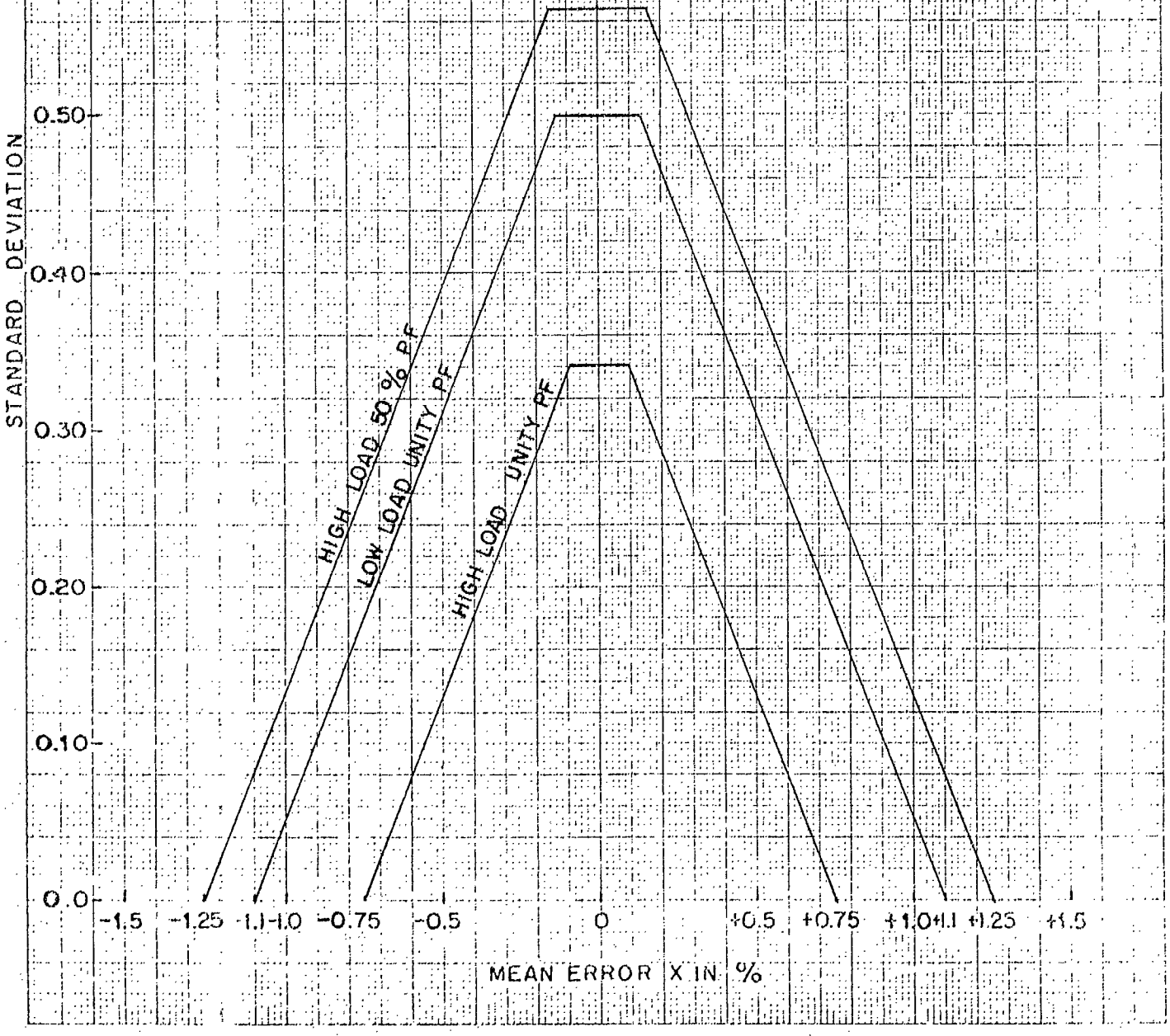
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL= 1 %

SAMPLE SIZE 50

	2.5 % BASE	2.2 % BASE	1.5 % BASE
s_1	.648	.570	.389
s_2	.568	.499	.341



SEP - 1975

ACCEPTANCE REGION

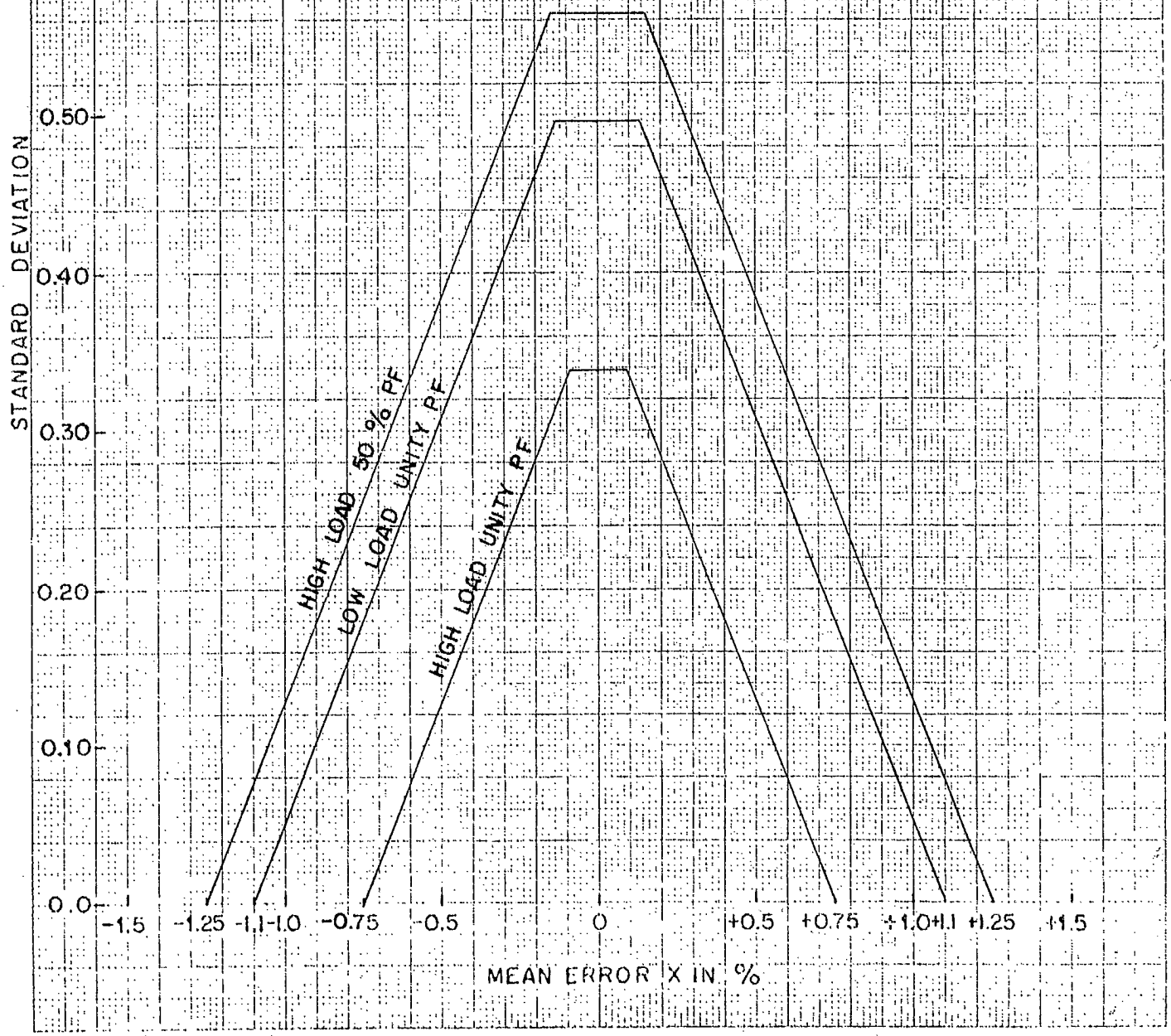
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL = 1 %

SAMPLE SIZE 60

	2.5 % BASE	2.2 % BASE	1.5 % BASE
S_1	.641	.564	.385
S_2	.564	.496	.338



46 1510

10 X 10 TO THE CENTIMETER 13 x 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

SEP - 1975

ACCEPTANCE REGION

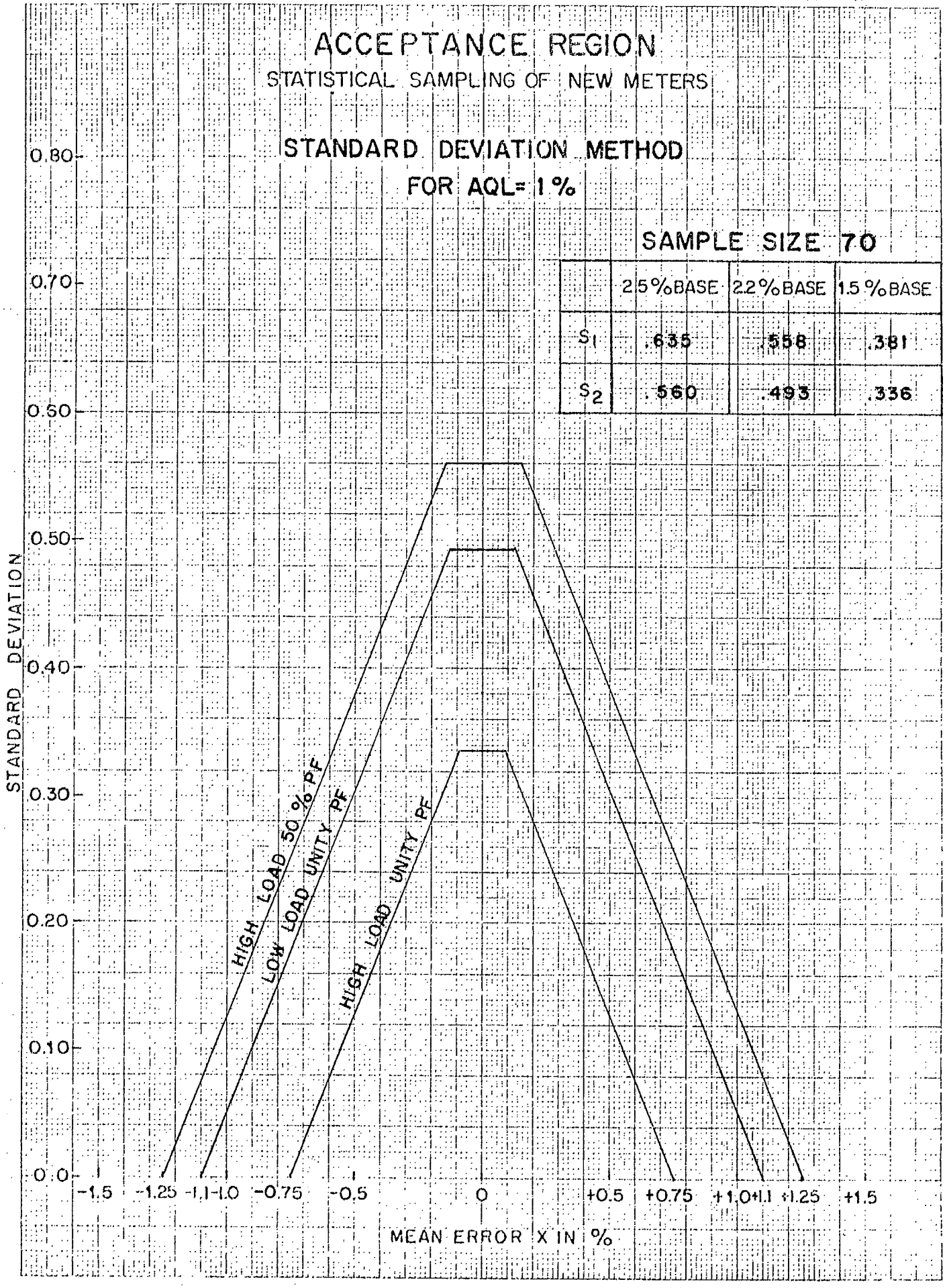
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL= 1%

SAMPLE SIZE 70

	2.5% BASE	2.2% BASE	1.5% BASE
S_1	.635	.558	.381
S_2	.560	.493	.336



46 1510

10 X 10 TO THE CENTIMETER
KEUFFEL & ESSER CO. MADE IN U.S.A.

SEP - 1975

ACCEPTANCE REGION

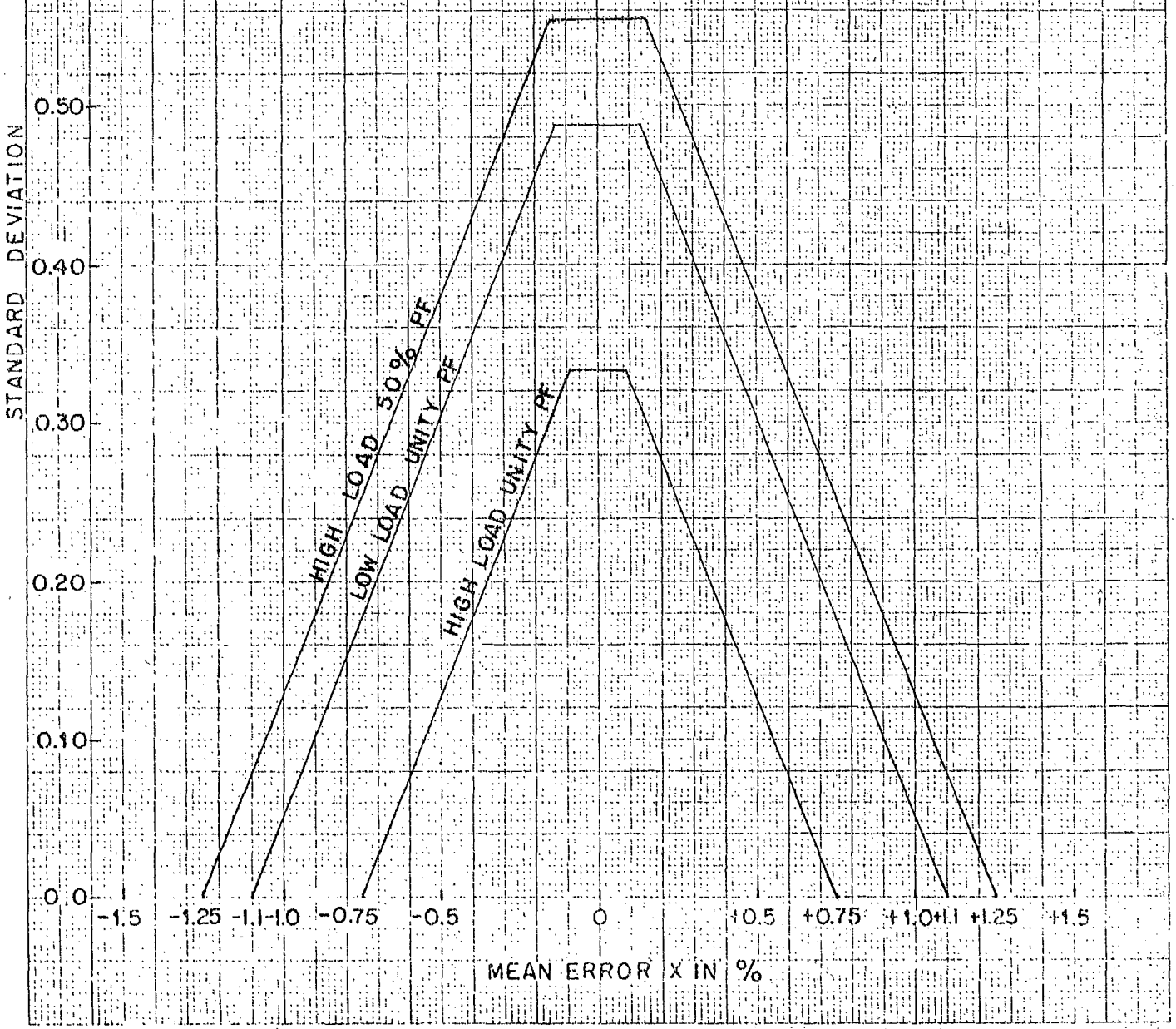
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL= 1%

SAMPLE SIZE 80

	2.5% BASE	2.2% BASE	1.5% BASE
S_1	.630	.554	.378
S_2	.555	.488	.333



ACCEPTANCE REGION

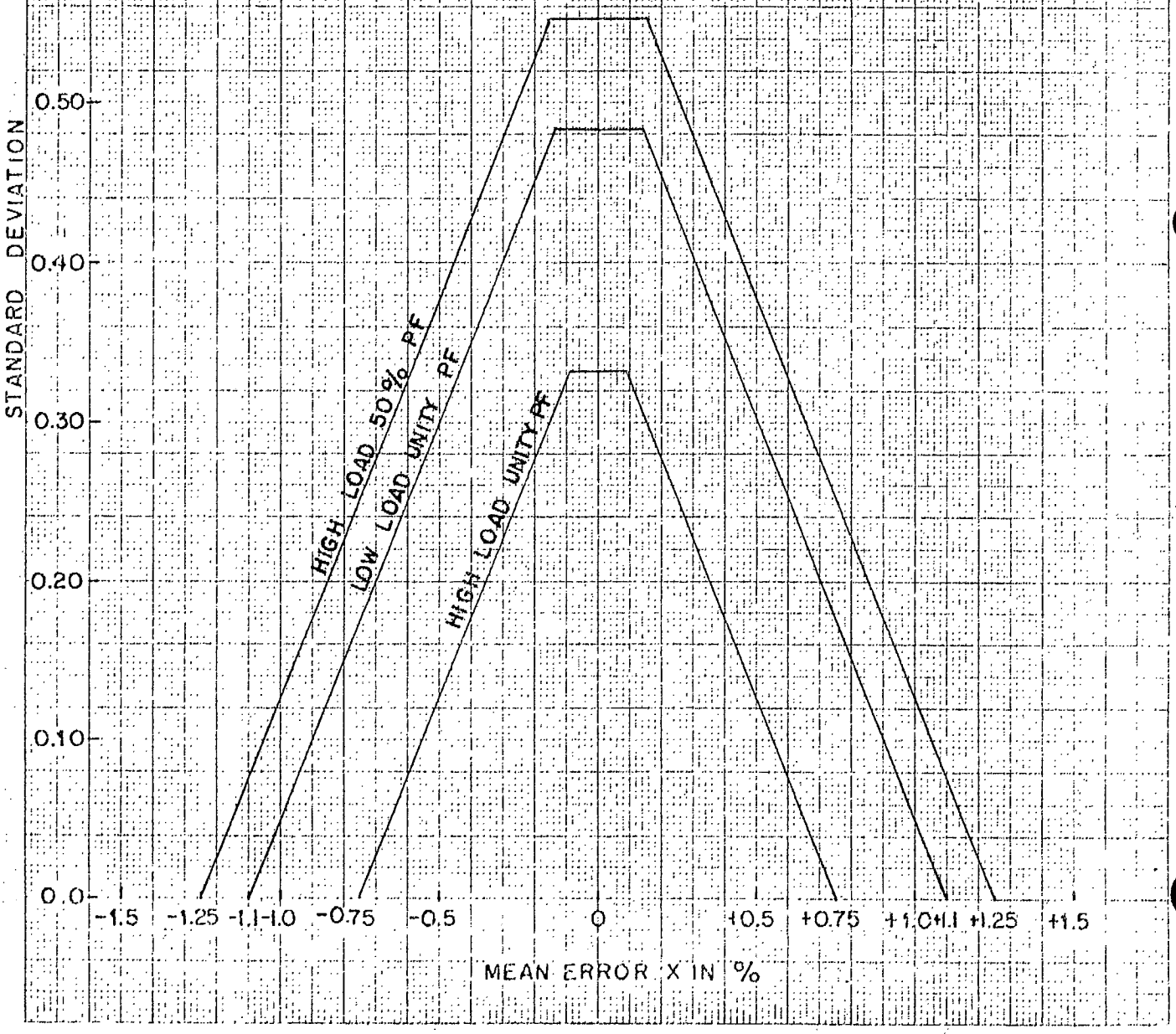
STATISTICAL SAMPLING OF NEW METERS

STANDARD DEVIATION METHOD

FOR AQL= 1%

SAMPLE SIZE 90

	2.5% BASE	2.2% BASE	1.5% BASE
S_1	.628	.553	.377
S_2	.553	.482	.332



SEP - 1975

ACCEPTANCE REGION

STATISTICAL SAMPLING OF NEW METERS

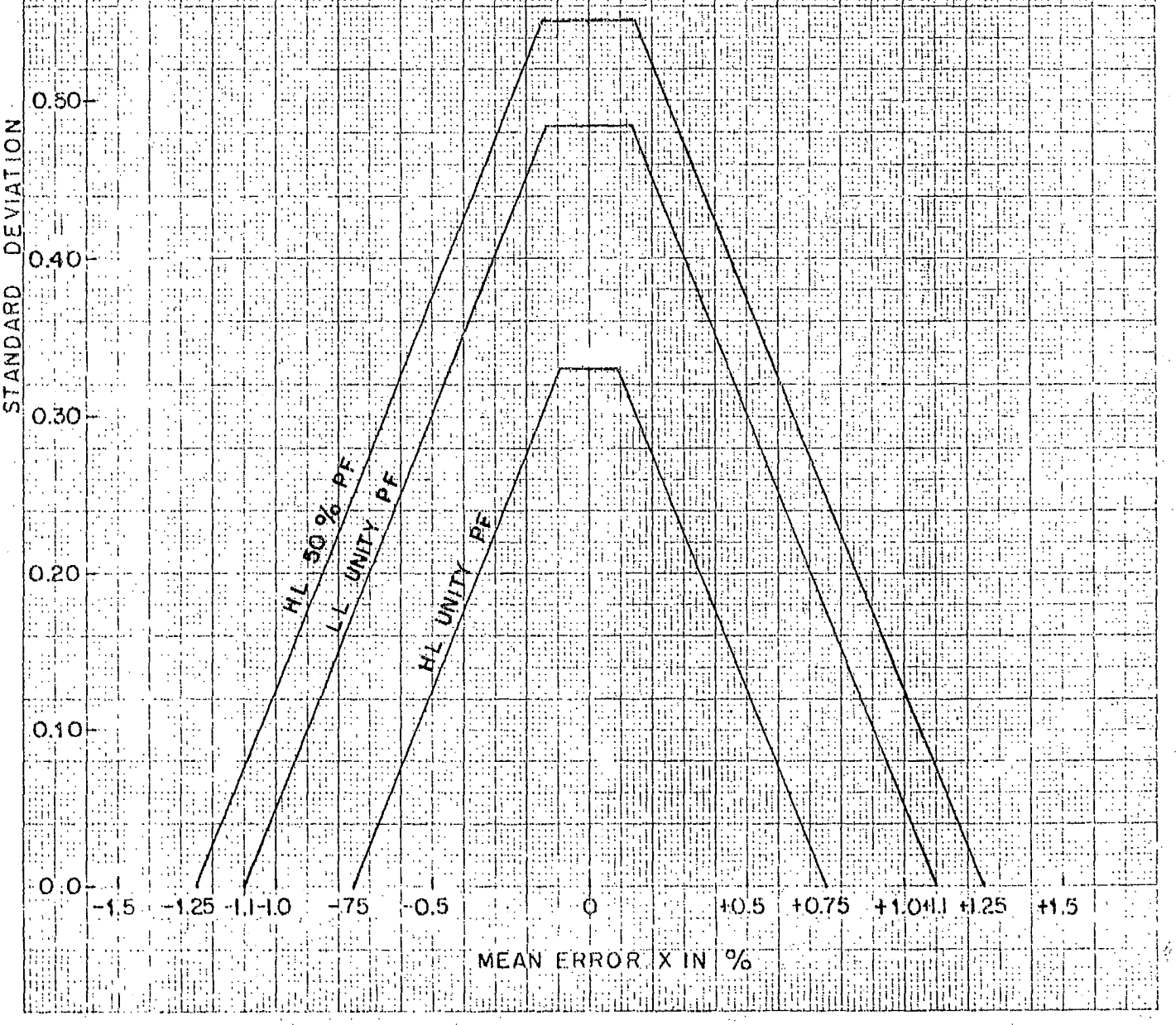
STANDARD DEVIATION METHOD

FOR AQL= 1%

SAMPLE SIZE 100

	2.5% BASE	2.2% BASE	1.5% BASE
S_1	.625	.550	.375
S_2	.550	.484	.330

FOR USE UNDER WITNESS TESTING



46 1510

10 X 10 TO THE CENTIMETER 13 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

SEP - 1975

ACCEPTANCE REGION

STATISTICAL SAMPLING OF NEW METERS

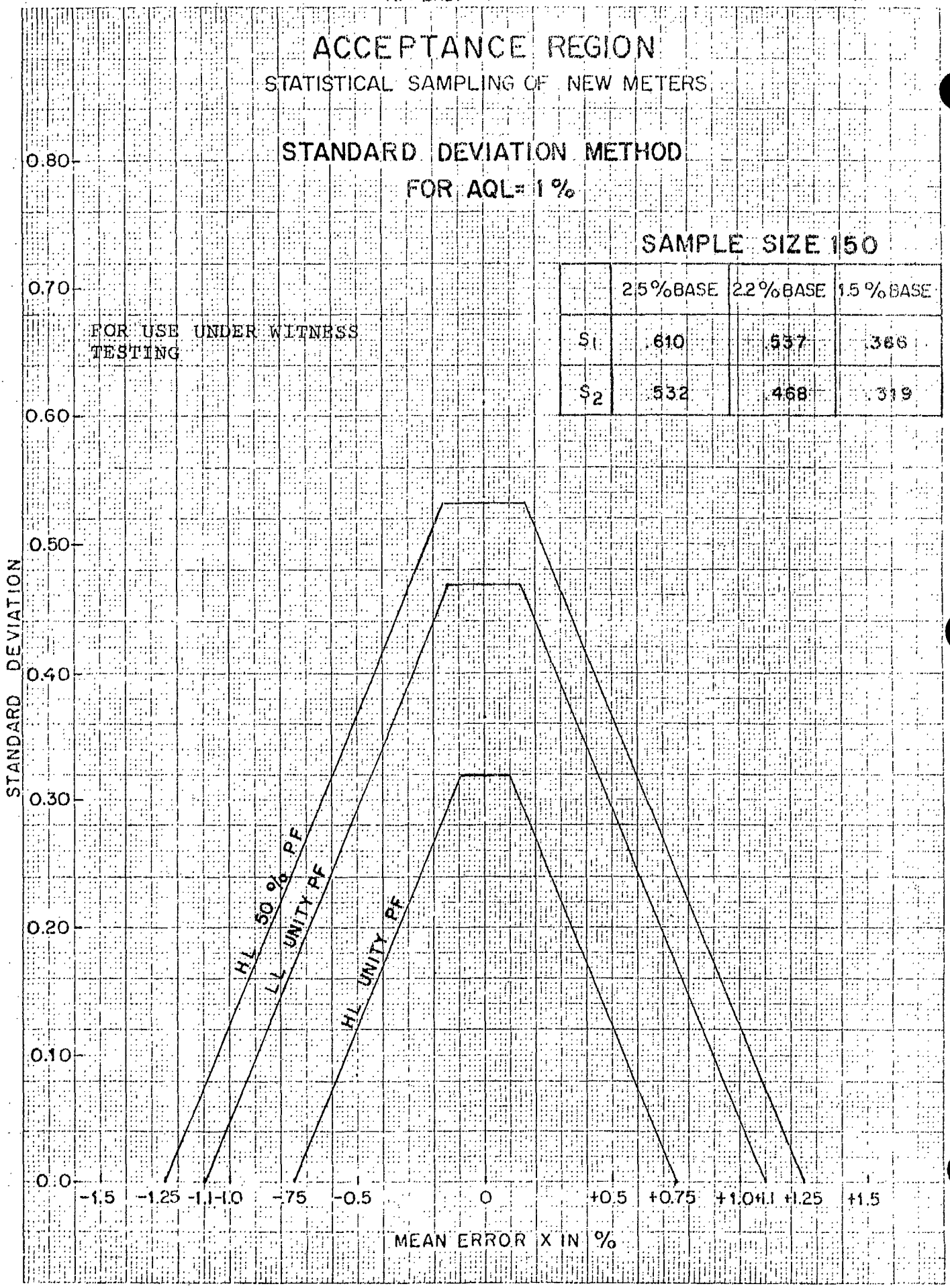
STANDARD DEVIATION METHOD

FOR AQL= 1 %

SAMPLE SIZE 150

	2.5 % BASE	2.2 % BASE	1.5 % BASE
S_1	.610	.537	.386
S_2	.532	.468	.319

FOR USE UNDER WITNESS TESTING



46 1510

10 X 10 TO THE CENTIMETER 18 X 25 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

ACCEPTANCE REGION

STATISTICAL SAMPLING OF NEW METERS

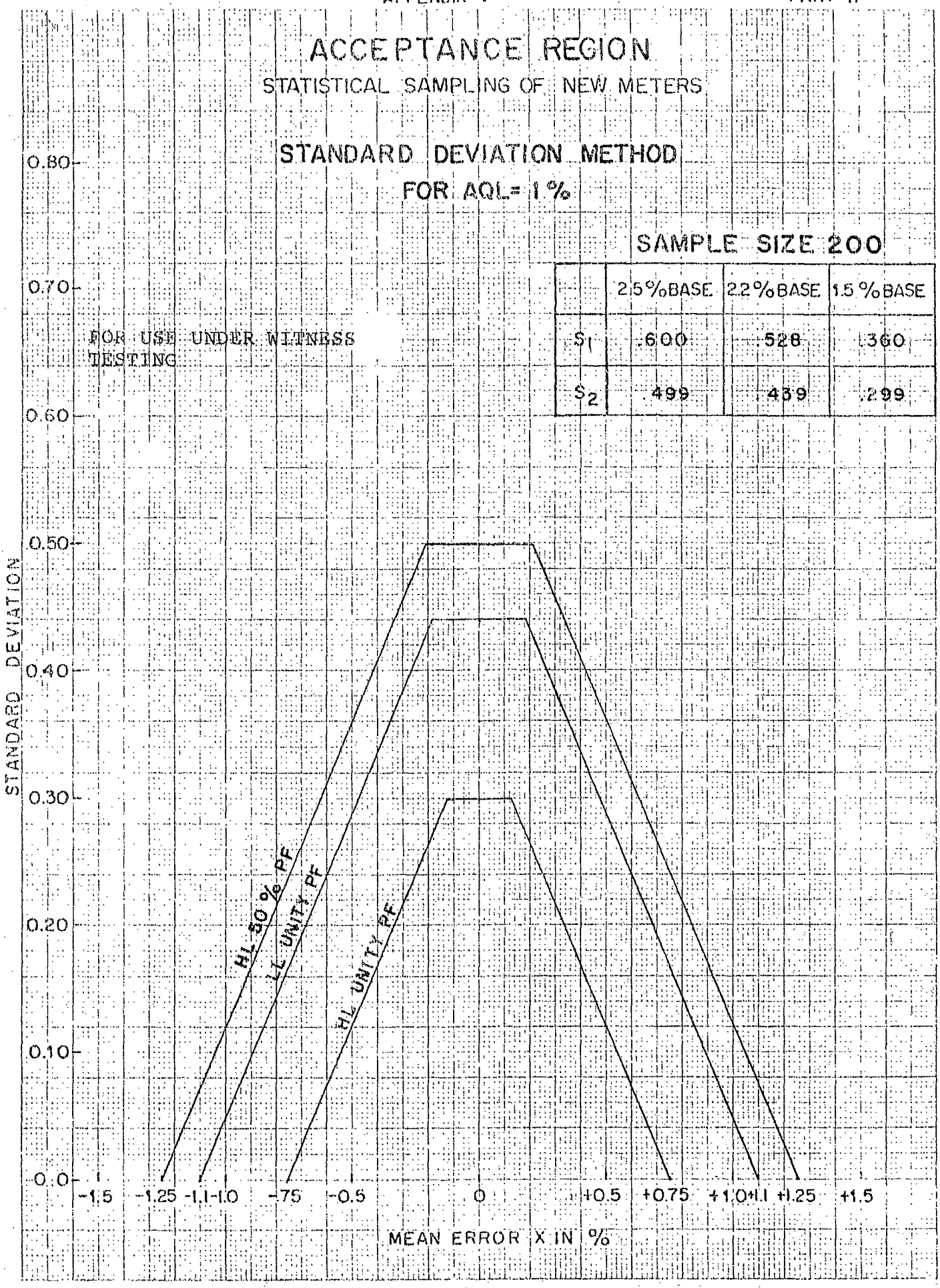
STANDARD DEVIATION METHOD

FOR AQL= 1%

SAMPLE SIZE 200

	2.5% BASE	2.2% BASE	1.5% BASE
S_1	.600	.528	.360
S_2	.499	.439	.299

FOR USE UNDER WITNESS TESTING



SEP - 1975

ACCEPTANCE REGION

STATISTICAL SAMPLING OF NEW METERS

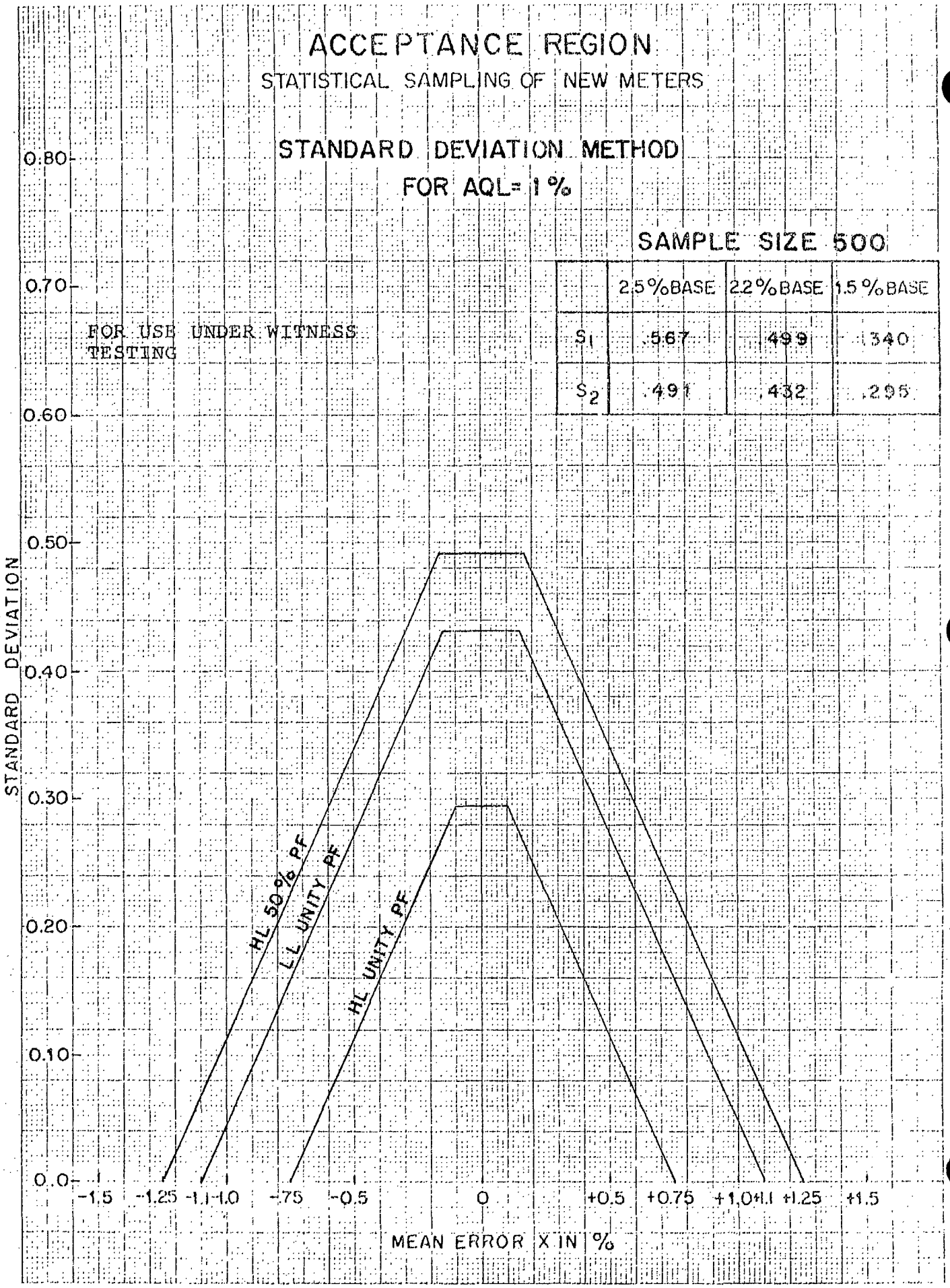
STANDARD DEVIATION METHOD

FOR AQL= 1%

SAMPLE SIZE 500

	2.5%BASE	2.2%BASE	1.5%BASE
S_1	.567	.499	.340
S_2	.491	.432	.295

FOR USE UNDER WITNESS TESTING



SEP - 1975

ACCEPTANCE REGION

STATISTICAL SAMPLING OF NEW METERS

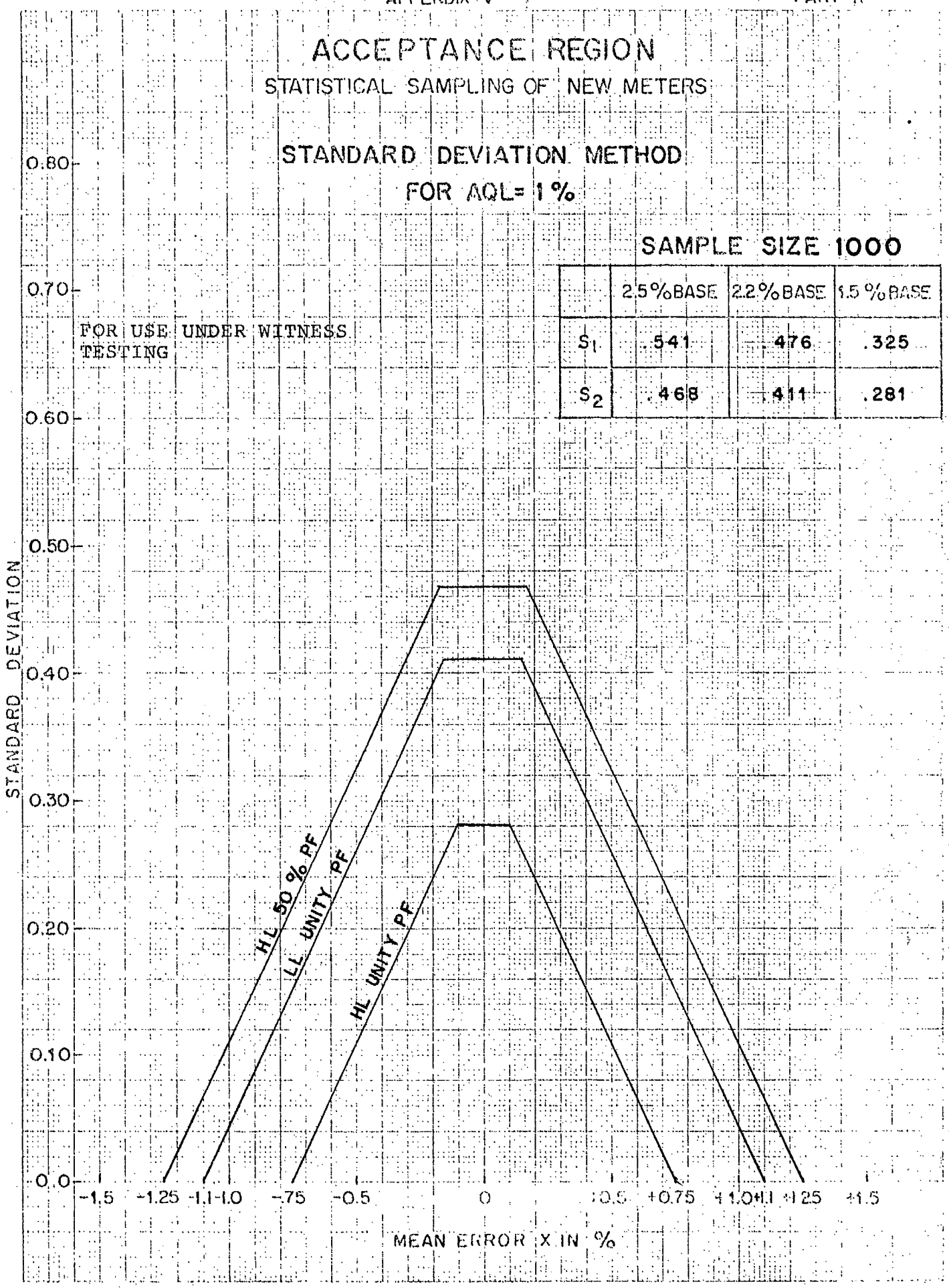
STANDARD DEVIATION METHOD

FOR AQL= 1 %

SAMPLE SIZE 1000

	2.5 % BASE	2.2 % BASE	1.5 % BASE
S_1	.541	.476	.325
S_2	.468	.411	.281

FOR USE UNDER WITNESS TESTING



461510

SEP - 1975

MONTH.....

BALANCE TESTS ON NEW SINGLE PHASE METERS

UTILITY	LOT NO.	METER TYPE	NO. IN SAMPLE	F.L.		L.L.		P.F.	
				O.C.	I.C.	O.C.	I.C.	O.C.	I.C.

DISTRICT.....

MONTH _____

BALANCE TESTS

NEW SINGLE PHASE METERS

___ " ___

Meter Type	No. of Samples	F. L.		L. L.		P. F.	
		Outside Limits	Inside Limits	Outside Limits	Inside Limits	Outside Limits	Inside Limits
XYZ *	10	1	9	1	9	0	10
PRS *	14	0	14	0	14	2	12

*Hypothetical examples

DISTRICT _____

CHECK SAMPLE REPORT

ELECTRIC METERS ☐ GAS METERS ☐

NEW ☐ RESERVICED ☐

METER TYPE _____ SEAL YEARS 19__ & 19__

UTILITY	SAMPLE SIZE	HIGH LOAD		LOW LOAD		POWER FACTOR	
		$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S

(Sgd.)

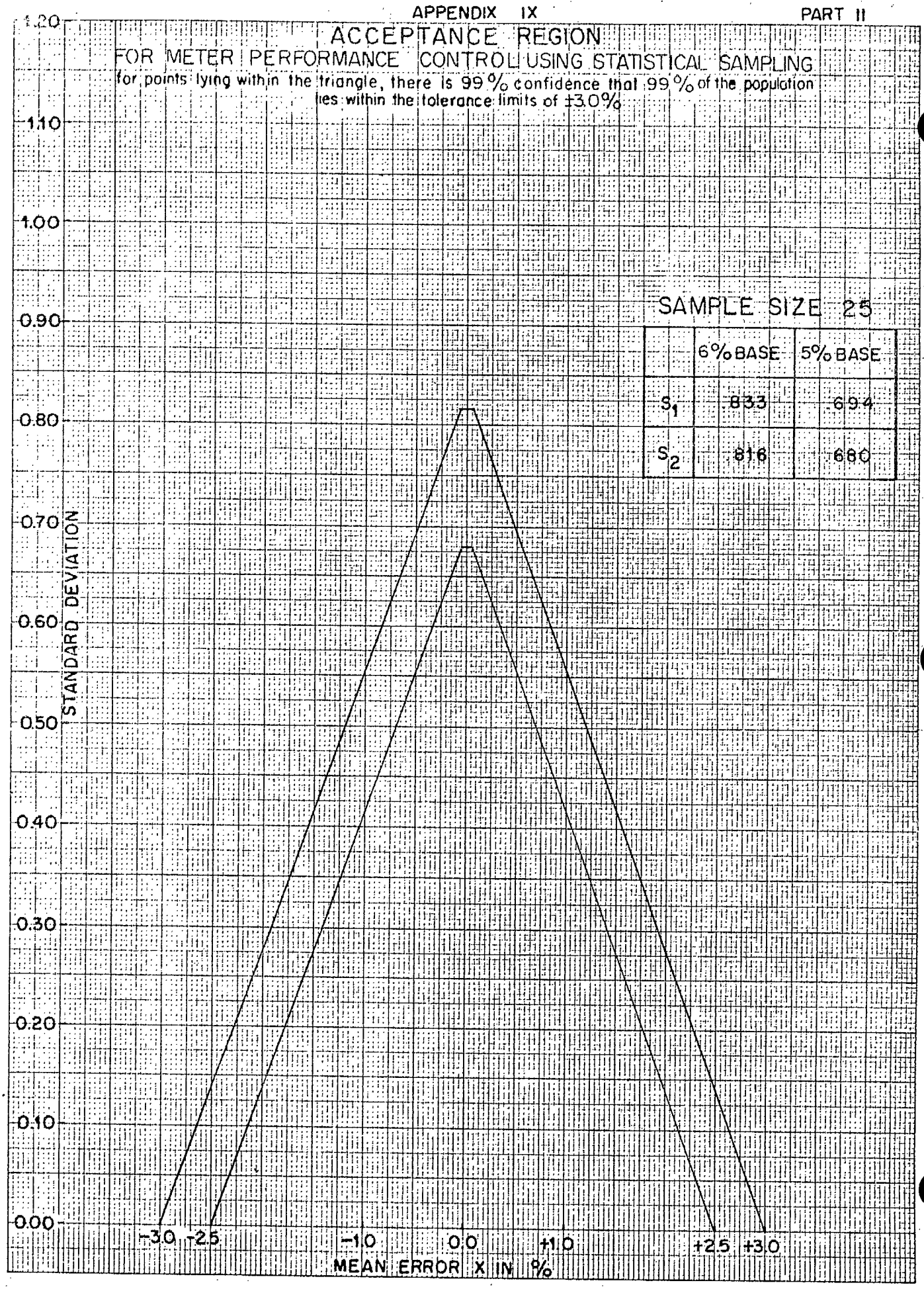
DISTRICT INSPECTOR E & G
_____DISTRICT

DATE: _____

SEP - 1975

ACCEPTANCE REGION
FOR METER PERFORMANCE CONTROL USING STATISTICAL SAMPLING

for points lying within the triangle, there is 99% confidence that 99% of the population lies within the tolerance limits of ±3.0%



SAMPLE SIZE 25

	6% BASE	5% BASE
S_1	.833	.694
S_2	.816	.680

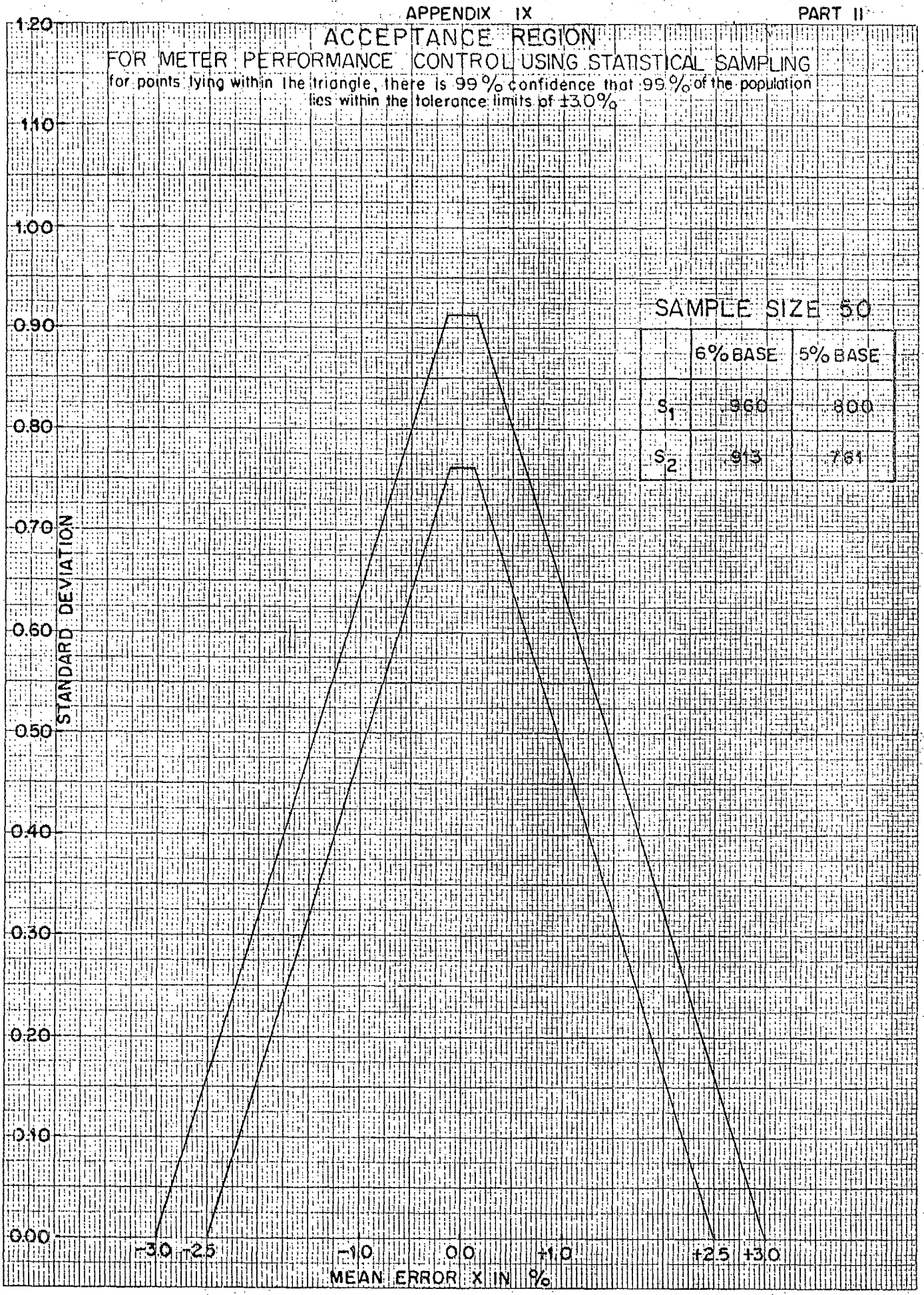
46 1510

10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

SEP - 1975

ACCEPTANCE REGION
FOR METER PERFORMANCE CONTROL USING STATISTICAL SAMPLING

for points lying within the triangle, there is 99% confidence that 99% of the population lies within the tolerance limits of ±3.0%



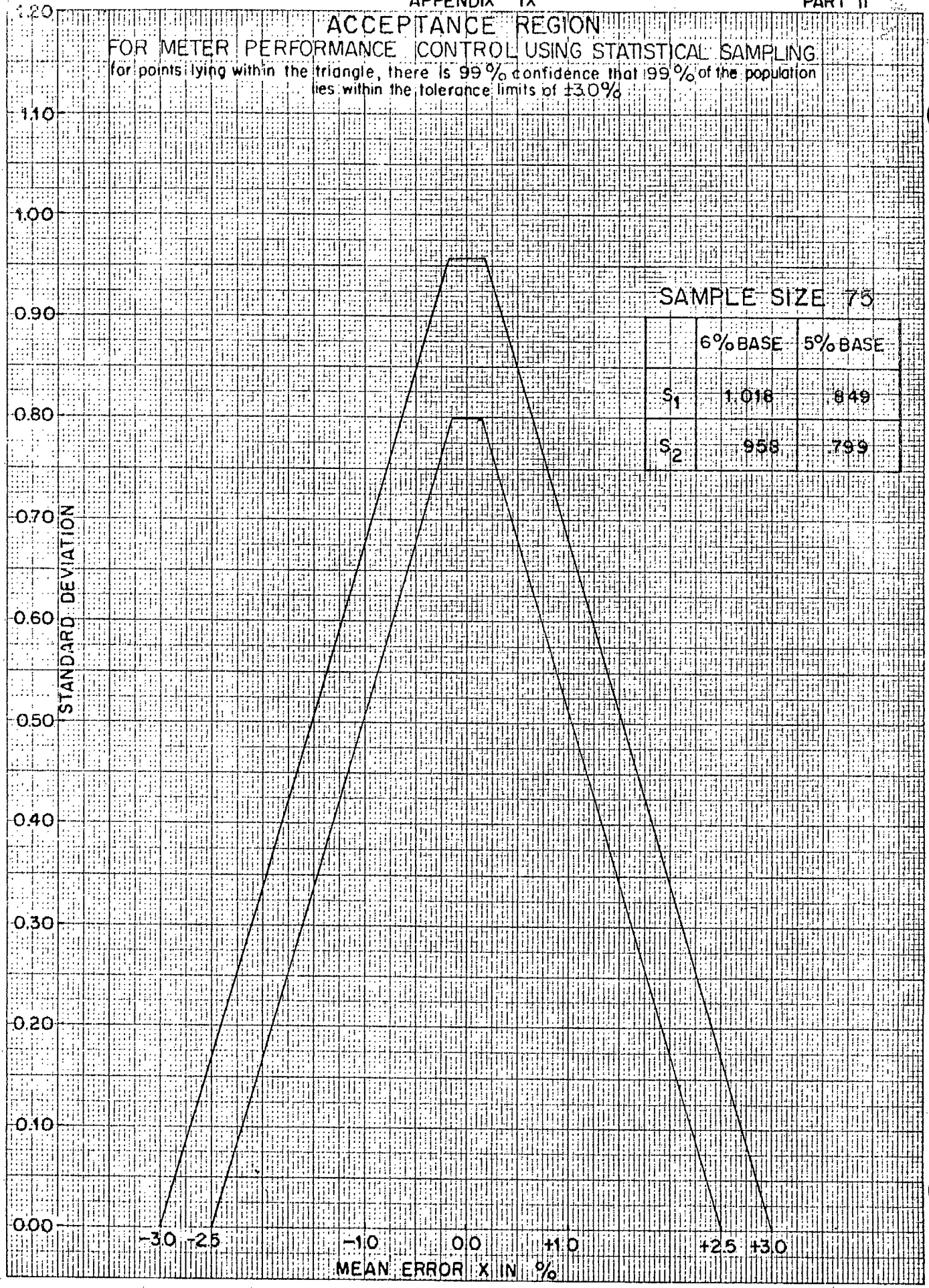
SAMPLE SIZE 50

	6% BASE	5% BASE
S_1	.960	.800
S_2	.913	.761

SEP - 1975

ACCEPTANCE REGION
FOR METER PERFORMANCE CONTROL USING STATISTICAL SAMPLING

for points lying within the triangle, there is 99% confidence that 99% of the population lies within the tolerance limits of ±3.0%



SAMPLE SIZE 75

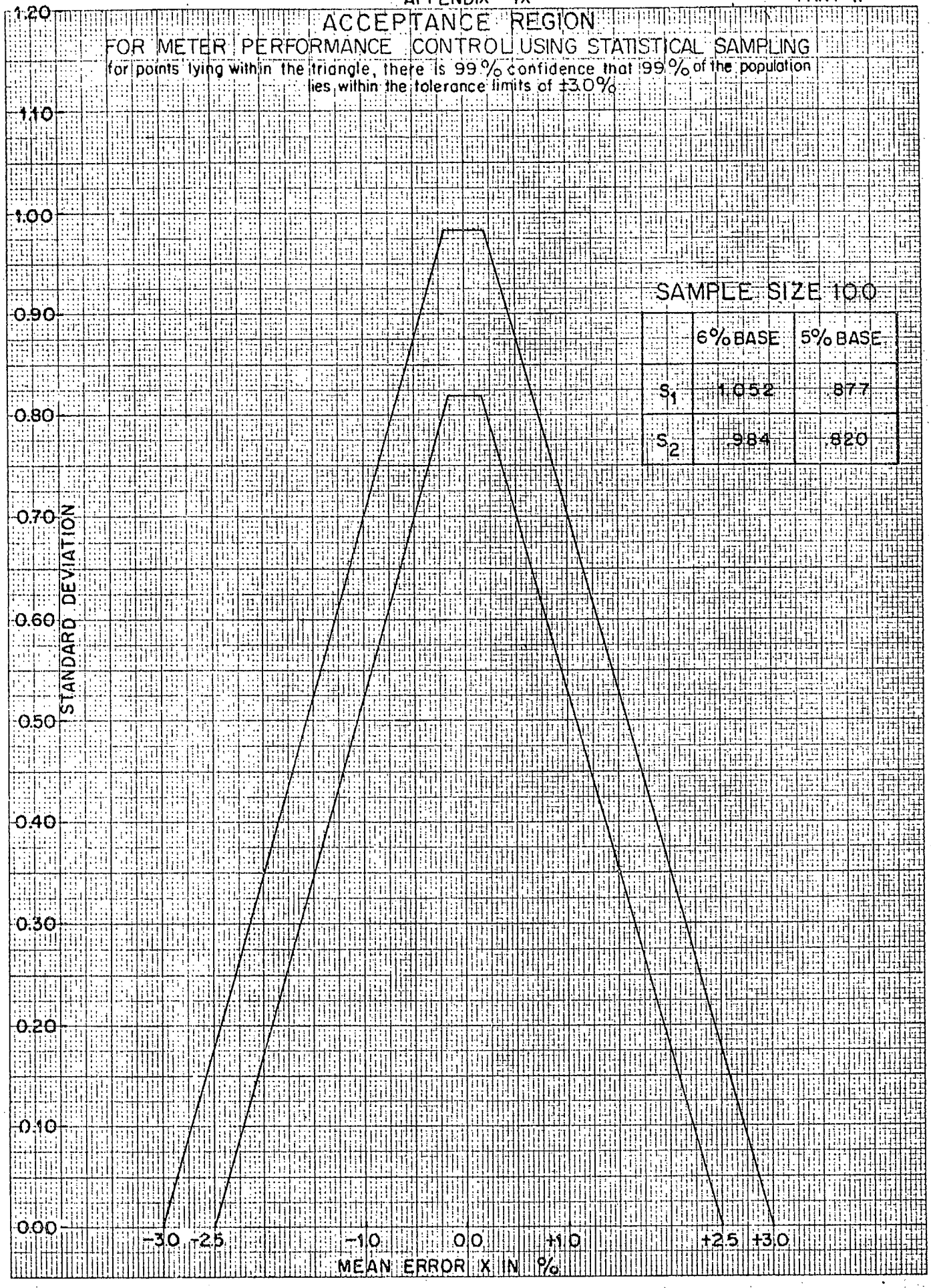
	6% BASE	5% BASE
S_1	1.016	.849
S_2	.958	.799

SEP - 1975

ACCEPTANCE REGION

FOR METER PERFORMANCE CONTROL USING STATISTICAL SAMPLING

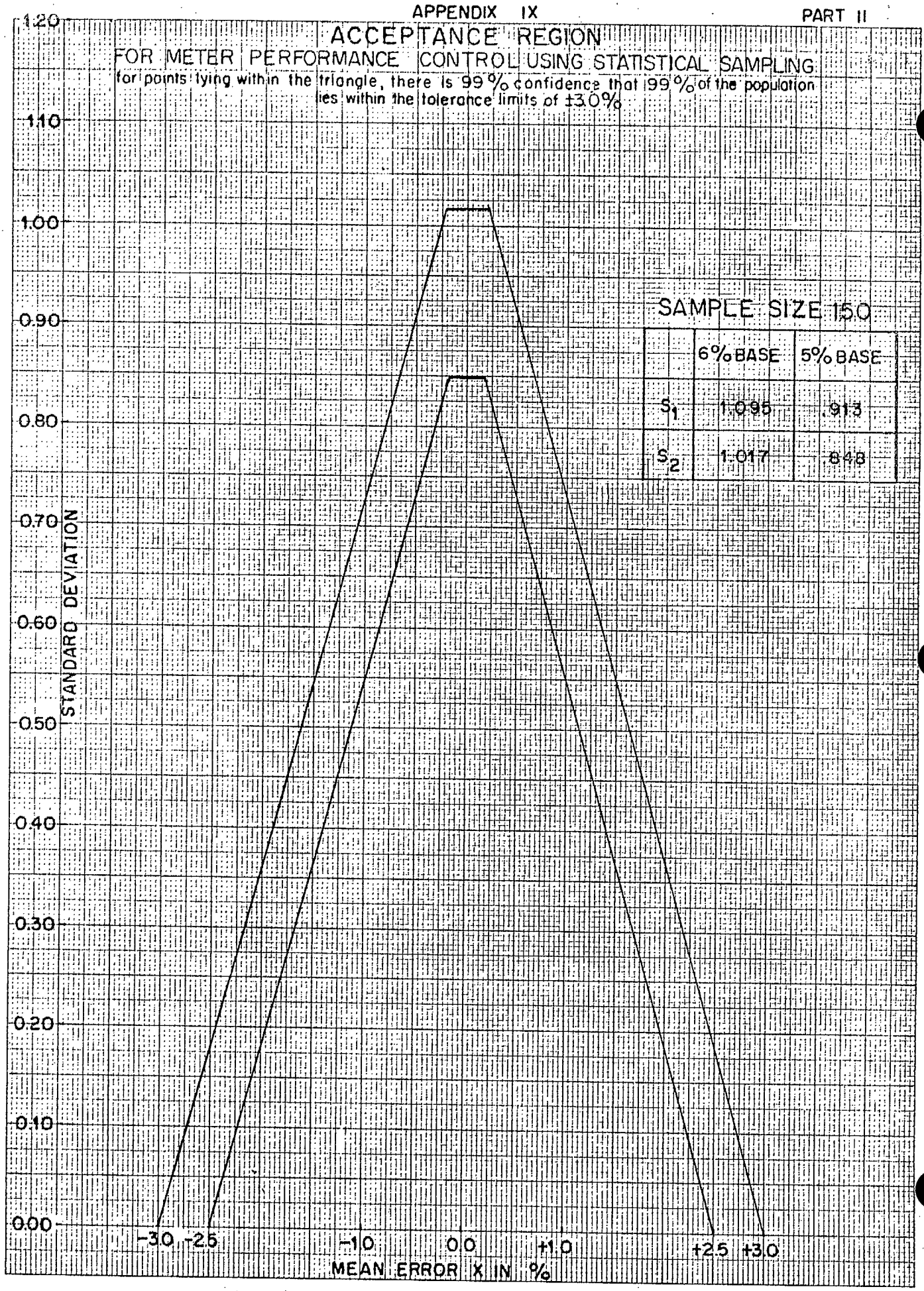
for points lying within the triangle, there is 99% confidence that 99% of the population lies within the tolerance limits of ±3.0%



SAMPLE SIZE 100

	6% BASE	5% BASE
S_1	1.052	.877
S_2	.984	.820

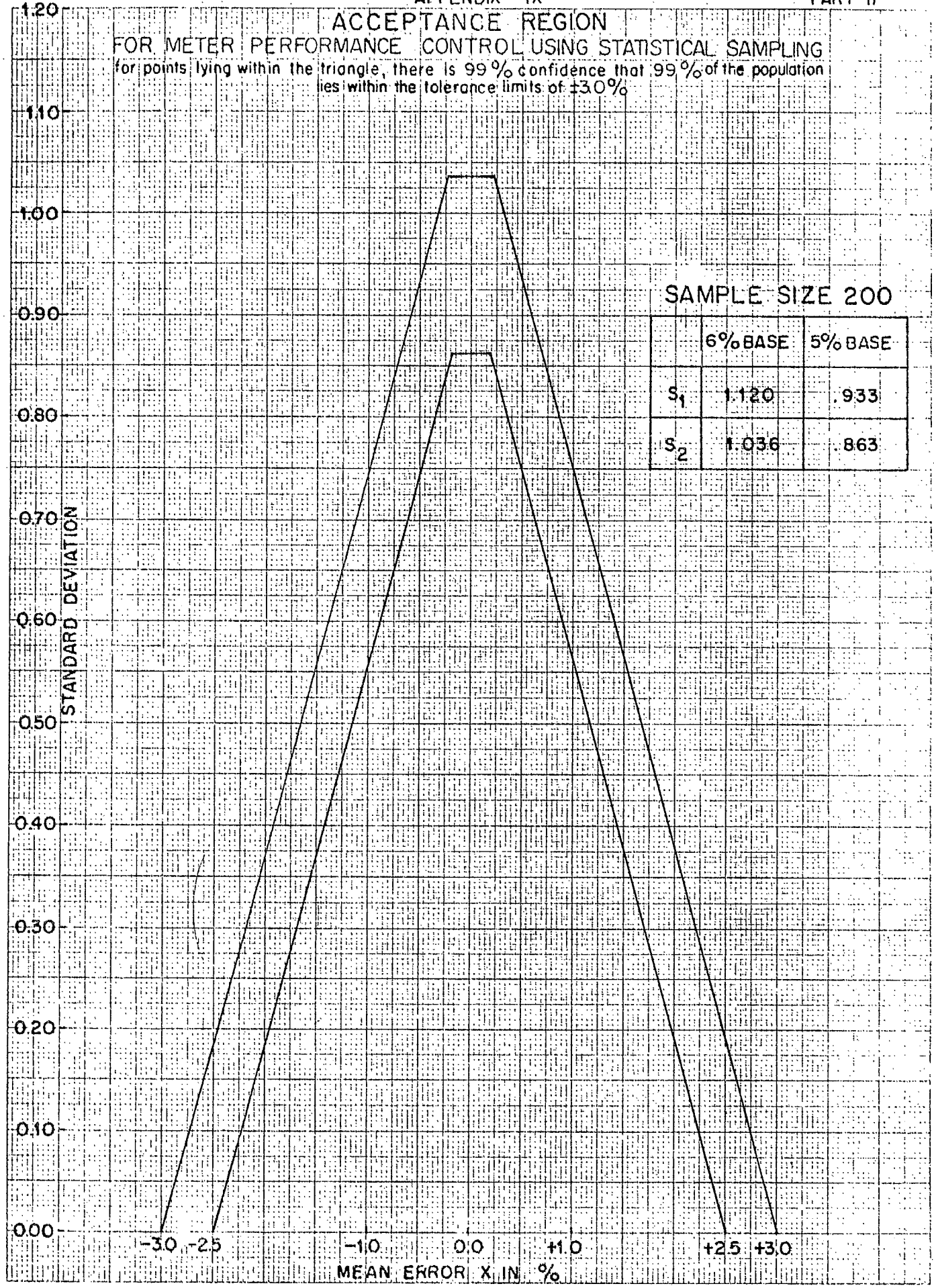
SEP - 1975



SEP - 1975

ACCEPTANCE REGION
FOR METER PERFORMANCE CONTROL USING STATISTICAL SAMPLING

for points lying within the triangle, there is 99% confidence that 99% of the population lies within the tolerance limits of ±3.0%



SAMPLE SIZE 200

	6% BASE	5% BASE
S_1	1.120	.933
S_2	1.036	.863

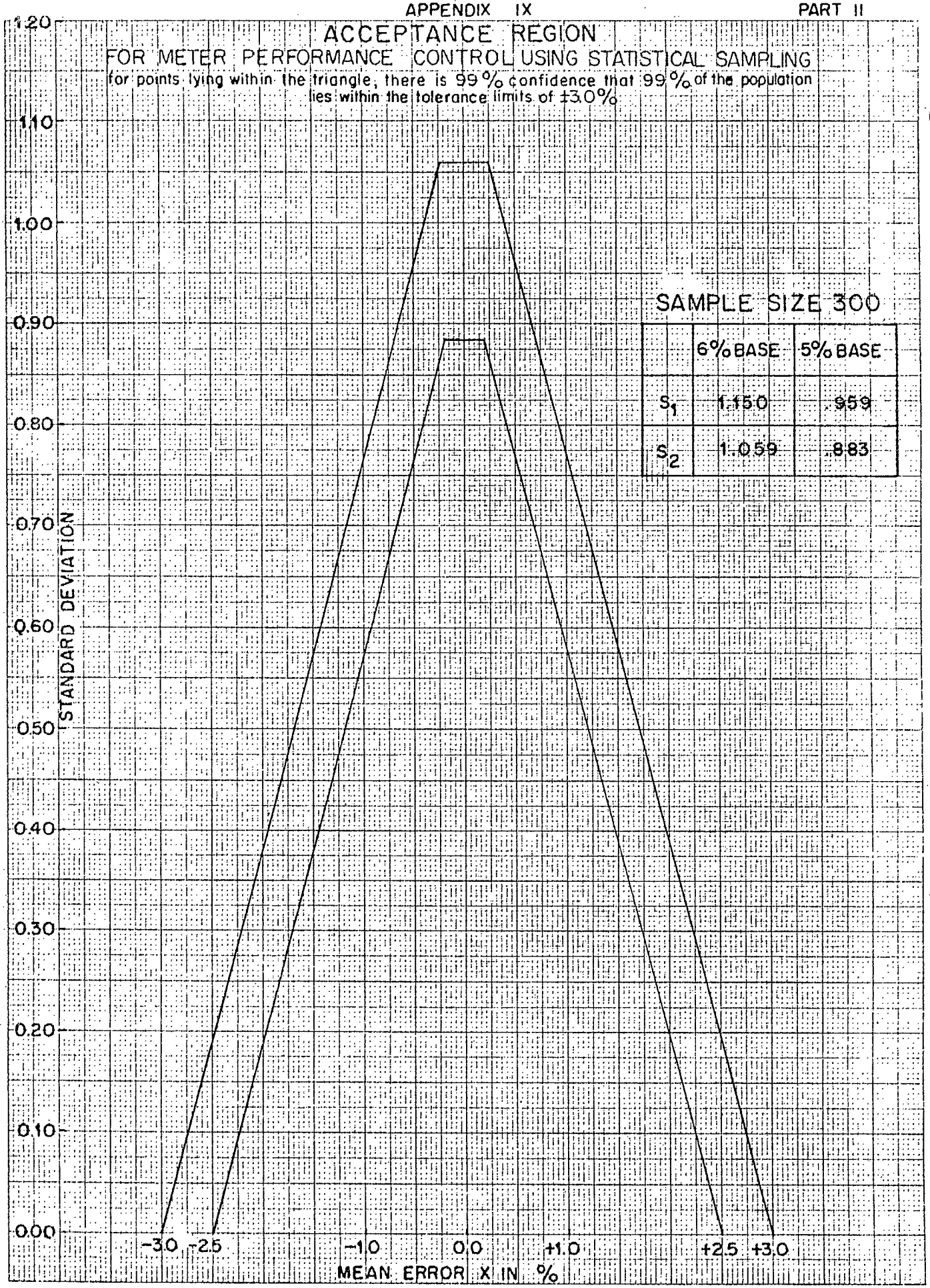
46 1510

10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

SEP - 1975

ACCEPTANCE REGION
FOR METER PERFORMANCE CONTROL USING STATISTICAL SAMPLING

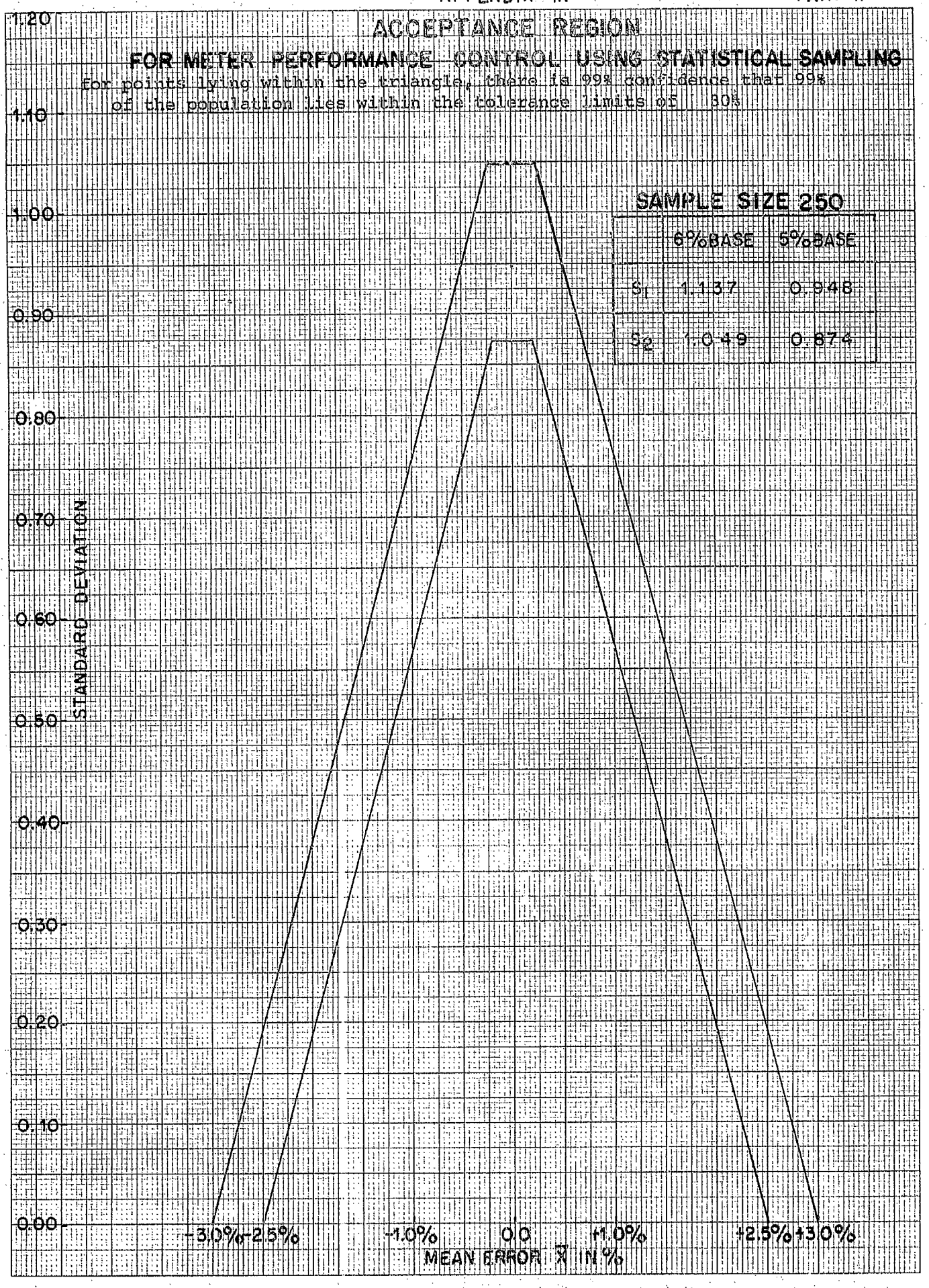
for points lying within the triangle, there is 99% confidence that 99% of the population lies within the tolerance limits of ±3.0%



SAMPLE SIZE 300

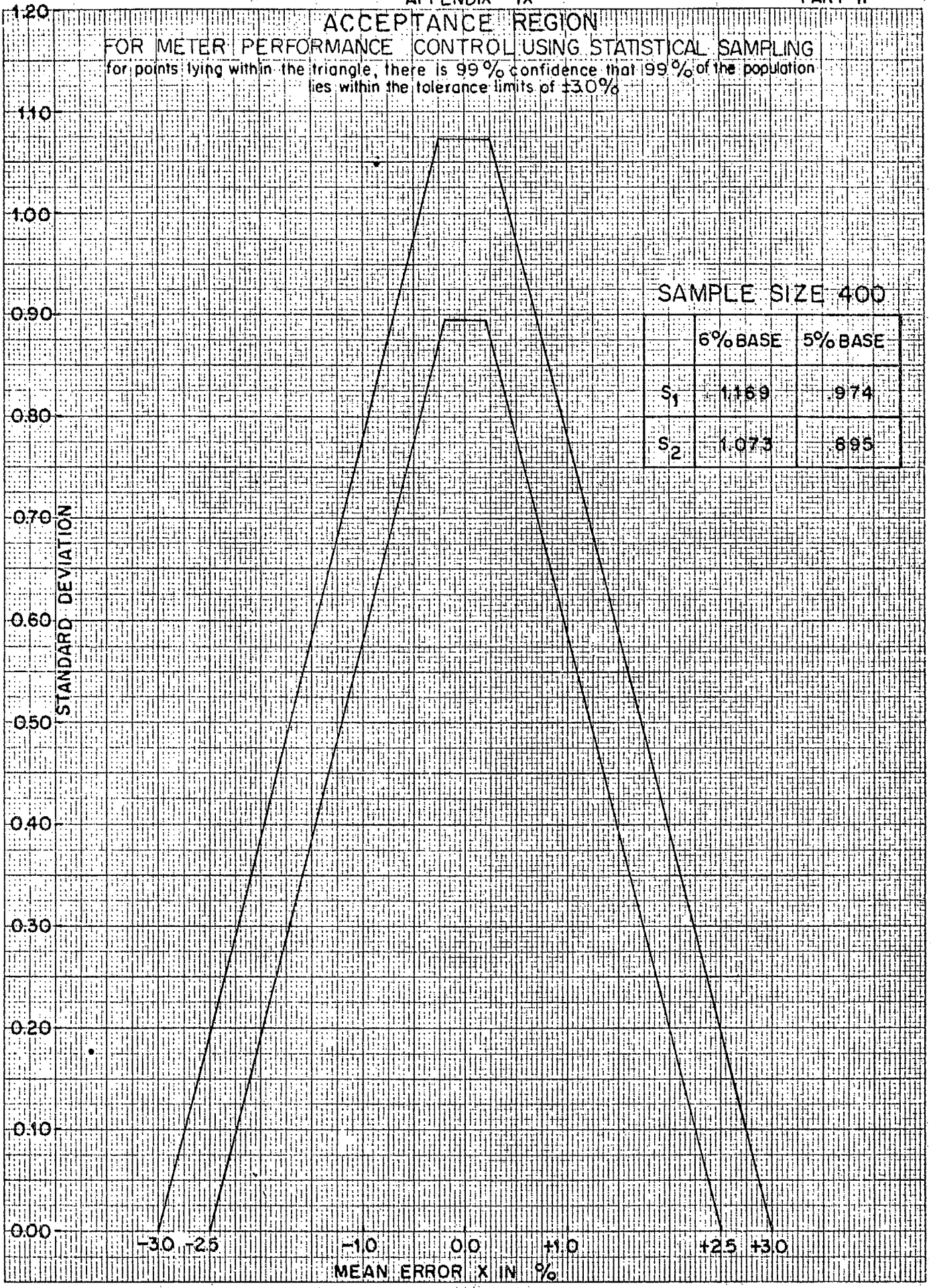
	6% BASE	5% BASE
S_1	1.150	.959
S_2	1.059	.883

SEP - 1975



ACCEPTANCE REGION
FOR METER PERFORMANCE CONTROL USING STATISTICAL SAMPLING

for points lying within the triangle, there is 99% confidence that 99% of the population lies within the tolerance limits of ±3.0%



SAMPLE SIZE 400

	6% BASE	5% BASE
S_1	1.169	.974
S_2	1.073	.695

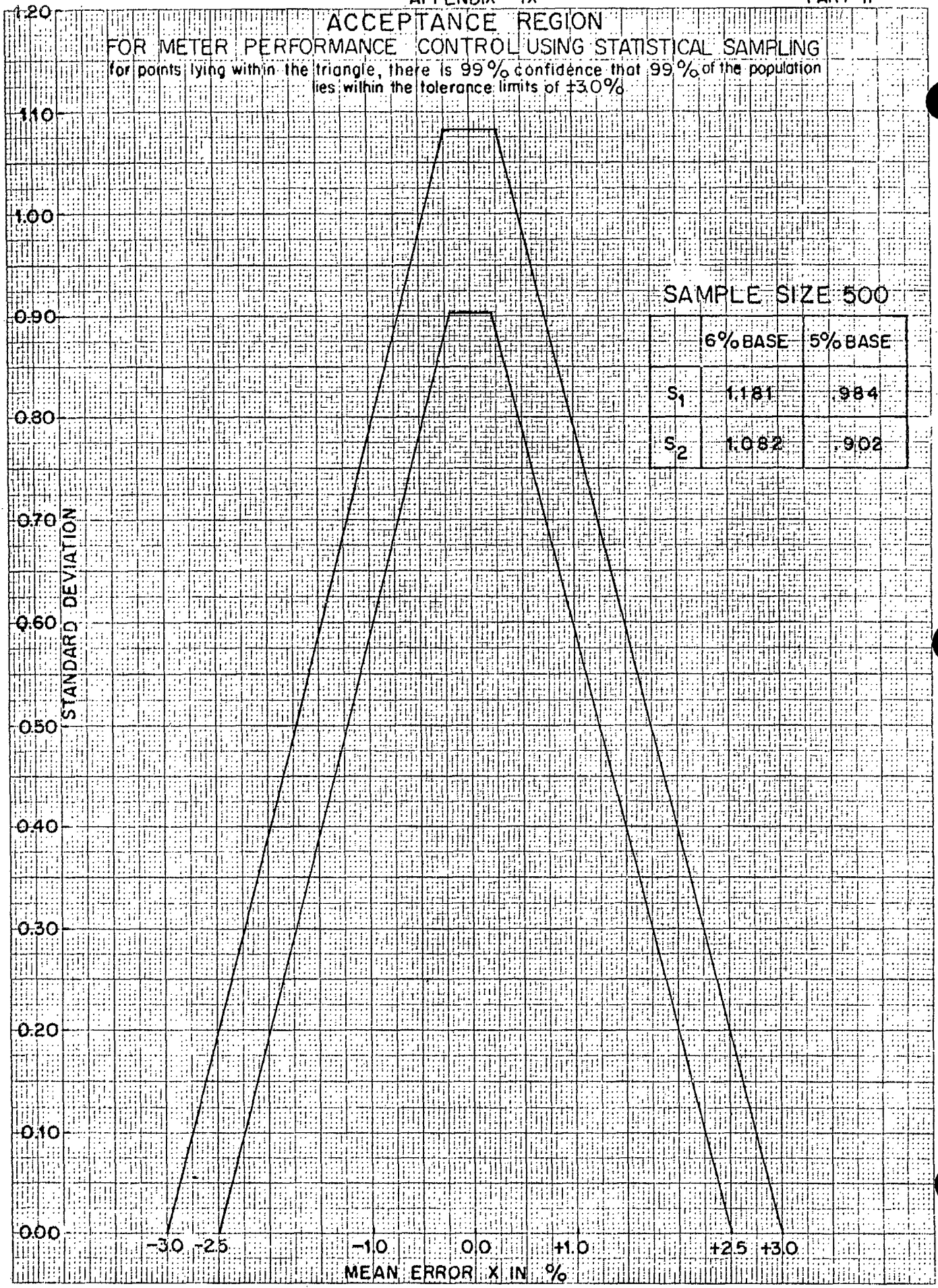
46 1510

10 X 10 TO THE CENTIMETER
KEUFFEL & ESSER CO. MADE IN U.S.A.

SEP - 1975

ACCEPTANCE REGION
FOR METER PERFORMANCE CONTROL USING STATISTICAL SAMPLING

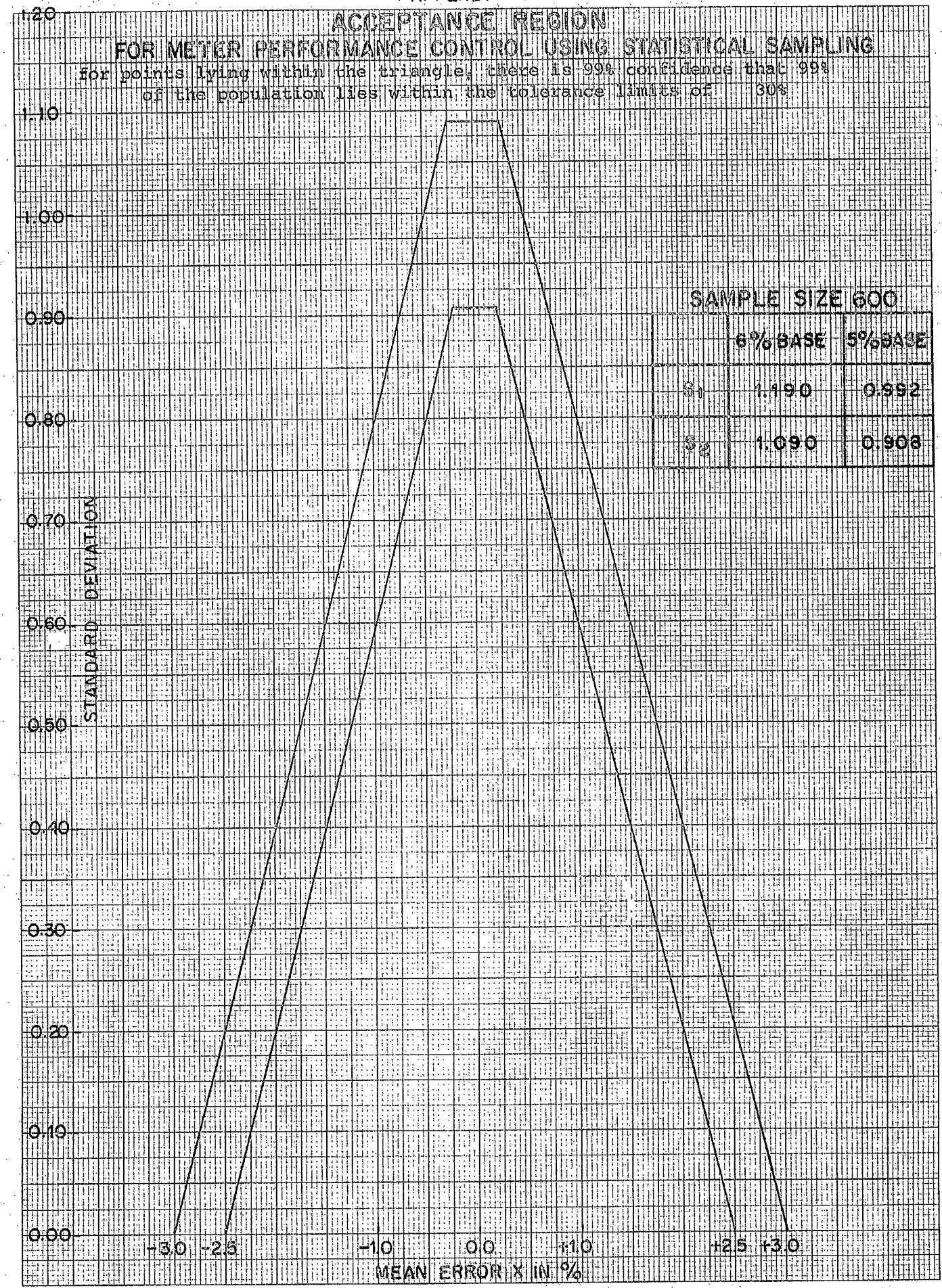
for points lying within the triangle, there is 99% confidence that 99% of the population lies within the tolerance limits of ±3.0%



SAMPLE SIZE 500

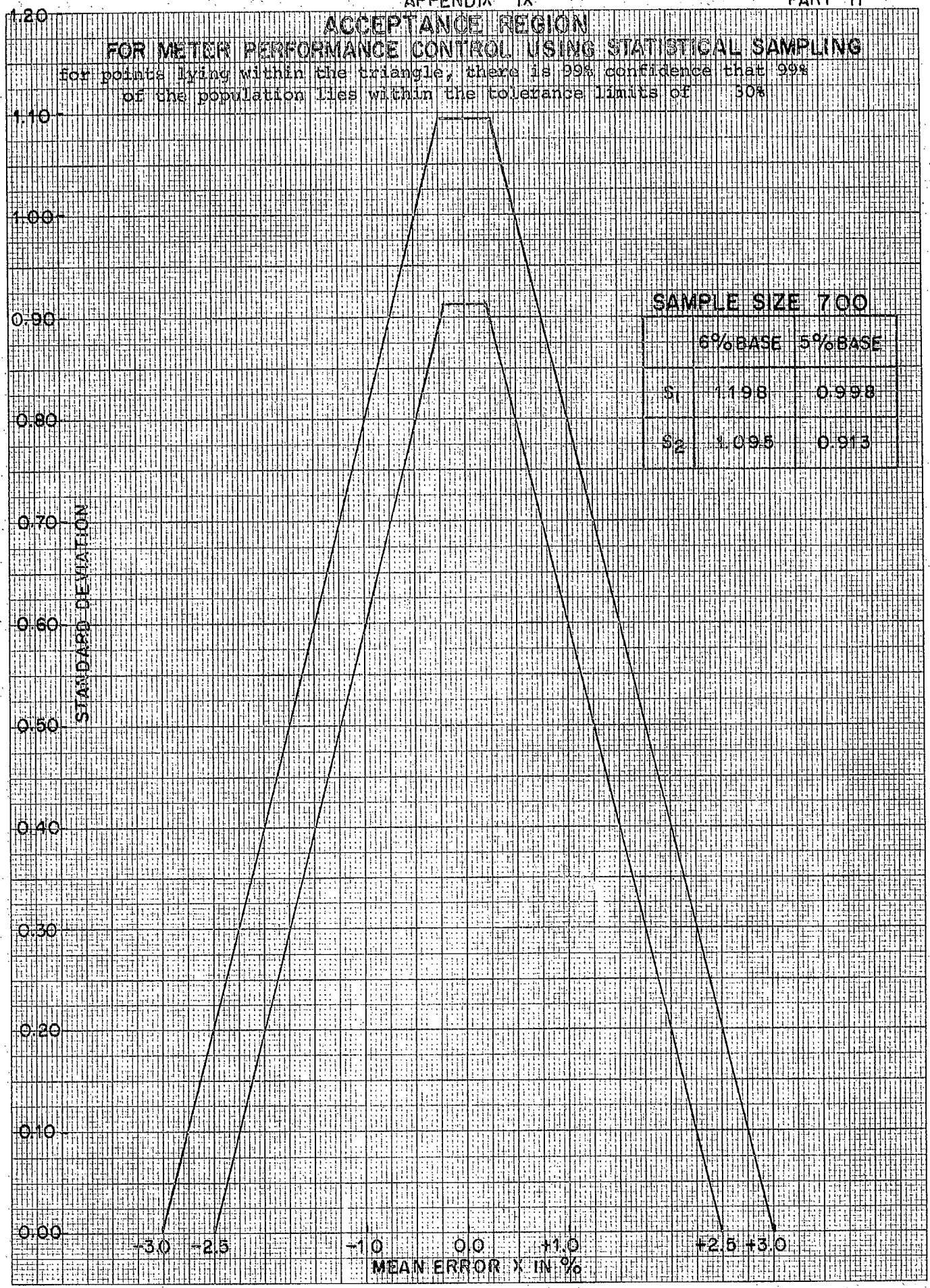
	6% BASE	5% BASE
S_1	1.181	.984
S_2	1.082	.902

SEP - 1975



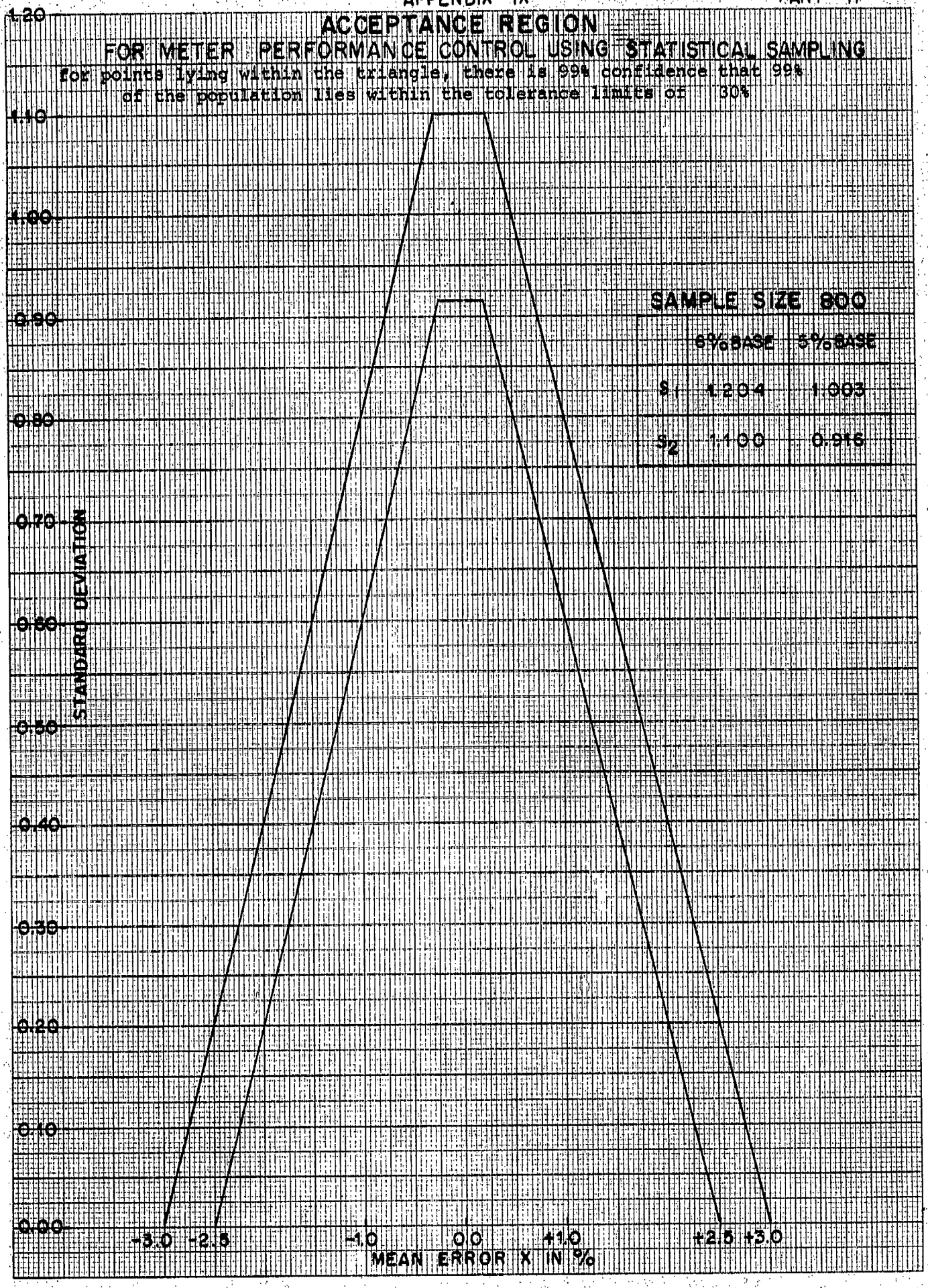
461510

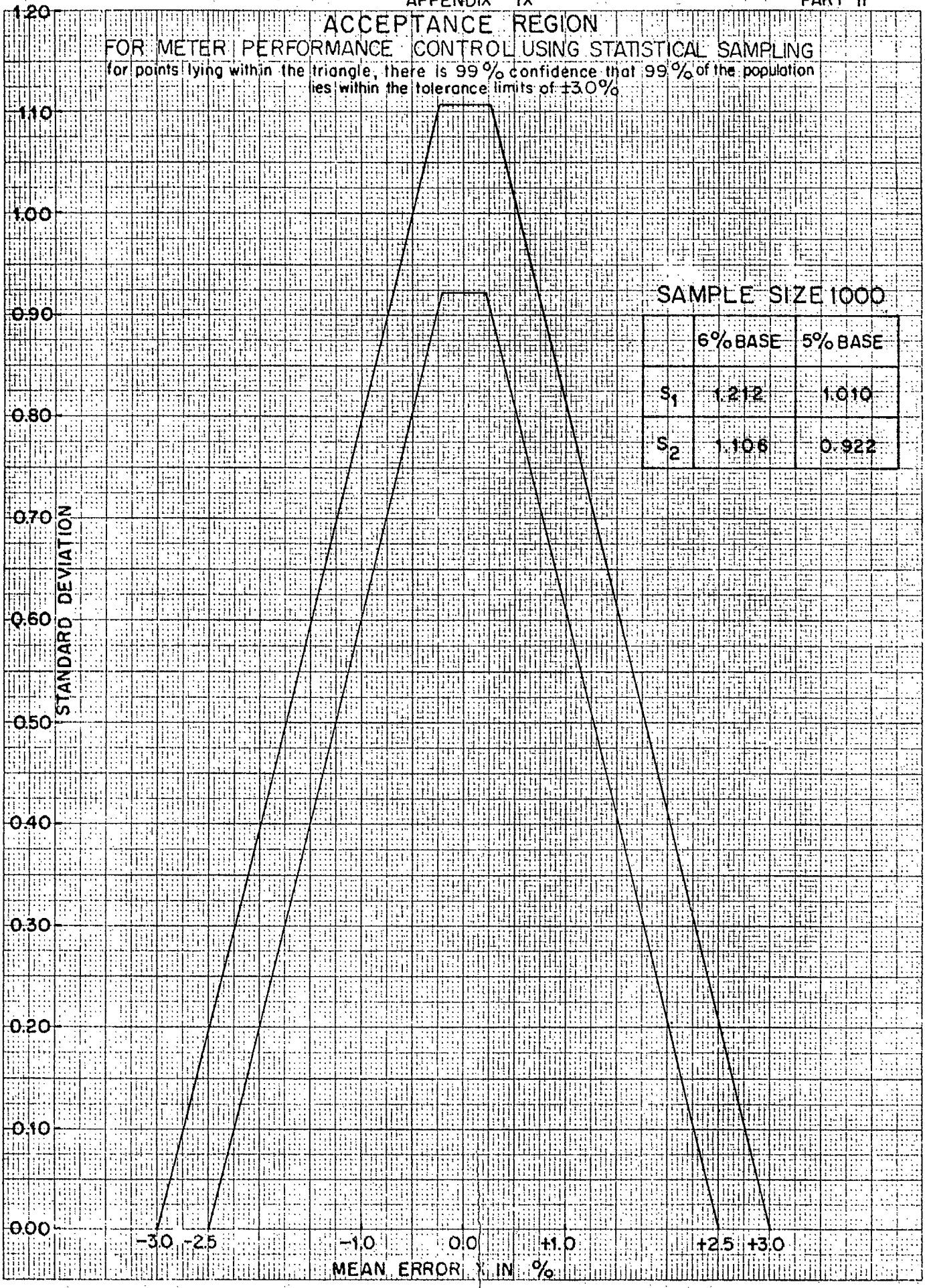
10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.



461510

10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.





APPENDIX X

PART II

SEP - 1975

APPENDIX XI PART II

STATISTICAL ANALYSIS OF METER GROUPS

UTILITY ..... SAMPLING .....

GROUP No ..... GROUP SIZE "N" ..... SAMPLE SIZE "n" .....

TYPE ..... MAKE ..... SEAL DATE ..... TEST .....

Frequency of $X_i +$ f_i^+	Cells x_i	Frequency of $X_i -$ f_i^-	Algebraic value of $(f_i^+ + f_i^-)$ or $f_i^+ + f_i^-$	Cells x_i	$f_i x_i$	Absolute value or $(f_i^+) + (f_i^-)$	x_i^2	$f_i x_i^2$
	3.0			3.0			9.00	
	2.9			2.9			8.41	
	2.8			2.8			7.84	
	2.7			2.7			7.29	
	2.6			2.6			6.76	
	2.5			2.5			6.25	
	2.4			2.4			5.76	
	2.3			2.3			5.29	
	2.2			2.2			4.84	
	2.1			2.1			4.41	
	2.0			2.0			4.00	
	1.9			1.9			3.61	
	1.8			1.8			3.24	
	1.7			1.7			2.89	
	1.6			1.6			2.56	
	1.5			1.5			2.25	
	1.4			1.4			1.96	
	1.3			1.3			1.69	
	1.2			1.2			1.44	
	1.1			1.1			1.21	
	1.0			1.0			1.00	
	0.9			0.9			0.81	
	0.8			0.8			0.64	
	0.7			0.7			0.49	
	0.6			0.6			0.36	
	0.5			0.5			0.25	
	0.4			0.4			0.16	
	0.3			0.3			0.09	
	0.2			0.2			0.04	
	0.1			0.1			0.01	
	0			0			0	
$\Sigma f_i^+ =$		$\Sigma f_i^- =$		$\Sigma f_i x_i =$				$\Sigma f_i x_i^2 =$

$\Sigma f_i^+ + \Sigma f_i^- = \Sigma f_i = n =$

$n =$ $\quad n - 1 =$ $\quad \bar{X} = \dfrac{\Sigma f_i x_i}{n} =$

$$s = \sqrt{\frac{\left[\Sigma f_i x_i^2\right] - \left(\left[\bar{X}\right] \times \left[\Sigma f_i x_i\right]\right)}{[n-1]}} = \sqrt{\frac{[\quad] - ([\quad] \times [\quad])}{[\quad]}}$$

$$= \sqrt{\quad} = \quad \%$$

OUTLIERS : FAST ☐ SLOW ☐

SAMPLE : ACCEPTED ☐ REJECTED ☐

Test Sheet No. ..... to ..... Date .....

Signature .....

SEP - 1975

H. Q. FILE NO._____

REPORT OF ELECTRIC METERS INSPECTED

DISTRICT: EXCELSIOR * OLD SINGLE PHASE MONTH: AUGUST 19 75

Utility	Lot No.	Size of Lot	Size of Sample	Meter Type	Class	Rotating Standard No.	Test Board No.	High Load		Low Load		Power Factor		S or D	A or R	Man-Hour
								X	S	X	S	X	S			
Excelsior Power	Rep-75-76	80	15	CS-1		766/790	3	.126	.243	-.133	.454	.146	.385	S	A	
	Rep-75-77	60	15	I-30		"	"	-.080	.108	-.293	.449	-.140	.192	S	A	
	Rep-75-78	15		D3 D4		"	"				SMALL	LOT			A	
Acme Power	Rap-75-35	100	15	D2 I-50 I-55		767	6	.060	.135	.026	.183			S	A	
	Rap-75-36	100	15	CJ3 I-55		"	"	.033	.104	.193	.228			S	A	
Johnson Corners		20		I-30						PART	IID				A	
TOTALS																

NOTE: S = Single, D = Double, A = Accepted, R = Rejected
2 = 2 Wire, 3 = 3 Wire, T = Transf., R = Remote Register
* Category of Meter e. g. New Single Phase
Old —"— —"—
New Net-work
Old Net-work

REMARKS: _____

CC A-

APPENDIX XIII

PART II

CELLS XL	FREQUENCY WITHIN CLASS INTERVAL				TOTAL
3.0					
2.9					
2.8					
2.7					
2.6					
2.5					
2.4					
2.3					
2.2					
2.1					
2.0					
1.9					
1.8					
1.7					
1.6					
PLUS 1.5					
1.4					
1.3					
1.2					
1.1					
1.0					
0.9					
0.8					
0.7					
0.8					
0.5					
0.4					
0.3					
0.2					
0.1					
0.0					
0.1					
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
MINUS 1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
2.3					
2.4					
2.5					
2.6					
2.7					
2.8					
2.9					
3.0					

CHECK : $\frac{\text{RANGE}}{\text{FACTOR}} \approx S$ (approx) $\approx$ _____ $\approx$ _____

DATE .....

HISTOGRAM

UTILITY .....

GROUP No. .....

GROUP SIZE .....

SAMPLE SIZE .....

MAKE .....

TYPE .....

SEAL DATE .....

TEST .....

OUTLIERS -

..... FAST

..... SLOW

$\bar{X}$ = ...

S = ...

FACTOR = Fr

Fr = 4.5 for Sample Size = 50
Fr = 5.0 for Sample Size = 100
Fr = 5.5 for Sample Size = 200

SEP - 1975

APPENDIX XIV — PART II

SAMPLE TEST SUMMARY FOR METERS – *RÉSUMÉ DE L'ESSAI D'UN ÉCHANTILLON POUR COMPTEURS*

UTILITY — *Service public*	D M Y	GROUP IDENT. — *Numéro du lot*	MAKE — *Marque*
TYPE — *Marque*	SEAL DATE — *Date du sceau*	GROUP SIZE — *Taille du lot*	NOM. SAMPLE (n) — *Taille de l'échantillon (n*

SINGLE PHASE ELECTRIC *Monophasé électrique* ☐ NETWORK ELECTRIC ☐ GAS *Gaz* ☐

NUMBER OF METERS SELECTED *Nombre de compteurs sélectionnés* (n')

LOCK OUTS *Absence du propriétaire*

BROKEN IN TRANSIT *Brisé pendant le transport*

REVEFIRIED SINCE LIST MADE *Revérifié depuis la mise au point de la liste*

OTHER REASONS *Autres raisons*

NUMBER OF METERS NOT RECEIVED *Nombre de compteurs non reçus*

WRONG SEAL DATES *Dates inexactes sur le sceau*

NOT BELONGING IN GROUP *N'appartient pas au lot*

DAMAGED IN TRANSIT *Endommagé pendant le transport*

OTHER REASONS *Autres raisons*

INELIGIBLE METERS *Compteurs inacceptables* (b)

FAST OUTLIERS *Suévaluateurs*

SLOW OUTLIERS *Sous-évaluateurs*

TOTAL OUTLIERS *Total évaluateurs*

METERS IN FINAL CALCULATIONS *Comptemps entrant dans les calculs finaux* (n_s)

TOTAL (n')

$n_s \geq .95n$

$n' - b - n_s \leq .15n$

$\frac{FL + LL}{2}$

$\bar{X}$ =

S =

FL SERIES

$\bar{X}$ =

S =

FL AVERAGE

$\bar{X}$ =

S =

LL AVERAGE

$\bar{X}$ =

S =

PF AVERAGE

$\bar{X}$ =

S =

WITHDRAWALS OTHER THAN OUTLIERS *Retraits autre que les évaluateurs*

RECOMMENDATION *Recommandation* ☐ ACCEPTANCE *Acceptation* ☐ REJECTION *Rejet*

FEE CALCULATION — *Calcul des droits*

METERS IN GROUP *Nombre de compteurs du lot*	CLASS *Catégorie* 1	CLASS *Catégorie* 2
LESS: SAMPLE METERS NOT RETURNED TO GR. *Moins: Compteurs de l'échantillon non*		
TOTALS *TOTAUX*		

FEE — *Droits* = 2 X (X $ + X $) =

* FIGURE FOR NORMALS SEAL PERIOD
Chiffre pour une période correspondant à un sceau normal

TESTED BY *Essai effectué par* _____

CALCULATED BY *Calculs effectués par* _____

REMARKS — *Observations*

SEP – 1975

APPENDIX XV

CANADIAN WESTINGHOUSE TYPE CS1, 25 AMP 3 WIRE METERS

SAMPLE TEST GROUP S.T. 1A

COUNT	METER NO.	SER. NO.
51	35744 A243	1033759
52	35745 A243	1025594
53	35746 A243	1030082
54	35748 A243	1033772
55	35749 A243	1034144
56	35750 A243	1034035
57	35751 A243	1033835
58	35752 A243	1005564
59	35753 A243	956445
60	35754 A243	956270
61	35755 A243	956503
62	35756 A243	956444
63	35757 A243	1034121
64	35759 A243	1033808
65	35760 A243	1034112
66	35761 A243	1033882
67	35762 A243	1034124
68	35763 A243	1033864
69	35764 A243	1033841
70	35765 A243	1033858
71	35766 A243	1034123
72	35767 A243	1033850
73	35768 A243	1034052
74	35769 A243	1005708
75	35770 A243	1005508
76	35774 A243	1033904
77	35775 A243	1034168
78	35776 A243	1034103
79	35777 A243	1033894
80	35778 A243	1034089
81	35779 A243	1005464
82	35781 A243	1005287
83	35782 A243	1029485
84	35783 A243	1034106
85	35784 A243	1034100
86	35785 A243	1034049
87	35787 A243	1033728
88	35788 A243	956184
89	35789 A243	956471
90	35790 A243	956479
91	35791 A243	956137
92	35792 A243	956302
93	35793 A243	956539
94	35794 A243	956185
95	35796 A243	956236
96	35797 A243	956601
97	35799 A243	1029538
98	35800 A243	956409
99	35801 A243	956197
100	35802 A243	956272

APPENDIX XVI

PART II

TEST RESULTS

SAMPLE TEST GROUP - _____

METER TYPE_____ ROTATING STD # _____

SEAL DATE_____ TEST BOARD # _____

Count No.	Insp. No.	Maker's No.	P.F.	F.L.	L.L.	X $\frac{FL+LL}{2}$	REMARKS	DIAL TEST & CREEP OK/OK

TESTED AT_____ TESTED BY_____

CITY_____ DATE_____

DEPARTMENT OF CONSUMER AND CORPORATE AFFAIRS

STANDARDS BRANCH

FILES: 2046-8 OTTAWA, January 30, 1974

TO: ALL DISTRICT INSPECTORS OF ELECTRICITY AND GAS

FROM: CHIEF, ELECTRICITY AND GAS DIVISION

The "Rules for Extension of Seal Period of Single-Phase Watthour Meters by Statistical Sampling Methods" state under Section 7.4:

> "The final calculation for $\bar{X}$ and s shall exclude sample meters which are outliers. An outlier shall be a meter for which the error is both:
>
> (i) more than three standard deviations (> 3 s) from the sample mean, $\bar{X}$, and
>
> (ii) above +3% or below -3%.

In some cases when judging whether a particular meter is an outlier or not, it is necessary to calculate $\bar{X}$ and s with the error of the particular meter excluded. If the meter then conforms to the above criteria it is an outlier.

Meters with the largest errors shall be judged and excluded if necessary before meters with smaller errors."

As Mr. J. B. Dumas, Regional Supervisor, E&G, Quebec has correctly pointed out it can, in some cases, make a difference if the last sentence is not correctly interpreted. When we say the "largest errors" should be judged and excluded first we mean those errors which deviate farthest from the mean, $\bar{X}$, not those errors which deviate farthest from zero error.

Thus, for example, if a sample has two meters which appear to be outliers one is 3.5+ and the other is 3.5-. Let us suppose that on first calculation $\bar{X} = 0.5$ and $s = .9$. Then to make the second calculation we should remove the 3.5- error from the calculations since it is 4.0% from $\bar{X}$ whereas the other outlier is only 3.0% from $\bar{X}$.

W.J.S. Fraser

W.J.S. Fraser

SEP - 1975

METHODS OF SELECTING A RANDOM SAMPLE FOR METER PERFORMANCE CONTROL USING STATISTICAL SAMPLING

It is assumed that the systematic sampling with a random start will be used. Consequently, before selecting the random start, it is necessary to arrange in order the individual meters in the group to be sampled. Any order is acceptable, but once ordered, the order must not be changed.

The next step is to determine the interval that will give the required sample size. Then a random number is found to determine the random start.

Random numbers may be obtained by rolling dice* from a table of random numbers, or from a computer programmed to generate random numbers. A detailed example follows:

Example

1. Place all meters in the group in order.

   Suppose 7992 meters are listed by inspection number, 1 column per page on 151 pages numbered in sequence. The order of the meters starts on page 1, then proceeds page by page in sequence.

2. Determine the interval to give the required sample size. Let interval number be i.

   Suppose nominal sample size is 200.
   Number of meters selected will be 230, or less.
   Interval $= \frac{7992}{230} = 34.7$
   Round off to next highest integral number to obtain i = 35.

   In certain circumstances when the number obtained for i is small, it may be advantageous to use alternate intervals of i and (i-1) provided the total number of samples selected does not exceed 115% of the nominal sample size.

3. Find a random number between 1 and i.

   Any procedure which ensures that the number is randomly chosen is satisfactory. One simple and economical way is to procure an inexpensive set of poker chips. Number the white chips on one side only, from 1 to 100.

* Coloured 20-sided dice are available from the Japanese Standards Association.

In our example, it is then only necessary to scramble chips 1 to 35, place them in a box and select blindly one chip from the box.

Suppose the number selected is 21, that is, j=21

4. Start sampling by choosing the j th (No.21) meter on the list and selecting every ith (35th) meter thereafter.

Thus the numbers chosen, are

21st meter
(21+35) i.e.56th meter
(21+2x35)i.e.91st meter
(21+3x35)i.e. 126th meter

and so on.

5. Check your selection

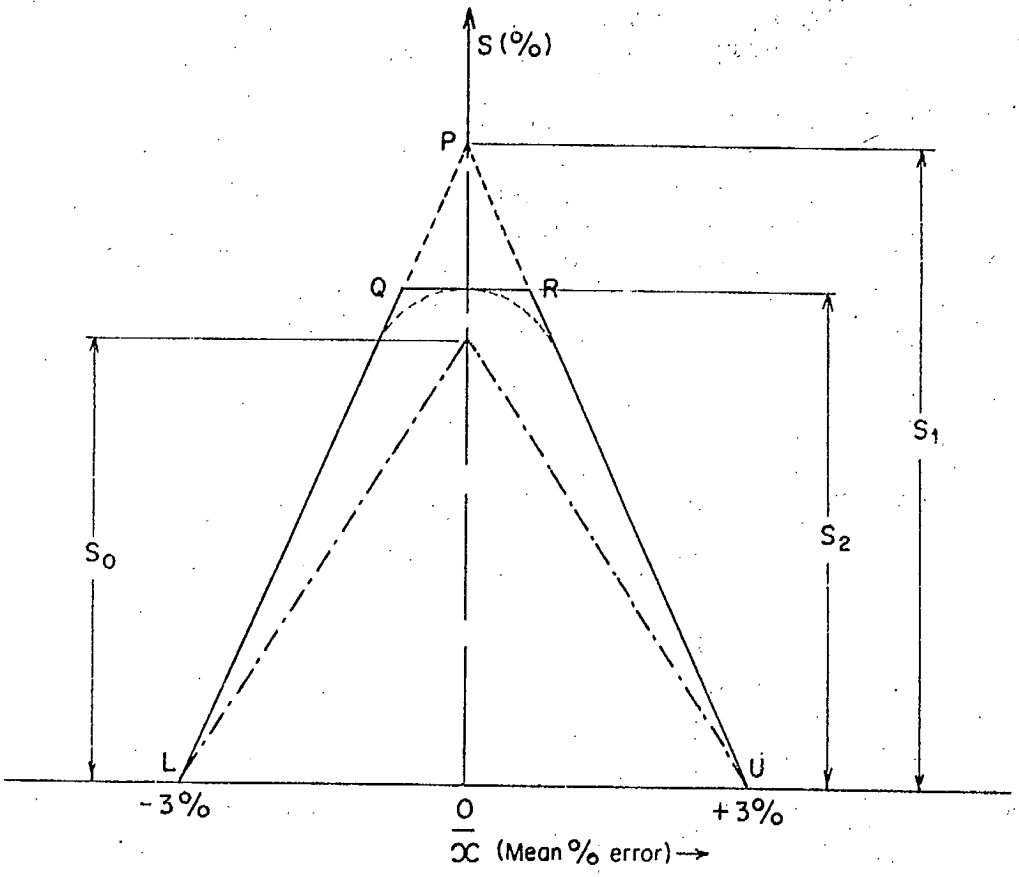
7992-21=7971

$$
\begin{array}{r}
227 \\
35\overline{)\,7971\,} \\
\underline{70} \\
97 \\
\underline{70} \\
271 \\
\underline{245} \\
26
\end{array}
$$

There should therefore be 228 meters selected for the sample with a remainder of 26 on the list when the last meter has been selected.

ACCEPTANCE REGION FOR ELECTRIC METERS

The "acceptance region" is defined by the truncated triangle or trapezium illustrated below:



The point L (-3.0%) and the point U(+3.0%) are each joined to the point P_1 whose ordinate is s_1.

The line parallel to the base of the triangle, with ordinate value S_2, cuts the lines LP and UP in Q and R respectively.

The truncated triangle LQRU is a close approximation to the "true" acceptance region (which lies below the "dotted curve" shown in the figure).

This acceptance region is (very nearly) such that if the pair of statistics ($\bar{X}$ and s) give a point which falls within the truncated triangle, then we can be 99% confident that at least 99% of the population has errors less than 3.0%.

The ordinate $s_1 = \frac{1}{2K}(U-L) = \frac{6.0}{2K} = \frac{3.0}{K}$

where "k" is given in the table below.

The ordinate $s_2 = F\ (U-L) = 6.0XF$

where "F" is given in the table below.

(N.B. The ordinate $S_o = \frac{U-L}{2K} = \frac{6.0}{2K} = \frac{3.0}{K}$

is always less than S_1 and is very nearly equal to S_2, although generally slightly smaller.)

Sample Size				For U-L = 6.0%		
n	k	f	K	S_1	S_2	S_o
200	2.680	0.173	2.921	1.119	1.036	1.027
100	2.852	0.164	3.096	1.052	0.984	0.969
50	3.124	0.152	3.385	0.960	0.913	0.886
25	3.601	0.136	3.904	0.833	0.816	0.768

The acceptance region, using a triangle with a maximum ordinate S , (as shown in previous issues of the Rules) is based upon the so-called "two sided tolerance factors", K, given in Chapter II of "Selected Techniques of Statistical Analysis" by Eisenhart, Hastay and Wallis (McGraw-Hill, 1947). This method is more conservative in general than the method whereby the acceptance region is the truncated triangle with maximum ordinate S_2. The latter method, using the acceptance region approximated by LQRU, is based upon the use of two

one sided tolerance factor, K, and the theory is given in Chapter I of Eisenhart et al and in the pulication of the U.S., Department of Defense "Mathematical and Statistical Principles Underlying MIL-STD-414".

Consumer and Corporate Affairs | Consommation et Corporations

Field Operations | Opérations extérieures

APPENDIX XX PART II ORIGINAL OR

ELECTRICITY METER FIELD NOTE
NOTES D'INSPECTION DE COMPTEURS ÉLECTRIQUES

NO. 237401

OF METERS TESTED AT / DES COMPTEURS VÉRIFIÉS À: Carlsbad, Ont | STANDARD NO. / NO DE STANDARD: E-465 | DISTRICT: Ottawa

Carlsbad Electric Power Co. | DATE: Sep. 20, 1976

INSPECTION NO. / NO D'INSPECTION	MAKER / FABRICANT	MAKER'S NO. / NO DU FABRICANT	TYPE / GENRE	AMPS.	VOLTS	ELEMENTS / ÉLÉMENTS	CYCLES	K.R OR D KV OU CONTESTATION	SEAL PERIOD / PÉRIODE DE SCEAU	REJECTED / REJETÉ	ERROR / ERREUR: FULL LOAD / PLEINE CHARGE	LIGHT LOAD / CHARGE LÉGÈRE	MAX DEM. / MAX DE LA DEM	90% P.F.	FEES $
1	Extension of Seal Period Sampling (Part IIC)														
	Group consists of 8172 Type T-2 Acme Meters														
	Group Accepted - complete details of tests on Field Notes 237402 - 237409 incl.														
	Fees Class II meters — 8172 x 0.75 x 2/8 =														1533.00
										TOTALS / TOTAUX					1533.00

F-V	S-L	R	TOTAL

CARDS ENTERED / CARTES ENTRÉES

SUMMARY ENTERED / RÉSUMÉ CONSIGNÉ

CERTIFICATE NO. / CERTIFICAT NO

DUPLICATE F.N. - DUPLICATA DE N.I. NO.

TO / À

RECEIVED BY / REÇU PAR
COMPANY REPRESENTATIVE / REPRÉSENTANT DE LA COMPAGNIE

TESTED BY - ÉPROUVES PAR

W. G. Brown
INSPECTOR / INSPECTEUR

RECEIVED PAYMENT OF ABOVE FEES / REÇU PAIEMENT DES DROITS CI-DESSUS

ECA-685 (3-72)

FEB 1973

ACCEPTANCE REGION

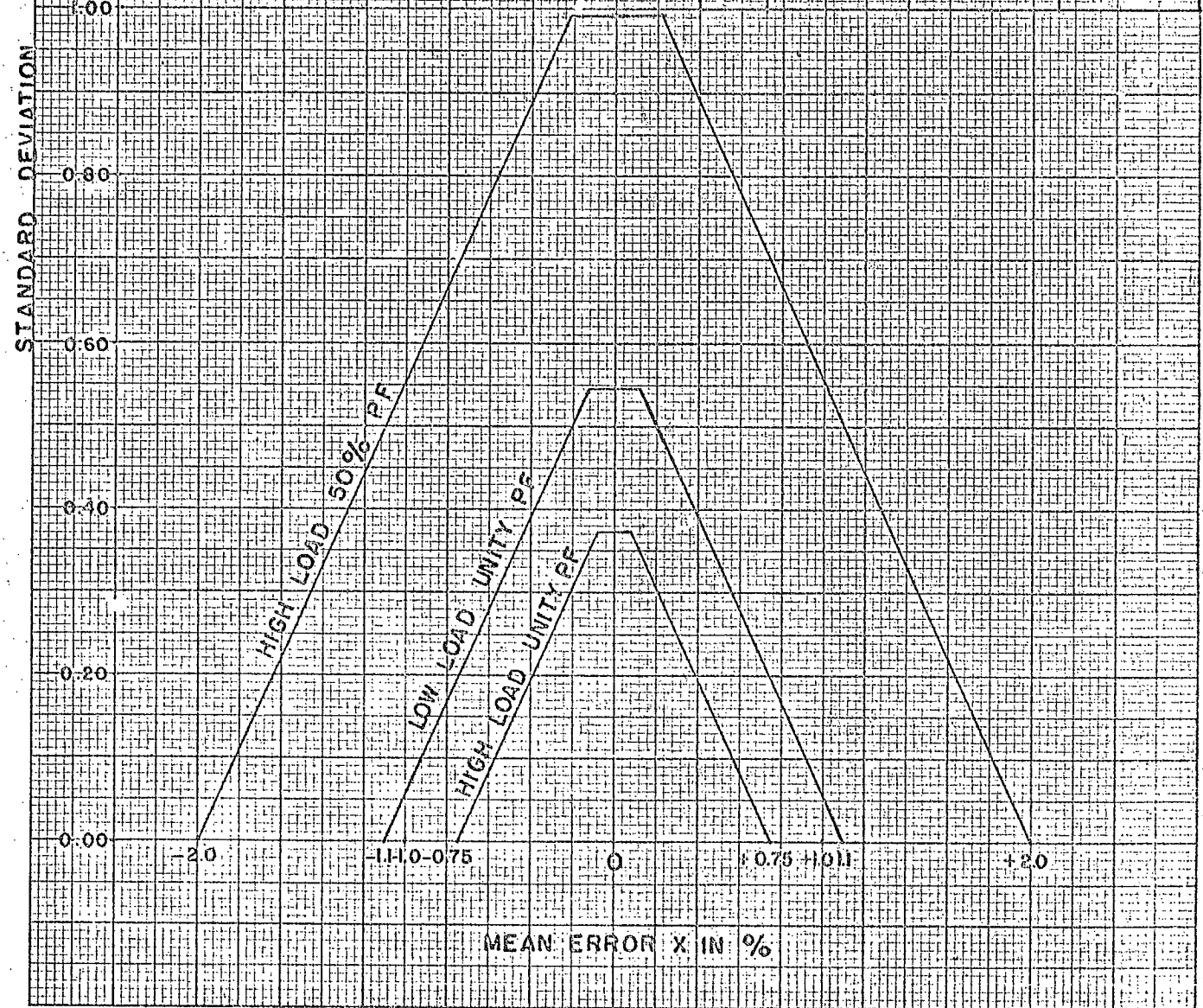
STATISTICAL SAMPLING OF REVERIFIED METERS

STANDARD DEVIATION METHOD

FOR AQL = 1%

SAMPLE SIZE 15

	4.0% BASE	2.2% BASE	1.5% BASE
S_1	1.117	0.612	0.418
S_2	0.992	0.546	0.372



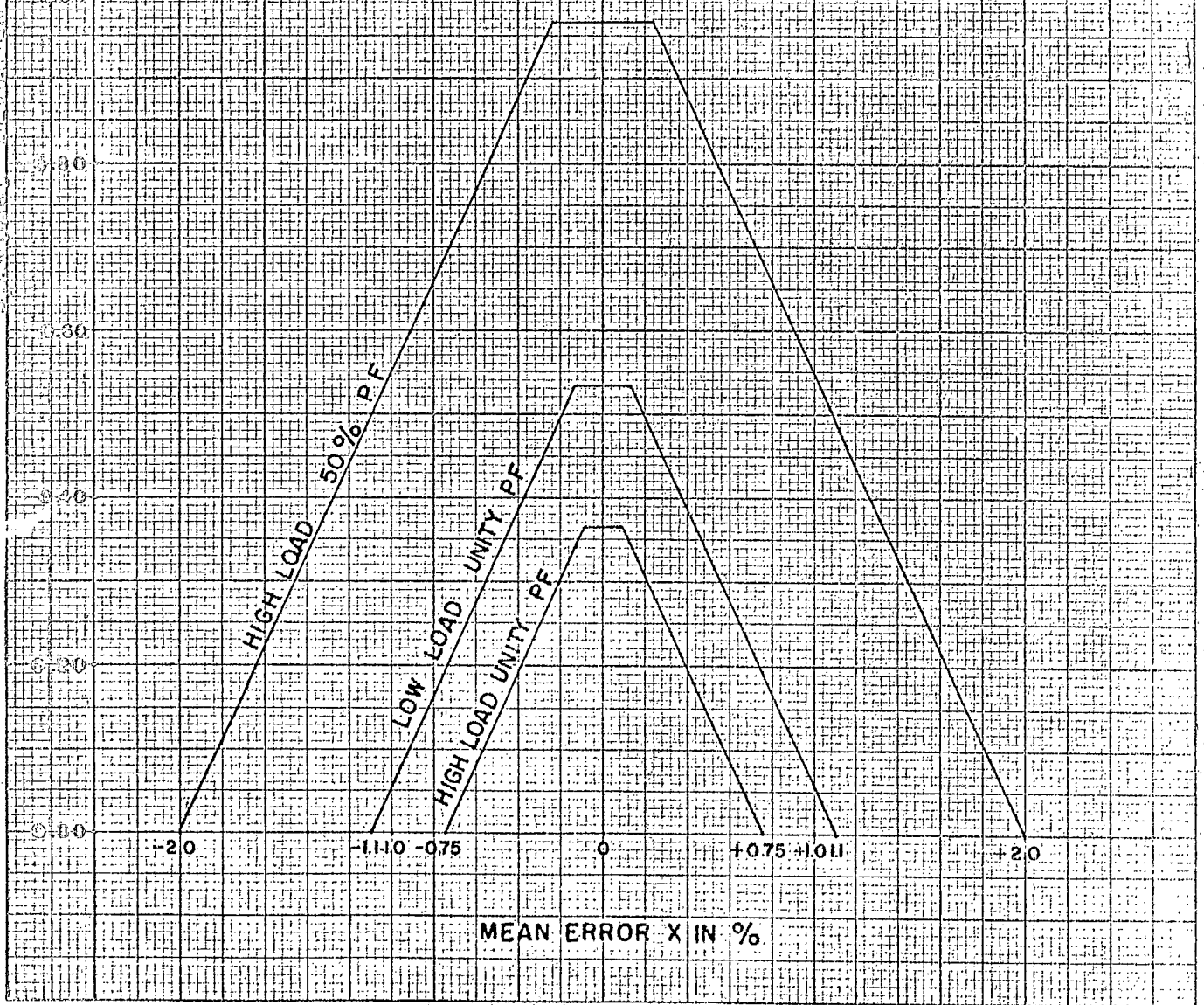
FEB - 1976

ACCEPTANCE REGION

STATISTICAL SAMPLING OF REVERIFIED METERS

STANDARD DEVIATION METHOD FOR AQL = 1%

	SAMPLE SIZE 20		
	4.0% BASE	2.2% BASE	1.5% BASE
S_1	1.099	0.604	0.412
S_2	0.968	0.532	0.363



FEB - 1976

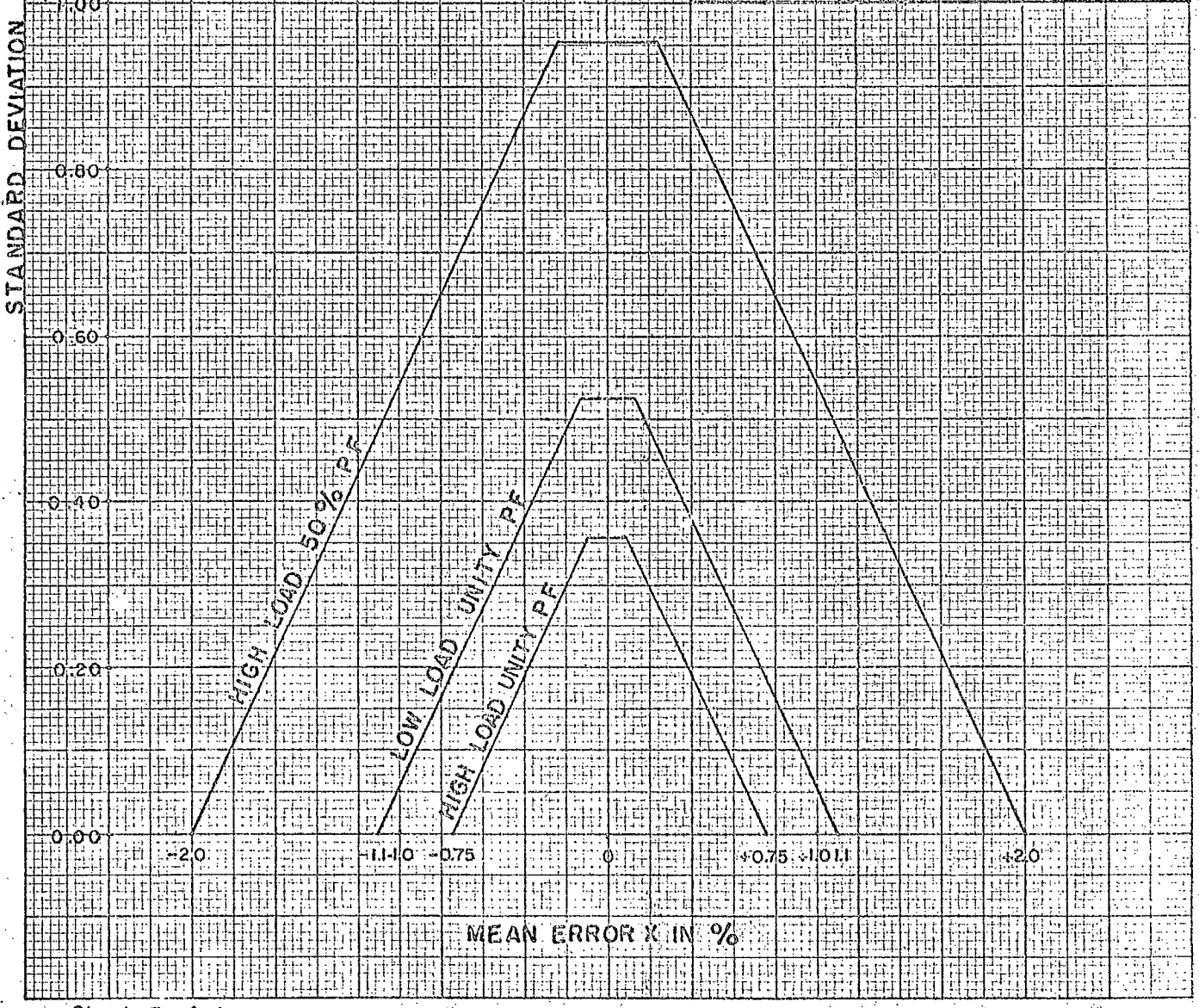
ACCEPTANCE REGION

STATISTICAL SAMPLING OF REVERIFIED METERS

STANDARD DEVIATION METHOD FOR AQL = 1 %

SAMPLE SIZE 25

	4.0% BASE	2.2% BASE	1.5% BASE
S_1	1.081	0.595	0.405
S_2	0.952	0.524	0.357



FEB - 1976

ACCEPTANCE REGION

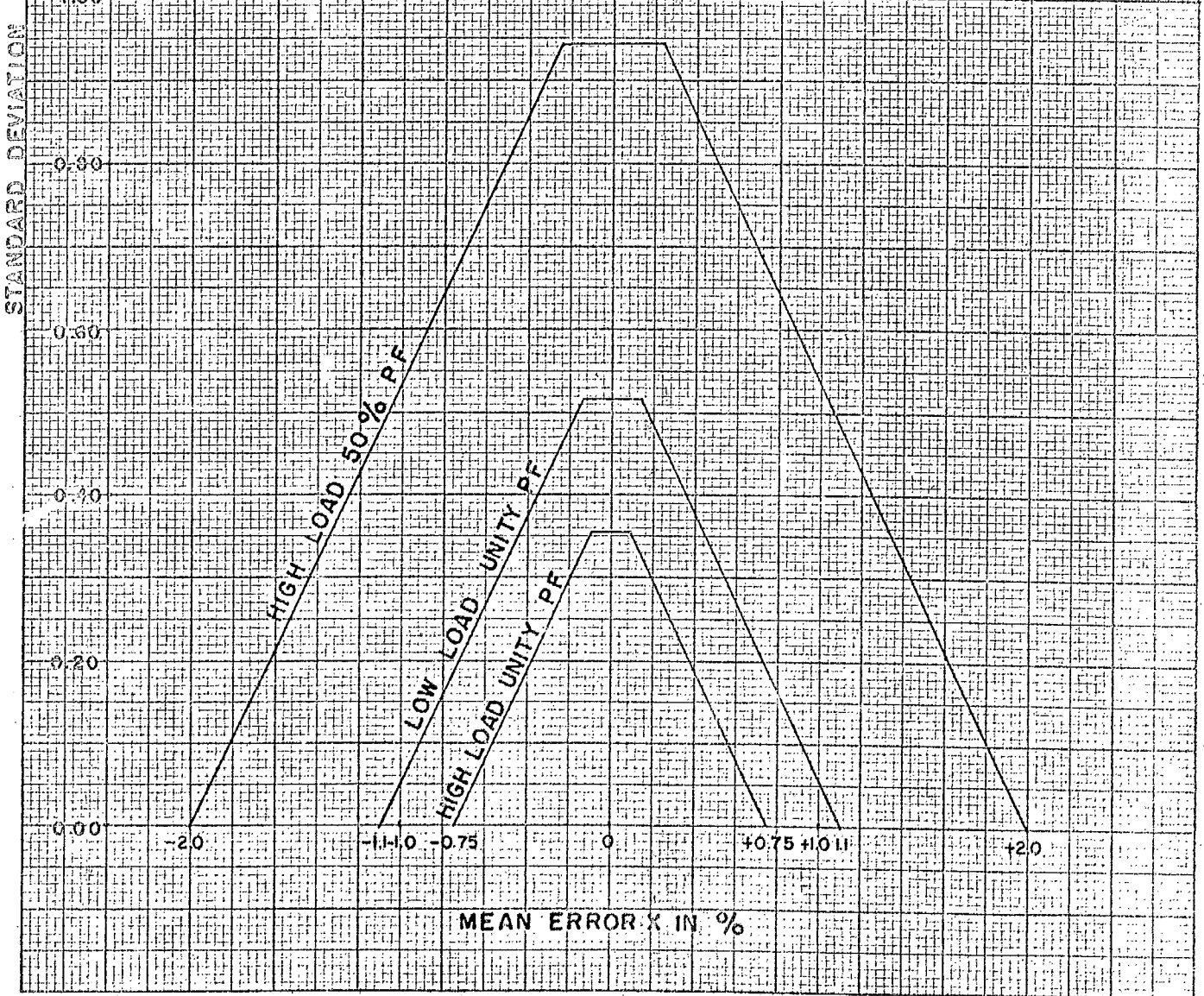
STATISTICAL SAMPLING OF REVERIFIED METERS

STANDARD DEVIATION METHOD

FOR AQL = 1 %

SAMPLE SIZE 30

	4.0% BASE	2.2% BASE	1.5% BASE
S_1	1.075	0.591	0.403
S_2	0.944	0.517	0.353



RULES FOR VERIFICATION OF NEW NETWORK METERS

1. SCOPE

1.1 Authorization

These rules cover the requirements for verification of new network meters entering service after January 1, 197 .

2. INSPECTION METHODS

2.1 Factory Calibration

While it is recognized that new meters have been calibrated and subjected to quality control procedures at the manufacturer's plant, for purposes of these rules "initial verification" means the verification of new network electric meters which takes place at the utility meter shops, independent meter shop, or District Office under the direction of an inspector.

2.2 Initial Verification by 100% Inspection

Except as provided under Section 2.3, the procedure for initial inspection of new network meters shall be by 100% inspection.

2.3 Initial Verification by Sampling Procedures

Where the sizes of shipments from meter manufacturers are sufficiently large, the utility may choose to have its new network meters inspected under a sampling procedure. In such cases, the inspector shall select a sample of meters from the lot presented for test, in accordance with Table I, Section 2.6 and verify the accuracy of the sample as outlined in Section 3.3. The selection of the sample shall be strictly random. The method of presentation of the lot and sample shall be determined by agreement with the District Office concerned.

2.4 Lot of New Meters

Where the utility has chosen to have its network meters inspected under the sampling procedure the meters shall be presented in lots. A lot may embrace a whole shipment from one manufacturer or be a part of a shipment but in no case shall a lot consist of more than 500 meters. A lot shall be strictly homogeneous as far as type is concerned and may not include meters of more than one rating.

2.5 Lot Identification No.

Every lot verified by sampling shall be assigned an identification number. This number is for departmental reference purposes and does not have any long term significance. However, the District Inspector must ensure that a designation completely and clearly distinguishes a lot from any other lot or group of the utility or those of other utilities in his area. The designation should distinguish between lots of network and lots of single-phase meters for example.

2.6 Sample Size

Table I below shows the authorized size of a sample in relation to the size of the lot.

TABLE I

Lot Size	Sample Size	$\bar{X}$ and s Required
1 to 19	100% inspection	No
20 to 40	20 or optional 100% inspection	Yes
41 to 110	20	Yes
111 to 180	25	Yes
181 to 300	30	Yes
301 to 500	35	Yes
501 to 700	40	Yes
701 to 1000	50	Yes

Where the sampling procedure has been chosen by a utility as the usual method, note that:

(i) for lot sizes of 20 and under 100% inspection is mandatory;

(ii) for lot sizes 21 to 40 sampling is optional and the choice of method may be influenced by a number of factors;

(iii) for lot sizes above 40, sampling is mandatory.

3. INITIAL VERIFICATION TESTS

3.1 Dial Test and Mechanical Inspection

All network meters shall be subjected to a dial test and mechanical inspection by an inspector. The meters shall be run on dial test for sufficient time to produce at least one complete revolution of the test dial or lowest reading dial of the register. Wherever feasible longer dial test runs should be made.

The dial test must be very carefully made. The test equipment and procedure shall be such that there will be good expectations of detecting registers which are in error as little as ±3%. Preferably the dial test should be made after the load tests. If the dial test is made in advance of the load tests sufficient time must elapse between dial tests and load test to ensure that meters have returned to ambient temperature.

At the time of making the dial test, all meters should be examined to ensure that there are no obvious loose screws, etc., and that all conform to the approval requirements.

3.2 Creep Test

All meters subjected to load test must also be subjected to a "creep test". This test shall be made with both voltage coils energized and in parallel. See Part XI for definition of creep.

3.3 Accuracy Tests

3.3.1 Test Loads

Every meter nominated for full tests shall be subjected to the following:

Low Load, Unity Power Factor, current coils in series;
High Load, Unity Power Factor, current coils in series;
High Load, Unity Power Factor, each coil separately;
High Load, 50% Power Factor, each coil separately;

The values of High Load and Low Load test currents shall be obtained from the most recent version of Test Table No. 1, Appendix I, PART II.

3.3.2 Meter Registers

Care should be taken with meters fitted with drum-type or cyclometer register that tests are made with only the most rapidly moving drum turning.

3.3.3 Meter Pre-conditioning

It should be emphasized once again that new meters should be tested under essentially the same conditions as pertained at the factory. The manufacturer does not energize the voltage

circuit for any length of time before making his test and therefore neither should we. However, it is very important that the meter be "soaked" at meter room temperature for at least four hours in advance of testing.

4. CRITERIA FOR ACCEPTANCE OR REJECTION

4.1 Dial Test and Mechanical Inspection

No specific criteria have been established for defective meters found under the dial test and mechanical inspection. Faults found will be brought to the attention of the manufacturer by Standards (and presumably the utility will do the same) and they will be treated on an individual, lot or shipment basis.

4.2 Creep Test

Any network meter whose disc creeps more than one revolution shall be rejected. If the meter is a member of a sample, it shall be replaced in the sample by another meter before the accuracy tests are made. Generally, a single creeping meter in a sample from a lot would not be cause for concern but if more than one were found the inspector should consult with the utility and investigate the matter. See Section 4.8.

4.3 Accuracy Requirements

4.3.1 100% Inspection

Error limits are as follows:

High load, series:	± 1.0%
Light load, series:	± 1.5%
High load, 0.5 Pf, each coil	- 0.7% to + 1.3%
Element balance, HL, 1.0 Pf:	1.0%

4.3.2 Sampling

$\bar{x}$ and s are to be calculated for the following:

High load, series
Light load, series
Power factor (for each coil)
Element balance, at high load 1.0 Pf

For acceptance, the points must lie within the appropriate truncated triangle of Appendix II or III. (Please note that the outer triangle of Appendix III is redundant.)

For determination of the balance the difference is to be considered positive if the left (upper) element error is more positive than that of the right (lower) element.

4.4 Double Sampling

If a sample fails a second sample of the same size shall be drawn and tested in accordance with Section 3.3. In order for the lot to be accepted the combined sample shall meet the requirements of Section 4.3 using the chart appropriate to the combined sample size.

5. PROCEDURES FOLLOWING ACCEPTANCE OF NEW METERS

5.1 Seal Validity

The seal on a new network electric meter is valid for eight years from the year of sealing, such validity being subject to extension, on the basis of the results of sample test made in accordance with the rules of Part IIIB.

6. PROCEDURE FOLLOWING REJECTION OF NEW METERS

6.1 Rejection of a Lot

If an inspector finds as a result of his tests that a lot of new meters fails to meet the acceptance criteria, he shall immediately take the following actions:

(i) re-check that the calculations have been correctly made;

(ii) check the test conditions, check the test board and make sure that the standards used are not responsible (see separate rules for checking out test boards, etc.)

(iii) advise the utility of the rejection.

It cannot be too strongly emphasized that in all cases of the rejection of new meters, the first responsibility of the inspector is to ensure that the test conditions and test equipment are not themselves at fault. In the case of small utilites or others which do not have frequent opportunities for check the burden of proof falls even more heavily on the test facilities.

6.2 Rejection of Individual Meters

Where individual meters have been rejected as result of 100% inspection, SMALL LOTS, dial tests, etc., such meters may be calibrated or otherwise serviced by the utility to bring them within the tolerances outlined in Section 4.4. The meters shall then be presented to the inspector for verification and sealing and if passed shall be considered the equal of other accepted meters under these rules.

6.3 Re-Instatement of Rejected Lots

As already noted, where a lot has been rejected all reasonable measures having been taken to ensure that there has been no error introduced by equipment or standards, the meters of the lot may be re-calibrated and then re-presented to the inspector for verification. The inspector shall treat them as any other lot of new* meters. It should be stressed, however, that not all the meters in a rejected lot should be re-adjusted, only those which are significantly out of line.

A lot of new meters which has been re-serviced and re-calibrated shall be assigned a new lot identification number. Such meters if passed shall be sealed by the inspector and shall be considered of equal status to other new meters accepted under these rules. Where possible, nevertheless, the district should endeavor to keep informed as to what happens to rejected lots. That is, there may be some value in the district and region knowing whether rejected lots are being returned to factory or re-serviced in utility meter shop, whether such lots when re-calibrated at factory are returned to same utility, etc.

*NOTE: The procedure should be as follows, for example:
Lot No. XY99 - rejected. Field note made but meter cards not prepared.
Lot No. XY100 - accepted. Field note made and meter cards prepared.

The same meters are in both lots and both are treated as new lots but the District Office staff need not get confused because only the meters of the accepted lot are entered in the meter record.

7. RECORDS AND REPORTS

7.1 Dial Test and Mechanical Inspection

Each District Office shall report on form CCA-1441 the network meters found defective under dial test and mechanical inspection.

7.2 Monthly Report of New Network Meters Sample Tested

At the end of each month, each District Office shall forward to Standards the statistics of all lots of new network meters tested under the sampling procedure during the month. Report on form in Appendix V.

7.3 Summary of New Network Meters Sample Tested

When reports from all the Districts have been received, Standards shall summarize the statistics obtained for each make and type. The summary shall include a listing of all the lots tested during the month together with the mean and standard deviation for each test load of each lot. See form in Appendix VI.

Copies of the summaries for all types shall be sent to the District Offices and the summary which concerns his own type shall be sent to each manufacturer.

RULES FOR EXTENSION OF SEAL PERIOD OF NETWORK WATTHOUR METERS BY STATISTICAL SAMPLING METHODS

1. SCOPE

1.1 Authorization

These rules cover the requirements of a statistical sampling program for seal extension of self-contained network type, polyphase, electric watthour meters. Any utility may choose to adopt this program, subject to the requirements of the rules regardless of whether or not it has opted for sampling of new network meters under Part IIIA. These rules are essentially consistent with those issued January 4, 1971 under the same title.

2. INSPECTION METHODS

2.1 Formation and Composition of Groups

Subject to the approval of Standards, the meters that a utility chooses for the statistical sampling programme shall be placed in homogeneous groups which will normally be formed according to type and seal vintage for example. Subsequently, groups may be modified or combined if warranted by the performance data. It must be noted that transformer types cannot be included in such groups.

Groups may be formed from meters of the same type having two successive seal dates. (The testing of the sample should take place early in the year in which the earlier of the two sub-groups is due.)

Groups which include overdue meters or meters where the expiration of the seal period is imminent will not be permitted.

2.2 Group Size

Because of the limited service use of network meters, groups will tend to be small. No restrictions apply as to maximum size of group.

2.3 Listing and Identification of Groups

A utility wishing to have a group of meters approved for sample testing shall prepare a list of the meters in the group and shall submit a copy of this list to the District Inspector of the area in which the meters are located.

The list of meters for the group shall be so arranged as to facilitate the selection of samples. The inspection numbers shall be presented in vertical columns in ascending order of magnitude and the listing shall normally include a sequential number, the inspection number, serial number, type designation, and the rating of each meter if all meters are not of the same rating. The serial number while generally very desirable may be left off the list if the District Inspector is satisfied that the inspection number sufficiently identifies the meter and that there is no risk that the meter records will become impaired.

Each statistical sampling group shall be assigned an identification number. In the sampling of single-phase meters, it has been the practice to use the initials of the utility with a numerical suffix e.g. Group CP-3 might identify the third group established by the Calgary Power Company. In the case of network meters, it would be preferable that a new series of identity numbers be established. The system of group identity numbers shall be arranged by mutual agreement between the utility and Standards to assure that each utility's identification system is unique.

A heading at the top of the list or on a cover sheet shall give full details of the composition of the group e.g.

> Alberni Power Company
> Group AP-2
> consisting of 1724 NETWORK meters
> Omega Electric Type Z-19
> seal dates 1966 and 1967

Typed lists should show fifty meters per page (or 100 per page if there is room on the sheet to place another 50 adjacent to the first 50). Computer listings are satisfactory since all the sheets are linked together and thus difficulties are not encountered in selecting the sample. Any listing which shows different numbers of meters on each sheet can be a source of error in selecting the sample and entail considerable extra man-hours.

It should be stressed that the list of meters submitted by a utility and designated by a group number explicitly defines and restricts the group if it is approved for sampling. A meter of the same

type and seal vintage deliberately or inadvertently left out of the group shall remain outside the group and shall be treated in the same manner as any other meter not belonging to the group. No meters can be added to the group after the listing has been approved.

2.4 Re-listing Prior to Re-sampling

If, in due course, a utility wishes to re-sample a group already approved for seal period extension in order to further extend the seal period, it may:

(i) submit a new listing of those meters still remaining in the original group but the new listing shall not include any meters not on the original list;

OR

(ii) If the District Inspector approves, submit a list of meters to be deleted from the original list for any valid reason.

The new sample shall be drawn from what remains of the group on the basis of the number of meters still left. While there is no objection to a few meters selected for the first sample being called for the second sample, it is considered undesirable that more than 10% of the sample should thus be chosen in a row. If this should happen the procedure for sampling should be repeated or the method of choice changed.

2.5 Selection of Samples

2.5.1 Method of Selection

For each established group of meters, a random sample shall be taken before any of the meters are due for re-verification, and further samples may be taken every two years thereafter, as long as the sample tests conform with the requirements. The samples shall be chosen by the District Office.

2.5.2 Timing of Tests

Where the group consists of a single seal vintage, the sample shall be drawn and the tests made before, but not too long before, the beginning of the year in which the meters are due. Where the group includes two seal vintages, the sample shall be drawn and the meters tested towards the end of the year preceding the earlier of the two due dates or shortly thereafter. In

some circumstances sampling and testing may be permitted up to April of the earlier due date year but it is stressed that the intent should always be that, as far as practicable, the timing of the sample tests should be such that they represent the condition of the meters on the due date yet not so late as to cause difficulties in bringing in all of the due meters if the sample should fail.

2.6 Sample Size

The nominal sample size n, shall be as given in Table I, PART IIC, page 75.

The actual number of meters selected for sample shall approach but not exceed 115% of the nominal sample size.

2.7 Presentation of Sample for Test

Every meter selected for the sample shall be transported to one location for testing, except when it is determined that either:

(i) the meter does not belong to the group being sampled;

OR

(ii) the meter has previously been removed or processed in a fashion to disqualify it from the sample.

In each case when a selected meter is not transported to the location for test the explanation shall be recorded by the utility and reported to the District Office.

3. VERIFICATION TESTS

3.1 Creep Test

All meters from the sample shall be submitted to a "creep test". This test shall be made with both voltage coils emergized in parallel. A meter shall be considered to creep if the meter disc makes one full revolution within 10 minutes.

3.2 Accuracy Tests

Tests will be as specified for 2-element meters in Test Table #1, Appendix 1, Part II.

4. CALCULATIONS

4.1 Errors

The following errors shall be determined for each meter:

HL-S, High Load, 1.0 P F, current coils in series
Unbalance, the difference between the errors for the two elements, tested singly.
LL-S Light Load, 1.0 P F, current coils in series
PF-1 High Load, 0.5 P F, #1 current coil
PF-2 High Load, 0.5 P F, #2 current coil.

4.2 The Sample Mean

The sample mean, $\bar{X}$, shall be calculated, for each of the five sets of errors described in Section 4.1, as follows:

$$\bar{X} = \frac{\sum x}{n_s}$$

where n_s = the number of meters in the selection that contributes to the final calculation.

4.3 The Sample Standard Deviation

The sample standard deviation, s, shall be calculated, for each of the five sets of errors described in Section 4.1, as follows:

$$s = \sqrt{\frac{n_s \sum x^2 - (\sum x)^2}{n_s (n_s - 1)}}$$

4.4 Outliers

An outlier shall be a meter for which the error at any one of the points described in Section 4.1 is both:

(i) more than three standard deviations from the sample mean, $\bar{X}$, for that set of errors; and

(ii) above +3% or below -3%.

The final calculations for $\bar{X}$ and s shall exclude sample meters which are outliers. In some cases when judging whether a particular meter is an outlier or not, it is necessary to calculate $\bar{X}$ and s with the error of the particular meter excluded. If the meter then conforms to the above criteria, it is an outlier.

Meters with the largest errors shall be judged and excluded, if necessary, before meters with smaller errors.

5. CRITERIA FOR ACCEPTANCE OR REJECTION

5.1 Sample Acceptability

The number of meters, n', selected for the sample - less the number of meters, b, in the selection found not belonging to the group - less the number of meters, n_s, in the selection that contribute to the final calculations of $\bar{X}$ and s, shall not exceed 15% of the nominal sample size, n.

That is

$$n' - b - n_s \leq 0.15n$$

where $n_s \geq 0.95n$

n_s is the number of meters included in calculations for $\bar{X}$ and s after the outliers have been excluded.

5.2 Outlier Acceptability

The criteria governing the maximum number of outliers permitted shall be the same as in clause 5.3 of PART IIC.

5.3 Accuracy Acceptability

If the points obtained, using the values of $\overline{X}$ and s for each of the sets of errors (defined under Section 4.1) as co-ordinates, all fall within the acceptance triangle (Appendix VII for the appropriate sample size) the group shall be deemed to conform to the accuracy requirements of these rules.

5.4 Creep Acceptability

If a meter creeps, its rate of creep shall be recorded on the test data sheet. Normally, creeping meters shall not be a cause for rejection of a group. However, if the number of creeping meters is large and the rates of creep significant the group may be considered for rejection by Standards.

6. PROCEDURE FOLLOWING ACCEPTANCE OR REJECTION OF A GROUP

6.1 Extension of Seal

If a sample meets the requirements of Sections 5.1 and 5.2, the group from which it was taken shall be eligible for an extension of the seal period previously established. Groups consisting of meters having magnetic suspension of the disc shall be eligible for a four year extension. For others the permissible extension is two years.

6.2 Treatment of Sample Meters

A sample meter from an accepted group may, if the utility so desires, be returned to service as a member of the original group provided that:

(i) it has not had its seal broken (new seals with the original seal date may be applied to such meters if the old seals are undecipherable or badly weathered);

(ii) the errors determined for the meter are within 2% for all the basic points listed in Section 4.1.

6.3 Rejection of a Group

If a sample fails to meet any of the requirements of Section 5, the group to which it belongs shall be rejected and each meter of the group shall be brought in for re-servicing and re-calibration before the expiration of its valid seal date. If the group is made up of two seal years, the call-in may, of course, extend over a period of up to two years.

7. RECORDS AND REPORTS

7.1 District Office Procedure

(i) Upon receipt of group listing from utility, if everything is in order, sample meters shall be selected and the sample list prepared. Copies of the sample list shall be sent to the utility and to Standards, Ottawa.

The following information shall also be supplied to Standards:

- the make and type of meters in the group;
- the seal date(s) of the meters;
- the number of meters currently in the group;
- the number of meters in the sample;
- details of the method and calculations used in choosing the sample (NOTE-this will not be required once Standards is satisfied that the whole sampling process is well understood by the district).

(ii) When the sample meters have been brought in to the meter shop by the utility, tests shall be made on the meters in accordance with these "Rules" and the results recorded on tests sheets, a sample of which is shown in Appendix VIII. The utility shall provide a detailed explanation for each sample meter not brought in for test (every effort shall be made to keep the number of such missing meters as near as possible to zero).

(iii) The results of tests shall be analyzed statistically and the acceptance criteria applied. Appendix IX shows the form which shall be used for the statistical analysis; Appendix VII portrays the acceptance regions for the $\overline{X}$ and s plots.

(iv) Field Notes shall also be written to cover groups sampled for seal extension. The make, type, seal year and number of meters in the group shall be recorded as well as the statistical results of sampling. Details of only those meters actually tested, together with their individual errors, shall be recorded.

(v) After a sample from a group has been tested, the District Office shall report its findings to Standards and offer its recommendations regarding acceptance or rejection of the group for seal extension. The report shall include:

- copies of histograms (this is not mandatory but particularly desirable if the results are unusual) (Appendix X);
- a summary showing full details pertaining to the group and sample (Appendix XI);
- a copy of the utility's explanation covering meters of the sample not brought in or tested;
- an explanation of what caused the outliers, either fast or slow to deviate significantly from the rest of the group;
- a tabulation of all the meters of the sample which are not suitable for return to the group. See Section 6.2.

(vi) If the group passes as a result of the sampling, the District Office shall check the group listing against its own records to ensure that the listing is essentially correct.

7.2 Procedure to be Followed by Standards

(i) Standards shall acknowledge receipt of sample list and data from District Office when group is first formed or when it is about to be re-sampled. See Section 7.1 (i).

(ii) Upon the receipt of a report from a District Office concerning the sampling of a group for seal extension (see Section 7.1 (v)), Standards shall advise if it accepts the recommendation or wishes to discuss the matter further. The eventual decision and the consequent action necessary will be passed to the utility by the District Office.

(iii) Standards shall maintain a cumulative summary of the results of sampling of each type of meter and shall report the latest statistics to the manufacturer concerned and to the District Offices at least once a year.

(iv) Statistics shall be charted and analyzed to provide useful and necessary information for continuous monitoring of the inspection program.

RULES FOR REVERIFICATION OF RESERVICED NETWORK METERS

1. SCOPE

1.1 Authorization

These rules cover the requirements for verification of reserviced network meters which have been serviced and calibrated in the utility meter shop and presented for inspection subsequent to January 1, 1976.

2. INSPECTION METHODS

2.1 Verification by 100% Inspection

Except as provided in Section 2.2 the procedure for verification of reserviced network meters shall be 100% inspection.

2.2 Verification by Sampling Procedure

Where the number of meters being processed by a utility is sufficiently large, the utility may choose to have its reserviced network meters inspected under a sampling procedure. In such cases the Inspector shall select a sample from the lot presented for test, in accordance with Table 1, Section 2.7 and verify the sample as outlined in Section 3. The selection of the sample shall be strictly random. The method of presentation of the lot and sample shall be determined by agreement with the District Office concerned.

2.3 Verification by Witness Testing or Sampling

The requirements governing witness testing or sampling are as set out in Sections 2.5 and 2.6 of PART IIB.

2.4 Formation of Lots

The requirements governing the formation of lots are as set out in Sections 2.1 and 2.2 of PART IIB.

3. VERIFICATION TESTS

Details of the tests required are as set out in Section 3 of PART IIIA.

4. CRITERIA FOR ACCEPTANCE

The criteria for acceptance are as given in Section 4 of PART IIIA.

5. PROCEDURE FOLLOWING ACCEPTANCE

The basic seal period for reverified network meters is as follows:

i) Those with magnetic suspension: 8 years

ii) Others : 6 years

6. PROCEDURE FOLLOWING REJECTION

The procedures for dealing with lots following rejection are outlined in Section 6 of PART IIIA.

7. RECORDS AND REPORTS

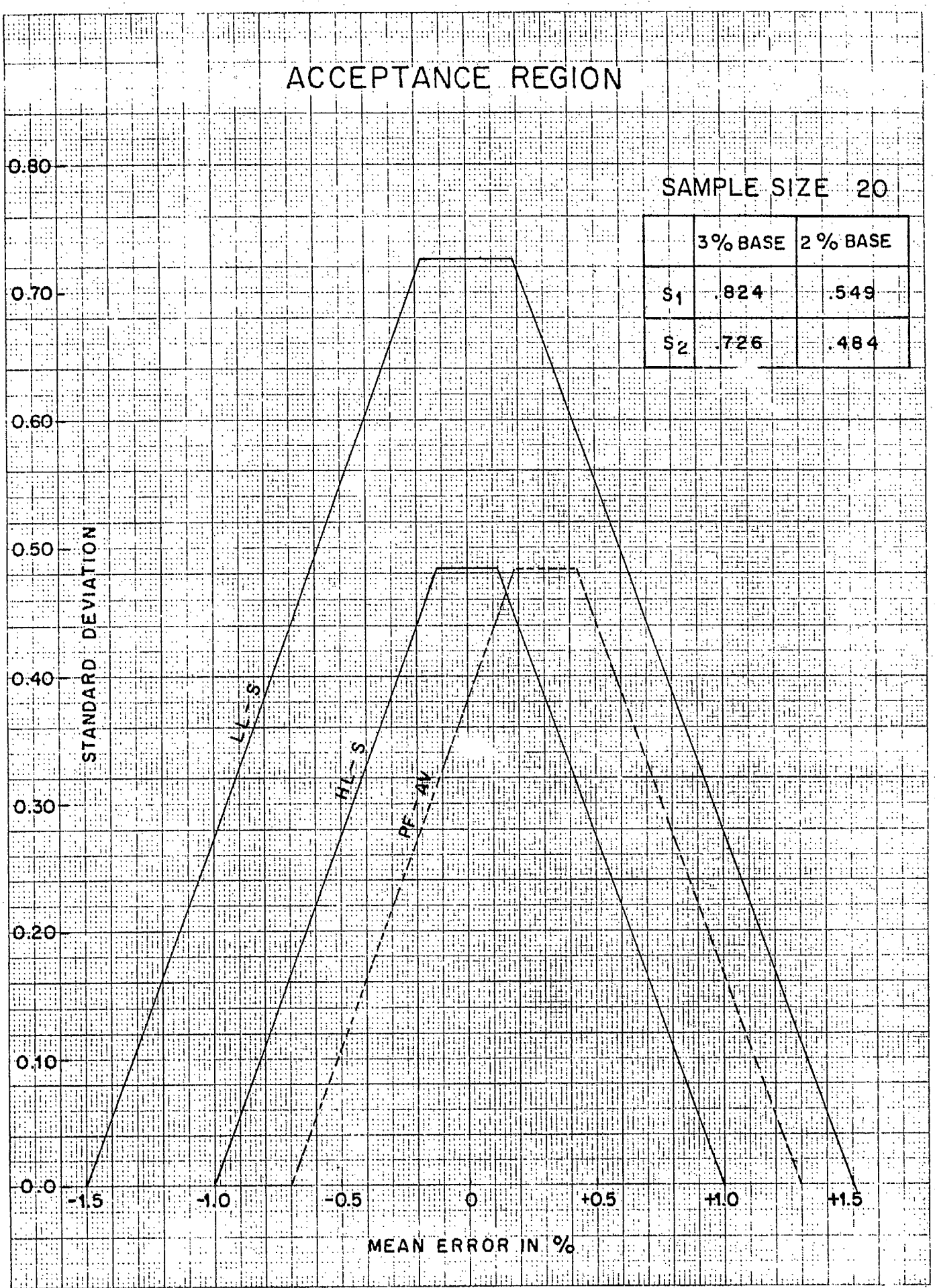
The statistics relating to reserviced network meters are to be reported to Standards monthly on the form shown in Appendix V, PART II.

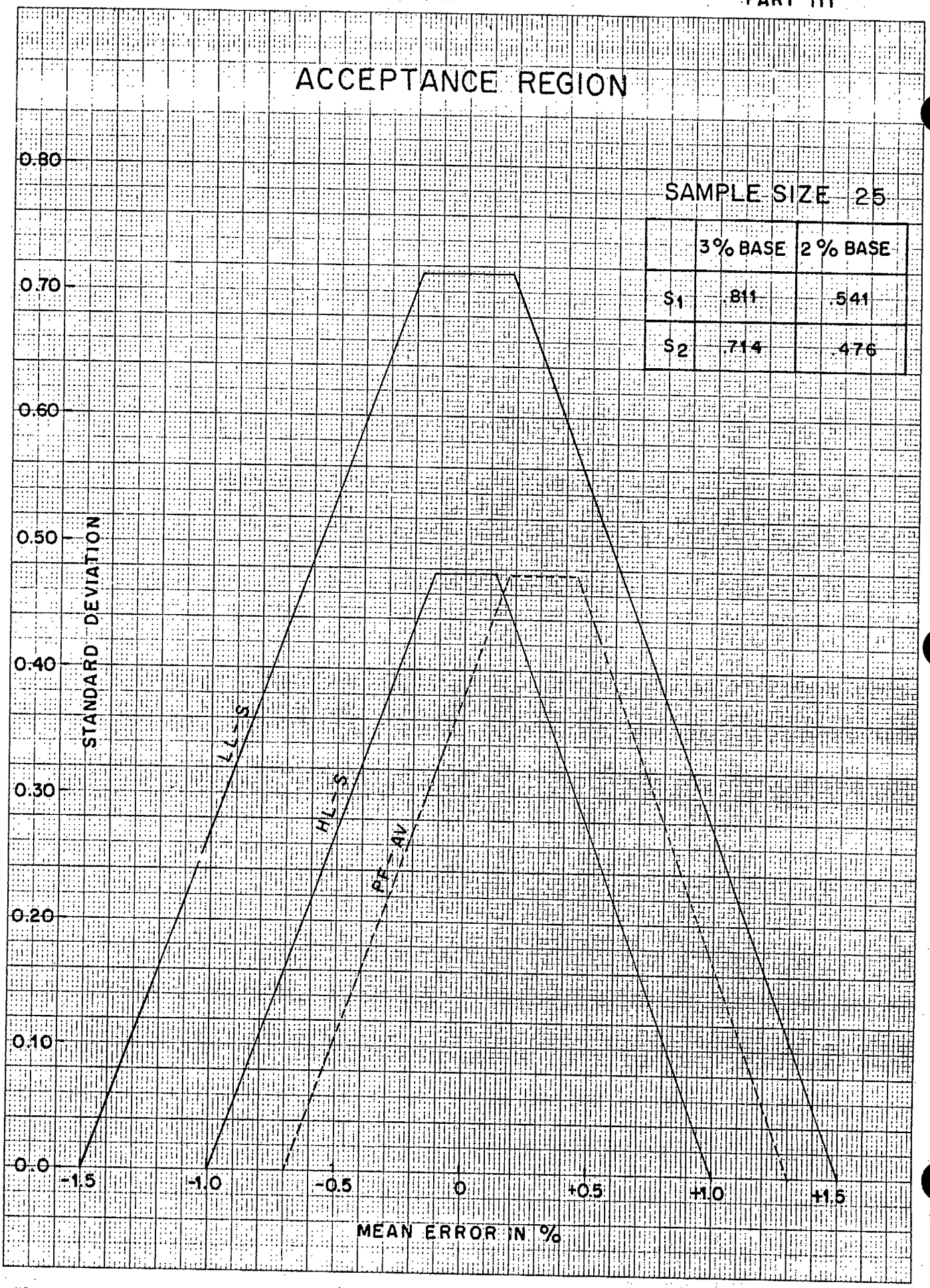
Test Table No. 1 — Watthour Meters

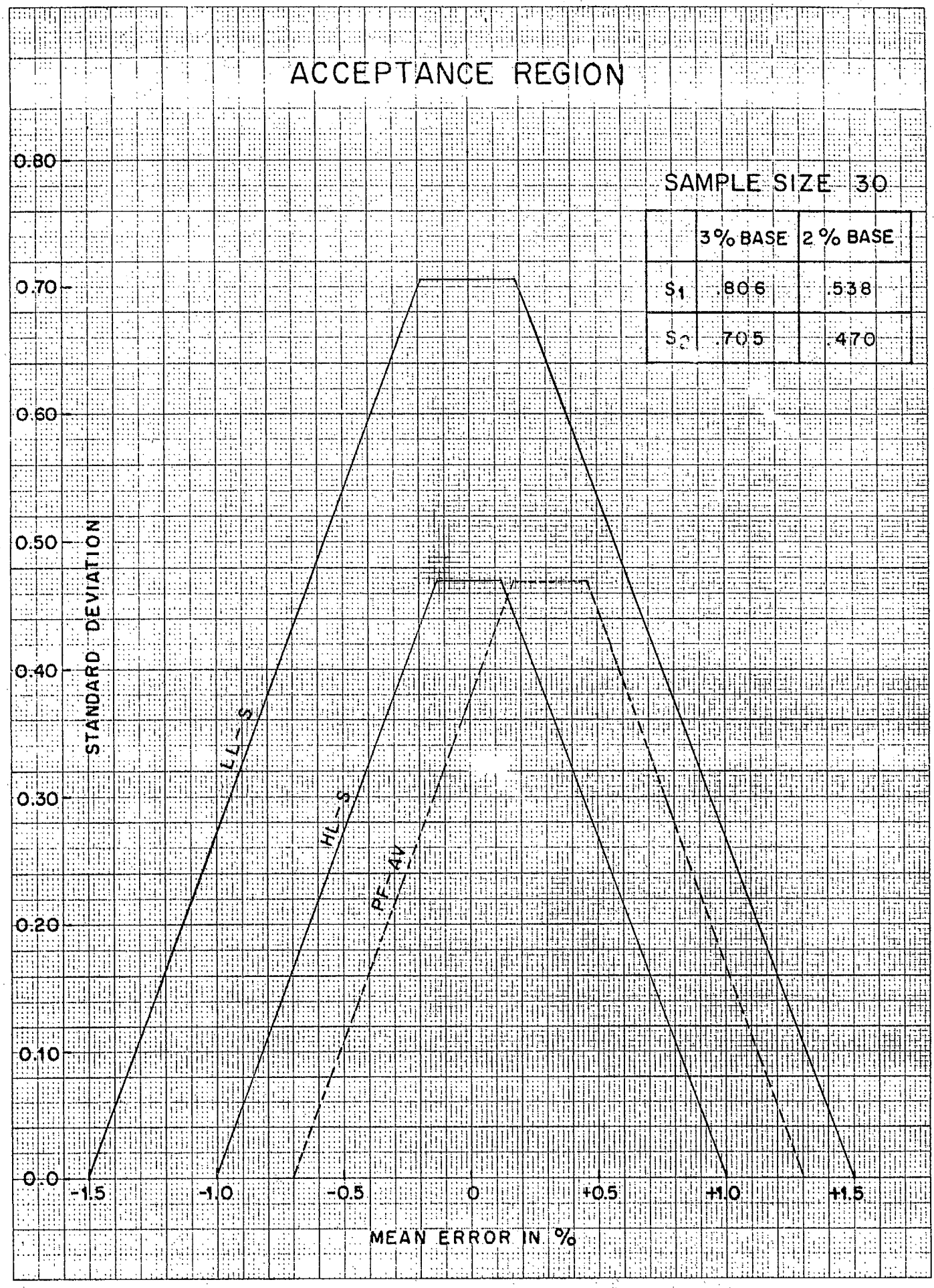
METER TYPE		REQUIRED TESTS	TYPE OF METER RATING					
			RANGE RATED			ALL OTHERS		
			HIGH LOAD	50% P. F.	LOW LOAD	HIGH LOAD	50 % P. F.	LOW LOAD
			TEST % MAXIMUM			TEST % NOMINAL		
1-PHASE, 2-WIRE			25	25	2.5	100	100	10
1-PHASE, 3-WIRE *		Single Coil	50	50	5	200	200	20
		Current Coils in Series	25	25	2.5	100	100	10
NETWORK	VERTICAL	Each Current Coil	25	25	—	100	100	—
		Current Coils in Series	25	—	2.5	100	—	10
POLYPHASE 2 & 3 ELEMENT	VERT. & HOR.	Each Current Coil	25	25	—	100	100	10
	VERTICAL	Current Coils in Series	25	—	2.5	100	—	—
POLYPHASE 2 1/2-ELEMENT Y	VERTICAL	Each Current Coil	50	50	5	200	200	20
	HORIZONTAL	Each Single Coil	50	50	5	200	200	20
	VERT. & HOR.	Split Coil	50	50	5	200	200	20
		All Current Coils in Series	25	—	—	100	—	—
POLYPHASE 2 1/2-ELEMENT DELTA	VERTICAL	2-Wire Element Alone	25	25	2.5	100	100	10
		3-Wire Element (Coils in Series)	25	25	2.5	100	100	10
	HORIZONTAL	2-Wire Element Alone	25	25	2.5	100	100	10
		3-Wire Element (Coils in Series)	25	25	2.5	100	100	10
	VERT. & HOR.	All Current Coils in Series	25	—	—	100	—	—

All potential coils of polyphase meters must be energised with correct voltage during any test except internal-connection test.

Low load tests shall be made at 1.0 P.F. only.







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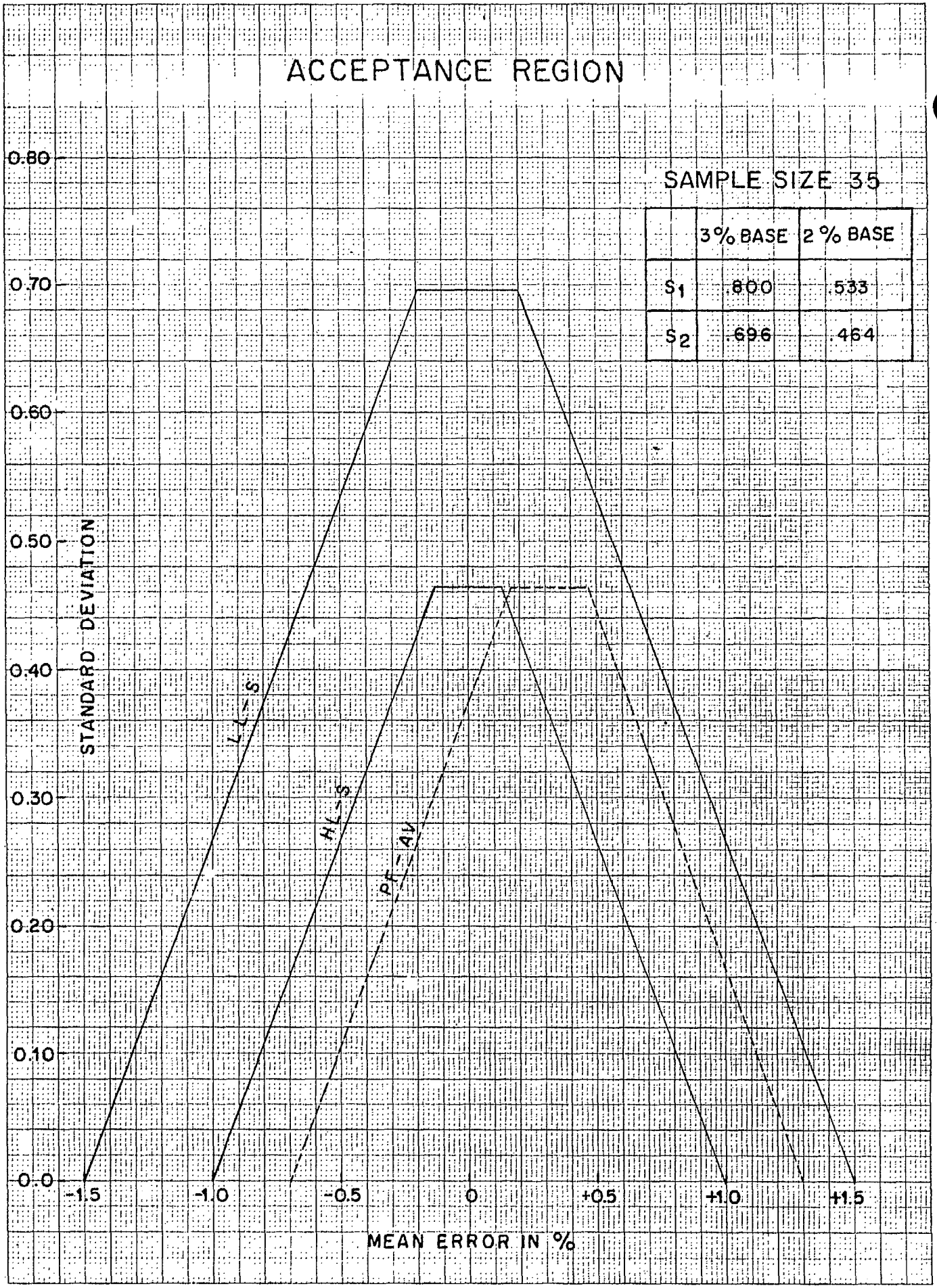
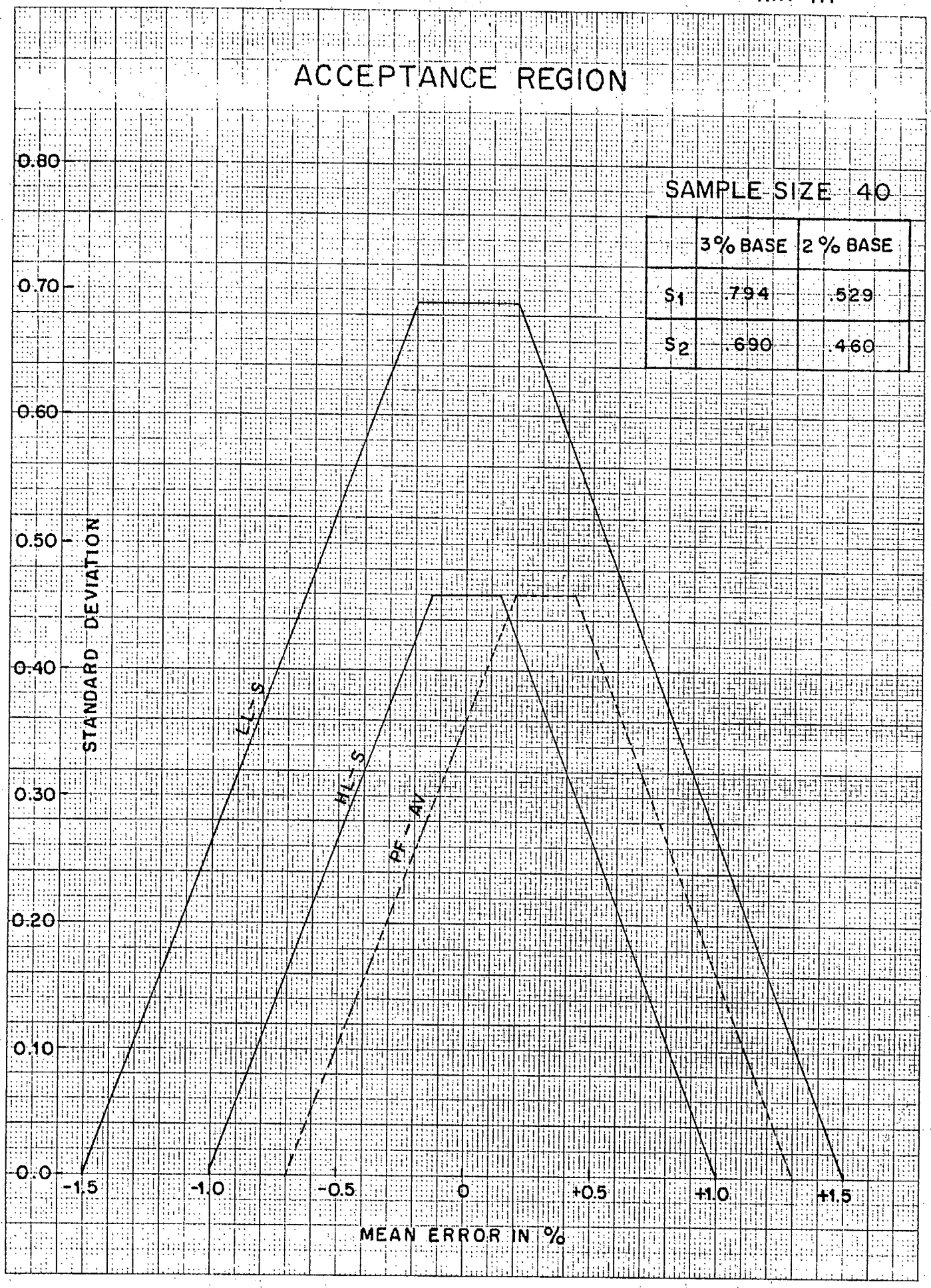
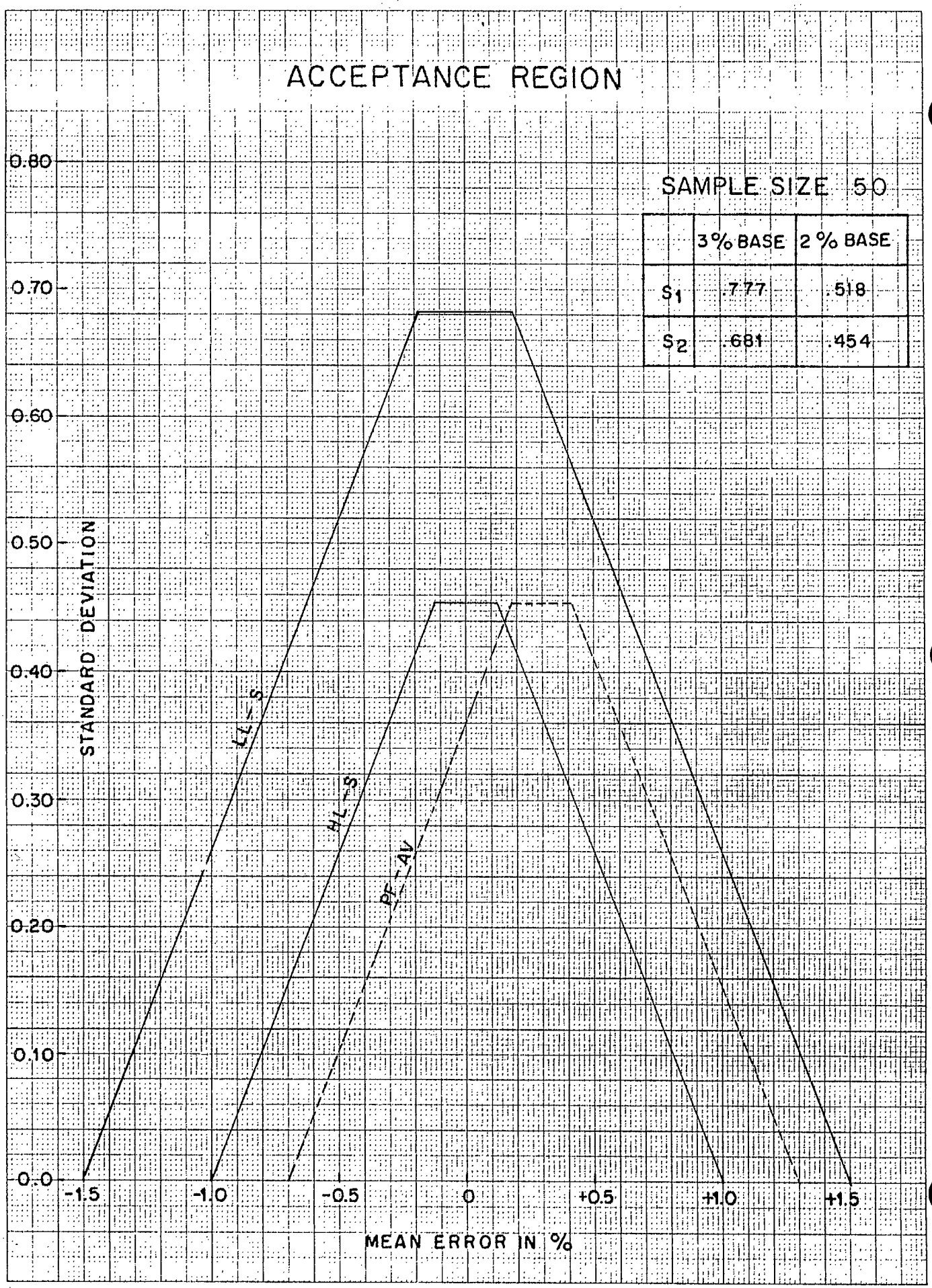


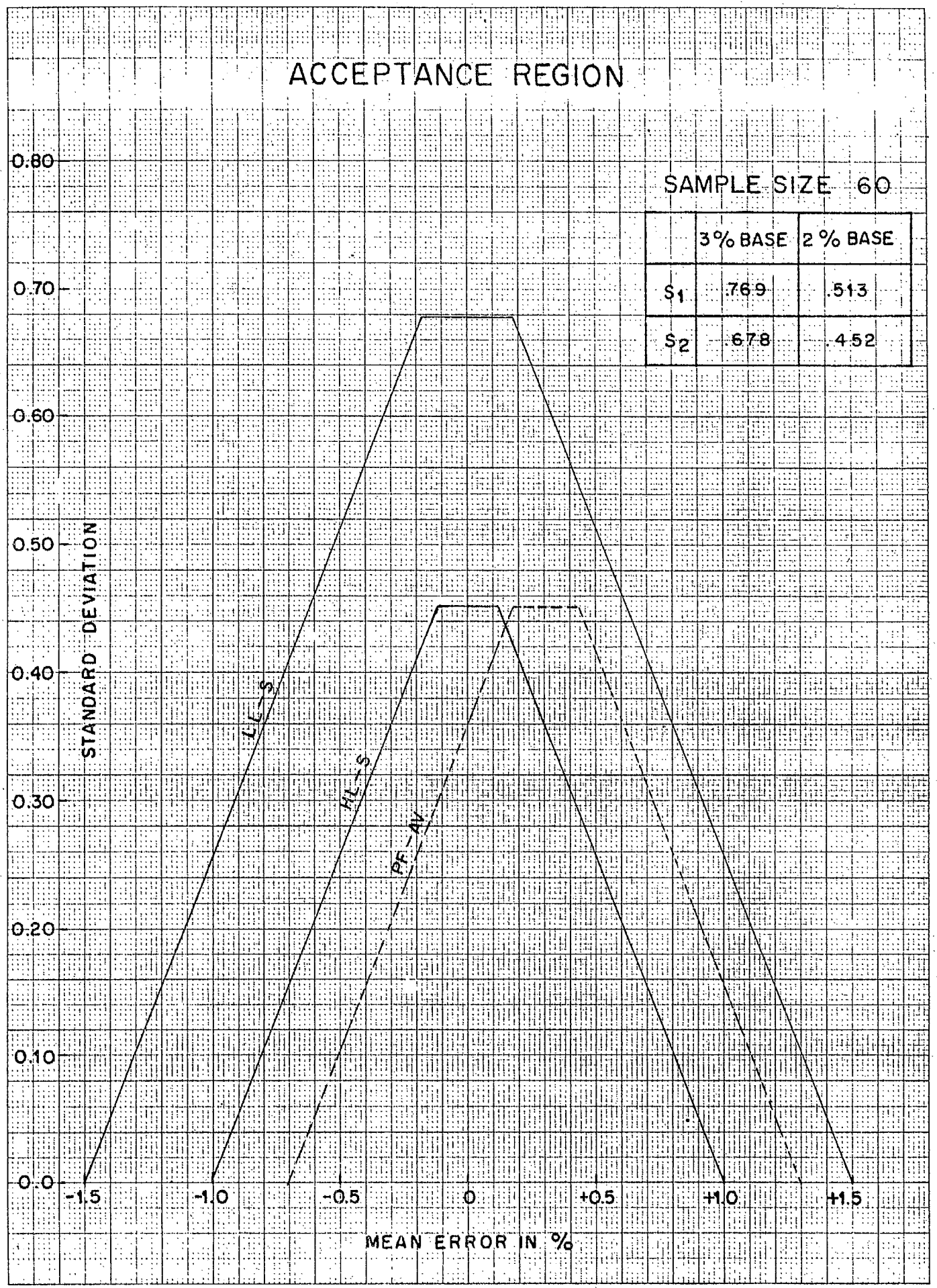
SEP - 1975

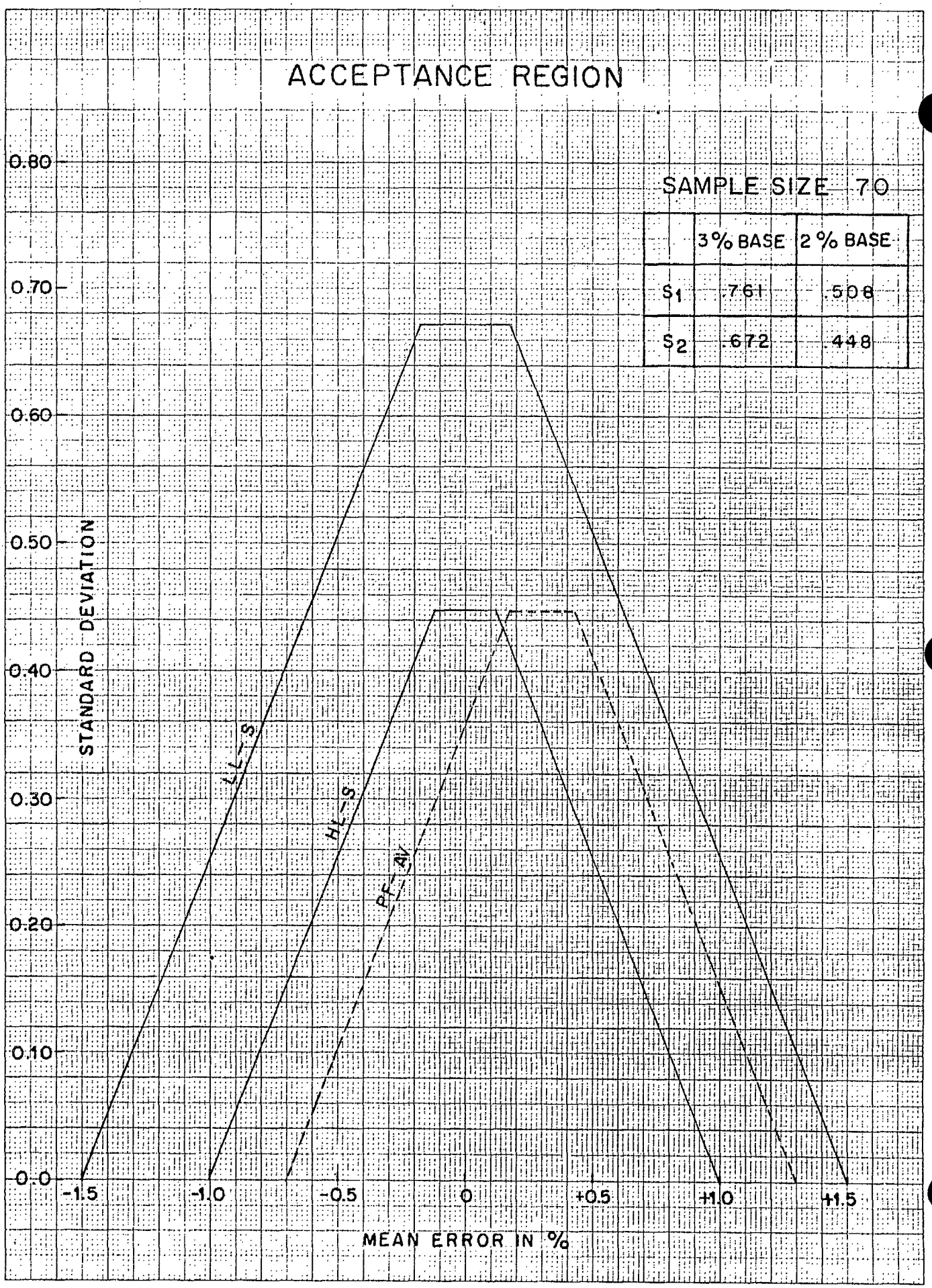


SEP - 1975

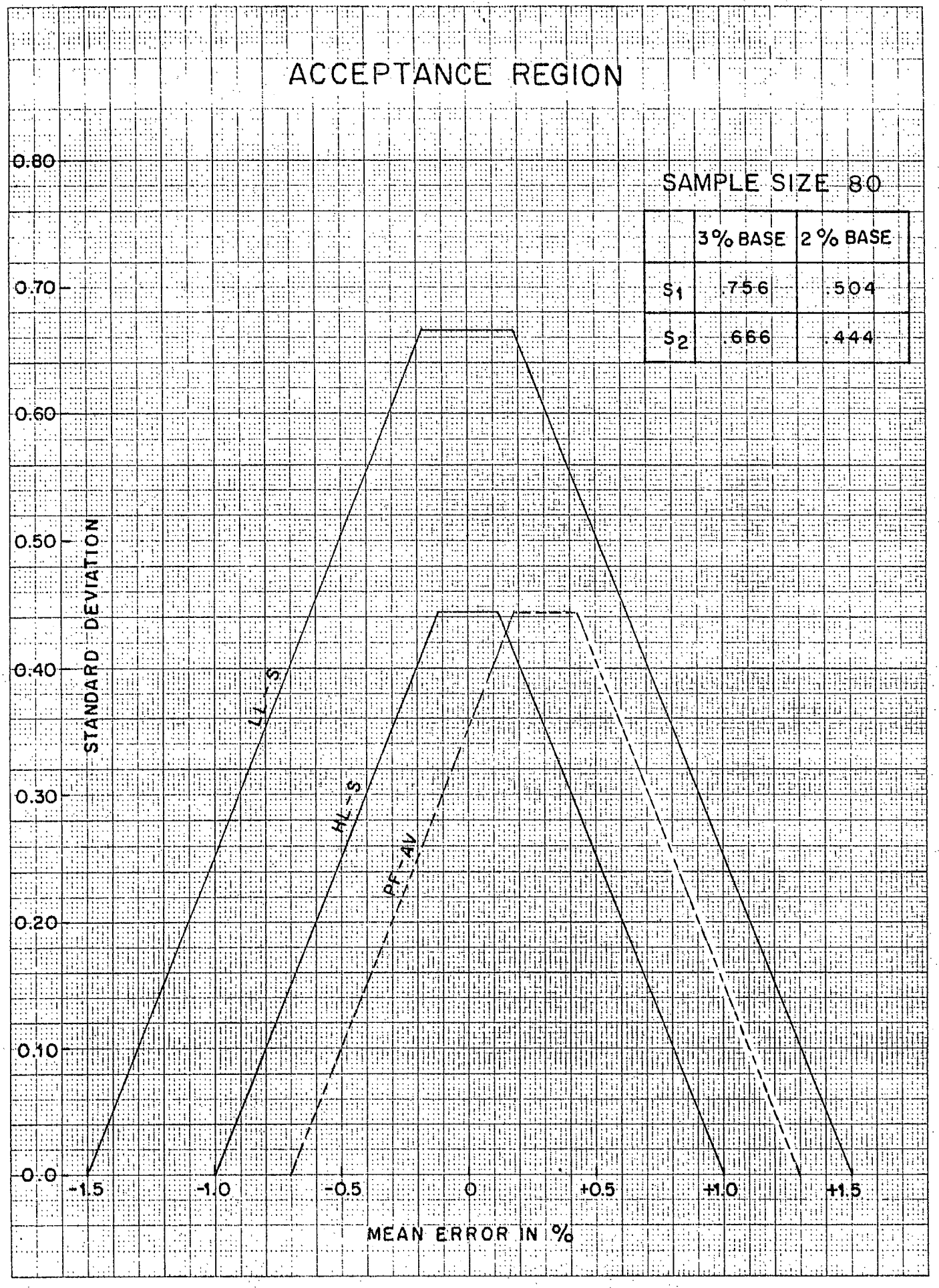


SEP - 1975

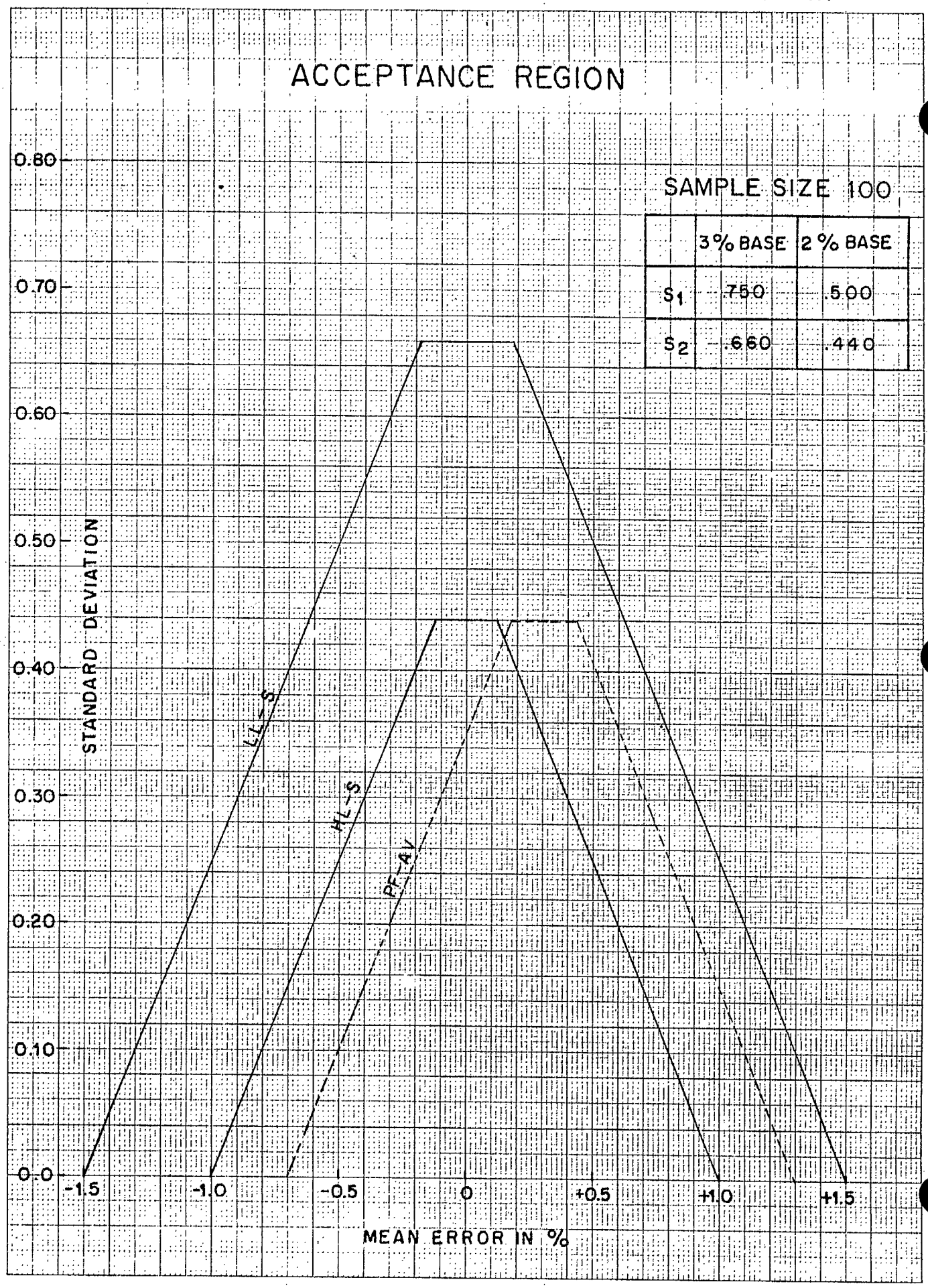




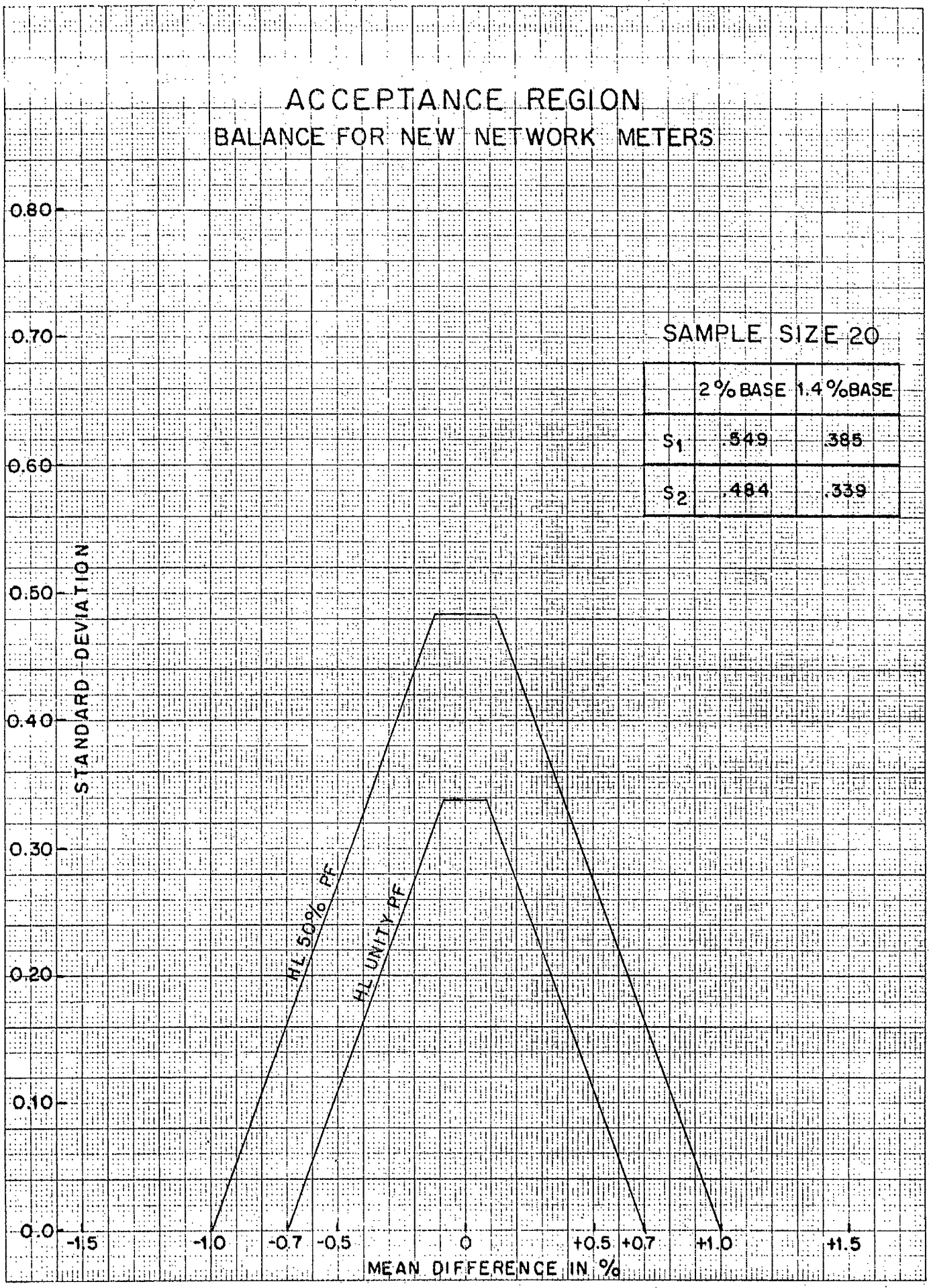
SEP - 1975



SEP - 1975



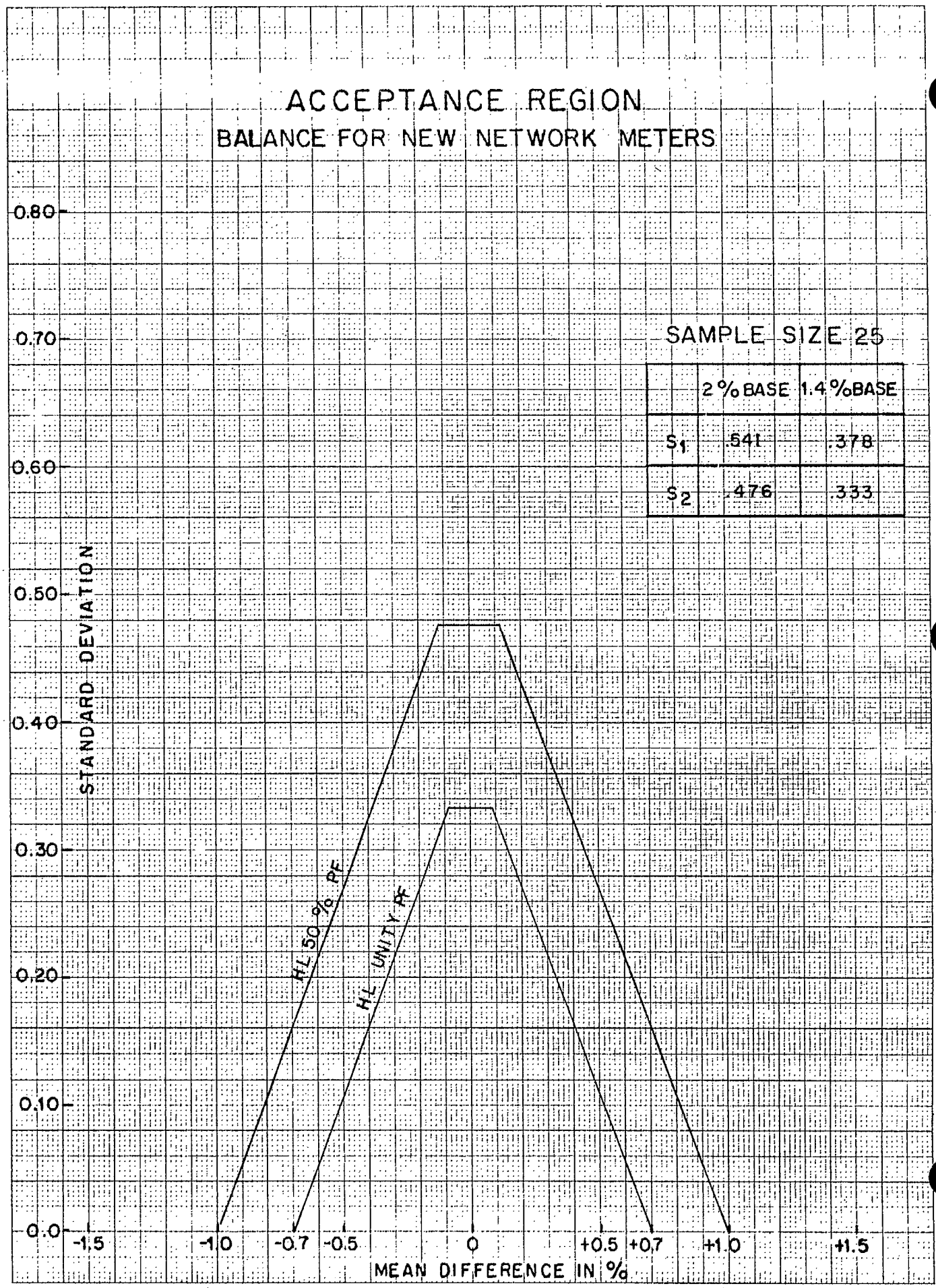
ACCEPTANCE REGION
BALANCE FOR NEW NETWORK METERS



SAMPLE SIZE 20

	2% BASE	1.4% BASE
S_1	.549	.385
S_2	.484	.339

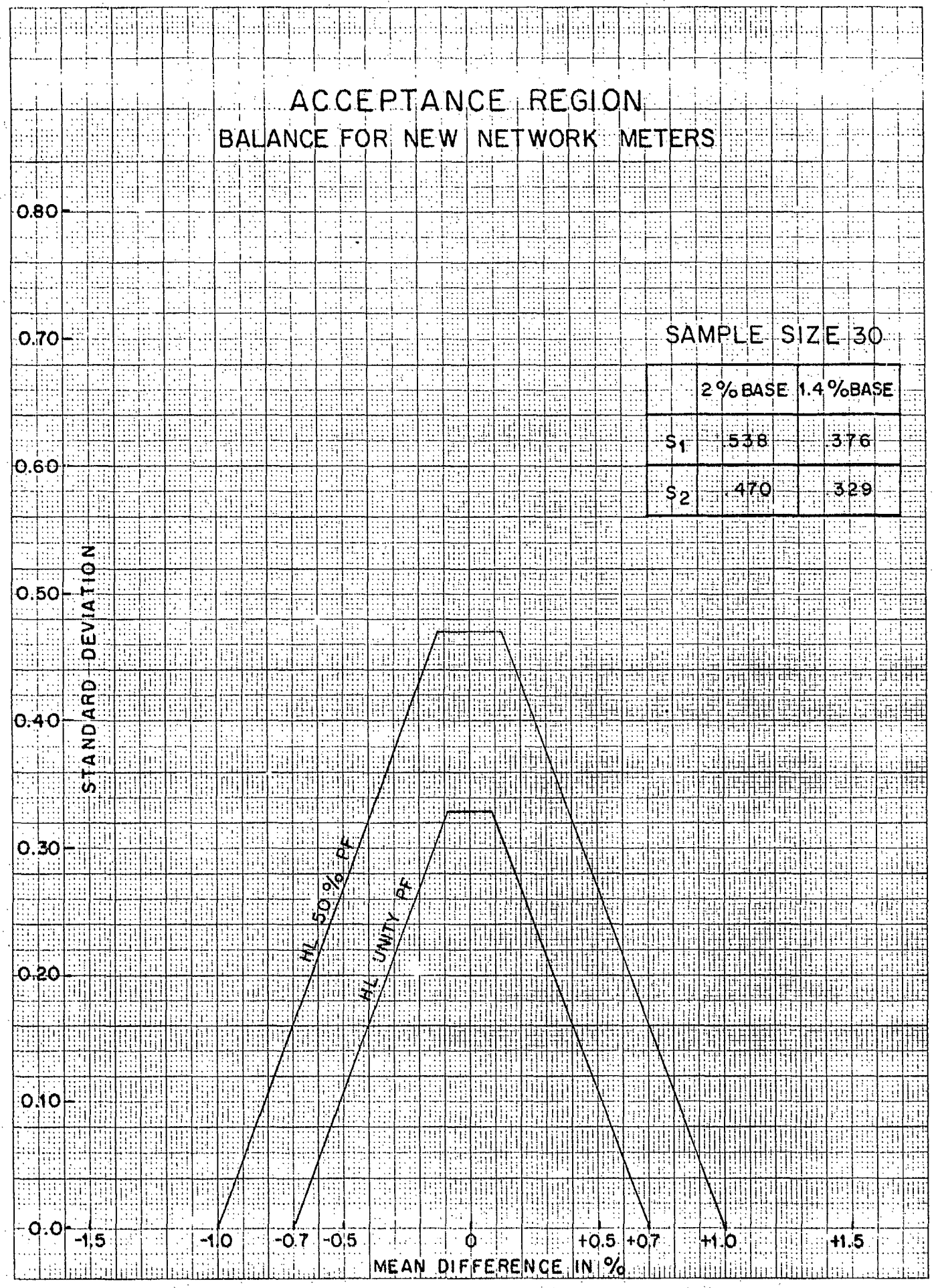
SEP - 1975



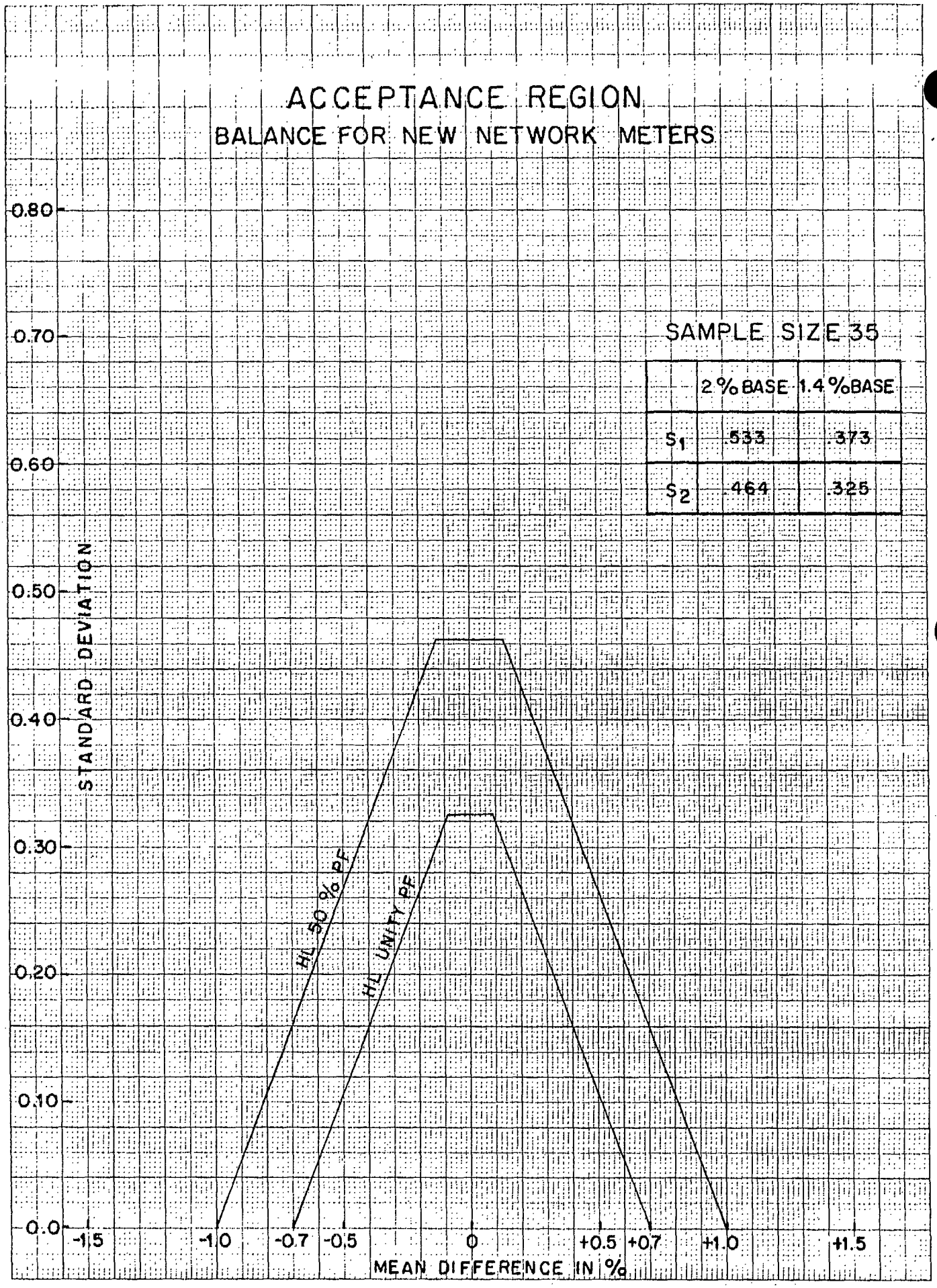
ACCEPTANCE REGION
BALANCE FOR NEW NETWORK METERS

SAMPLE SIZE 30

	2% BASE	1.4% BASE
S_1	.538	.376
S_2	.470	.329



SEP - 1975

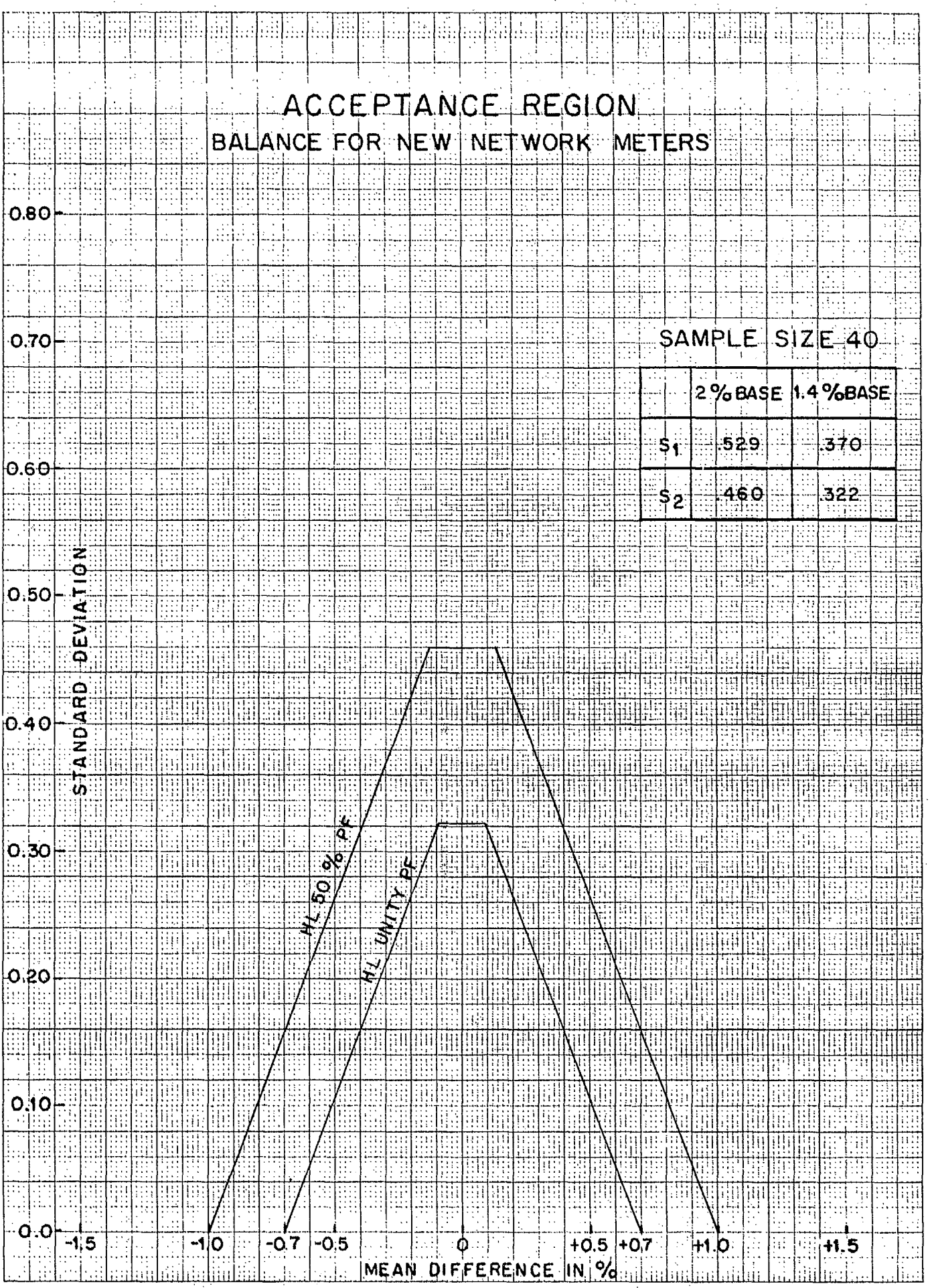


SEP - 1975

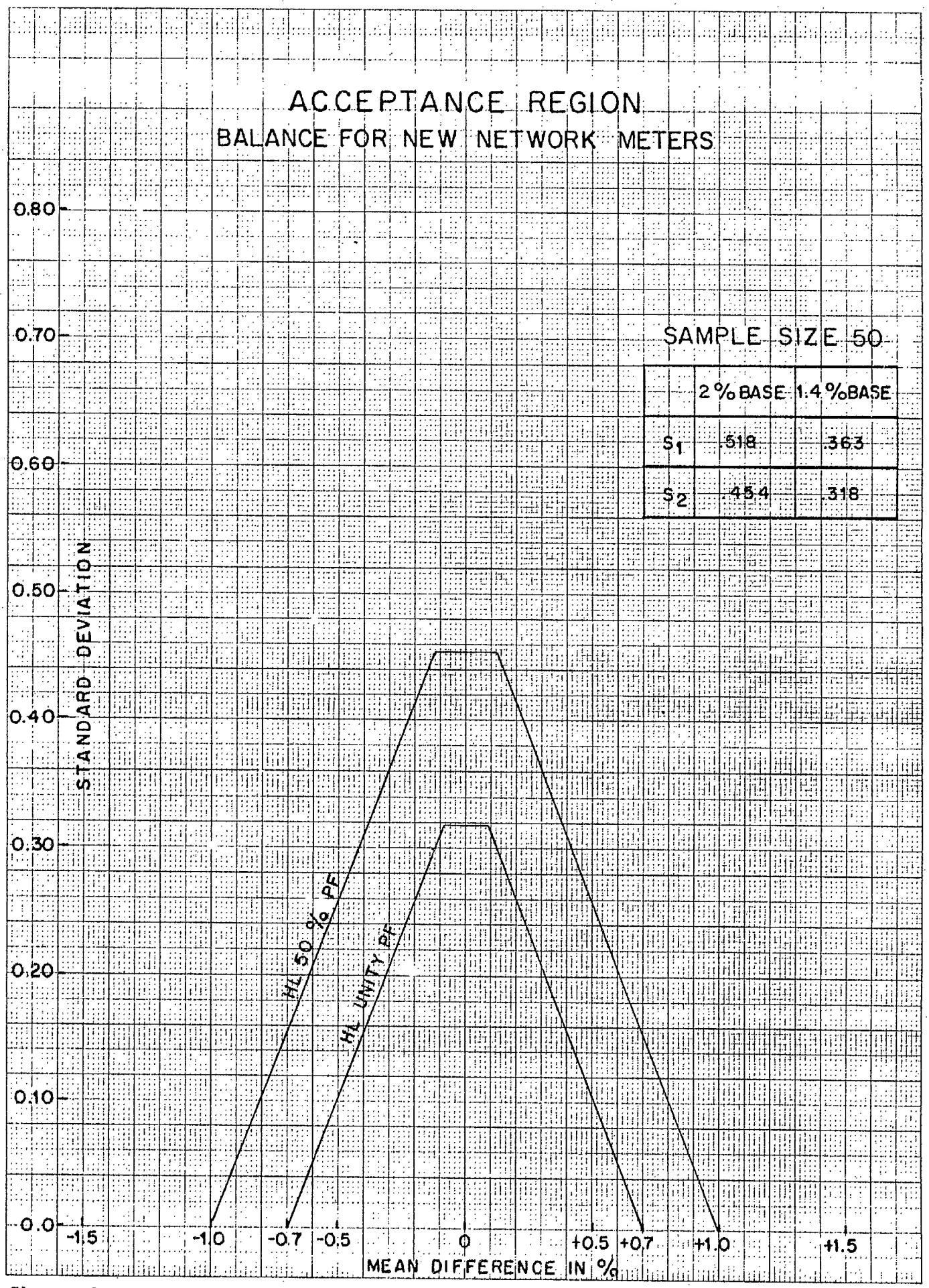
ACCEPTANCE REGION
BALANCE FOR NEW NETWORK METERS

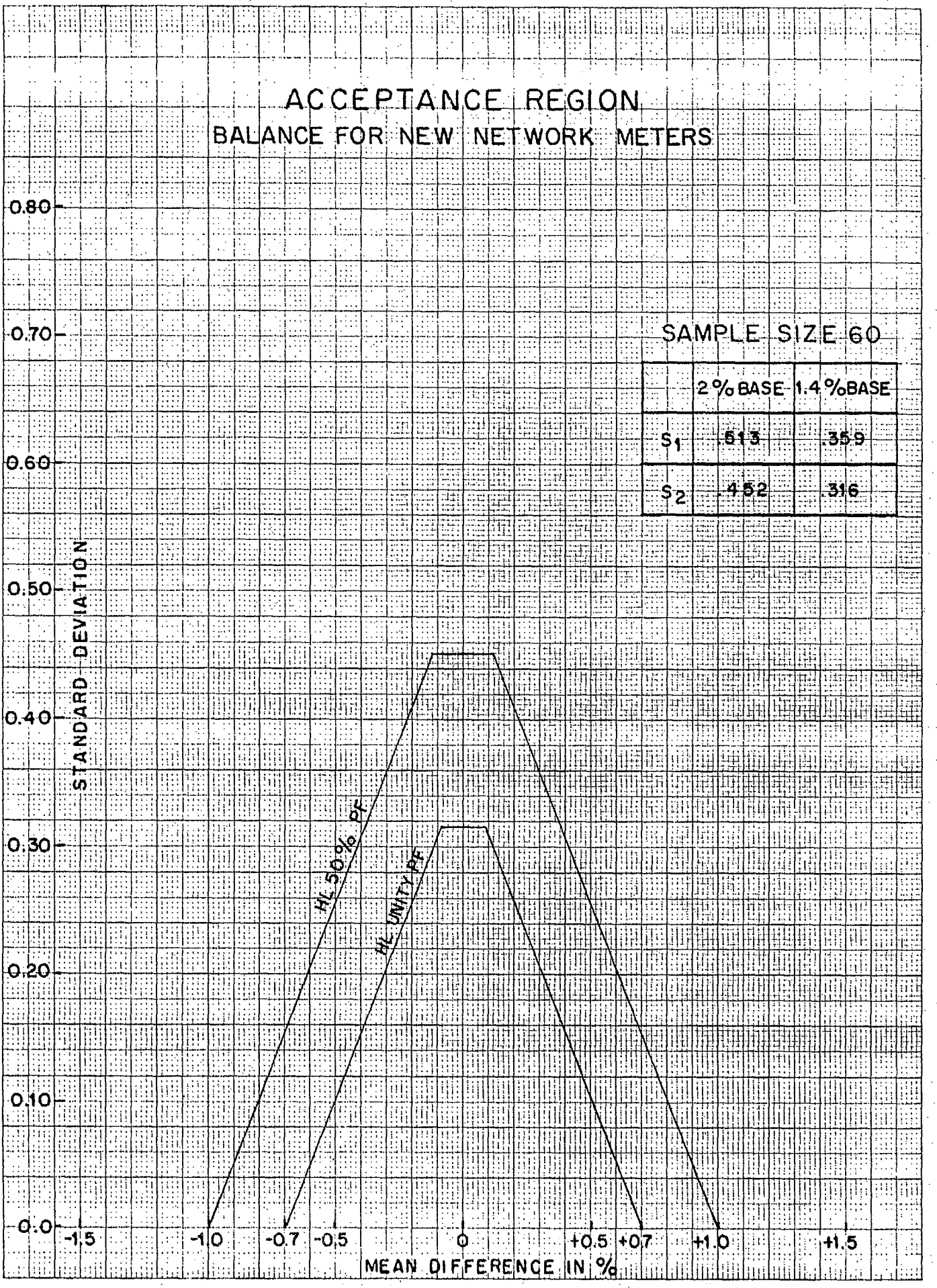
SAMPLE SIZE 40

	2% BASE	1.4% BASE
S_1	.529	.370
S_2	.460	.322



SEP - 1975



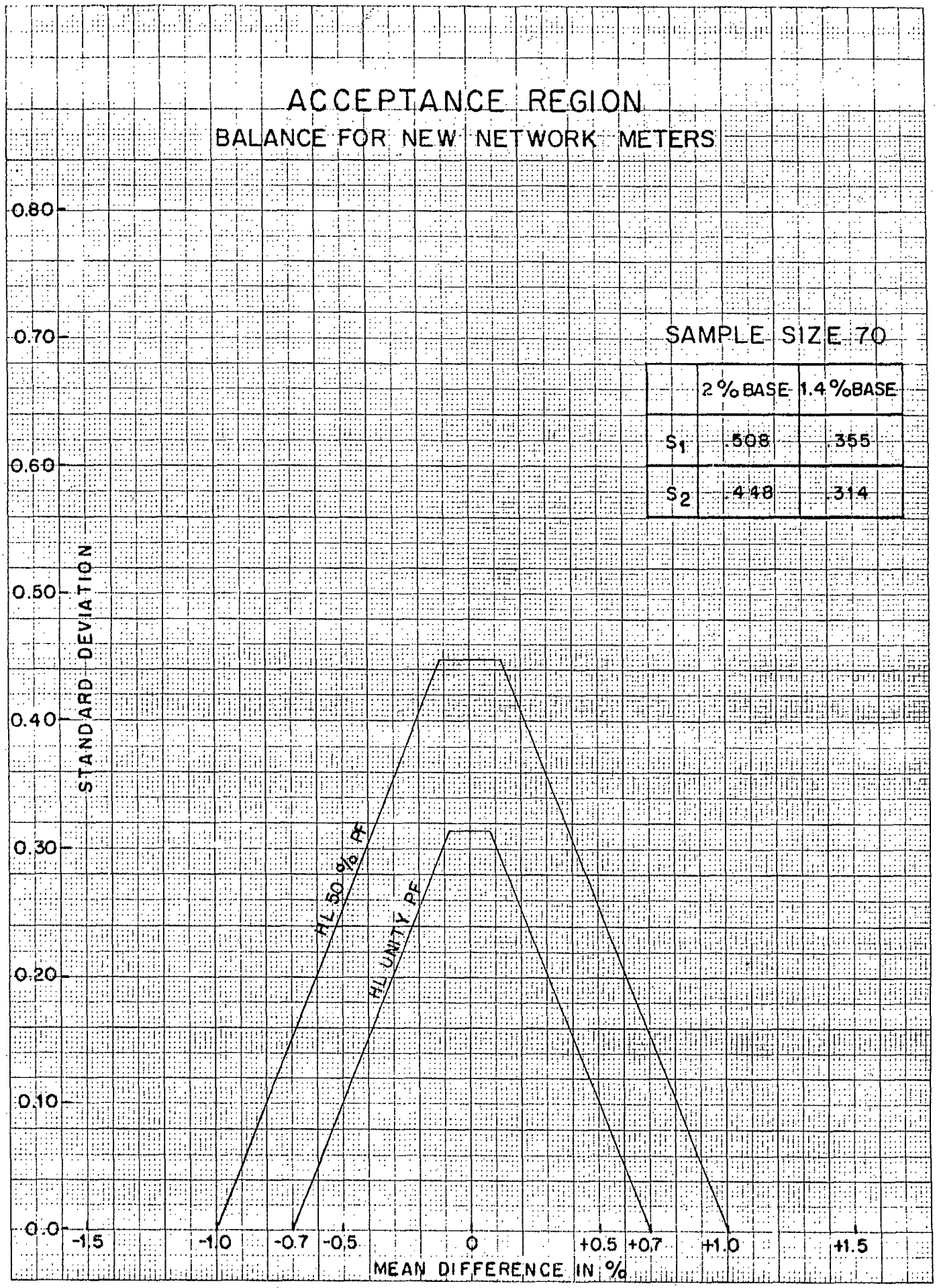


SEP - 1975

ACCEPTANCE REGION
BALANCE FOR NEW NETWORK METERS

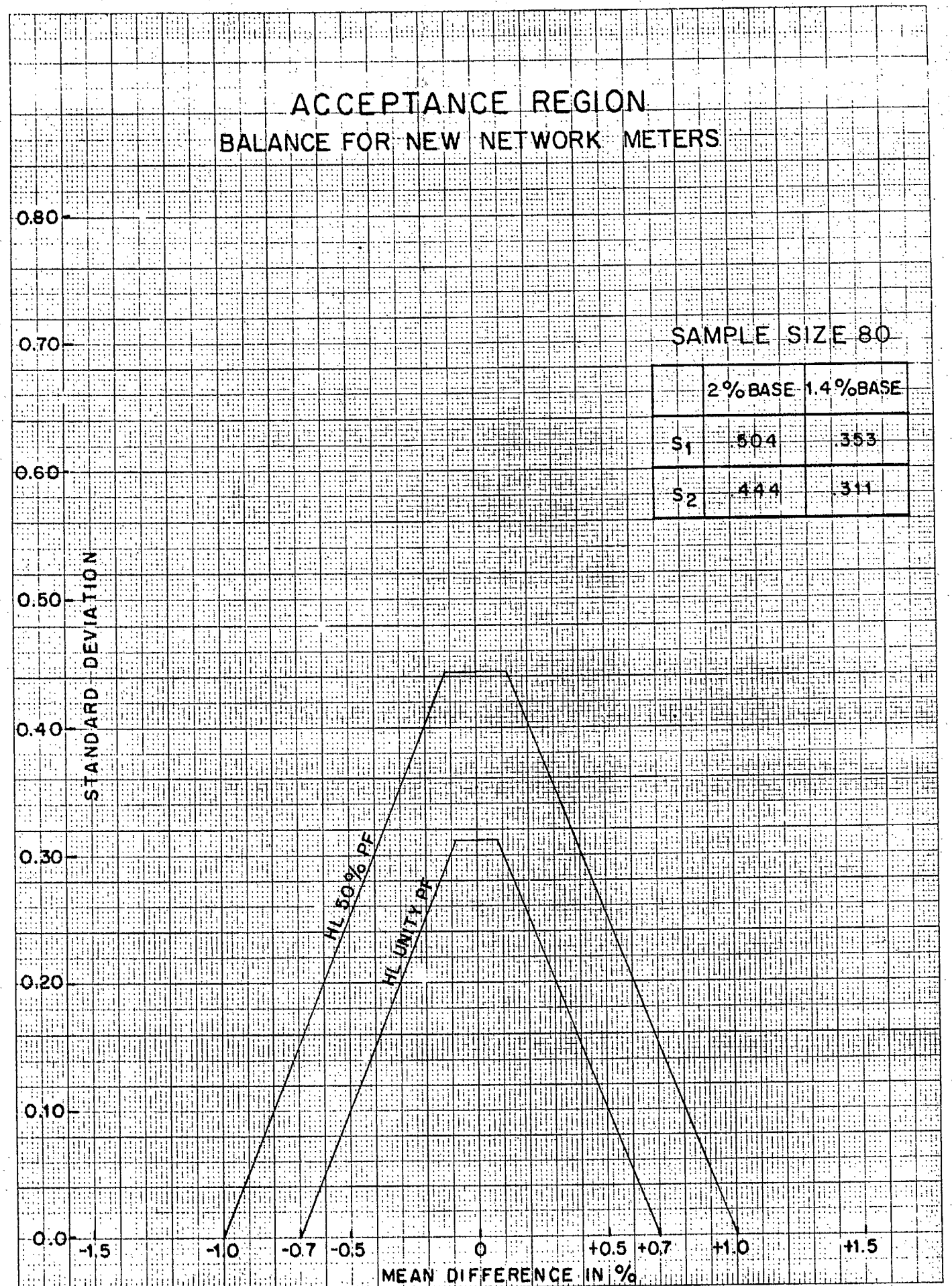
SAMPLE SIZE 70

	2% BASE	1.4% BASE
S_1	.508	.355
S_2	.448	.314



SEP - 1975

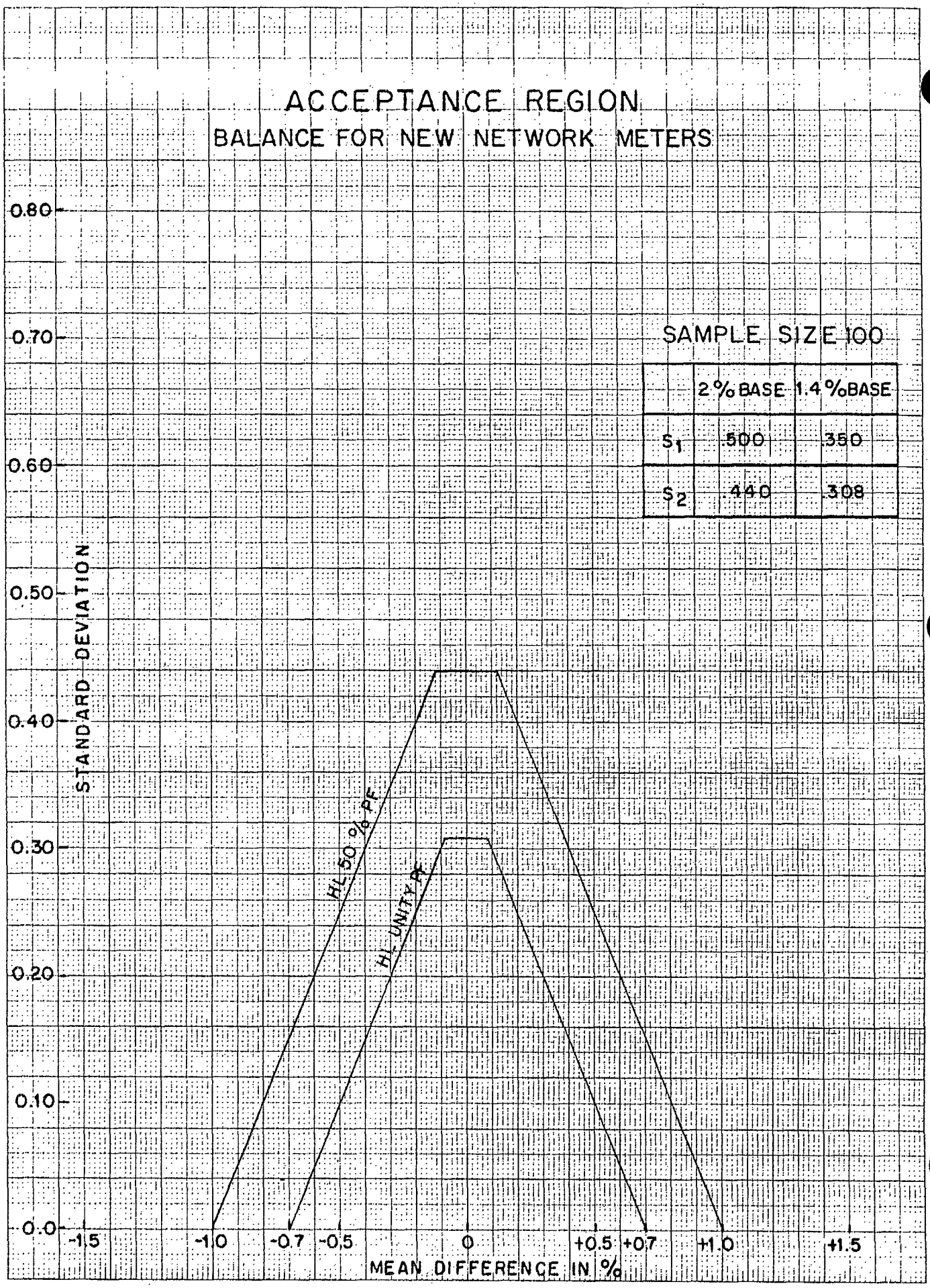
ACCEPTANCE REGION
BALANCE FOR NEW NETWORK METERS



SAMPLE SIZE 80

	2% BASE	1.4% BASE
S_1	.504	.353
S_2	.444	.311

SEP - 1975



SEP - 1975

APPENDIX IV PART III

MECHANICAL CHECK INSPECTION REPORT

CATEGORY OF METER[1]: _____ DISTRICT: _____

TYPE OF METER: _____ DATE: _____

TOTAL NO. OF METERS ACTUALLY INSPECTED: _____ TOTAL NO. PASSED[2]: _____

DEFECTS		
I	WRONG REGISTERS : FAST : SLOW	
II	REGISTER MESHING :	
III	FOREIGN MATTER IN METER :	
IV	OTHER FAULTS (STIPULATE) _____ _____ _____ _____	
		TOTAL: _____ % DEFECTS: _____

COMMENTS OR RECOMMENDATIONS : _____

1. NEW SINGLE PHASE
   OLD SINGLE PHASE
   NEW NETWORK
   ETC.
2. APPLICABLE TO SINGLE PHASE METERS ONLY

_____
DISTRICT INSPECTOR

SEP - 1975

NEW NETWORK METERS SAMPLE TESTED

H.Q. FILE NO. _____ DISTRICT _____ MONTH _____ 19 ____

UTILITY	LOT NO.	SIZE OF LOT	SIZE OF Sample	METER TYPE	Rotating Standard NO.	TEST Board NO.	HIGH LOAD SER.		LOW LOAD SER.		PF AV.		S OR D	BAL.	A OR R	MAN-HOUR
							$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S				
																TOTAL

NOTE: S = SINGLE D = DOUBLE A = ACCEPTED R = REJECTED BAL.=BALANCE

REMARKS: UNDER BAL. PUT G= GOOD or NG = NO GOOD

CCA-

SEP - 1975

APPENDIX VI

PART III

SUMMARY

NEW NETWORK METERS SAMPLE TESTED

TYPES __________

MONTH __________

UTILITY	LOT NO.	LOT SIZE	METER TYPE	FL-S		LL-S		PF AV		BAL.*	A OR R
				$\bar{X}$	S	$\bar{X}$	S	$\bar{X}$	S		
$\bar{\bar{X}}$ WEIGHTED AVERAGE											
AV. S_g											

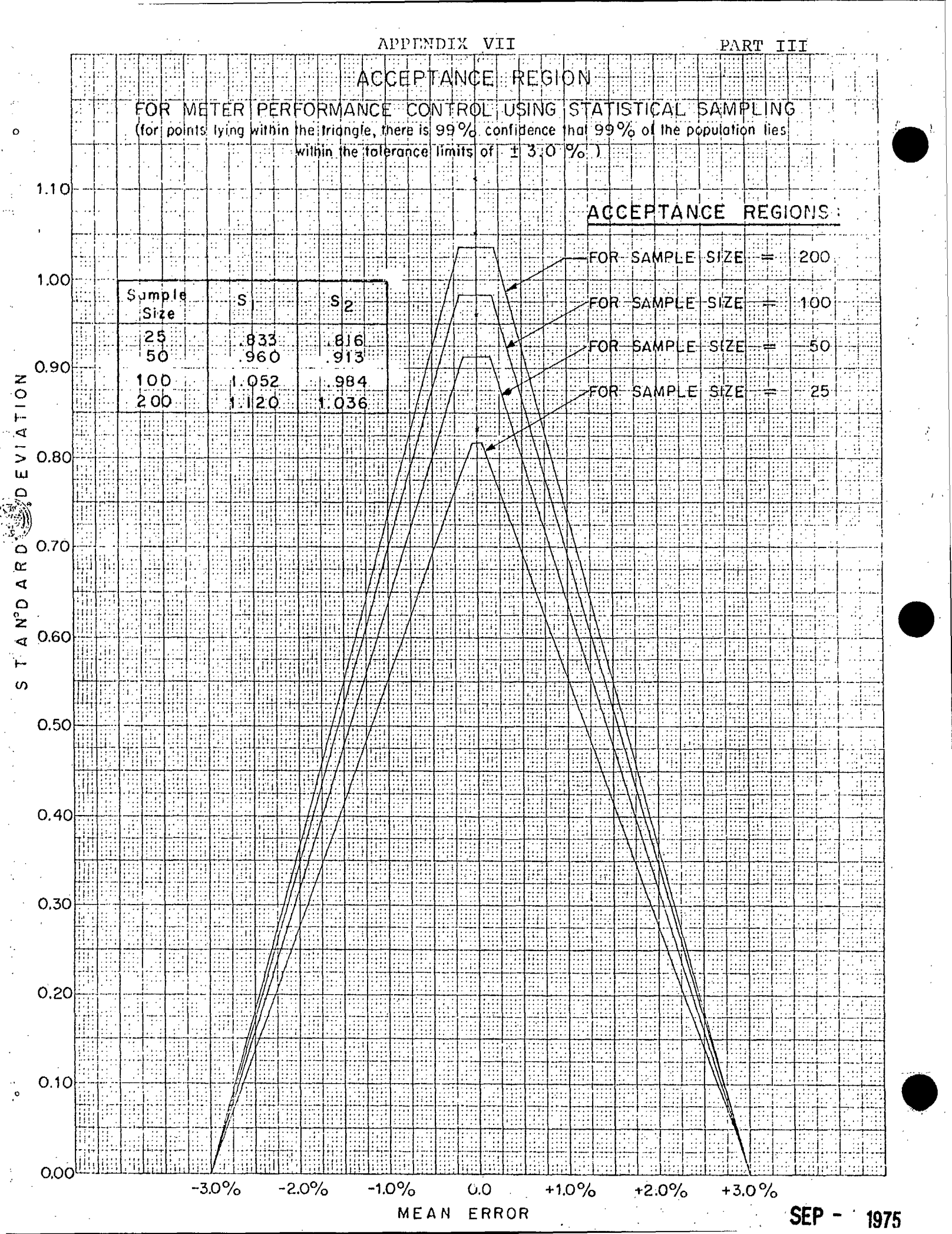
* IF REJECTED BECAUSE OF BALANCE PUT ✓ IN BAL. COLUMN

SEP - 1975

ACCEPTANCE REGION

FOR METER PERFORMANCE CONTROL USING STATISTICAL SAMPLING

(for points lying within the triangle, there is 99% confidence that 99% of the population lies within the tolerance limits of ± 3.0 %)



Sample Size	S_1	S_2
25	.833	.816
50	.960	.913
100	1.052	.984
200	1.120	1.036

SEP - 1975

SAMPLE TESTS FOR NETWORK METERS

UTILITY _____ SAMPLE GROUP No. _____

MAKE _____ TYPE _____

TEST BOARD No. _____ DISTRICT _____

STANDARD No. _____ DATE _____ 19__

INSPECTION No.	VOLTS	AMPS	HL S	HIGH LOAD UC	HIGH LOAD LC	HL AV	LOW LOAD UC	LOW LOAD LC	LL S	POWER FACTOR UC	POWER FACTOR LC	PF AV

HL = HIGH LOAD LL = LOW LOAD PF = POWER FACTOR

S – SERIES UC = UPPER COIL LC = LOWER COIL

Inspector

SHEET NUMBER

STATISTICAL ANALYSIS OF METER GROUPS

UTILITY ..... SAMPLING .....

GROUP No. ..... GROUP SIZE "N" ..... SAMPLE SIZE "n" .....

TYPE ..... MAKE ..... SEAL DATE ..... TEST .....

Frequency of $X_i +$ f_i^+	Cells x_i	Frequency of $X_i -$ f_i^-	Algebraic value of $(f_i^+ + f_i^-)$ or $f_i^+ + f_i^-$	Cells x_i	$f_i x_i$	Absolute value or $(f_i^+) + (f_i^-)$	x_i^2	$f_i x_i^2$
	3.0			3.0			9.00	
	2.9			2.9			8.41	
	2.8			2.8			7.84	
	2.7			2.7			7.29	
	2.6			2.6			6.76	
	2.5			2.5			6.25	
	2.4			2.4			5.76	
	2.3			2.3			5.29	
	2.2			2.2			4.84	
	2.1			2.1			4.41	
	2.0			2.0			4.00	
	1.9			1.9			3.61	
	1.8			1.8			3.24	
	1.7			1.7			2.89	
	1.6			1.6			2.56	
	1.5			1.5			2.25	
	1.4			1.4			1.96	
	1.3			1.3			1.69	
	1.2			1.2			1.44	
	1.1			1.1			1.21	
	1.0			1.0			1.00	
	0.9			0.9			0.81	
	0.8			0.8			0.64	
	0.7			0.7			0.49	
	0.6			0.6			0.36	
	0.5			0.5			0.25	
	0.4			0.4			0.16	
	0.3			0.3			0.09	
	0.2			0.2			0.04	
	0.1			0.1			0.01	
	0			0			0	
$\Sigma f_i^+ =$		$\Sigma f_i^- =$		$\Sigma f_i x_i =$				$\Sigma f_i x_i^2 =$

$\Sigma f_i^+ + \Sigma f_i^- = \Sigma f_i = n =$

$n =$ $\quad n - 1 =$ $\quad \bar{X} = \dfrac{\Sigma f_i x_i}{n} =$

$$s = \sqrt{\frac{\left[\Sigma f_i x_i^2\right] - \left(\left[\bar{X}\right] \times \left[\Sigma f_i x_i\right]\right)}{\left[n-1\right]}} = \sqrt{\frac{\left[\quad\right] - \left(\left[\quad\right] \times \left[\quad\right]\right)}{\left[\quad\right]}}$$

$$= \sqrt{\quad} = \quad$$

OUTLIERS : FAST ☐ SLOW ☐

SAMPLE : ACCEPTED ☐ REJECTED ☐

Test Sheet No. ..... to ..... Date .....

Signature .....

APPENDIX X

PART III

DATE .....

CELLS X_i	FREQUENCY WITHIN CLASS INTERVAL				TOTAL
3.0					
2.9					
2.8					
2.7					
2.6					
2.5					
2.4					
2.3					
2.2					
2.1					
2.0					
1.9					
1.8					
1.7					
1.6					
1.5					
1.4					
1.3					
1.2					
1.1					
1.0					
0.9					
0.8					
0.7					
0.6					
0.5					
0.4					
0.3					
0.2					
0.1					
0.0					
0.1					
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
2.3					
2.4					
2.5					
2.6					
2.7					
2.8					
2.9					
3.0					

PLUS

MINUS

HISTOGRAM

UTILITY .....

GROUP No. .....

GROUP SIZE .....

SAMPLE SIZE .....

MAKE .....

TYPE .....

SEAL DATE .....

TEST .....

OUTLIERS -

..... FAST

..... SLOW

$\bar{X}$ = ...

S = ...

FACTOR = Fr

Fr = 4.5 for Sample Size = 50
Fr = 5.0 for Sample Size = 100
Fr = 5.5 for Sample Size = 200

CHECK : $\frac{\text{RANGE}}{\text{FACTOR}}$ = S (approx) = ——— = ———

APPENDIX XI — PART III

SAMPLE TEST SUMMARY FOR METERS – *RÉSUMÉ DE L'ESSAI D'UN ÉCHANTILLON POUR COMPTEURS*

UTILITY – *Service public*	D M Y	GROUP IDENT. – *Numéro du lot*	MAKE – *Marque*
TYPE – *Marque*	SEAL DATE – *Date du sceau*	GROUP SIZE – *Taille du lot*	NOM. SAMPLE (n) – *Taille de l'échantillon (n)*

SINGLE PHASE ELECTRIC *Monophasé électrique* ☐ NETWORK ELECTRIC ☐ GAS *Gaz* ☐

NUMBER OF METERS SELECTED *Nombre de compteurs sélectionnés* (n')

LOCK OUTS *Absence du propriétaire*

BROKEN IN TRANSIT *Brisé pendant le transport*

REVERIFIED SINCE LIST MADE *Revérifié depuis la mise au point de la liste*

OTHER REASONS *Autres raisons*

NUMBER OF METERS NOT RECEIVED *Nombre de compteurs non reçus*

WRONG SEAL DATES *Dates inexactes sur le sceau*

NOT BELONGING IN GROUP *N'appartient pas au lot*

DAMAGED IN TRANSIT *Endommagé pendant le transport*

OTHER REASONS *Autres raisons*

INELIGIBLE METERS *Compteurs inacceptables* (b)

FAST OUTLIERS *Surévaluateurs*

SLOW OUTLIERS *Sous-évaluateurs*

TOTAL OUTLIERS *Total évaluateurs*

METERS IN FINAL CALCULATIONS *Comptemps entrant dans les calculs finaux* (n_s)

TOTAL (n')

$n_s \geq .95n$

$n' - b - n_s \leq .15n$

$\frac{FL + LL}{2}$

$\bar{X}$:

S =

FL SERIES

$\bar{X}$ =

S =

FL AVERAGE

$\bar{X}$ =

S =

LL AVERAGE

$\bar{X}$ =

S =

PF AVERAGE

$\bar{X}$ =

S =

WITHDRAWALS OTHER THAN OUTLIERS *Retraits autre que les évaluateurs*

RECOMMENDATION *Recommandation* ☐ ACCEPTANCE *Acceptation* ☐ REJECTION *Rejet*

FEE CALCULATION – *Calcul des droits*

METERS IN GROUP *Nombre du compteurs du lot*	CLASS *Catégorie* 1	CLASS *Catégorie* 2
LESS: SAMPLE METERS NOT RETURNED TO GR. *Moins: Compteurs de l'échantillon non*		
TOTALS *TOTAUX*		

FEE – *Droits* = 2 X (X $ + X $) =

* FIGURE FOR NORMALS SEAL PERIOD
Chiffre pour une période correspondant à un sceau normal

TESTED BY *Essai effectué par* _____

CALCULATED BY *Calculs effectués par* _____

REMARKS – *Observations*

_____

_____

_____

VERIFICATION OF POLYPHASE INTEGRATING METERS AND COMPONENTS

1. SCOPE

The rules under this Part pertain to:

(i) all types of polyphase integrating meters, new or re-serviced, except network meters which are covered under Part III;

(ii) the polyphase integrating components of combination meters.

The rules thus apply to watthour meters, varhour meters, Q-hour meters and such polyphase integrating components used as a basis for obtaining maximum demand indications.

2. INSPECTION METHODS

The procedure for the inspection of all polyphase meters covered by this Part shall be by 100% inspection.

3. VERIFICATION TESTS

3.1 Dial Test and Mechanical Inspection

(i) Each meter or integrating component shall be subjected to a dial test the purpose of which shall be to ensure that the integrations of the basic elements are being accurately transferred to the register. The test shall be made with the maximum load feasible for the particular rating and the duration shall be such as to produce at least one complete revolution of the test dial if the meter is so fitted. For meters or components without test dials the duration shall be such as to produce two divisions of the fastest moving dial of the register.

(ii) Differential registers and other registers which indicate the sum or difference from two or more sources shall be dial tested in such a manner and for such a duration that it can be definitely established that the quantity from each source is being accurately transferred to the register. That is to say, it shall be necessary to make dial tests with each source separately as well as with all operating together.

(iii) In complex metering devices employing more than one register, dial tests shall be made on all registers.

(iv) All meters shall be given a careful visual inspection to seek out defects such as dirt in meters, loose screws, or other apparent mechanical problems. Such defects shall be reported.

3.2 Creep Test

Each meter or integrating component shall be subjected to a creep test with all voltage coils energized, in phase, with the correct rated voltage applied and it shall be rejected if the disc creeps more than one complete revolution. This requirement is not applicable to solid state meters.

3.3 Correct Internal Connections

Each meter or integrating component shall be tested for correct internal connections to prove that each voltage coil is properly associated with the correct current coil.

3.4 Accuracy Tests

3.4.1 All voltage coils are to be connected in parallel.

3.4.2 Tests are as specified in Test Table #1, Appendix 1, Part II.

3.4.3 Varhour meters and Q hour meters which operate on the crossed phase principle (e.g. VA-63, KYR, FMFR) shall be tested as watt hour meters. Var hour meters with internal phase shifting (e.g. L&G, L-series) shall be tested using a var hour reference standard. For such meters the test points will be the same as for watt hour meters but reactive factor is to be substituted for power factor.

Power factor = cos ϕ reactive factor = sin ϕ

4. CRITERIA FOR ACCEPTANCE

4.1 Accuracy Tests

Error limits are as follows:

H.L.	All tests*	±1.0%
L.L.	All tests	±1.5%
P.F.	2, 2½, 3 el. (Vert)	-0.7% to +1.3%
	All other meters	±1.5%
Element unbalance	2, 2½, 3 el. (Vert)	1.5%

* For 2, 2½, & 3 element (vertical) meters there is no error limit for the individual coil tests at HL 1.0 P F. Individual coil tests are to be carried out to determine compliance with the unbalance requirement.

4.2 Other Tests

A meter shall be rejected if it creeps, if the internal connections are incorrect, if the dial test fails or if it is dirty inside. Certain defects such as loose screws in the meter can usually be readily corrected and would not necessarily constitute a rejection, but they shall be reported under Dial Test and Mechanical Inspection.

5. Seal Period

For self-contained polyphase meters, including network meters with magnetic suspension of the disk the basic seal period is eight years.

For all other polyphase watt hour meters it is six years.

5.2 Seal Period

Self-contained polyphase watthour meters having magnetic suspension of the disc, including network meters with the same type of suspension, shall have a basic eight year seal period. All other polyphase watthour meters shall have a six year seal period.

6. PROCEDURE FOLLOWING REJECTION

Any meter rejected under the above shall be returned to the utility for servicing and re-calibration.

7. RECORDS AND REPORTS

7.1 District Office Records

Results of tests shall be recorded on the standard Electricity Meter Field Note. It is suggested, however, that to properly register all the data several lines of the sheet should be taken for each meter.

AUXILIARY ATTACHMENTS OTHER THAN DEMAND

1. SCOPE

This part describes the requirements for inspection of:

(i) pulse initiator attachments other than those used with remote reading registers which are covered in Part VI.

(ii) prepayment meters

The watthour elements of the meters shall meet the requirements appropriate to the kind of meter under Part II, Part III or Part IV.

2. PULSE INITIATORS

2.1 Test Requirements

The meter shall be run for a sufficiently long time on a suitable load to generate at least 500 pulses (1000 pulses would be preferred). It shall be determined that the pulses are being emitted reliably and that the value in watthours per pulse shown on the nameplate is essentially correct.

2.2 Tolerances

(i) When under test, the pulse count shall be within ± 2 of the correct count i.e. it is possible to gain or lose a count at the beginning and end of the test run.

(ii) The value of the pulse in watthours per pulse as determined by test shall be within $\pm 0.5\%$ of that declared on the nameplate.

The error shall be derived in such a way that it does not include the error of the watthour meter itself.

3. PREPAYMENT METERS

3.1 Test Requirements

Three tests shall be made at the High Load test rate, by inserting a coin of correct value each time in the prepayment mechanism.

3.2 Tolerances

(i) The average value of the three tests, for the energy per coin shall be within ± ½% of that stated on the nameplate.

(ii) The maximum variation of the value for any one coin from that determined in (i) above shall not exceed ± 2%.

VERIFICATION OF DEMAND METERS, DEMAND ATTACHMENTS, REMOTE ENERGY RECORDERS AND SUMMATORS

1. SCOPE

1.1 Authorization

1.1.1 Demand Meters and Demand Attachments

The rules of Part V cover the requirements for verification and re-verification of all types of meters and devices used for the measurement of demand. They may be single-phase or polyphase and may register in kilowatts, kilovars or kilovoltamperes. The registration may be by indicating pointer on a scale, by clock or cyclometer dial, by a line on a chart, by printing on a tape, by pulse on a magnetic tape, by coded punchings on a paper tape, etc.

1.1.2 Remote Energy Recorders and Summators

Some types of pulse receivers are used for the remote reading of energy and for summating purposes. Such devices are also covered under Part V which deals as well with pulse receivers used for the recording of demand.

1.2 Classifications of Devices

For the purposes of these rules demand meters and devices are classified as follows:

(i) Demand Meters. These meters are housed in their own case and are not dependent upon any other device (except instrument transformers) for determination of the demand quantity.

(ii) Energy/Demand Meters. These devices are housed with an integrating meter in a single case. The demand element may be dependent upon the integrating meter (as in the case of integrating demand or block interval attachments) for the determination of the demand. Again they may be essentially independent of the integrating meter (as in the case of thermal devices) for the determination of the demand quantity, but the construction of the whole combination may be such that the demand element is not an attachment and cannot be separated from the integrating element.

(iii) Transmitting Devices. These devices provide an output which is proportional to the rate at which the particular quantity, i.e. active energy, reactive energy, etc., is being supplied to the load. They require connection to an appropriate receiving device in order for the demand and/or energy to be determined.

(iv) Receiving Devices. These devices provide a registration of demand and/or energy when suitably connected to an appropriate transmitting device such as described in (iii) above.

2. TEST CONDITIONS

2.1 Test Facilities and Test Conditions

The test board and test conditions shall be as described in Sections 5 and 6 of Part I. However, a prime requisite for a demand meter test board is the ability to readily maintain a very stable load.

2.2 Test Loads

(i) Test loads shall be as shown in Test Table No. 2, Appendix I, except as otherwise specified in the text. These specified loads are approximate and they should be interpreted as meaning the nearest major scale division above the specified point. The loads shall be accurately measured, of course, and be maintained constant within $\pm$0.2% of the set value.

(ii) Care must be taken when testing the energy section of certain energy/demand meters to ensure that the demand section is not seriously overloaded. If necessary the High Load test point for the energy section should be reduced to avoid such overload.

3. METER ERRORS

3.1 Energy Measuring Element

The energy measuring elements of energy/demand meters shall meet the requirements of Parts II, III, or IV as applicable. The allowable errors given in this Part apply to the demand element only, i.e., these are maximum errors in the demand not including the errors of the energy element.

3.2 Demand Errors

Errors of demand meters and demand elements shall be expressed as a percentage of full scale. In general, full scale is defined as the total calibrated span of the scale. In the case of instruments having their zero between the ends of the scale, the full scale value is the arithmetic sum of the values of the actuating electrical quantity corresponding to the two ends of the scale. For cummulative demand meters, full scale is represented by the marked full scale value of the small demand dial, or is equivalent to the maximum load for the meter when this value is marked on the meter.

4. PERFORMANCE REQUIREMENTS - DEMAND METERS

4.1 Thermal Demand Meters

4.1.1 Thermal Demand Meters - General

(i) The duration of each accuracy test shall be equal to three times the response period.

(ii) All thermal meters shall have their voltage coils energized at rated voltage for at least four hours immediately prior to being tested with the exception of Sangamo types "KW", "KYW", "KYL", "WY" and "LY".

(iii) Every meter shall be checked for zero indication, which shall not differ from true zero by more than 1/16 inch.

4.1.2 Thermal Indicating Demand Meters

(i) Meters equipped with a thread and pulley device shall be tested for friction at the points prescribed for accuracy tests. Friction shall not be less than 1% nor greater than 2% of full scale at any test point.

(ii) Meters equipped with grease-damped pointers shall be checked for pull-back of the driven pointer on the first test at the low-load test point and shall be checked for the retentive effect of the pointer at the high-load test point. A "flip test" shall be used to determine friction, that is, the driving hand shall be depressed by the driven hand approximately one major scale division and sharply released. With thread-and-pully devices, the maximum demand pointer should be flipped free of

the driving hand. The grease-damped pointer must remain in contact with the driving hand after the test but must not draw back with the driving hand when the load is removed.

(iii) When meters with 1200 watt and 1500 watt full scales are tested simultaneously, the test points specified for 1500 watt full scale may be used for both.
It should be noted too, that some types of thermal meters have restricted demand scales and the prescribed High Load tests for the watthour elements would drive the demand pointer considerably off scale if the tests were prolonged beyond 10 to 12 minutes. When gang-testing meters of this kind, the High Load test current should be reduced to the value which, at unity power factor, would produce a full scale reading.

(iv) In some single-phase, 3 wire thermal meters, the watthour elements and the thermal elements are both energized from the secondaries of the same internal current transformers. With this type of meter, the condition of balance can be determined by the tests on the watt-hour elements. If this is done, series tests only are required for the demand section. If doubt exists as to the construction of the meter under test, single coil tests are prescribed in Test Table No. 2 shall be carried out.

(v) The error of a thermal demand meter on any test shall not exceed $\pm$1.5% of full scale with the indicating pointer in contact with the driving pointer nor $\pm$2.5% of full scale with the driving pointer unrestricted.

4.1.3 Rectithermal Demand Meters

(i) Thermal Demand Meters with Secondary Rectification shall be subjected to the same tests and shall meet the same requirements as specified for Thermal Indicating Demand Meters under Section 4.1.2. However, they shall be tested using a rectifier convertor and watt-meter as a standard.

(ii) In addition, they shall be tested with the current coils in series at approximately 2/3 of full scale with a lagging power factor of 50%. The error on this test shall not differ by more than 1.5% from the error shown on the unity-power-factor test at the same scale point.

(iii) On single phase tests the test currents shall be based on the single phase constant marked on the meter.

4.1.4 Thermal Voltampere Demand Elements Containing Tapped Phase-shifting Transformers

(i) When tested on single phase these meters must be connected for "watts" operation.

(ii) The same single phase tests and requirements apply to these meters as to other thermal meters as listed in Section 4.1.2.

4.1.5 Thermal Recording Meters

(i) Meters of this type shall be subjected to the same test loads as specified for Indicating Thermal Demand Meters.

(ii) The zero indication shall be correct to within 0.25% of full scale.

(iii) The maximum allowable error on load tests shall be $\pm$2% of full scale.

(iv) In all tests the pen must come up-scale to the calibration point from a value at least 10% of full scale below the set test point.

4.1.6 Duplex Thermal Demand Meters (Totalizers)

(i) Each meter section of a duplex instrument shall be subjected to the test loads shown in Test Table No. 2, Appendix I. If it is an indicating instrument it shall meet the tolerances outlined in Section 4.1.2. If it is a recording instrument it shall meet the tolerances shown in Section 4.1.5.

(ii) Test points specified in Test Table No. 2 apply to meters in which the two sections have approximately equal full load values. The same test points may be used where the ratio of full load values does not exceed 1.5 to 1. When this ratio of the two meter elements exceeds 1.5 to 1 the specified test points apply to the higher reading element with proportional values being assigned to the lower reading element. In this case, overall series test shall be made using a current equal to the full-load value of the lower reading element.

(iii) There are in service a few special meters of this type in which one meter section alone will cause a full scale indication at the rated high load current. Such instruments are considered as two separate meters.

INSTANTANEOUS DEMAND METERS

4.2 4.2.1 Instantaneous Recording Meters

(i) Meters classed as instantaneous response instruments shall be subjected to tests as indicated in Test Table No. 2, Appendix I. The unity power factor tests shall be made on both a rising and falling load.

(ii) Zero indication shall agree with the chart zero within 0.25% of full scale.

(iii) The maximum permissible error at any test load shall be ±2% of full scale.

4.2.2 Duplex Instantaneous Recording Meters (Summators))

Meters of this class shall be subjected to tests on each element and meter section as shown in Test Table No. 2, with unity power factor tests being made on both a rising and falling load.

5. PERFORMANCE REQUIREMENTS - ENERGY/DEMAND METERS

5.1 Thermal Demand Elements

Where an energy/demand meter has a thermal demand element, such element shall conform to the appropriate requirements outlined in Section 4.1: thus, the requirements of Section 4.1.1 apply to all; Section 4.1.2 to Thermal Indicating elements; Section 4.1.3 to Rectithermal elements; 4.1.4 to Thermal Voltampere elements containing tapped phase-shifting transformers; Section 4.1.5 to Thermal Recording elements; and Section 4.1.6 to Duplex Thermal Recording elements.

INTEGRATING (BLOCK INTERVAL) DEMAND ELEMENTS

5.2 5.2.1 Indicating Instruments

(i) The zero indication shall be correct to within 1/32 inches.

(ii) The demand interval shall be checked and shall not have an error greater than 1%. This test can usually be made during a demand run and should not require a separate test.

(iii) Accuracy tests for the demand element shall be carried out at unity power factor load only and the load shall be maintained for at least two complete demand intervals. The required test points are as given in Test Table No. 2, Appendix I. Max. Error is 1½% F.S.

(iv) Some energy/demand meters with integrating demand elements with a voltage rating greater than 230 volts, are used with an external step down voltage transformer to supply the clock circuit. This transformer must be connected to the clock circuit with correct polarity for calibration and for connection in service.
Internal connections of the clock

circuit shall be made in a manner that will cause the meter to under-register when the secondary of the voltage transformer is reversed.

5.2.2 Cumulative Demand Instruments

The same requirements apply as for elements covered by Section 5.2.1, but the value of full scale is as described in the second paragraph of Section 3.2.

5.2.3 Recording Meters of the Integrating Type

(i) The test loads for this type of meter are the same as for Indicating Meters, as shown in Test Table No. 2, Appendix I.

(ii) The zero indication shall be correct to within 0.5% full scale.

(iii) The demand interval shall not be in error by more then 1%.

(iv) The error in demand registration on any test shall not exceed 2% of full scale.

5.2.4 Gear-driven Voltampere Demand Meters

(i) The demand element of this type of instrument is driven by a system of differential gears from a watthour meter and a reactive voltampere-hour meter. Read-out may be as an indicating instrument or as a recorder.

(ii) Test Connections shall be as shown in the appropriate drawing of Appendix II.

(iii) Timing motors shall be supplied with the correct voltage. In some cases this may require a separate circuit when testing on single-phase.

(iv) The demand element shall be tested by application of the following loads to both primary metering elements with all current coils in series:

(a) a 50% power factor load to produce a demand reading of approximately 1/3 full scale.

(b) an 86.6% power factor load to produce a demand reading of approximately 2/3 full scale.

(c) error limits for zero indication on load tests shall be those applying to indicating instruments, Section 5.2.1, or recording instruments, Section 5.2.3, depending upon the method of read-out.

6. PERFORMANCE REQUIREMENTS FOR TRANSMITTING DEVICES

6.1 Impulse Transmitters

Impulsing auxiliary devices incorporated into primary energy meters have been covered in Part IVB and the requirements specified. The number of pulses are proportional to the number of revolutions of the meter disc and hence each pulse represents a constant value in kilowatt-hours, varhours or kilovoltampere hours. A suitable receiver can, therefore, record at a distance, energy or demand or both.

Pulses from two or more impulse transmitting meters may be received by a summator or by totalizing relays which re-transmit pulses of the same or proportional values to a receiving meter. The totalizing relays, like the summating meters, are equipped with counters by which the output of the primary meters can be checked. The requirements for receiving meters (and totalizing relays) are covered by Section 7.1 below.

THERMAL CONVERTERS

6.2 (i) Thermal converters are similar in principle to thermal demand meters, but instead of indicating demand by means of a pointer on a scale, they produce a D.C. output in millivolts which varies directly with the input quantity. For demand purposes the output voltage may be recorded by a potentiometer recorder.

(ii) Like other thermal instruments, most converters must have their voltage coils pre-heated with rated voltage for at least 4 hours before being tested. If the voltage circuit is opened or the instrument cover removed during test, normal condition should be restored before resuming the test. No warm-up period is required with the Sangamo type 'H' Thermal converter.

(iii) The single-phase test procedure and test points shall be as follows:

(a) Each converter shall be checked for zero. With rated voltage applied to the voltage coils in parallel but no load on the current coils, the output voltage shall not exceed 0.05 millivolt.

(b) A unity power factor load of 30% of the A.C. rating shall be applied to each current coil separately, producing a D.C. output voltage equal to 3/10 of the nominal output for one element.

(c) With the current coils in series, a load of 1/2 the A.C. rating for 2-element converters, or 1/3 the A.C. rating for 3-element converters, shall be applied at unity power factor, producing a D.C. voltage equal to the rated full load output of the converter. This test shall be repeated with the current reversed through the current coils, the output voltage being recorded as minus.

(d) With the current coils in series, the same currents as in (c) above, but in the forward direction only, shall be applied at 50% power factor producing a D.C. voltage equal to 1/2 the rated full load output of the converter.

The A.C. rating and the rated D.C. voltage are the values in kilowatts input and millivolts output respectively, as marked on the converter nameplate.

(e) Thermal converters shall be tested for correct internal connections to prove that each voltage coil is associated with its correct current coil.

(f) Some types of thermal converters can be checked for balance by means of a centre tap. All accuracy tests on instruments of this kind may be made with the current coils in series. Unity power factor loads to produce 30% and 100% of rated output and a 50% power factor load to produce 50% of rated output shall be applied for these tests.

(g) The error limits on load tests shall be ±0.5% of full scale or ±0.05 millivolts whichever is greater.

(iv) Duration of each test shall be equal to at least three times the response period of the convertor. The load must be held steady during the test but if there is any question about its constancy, a rotating standard watthour meter shall be inserted into the circuit along with the indicating wattmeter.

TORQUE BALANCE DEVICES

6.3 6.3.1 Torque Balance Telemeter Transmitters

(i) The primary measuring elements in Torque Balance Telemeter Transmitters are similar electrically and mechanically, to polyphase watthour and varhour meters but they differ in that the discs are restrained to a small angle. Since the discs do not rotate, there is no register. The torque balance mechanism incorporated in the meter, which supplies the force required to balance the rotational torque of the disc, produces a D.C. output in milliamperes proportional to the total load on the primary elements, with a polarity matching the direction of the current flow.

(ii) For specific types of Torque Balance Transmitters reference should be made to the Approval of Type Notice and applicable Technical Electric Circulars.

(iii) If possible, reactive meters shall be connected so that they may be tested as wattmeters. If this is not possible, a standard varmeter shall be used to measure the load, and, in the procedures outlined below, a zero power factor load shall be used in place of a unity power factor load and an 86.6% lagging load in place of a 50% power factor load.

(iv) The transmitters shall have their voltage circuits pre-heated with rated voltage for at least four hours before being tested.

(v) Since it is necessary to pass the output D.C. current through a standard resistor in order to measure it on a potentiometer, care must be taken to ensure that the resistor is of correct value. Also, an appropriate approved filter shall be inserted in the output circuit of the meter to remove any ripple in the output current.

(vi) The single phase test procedure and test points shall be as follows:

(a) Each transmitter shall be checked for zero indication, with rated voltage applied to the voltage coils in parallel but no load on the current coils, the output current shall not exceed 0.025 milliamperes.

(b) A unity power factor load of 30% of the A.C. rating shall be applied to each current coil separately, producing a D.C. output current equal to 3/10 of the nominal output current.

(c) With the current coils in series, a load of 1/4 of the A.C. rating for 2-element transmitters, or 1/6 of the A.C. rating for 3-element transmitters,

shall be applied at unity power factor, producing a D.C. output current equal to half the full load rated output of the transmitter.

(d) With the current coils in series, a load of ½ of the A.C. rating for 2-element transmitters, or 1/3 of the A.C. rating for 3-element transmitters, shall be applied at unity power factor, producing a D.C. output current equal to the full load rated output of the transmitter. This test shall be repeated with the current reversed through the current coils, the output current being recorded as minus.

(e) With the current coils in series, the same loads as in (d) above, but in the forward direction only, shall be applied at 50% power factor producing a D.C. current equal to ½ the rated full load output of the transmitter.

The A.C. rating and the rated D.C. current are the input (kilowatts or vars) values and milliampere output respectively, as marked on the transmitter nameplate.

(f) The transmitters shall be tested for correct internal connections to prove that each voltage coil is associated with its correct current coil.

(g) The error limits on load tests shall be ±0.5% of full rated output.

6.3.2 Torque Balance Convertors

(i) The torque balance convertor is intended for use in telemetering service where interference picked up by the transmission line is of such magnitude as to interfere with the millivolts from thermal convertors often used for this service. The torque balance convertor is to be used with a thermal convertor having a response period not less than 5 seconds.

The output of the torque balance convertor being in milliamperes and the same in all parts of the circuit is less affected by interference affecting the transmission line. However, it is necessary to convert the output milliamperes to millivolts in order for them to be recorded. This is done by passing the current through a fixed resistor and applying the voltage drop across it to the recorder.

(ii) Before testing a specific type of Torque Balance Convertor reference should be made to the Approval of Type Notice and applicable Technical Electric Circular.

(iii) The torque balance convertor may be tested by applying a voltage from a potentiometer or other stable millivolt source to its input circuit and measuring the milliampere response.

(iv) Input voltage shall be applied in steps of 10% from 0 to full rating and the error shall not exceed ±0.5% of full output on zero indication or on load tests.

SOLID STATE TRANSDUCERS

6.4 (1) Solid state transducers operate on what is termed mark-space-amplitude multiplication or amplitude modulation/pulse width modulation.

(ii) Transducers differ from thermal convertors in that they respond instantly to changes in load and the output is in milliamperes D.C. The milliamperes are converted in use to millivolts D.C. by means of a dropping resistor and applied to an approved potentiometer recorder. The output is proportional to the instantaneous product of the input volts and amperes.

(iii) The circuitry of the var transducer is the same as the watt transducer except for phase shifting networks in the secondaries of each of the internal transformers for a total phase angle of 90°, so that the instrument produces an output proportional to the vars in the primary circuit.

(iv) Before testing a specific type of Transducer reference should be made to the Approval of Type Notice and applicable Technical Electric Circular.

(v) The test procedure and permitted tolerances shall be the same as those for Torque Balance Transmitters, Section 6.3.1 subsections (iii), (v), (vi). It is not necessary to pre-heat the voltage circuits before load tests are made.

7. PERFORMANCE REQUIREMENTS FOR RECEIVERS

7.1 Impulse Receivers

7.1.1 General Requirements

(i) Impulse receivers are used in three ways:

(a) as demand recorders. Such instruments are covered under Sections 7.1.2, 7.1.3, 7.1.4 and 7.1.5. They may record by the indication of a pointer against a fixed scale, by a pen or stylus on a chart, by printing on a paper tape, by pulses on a magnetic tape or by code punching on a paper tape.

(b) as remote energy recorders or as summators. Such instruments are covered under Section 7.1.6. They usually record on counter type registers.

(c) as energy/demand recorders. The appropriate parts of Sections 7.1.2, 7.1.3, 7.1.4, 7.1.5 and 7.1.6 apply.

(ii) Accuracy tests shall be made at approximately 20%, 60% and 98% of full scale or of maximum rate by application of:

(a) measured loads to the primary meters with which the recorder will be used in service. This is the preferred method since it gives greater assurance that the component devices in the system are fully compatible.

(b) measured loads to meters similar to those intended to be used in service, provided the units-per-impulse constant is correct.

(c) a compatible pulsing device.

An additional accuracy test at 98% of full scale or maximum rate may be substituted for the 20% and 60% tests where the only tolerance applicable is ± 2 impulses.

If intermediate relays are to be connected in the transmission line in service, these relays shall be included in the test circuit.

7.1.2 Indicating and Graphic Demand Instruments

(i) Meters falling within this class shall be inspected for zero indication with no input on the transmission circuit. The zero indication shall not differ from the true zero by more than 1/32 inch in the case of indicating instruments or ¼ of 1% of full scale value in the case of graphic meters.

(ii) The timing error of the trip mechanism, if it is an integral part of the instrument, shall not exceed 1% of the response period. If the timing device is a separate instrument it shall, of course, meet this requirement.

(iii) The error in demand indication on any load test shall not exceed 1.5% of full scale for indicating instruments or 2% of full scale for graphic instruments.

7.1.3 Printing Type Demand Instruments

(i) Printing type demand meters shall be tested in the same manner as indicating or graphic meters, except that a zero indication test is not required.

(ii) The tape is the official record of demand but auxiliary demand indicators may be provided on the meter. Although the indications of the latter should be compatible with the registrations on the tape, no tolerance requirements apply. Full scale values shall be determined from the nameplate of the instrument but they may also be indicated on a small demand deal.

(iii) The tolerance on accuracy tests shall be 1.5% of full scale.

7.1.4 Magnetic Tape Demand Recorders

(i) When verifying a magnetic tape recorder the installed tape cartridge must be removed, otherwise signals from the verification test would be recorded on the tape and could cause confusion or error when the tape was used later. However, a test tape kept for the purpose may be installed if equipment for reproducing the pulses from it is available.

(ii) Each input channel of the recorder shall be tested at the specified pulse rates by supplying compatible pulses to it through an appropriate device over a period not less than two demand intervals for each test.

(iii) The input pulse count for each rate shall be compared to the recorded pulse count obtained from the test jacks by means of ear-phones, appropriate plug-in counter, or light emitting diode test probes. The pulses recorded on a test tape, if used, may of course be counted if appropriate equipment is available.
Some recorders are equipped with light emitting diodes connected in series with the recording heads of each channel so that they indicate when a signal is passed to the recording head and thence to the tape. The permitted error at either test is ±2 pulse counts.

(iv) The timing mechanism shall be checked and the error shall not exceed 1% of the nominal demand interval.

(v) Where the recorder is fitted with a demand register and/or pulse counter, the recorded values shall be consistent with the pulse count determined under (iii) above. These, however, are indicators only and their registrations shall not be used in billing.

(vi) On a new instrument inspected for the first time, the intervals indicated on the clock shall be consistent with the known duration of the tests.

7.1.5 Paper Tape Digital Pulse Recorders

(i) Each input channel of the recorder shall be tested at the stipulated pulse rates by supplying compatible pulses to it through an appropriate bi-stable buffer relay over a period not less than two demand intervals for each test.

(ii) The input pulse count for each rate shall be compared with the recorded pulse count punched on the paper tape in binary coded form.
The permitted error at either test is ±2 pulse counts.

(iii) The timing mechanism shall be checked and the error shall not exceed 1% of the nominal demand interval.

(iv) Where the recorder is fitted with a demand register and/or pulse counter, the recorded values on these shall be consistent with the pulse count determined under (ii) above.
These, however, are indicators only and their registrations shall not be used in billing.

(v) On a new instrument inspected for the first time, the interval of time indicated by the clock shall be consistent with the known duration of the tests.

7.1.6 Remote Energy Recorders and Summators

(i) These devices are basically pulse counters and the ±2 counts tolerance shall apply. However, a sufficiently large number of pulses (say 1000) should be counted to provide assurance that no more than the tolerated amount are being added or subtracted.

(ii) In the case of summators, test pulses shall be fed to all input circuits and the tolerance of ±2 counts applies to each circuit. In addition, the positive and negative pulses shall be totalized correctly to within ±2 counts of the algebraic sum of all the counts registered by the input circuits.

7.2 Self-Balancing Null Type Recorders

7.2.1 Potentiometer Recorders

(i) Recording potentiometers used in the measurement of power are of the self-balancing null type in which the voltage unbalance between the external circuit and the potentiometer circuit may be detected by a galvanometer or by an electronic amplifier. With the electronic type, the resistance of the transmission channel, below 3,000 to 4,000 ohms, has no appreciable effect on performance but with the galvanometer type, the external resistance should be approximately equal to the CDRX value marked on the instrument nameplate. "CDRX" is the critical damping resistance of the external circuit.

(ii) A D.C. potentiometer of suitable range shall be used as a source of voltage supply for testing this type of instrument.

(a) With the potentiometer connected to the recorder input terminals with correct polarity but no voltage applied, the zero indication shall coincide with the true zero within ¼ of 1% of full scale.

(b) The potentiometer shall be adjusted in successive steps to provide up-scale readings at each major scale division and down-scale readings at 50% of full scale and at zero. With centre-zero instruments the tests shall be made for each major scale division in both directions and at zero from both directions.

(c) With this type of instrument the error shall be within 0.5% of full scale. "Full scale" represents the total calibrated span of the instruments; therefore, with a centre-zero recorder, an error of 0.25% of full scale is actually 0.5% of the effective scale. A test shall be made at approximately mid scale to determine the minimum change in magnitude of the signal voltage required to initiate response either up scale or down scale. This value must not exceed 0.3% of full scale in either direction. With galvanometer-type instruments a resistance approximately equal to the marked CDRX value of the recorder should be connected in series with test circuit for all tests.

8. SEAL PERIOD AND SEALING

8.1 Seal Period

Meters covered under Part V shall have fixed seal periods. The present authorized period is six years except for magnetic and punched paper tape recorders and summators for which the seal period is thirty years.

8.2 Sealing

Most of the types of instruments covered under this Part require to be sealed except those with charts, tapes, etc. but these latter types may require the range adjustments to be sealed. The Approval of Type Notice for each type is specific regarding the sealing.

Test Table No. 2 - Demand Meters

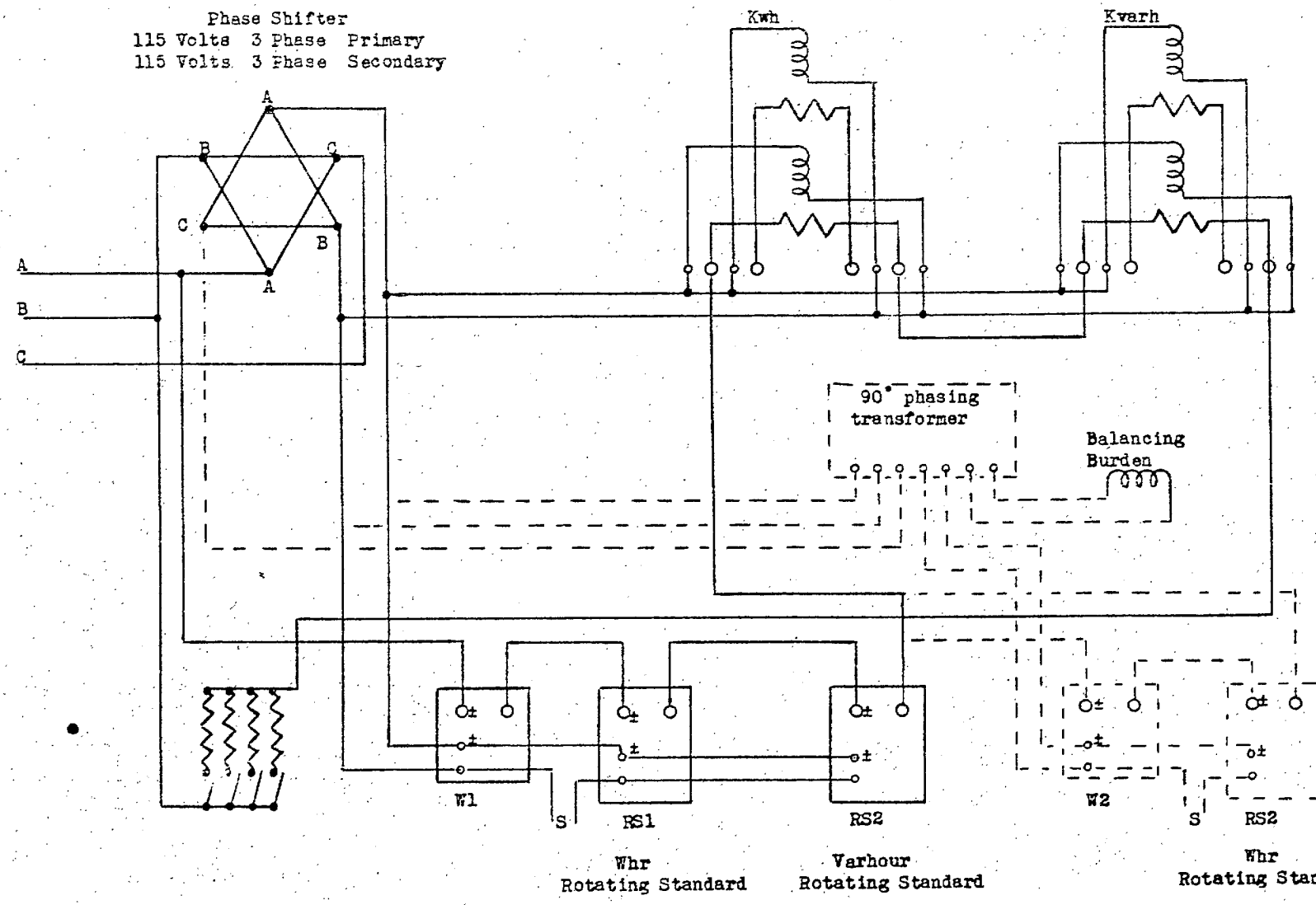
TYPE	PHASE	WIRE	ELEMENTS	METER COILS	TEST POINTS % FULL SCALE	
					1.0 P.F.	0.5 P.F.
INTEGRATING (BLOCK - INTERVAL) INDICATING OR GRAPHIC	1	2			66.6	
	1	3		Series	66.6	
	3		2, 2 1/2 or 3	Series	66.6	
THERMAL	1	2			20 66.6	
	1	3		Each Coil Series * Series	20 33.3 66.6	
	3		2	Each Coil Series	20 66.6	*** 66.6
	3		3	Each Coil Series	20 66.6	*** 66.6
	3		2 1/2 Y	Each Single Coil Split Coil ** Series	16.6 33.3 66.6	 *** 66.6
	3		2 1/2 Δ	2-Wire Element 3-Wire Element (Series) All Coils in Series	20 20 66.6	
THERMAL DUPLEX, INDICATING OR GRAPHIC	3		2	Each Coil Each Meter (Series) All Coils in Series	20 40 80	
INSTANTANEOUS GRAPHIC	3		2	Each Coil Each Coil Series	20 40 80	 20 40
INSTANTANEOUS GRAPHIC DUPLEX	3		2	Each Coil Each Meter (Series) All Coils in Series	20 40 80	 20 40

NOTE : Test points specified in this Table do not apply to special types for which the test points are specified in the text.

* This test applies only to those meters on which single-coil tests can be omitted.

** For rectifier-type meters, split coil is tested at 16.6%.

*** For rectithermal meters only.



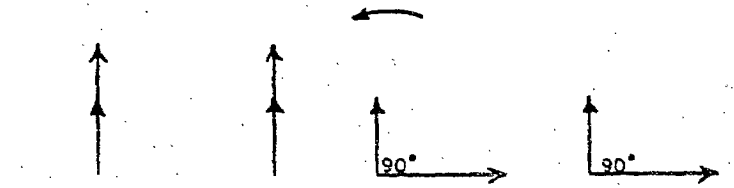
TEST CONNECTIONS FOR WATTHOUR METER & VARHOUR METER IN COMBINATION

DWG No. X1

(Varhour meter with internal resistance-reactance networks)

WATTHOUR METER TESTS

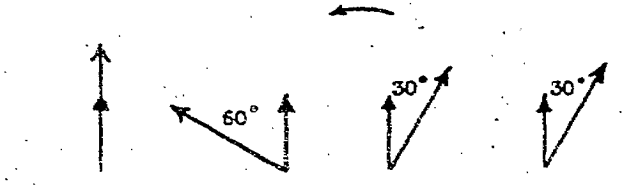
POWER FACTOR = 1.0



Phase shifter at 1.0 power factor

Test watthour meter with RS1

POWER FACTOR = 0.5(LAG)



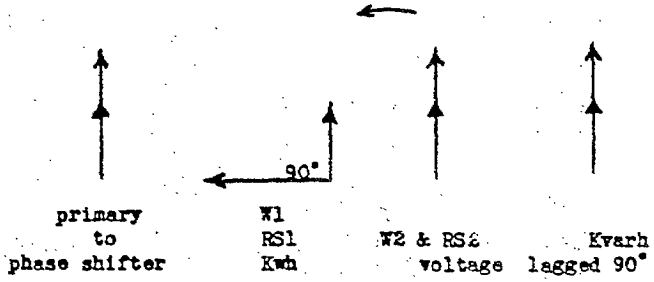
Phase shifter turned to produce voltage lead of 60°

Test watthour meter with RS1

VARHOUR METER TESTS

POWER FACTOR = 0(LAG)

(Equivalent to 1.0 P.F. test on watthour meter)

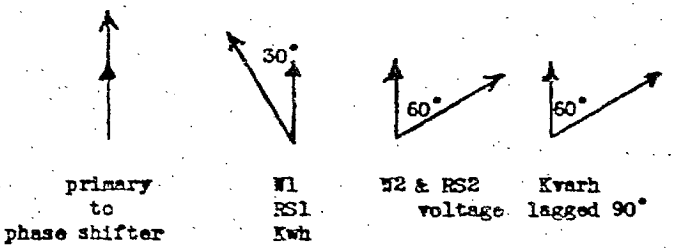


Phase shifter turned to produce voltage lead of 90°

Test varhour meter with RS2

POWER FACTOR = .866 (LAG)

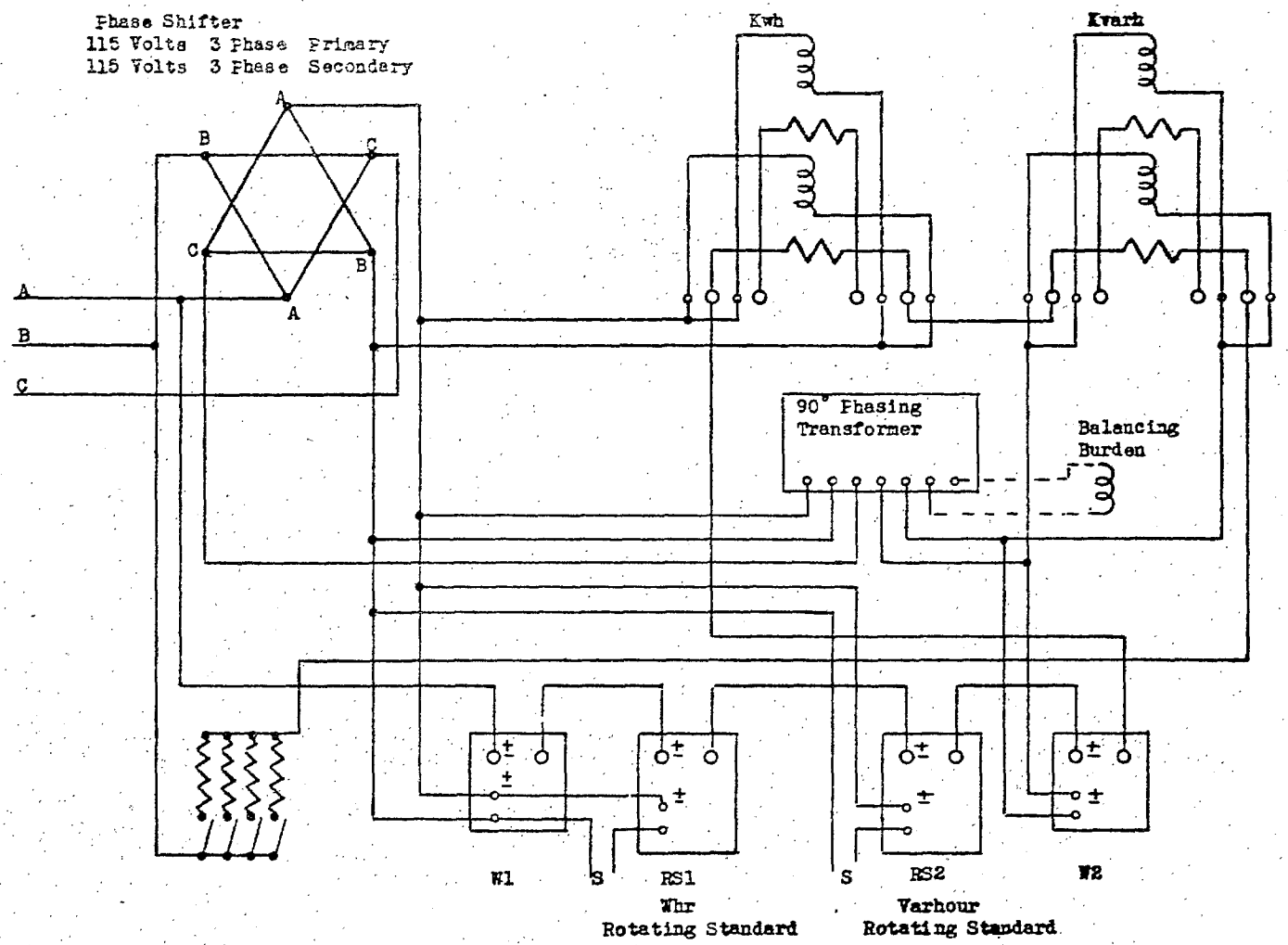
(Equivalent to .5 P.F. test on watthour meter)



Phase shifter turned to produce voltage lead of 30°

Test varhour meter with RS2

DWG No. X2



TEST CONNECTIONS FOR WATTHOUR METER & VARHOUR METER IN COMBINATION

DWG. No. X -3

(Varhour meter with external phase shifting transformer)

VERIFICATION OF REMOTE METER READING SYSTEMS AND AUTOMATIC METER READING SYSTEMS

1. SCOPE

The rules of Part VI cover the verification of Remote Meter Reading Systems and Automatic Meter Reading Systems. These, of course, resemble, in some ways, telemetering systems which are covered to some extent under Part VIIA. The essential distinctive feature is that the subject systems are designed to facilitate the reading of domestic meters.

2. VERIFICATION OF THE METER

2.1 Testing the Watthour Element

(i) A meter fitted with a transmitter and intended for use in a remote reading system shall, when presented for inspection, be tested in the same manner and at the same test points as any other meter of the same type, class and capacity which is not fitted with a transmitter.

(ii) Where sampling procedures have been authorized for a type and class of meter, meters of such type and class fitted with transmitting devices may be so inspected for accuracy provided that the lot sampled includes only meters fitted with transmitting devices. However, the performance of the pulsers themselves shall be determined on a 100% inspection basis. The monthly summary of sampling which includes meters with transmitting pulsers shall include a note to show which lots pertain to meters fitted with pulsers.

2.2 Testing the Pulsing Device

(i) The inspector shall check the transmitter pulsing device fitted in the meter to determine that it is functioning correctly. The utility shall provide satisfactory means for checking the output from the transmitter and such means shall be commensurate with the number of such meters which have to be checked.

(ii) It is considered that two pulses from the pulser should provide an acceptable check. If suitable testing arrangements are made, the two pulses should embrace only a

slightly greater period of time than the time required to register the interval between them. The interval between the test pulses should then equal the declared quantity per pulse. If it can be conveniently arranged, a greater number of pulses is desirable as it would provide greater assurance of the proper functioning of the transmitter.

3. VERIFICATION OF THE REMOTE REGISTER

(i) Each remote register shall be checked by the utility to ascertain that it is working correctly. For this purpose a single meter with transmitter may be used to check several remote registers. However, if quantities are large enough a more suitable pulsing device could provide faster and generally more satisfactory results.

(ii) Although verification of the remote registers is the responsibility of the utility, the inspector must ensure that such verifications are being performed and that facilities are satisfactory for the purpose.

(iii) Remote registers do not have serial numbers nor is there a specified maintenance or re-verification schedule. However, the utility must set up procedures to ensure that these devices are checked periodically and if there is evidence of malfunction or indications that major servicing is required they shall be removed from service. The District Inspector shall be advised of the procedure established for this purpose.

4. INSTALLATION REQUIREMENTS

(i) When the metering system is installed the remote register must read the same as the main meter register.

(ii) At the time of installation the utility meterman shall check to ensure that the transmitter emits pulses and that the remote register received the pulses.

(iii) The onus is on the utility to establish from time to time that both registers of the system continue to read the same. For all practical purpose, it shall be considered that the readings are the same if the discrepancy between registers does not exceed plus or minus three divisions of the lowest value dial of the main meter register.

(iv) The remote register shall be badged with the same inspection number as the meter to which it is connected. At any particular location, then, if either the meter or remote register is changed, the badge number of the remote register must be changed to conform.

5. DISPUTES AND CONSUMER COMPLAINTS

In the case of a dispute or consumer complaint, the reading of the register on the meter itself shall be taken as indicating the consumer's consumption unless of course under a dispute test the meter itself is found to be in error.

6. SEALING

(i) The meter shall be sealed in the usual way by the inspector following inspection. If this process also seals the connections to the terminals of the pulsing device, then a sufficient length of the inter-connecting transmission cable shall be attached to the pulser terminals before sealing to allow satisfactory installation of the system later.

(ii) If the pulser terminals of the meter are available to the meterman after the meter has been sealed then such terminals shall be sealed by the utility following connection of the transmission cable.

7. RECORDS

The utility shall maintain a complete record of all remote reading installations, which record shall be made available to the District Inspector. The record shall include an account of system and component failures.

8. VERIFICATION OF AUTOMATIC METER READING SYSTEMS

(Since no Automatic Meter Reading Systems have yet been approved for billing systems and since quite a variety of such systems are mooted or under development, it is premature to establish rules. However, the practical utilization of such systems may not be too far off and thus space is being allowed in this document to insert the necessary rules if or when the time comes.)

INSPECTION OF ELECTRIC METERING INSTALLATIONS

1. SCOPE

1.1 Authority

Part VII outlines the requirements for the inspection of electric metering installations, that is to say, the tests to verify that all meters and associated auxiliary devices are of an approved type, that they are of correct rating for the application, and that they are so connected as to correctly measure the desired quantity or quantities. "In situ" tests of the meters and auxiliary devices themselves may be made at the time of verification of the installation but this will only be done under special circumstances and will not normally be the case.

1.2 Classification of Metering Installations

1.2.1 Metering Installations

The general term "Metering Installation" includes any installation whether it is single-phase or polyphase, with or without instrument transformers, simple or complex, registered or not registered, etc.

1.2.2 Basis Metering Installations

For the purposes of these rules, a Basic Metering Installation is one which incorporates instrument transformers and is either single-phase or polyphase but does not perform any other function such as totalizing or telemetering.

1.2.3 Totalizing Installations

(i) Any metering installation which measures the loads of two or more circuits and sums them is classified as a totalizing installation.

(ii) When quantities from two primary circuits are measured by a single meter, the installation is classed as a totalizing system regardless of whether or not the primary circuits are operated in parallel or as alternate sources of supply.

(iii) In all cases where totalizing methods are used for revenue metering by means of a single scale or register, the units being totalized must represent equal values of primary quantities and the contract rates must be the same for each.

(iv) Any installation classified simply as a totalizing installation is one in which no telemetering, as defined in 3.4 below, takes place.

1.2.4 Telemetering Installations

(i) A telemetering installation is one in which the value of the measured quantity is translated into a proportional quantity of a different kind and transmitted to a remote receiver which indicates or records in the original or in the proportional units.

(ii) A system which is classified simply as a telemetering installation is one in which no other function, such as totalizing, is performed. The classification may thus apply to a circuit which transmits signals proportional to a number of quantities e.g. watthours, varhours, watt, vars, kva, etc.

1.2.5 Totalizing-Telemetering Installations

A totalizing-telemetering system is one in which both totalizing and telemetering are involved.

1.2.6 Cascaded Telemetering Installations

A cascaded telemetering system is one in which the quantities are transmitted to receivers and then re-transmitted, either directly or through other auxiliary devices, to other receivers which function as the billing meters.

2. REGISTRATION OF INSTALLATIONS

2.1 Basic Requirements

(i) Any metering installation utilizing one or more instrument transformers must be registered with the Department i.e., with the District Office. Therefore, all Basic Installations must be registered as well as most, if not all, Totalizing Telemetering, Totalizing-Telemetering and Cascaded Telemetering Installations.

(ii) Inspectors are authorized to inspect any installation used for billing purposes, whether it is a type which is required to be registered or not. Generally, however, unless there is some special reason, inspections will be confined to those installations which are required to be registered.

2.2 Registration Procedure

(i) Registration is to be made on Form CCA 636, or an equivalent utility form which is acceptable to Standards and the District Office. Full details of each installation, as indicated by the form, shall be recorded, giving the identification and rating of each component. A copy of the Form CCA 636 is attached as Appendix I.

(ii) Where relays, or other non-billing instruments or devices are connected in the metering circuit, details of these must be provided with registration, either on the form or on an attached sheet. Such devices must not interfere with convenient testing of the metering circuit nor affect the accuracy of measurement.

(iii) Registration forms must be kept up-to-date. A new form is required whenever a significant change is made to an installation. Replacement of a meter for normal re-verification purposes or replacement of any other component by another of the same type and rating shall not be considered a significant change.

3. STANDARD AND NON-STANDARD RATINGS

3.1 Requirements for "Standard" Rating

An installation shall be rated "Standard" if it meets all the following requirements:

(i) The installation is identified by an inspection number or company number and the various components are identified as required under Section 3.1, Part I.

(ii) If mounted indoors, the meters are located in a clean, dry and convenient place, reasonably free from vibration, and adequately illuminated, where tests can be made without undue danger to the tester.

(iii) If mounted outdoor, the meters are of a type suitable for outdoor use or protected by an enclosure. The installation must conform to the Canadian Electrical Code or equivalent Provincial Regulations. (If the metering equipment is mounted above a convenient working height from the ground, the owner shall supply, at his own expense, ladders or other equipment necessary for complete inspection and test)

(iv) All equipment is properly grounded. Meters and instrument transformers may be considered as properly grounded if grounded on a metal panel which is grounded;

(v) A satisfactory form of test block is installed in a convenient place, in close proximity to the meter. A test block will be considered satisfactory if it does not contravene the Canadian Electrical Code and if it provides the following features:

(a) a fuse or disconnect in each voltage connection;

(b) convenient means for safely short-circuiting each current transformer secondary; and

(c) convenient means whereby the current test links can be opened to permit insertion of test meters in series with each current coil of the meter and each secondary circuit of the current transformers.

It is considered that the requirement of 3.1(v) will be met if satisfactory portable test facilities are provided by the utility.

(vi) Secondary leads from instrument transformers are brought directly to the line side of the test block if at all feasible. The use of terminal blocks shall be kept to a minimum and only the type specially designed for current transformer secondary circuits shall be used for this purpose;

(vii) Instrument transformer secondary wires which are to be grounded are interconnected and grounded at only one point;

(viii) Relays, instruments, or other devices not used for billing, do not affect the accuracy of the billing measurement, do not interfere with the convenient testing of the billing meters, and the burden details of such devices as well as the connection wiring diagram are available at the time of inspection;

(ix) Meter connections conform to the appropriate diagram shown in the "Standard Drawings for Electricity Metering Installations". The latest revision of this document, dated June, 1975, is available from Standards.

(x) Where instrument transformers are used, all secondary wiring which cannot be readily traced visually is colour coded. The colour coding shall be continuous from end to end. Installations completed and registered prior to October 1967 may be accepted as "Standard" if the identification is by means of suitable tags or permanent labels. There is no requirement for colour coding of primary conductors. The Departmental Standard Colour Code is as shown in the Standard Drawings. However, an installation with the local colour code of a utility will be accepted, as "Standard", provided that:

(a) the difference between current and voltage leads is clearly distinguishable.

(b) the use of green and white is restricted to such purposes as conform to the Canadian Electrical Code.

(c) the code is consistent throughout the utility or a significant division of that utility, and a copy of this code is registered with the District Inspector.

(xi) Where three current transformers are delta-connected, the six secondary leads are brought out and the delta formed at the test block. Where three instrument transformers are Y-connected, the Y-connection may be made either at the test block or at the transformers.

3.2 "Non-Standard" Installations

Any verified installation which does not fully meet the requirements of a "Standard" rating shall be rated "Non-Standard".

4. SELECTION OF INSTALLATIONS FOR INSPECTION

4.1 Man-power Allotments

It is imperative that due attention be paid to the inspection of installations commensurate with the potential inaccuracy and dollar inequity that results from faulty installations.

4.2 Guidelines for Selecting Installations for Test

(i) For any particular utility, the District Inspector should, as far as possible, choose installations for test from different geographical areas, different administrative regions, from rural areas as well as from the city, from different types of metering systems, from old installations

as well as new, etc. Some emphasis should be placed on selecting those areas which offer the greatest potential for finding improper or incorrect installations.

(ii) The number of installations tested for each utility in a year should be roughly equal to the number of its installations multiplied by one and one half times the percentage of installations found faulty in the previous calendar year. For example, if in 1975 it was found that 3.1% of the installations tested for a certain utility (having say 10,000 installations) were faulty, the 1976 program for installation inspection for this utility should include approximately 465 installations.

(iii) Regardless of how good the record of a particular utility may be with respect to the quality of its installations, a minimum sample should be taken each year. A target figure should be not less than 1.5% of the installations registered by the utility.

5. VERIFICATION OF INSTALLATIONS

5.1 General Comments Regarding Inspection

(i) A utility representative shall be present when an installation is inspected.

(ii) "Verified" as used in these rules means only that the installation has complied with the general requirements specified for that classification. It does not imply that an "in situ" verification has been made on the meter or meters.

(iii) Any installation is subject to inspection at any reasonable time but, once verified, an installation will not normally be inspected again unless a significant change is made.

(iv) An installation may be inspected by the Department at any time upon request by either the supplier or the customer and upon payment of the statutory fee.

(v) The actual verification tests may be performed by an inspector or by a qualified employee of a utility. In the latter case all tests must be witnessed and approved by an Inspector.

(vi) When an installation has been tested and all information required for verification has been obtained, except the errors and other data pertaining to the instrument transformers, the installation can be verified as to secondary measurement only and this shall be so noted on the field note.

(vii) Any installation may be verified as correct whether it conforms to standard specifications or not if it can be proved that the total load is being measured correctly under all normal service conditions and if only approved devices are used for billing.

(viii) It is generally assumed that a sealed meter of the proper type and rating will register within the tolerance when correctly connected in a circuit unless there is evidence to the contrary. An "in situ" test of the meters may, however, be made for good reason as an addition to the verification of the installation.

5.2 Verification - General

(i) Registration forms CCA 636 and/or CCA 622 are to be checked against the installation and corrected where necessary. Form CCA 622 is shown in Appendix II.

(ii) Equipment is to be examined to ensure that all components are of an approved type, that types and ratings are correct for the application, that inspection numbers are satisfactory, that meters are 'in date' and that seals are applied where required.

(iii) It must be determined that the total burden including leads and that due to auxiliary transformers on any transformer, does not exceed the maximum burden rating for which the transformer has been approved.

(iv) Where phase sequence could be a factor in the measurement, assurance must be obtained that this is of the correct cyclic order.

(v) Assurance must be obtained that the correct multiplier is being applied.

(vi) Wiring must be checked. Either it must be established that the wiring conforms with one of the Standard Drawings, or a drawing showing actual connections, is to be made. It is to be noted that the Standard Drawings are schematic only. All Standard Drawings show transformer type meters where instrument transformers are used. Installations in which self-contained meters are used may be verified but special precautions must be observed because of the shock hazard. Such installations are rated "Non-Standard".

(vii) Dynamic tests (test meter readings under load conditions), are to be carried out where possible. These are to be as complete as possible, and are to include, where applicable, demand meter readings (indicating and Maximum), watthour meter readings, disc speed, voltages between phases and phase to ground, clip-on ammeter readings, cross-phased wattmeter readings, phase sequence, etc.

(viii) The remainder of Section 5. outlines what tests must be made and what procedures must be followed. Complete details of how tests are to be made for each type of installation will be found in the "Technical Training Manual for Electricity Inspection," supplied by Standards.

(ix) Circuits are to be checked after completion of tests to assure that all connections are correct and tight and that test links and switches have been restored to their normal operating condition.

(x) A uniform procedure should be followed as far as possible in verifying an installation and in recording the test results.

5.3 Verification - Single-Phase Installations

5.3.1 Connections

(i) Installations with any of the connections shown in the Standard Drawings may be accepted for verification.

(ii) A current transformer or meter current coil must not be connected in the neutral conductor.

(iii) Connections as shown in Dwgs. 1309 and 1310 will cause the meter to register double the correct amount. A multiplier of ½ (nominal C.T. ratio) must be conspicuously marked except on transformer-rated meters in which the correct multiplier is incorporated in the gear train.

5.3.2 Rating

A test block is not mandatory for a standard rating if the secondary terminals of the current transformers are accessible and can conveniently be short-circuited.
The Standard Drawings show the preferred colour coding but this is not mandatory for a standard rating.

5.4 Verification - 3-Wire Network Installations

5.4.1 Connections

Connections for this type of installation are shown in drawings 3318-3323 of the Standard Drawings.

5.4.2 Rating

A test block is not mandatory for a standard rating if the current transformer secondary terminals are accessible and can conveniently be short-circuited.

5.5 Verification - Polyphase Installations

5.5.1 Connections

(i) The Standard Drawings are schematic only. In particular, no attempt has been made to show detailed connections at current test blocks.

(ii) The use of two single-phase meters to measure 3-phase, 3-wire loads or three single-phase meters to measure 3-phase, 4-wire loads is permissible where demand measurement is not involved.

5.5.2 Self-Contained Polyphase Meters

(i) All wiring must be traced to the extent necessary to prove that the meter is correctly connected.

(ii) These installations will not normally have any test block so that only limited dynamic tests can be carried out. As many readings as possible should be obtained, e.g. clip-on ammeter and watt-meter readings, voltages, disc speeds, demand readings, etc.

5.5.3 3-Phase, 4-Wire with 3-Phase, 3-Wire Load

(i) If it is known that there is no phase-to-neutral load, then this service may be metered correctly by means of standard 3-phase, 3-wire metering. If phase-to-neutral load is, or may be connected, the circuit should be metered as a 3-phase, 4-wire circuit.

(ii) At the higher voltages, i.e. above 1,000 volts, the possibility of inadvertent phase-to-neutral load is small, and 3-phase, 3-wire metering installations are acceptable. At voltages below 1,000, the use of 3-phase, 4-wire metering is advisable. A 3-phase, 3-wire installation would only be accepted, as non-standard, if the Utility will provide assurance that there is no phase-to-neutral load.

(iii) Such installations should be carefully examined for possible contravention of the Canadian Electrical Code. Where such contravention is apparent, it should be reported to the Inspection Authority.

5.6 Verification - Totalizing Systems

5.6.1 Methods of Totalizing

There are various means whereby the loads of two or more circuits can be totalized on one meter. Some are direct methods such as paralleling of current transformer secondaries; by means of totalizing current transformer; or by use of totalizing meter. Other systems employ some form of telemetering and these are described under that heading.

5.6.2 General Requirements

(i) When current transformer secondaries are paralleled, the following conditions apply:

(a) Paralleled circuits must be of the same voltage and frequency.

(b) The current transformers must have identical ratios and similar design features.

(c) Paralleled units must be installed in corresponding phases of the primary lines.

(d) Potential circuits of the meter must be supplied from a common bus to which the primary circuits are connected.

(e) The meter must have a rating adequate for the totalized load.

(f) To reduce the burden, current transformer secondaries should be paralleled at the meter preferably on a test block.

(g) Paralleling of more than two circuits is not recommended and will require special consideration.

(h) When both the primaries and the secondaries of current transformers are paralleled merely to increase the capacity of a circuit, totalizing is not involved.

(i) When two primary lines are measured by one metering installation but are used as alternate sources of supply, the current transformer secondaries in the unused line must be short-circuited and effectively isolated from the meter circuit.

(ii) When a totalizing current transformer is used, the following conditions apply:

(a) The primary circuits must be of the same voltage and frequency.

(b) The potential coils of the meter must be supplied from a common bus to which all the primary circuits are connected.

(c) All primary windings of a totalizing transformer must be supplied from corresponding phases of the primary lines.

(d) Primary current transformers may have different ratios.

(e) Each primary winding of a totalizing transformer in conjunction with its primary current transformer must produce the correct proportion of the total secondary current.

(f) The overall multiplier to be used in connection with a totalizing transformer is the sum of the ratios of all the primary current transformers which supply that unit.

(iii) When a multi-element meter is used as the totalizing instrument, the following conditions apply:

(a) A totalizing meter may consist of two or more complete meter units supplied from separate primary circuits and driving a common read-out device.

(b) The various meter units may have different values of current and voltage ratings and in some cases different frequency ratings.

(c) Each meter section must contribute to the total read-out its correct proportion of the total load.

(d) The voltage coils of each meter unit must be supplied from the primary circuit which supplies the current coils of that unit.

5.6.3 Connections

(i) Test links and wiring should be arranged in a manner that will permit the insertion of a test meter in each current circuit of the meter and in the secondary of each current transformer.

(ii) Suggested connections for paralleled secondaries of current transformers are shown in Appendix 4 and 5.

5.6.4 Ratings

A totalizing system may be rated as standard if the individual circuits are of standard construction and if the various components can be conveniently isolated and tested 'in situ'.

5.6.5 Test Procedures

(i) The general requirements for verification are covered in Section 6.2.

(ii) Each primary circuit of a totalizing system is to be tested separately in accordance with the method specified for that type of installation.

(iii) Current circuits not immediately under test must be short-circuited and effectively disconnected from the meter circuit.

(iv) Voltages are to be maintained on all potential elements of the meter during tests.

5.7 Verification - Telemetering Systems

5.7.1 Methods of Telemetering

(i) A telemetering system consists essentially of a primary meter which measures the load and transmits signals of proportional value over a transmission channel to a receiver instrument which registers or otherwise records in terms of true primary units.

(ii) For measurements of power circuits the most common forms of signals are voltage; impulse frequency or pulse count; impulse duration; frequency, including tone modulation.

(iii) The transmission medium may be a separate metallic circuit; and existing communication circuit; a carrier current system; radio frequency.

(iv) Some cascaded systems utilize a combination of signals and transmission media.

(v) Any of these systems may be accepted for verification.

5.7.2 General Requirements

(i) It is expected that an inspector will be provided with all necessary details of an installation and its components before inspection and tests are undertaken.

(ii) Primary meters and billing meters must be of approved types but some intermediate components may be considered as part of the transmission channel and may operate under a special approval granted for that system only.

5.7.3 Connections

A watthour meter, when used in series with a thermal converter or other form of transducer, should be installed in a manner that will permit its continued operation while the telemetering system is out of service.

5.7.4 Rating

A telemetering system may be rated as standard when the primary circuits are of standard construction and if the various components of the system can be conveniently isolated and tested 'in situ'.

5.7.5 Test Procedures

(i) For testing, the telemetering system must be isolated from the primary systems by short circuiting the current transformer secondaries and opening the current links to the transmitting meters.

(ii) Each of the primary meters should have been tested in a meter shop prior to installation because of the difficulty in testing at other than unity power factor in the field.

(iii) The main consideration with any form of telemetering is that each primary quantity be faithfully recorded on the billing meter. Testing therefore requires the application of a measured load to each of the primary meters in turn and a check of its recorded value on the receiving meter.

(iv) A check of each transmitting meter output against the measured input should be made to ascertain whether existing errors in recorded values, when they occur, are due to the primary meters, the transmission channel or the recorder.

(v) Auxiliary devices installed between the transmitting meters and the recorder in a cascaded system can be considered as part of the transmission channel and need not be tested separately when the recorded values on the billing meter are in agreement with the outputs from the primary meters.

7. RESULTS OF INSTALLATION INSPECTION

7.1 Proper Description of Results

Table I below illustrates the various possibilities which arise from the inspection and an example is indicated.

Table I

Rating	Verified Correct	Corrected & Verified	Rejected	Undue Difficulty
Standard				
Non-Standard		x		x

In the example the installation is designated as: Rated Non-standard; Corrected and Verified; Undue Difficulty. The other possibilities are obvious.

7.2 Installations Requiring Correction

7.2.1 General

Any condition resulting in incorrect measurement, or incorrect billing must be corrected as soon as possible.

7.2.2 When correction can be made immediately

Frequently, as in the case of an incorrect multiplier, or certain cases of incorrect connections, the correction can be made immediately. The inspection will be recorded on the field note and on the monthly return as "corrected and verified". The rating which applies after correction is the one which should be assigned to the installation.

7.2.3 When correction cannot be made immediately

(i) An installation is to be rejected when any of the following conditions exists, and cannot be corrected immediately:

(a) Measurement is incorrect

(b) Equipment is not approved

(c) Equipment is not of the correct type and rating for the application.

(d) A meter seal is broken or out of date.

(ii) When an installation is rejected, the inspection is to be recorded on the field note.
When the condition is corrected, another inspection is to be made, at which time the installation will be verified. A field note entry is to be made for this inspection also, which is to be recorded and designated as "corrected and verified". An explanatory note should be inserted on the monthly return.

(iii) An installation may be rejected and yet rated "Standard" if the cause for rejection is one of the following:
- Seal overdue
- Meter cover cracked or broken
- Blown fuse which cannot be replaced immediately.

8. RECORDS AND REPORTS

8.1 District Office Records

(i) An entry is to be made on the field note for each installation test or inspection.

(ii) Results of inspections and tests on simple installations may be summarized on the back of Form CCA 636, but for totalizing, telemetering and some polyphase installations a more detailed report will be required.

8.2 Reports to Standards

(i) Details of the number of inspections, the number requiring correction, cause for rejection, etc., are to be submitted, separately for each utility, to Standards, on the monthly return form. A copy of the form is shown on Appendix III.
It is of particular importance to supply Standards with full details of all inspections which result in rebates or readjustments. In many cases it will not be possible to supply this information at the end of the month in which the inspection took place. However, it should be forwarded to Standards as soon as it is available.

(ii) Once per year, each District shall forward to Standards, copies of the complete inspection reports for all installations rejected or corrected and verified during the specified calendar month. The schedule for submitting this information is as follows:

Month	District
Jan.	Vancouver
Feb.	Toronto
Mar.	Montreal
April	Winnipeg
May	St. John's & Penticton
June	Edmonton & Charlottetown
July	Calgary & Thunder Bay
Aug.	Fredericton & Ottawa
Sept.	Halifax & Ottawa
Oct.	Hamilton & Trois Rivieres
Nov.	London & Quebec
Dec.	Belleville & Sudbury

Appendix I

PART VII

STANDARDS BRANCH – DIRECTION DES STANDARDS

Department of consumer and corporate affairs/Ministère de la consommation et des corporations

INSTALLATION NO.					CLASSIFICATION
UTILITY – *Fournisseur*					
CUSTOMER – *Client*					Contract no – *Contract N°*
ADDRESS – *Adresse*					
PRIMARY: VOLTS *Primaire:*	AMPERES *Ampères*	Hz.	PHASE	WIRE *Fils*	NETWORK – *Réseau* Y or *ou* Δ
MULTIPLIER USED FOR BILLING: *Multiplicateur total:*	DEMAND *De pointe*		ENERGY *D'energie*		
DEMAND: *Unité de point:* KW	KVA	KW & KVA	KW & RKVA *KW & KVAR*		
METER SEAL DATES – *Dates d'inspections du compteur*					

METERS – COMPTEURS

INSPECTION NO. *N° inspection*	MAKER *Fabricant*	SERIAL NO. *N° de serie*	TYPE	VOLTS	AMPS.	MULT.	K_h	PHASE	WIRE *Fils*	Elements

INSTRUMENT TRANSFORMERS TRANSFORMATEURS DE MESURAGE			VOLTS		AMPS.		Acc., class *Categorie de precision*	WIRE *Fils*	PRIMARY THRU WINDOW *Tours primaire*
			PRIMARY *Primaire*	SEC.	PRIMARY *Primaire*	SEC.			
METERING UNIT *Cuve de mesurage*									
CT'S *Tr. d'intensité*			—	—					
			—	—					
			—	—					
VT'S *Tr. de tension*					—	—		—	—
					—	—		—	—
					—	—		—	—
AUX. TRANS. *Tr. auxiliaire*									

NATURE OF LOAD – *Nature de la charge*

P.F. CORRECTION *Y a-t-il correction du facteur de puissance.* YES *Oui* ☐ NO *Non* ☐

DATE

FOR UTILITY – *Representant*

CCA 636 (7.73)

SEP - 1975

STANDARDS BRANCH
DEPARTMENT OF TRADE & COMMERCE

Installation No. _____ Code _____

Utility _____

Customer _____ Contract No. _____

Address _____

Billing: Energy only; Demand only; Demand & Energy. Billing Multiplier _____

Demand: KW only; KVA only; KW & KVAR. No. of Primary Circuits _____

System: Totallzing only; Telemetering only; Totalizing–Telemetering.

Totalizing: Paralleled CTs; Totalizing CTs; Totalizing Meter.

Telemetering: Millivolts; Impulses; Cascaded System.

Transmission: Private Lines; Rented Telephone Lines; Carrier Current; Radio.

Billing Meter: Inspection No. _____ Serial No. _____

Maker _____ Type _____ Time Interval _____ Min.

Scale Range _____ KW; _____ KVAR; _____ KVA.

Multiplier _____ Full Scale MV. or Impulses _____ CDRX _____ OHMS

PRIMARY METERS AND INTERMEDIATE DEVICES

Inspection No.	Serial No.	Maker	Type	Response Period or Units per Impulse	MV. or MA Output Per Unit Input	Seal Date

_____ Date

_____ For Utility

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S–E. 24a (Rev. 63)

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INSPECTION REPORT Classification____ Standard

Transmission Circuit: _____

Chart: Maker_____ Number_____ Scale_____

Date	Field Note Number	Verified or Rejected	Error % Full Scale	Inspector

Disputed tests to be entered in red ink

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Appendix III

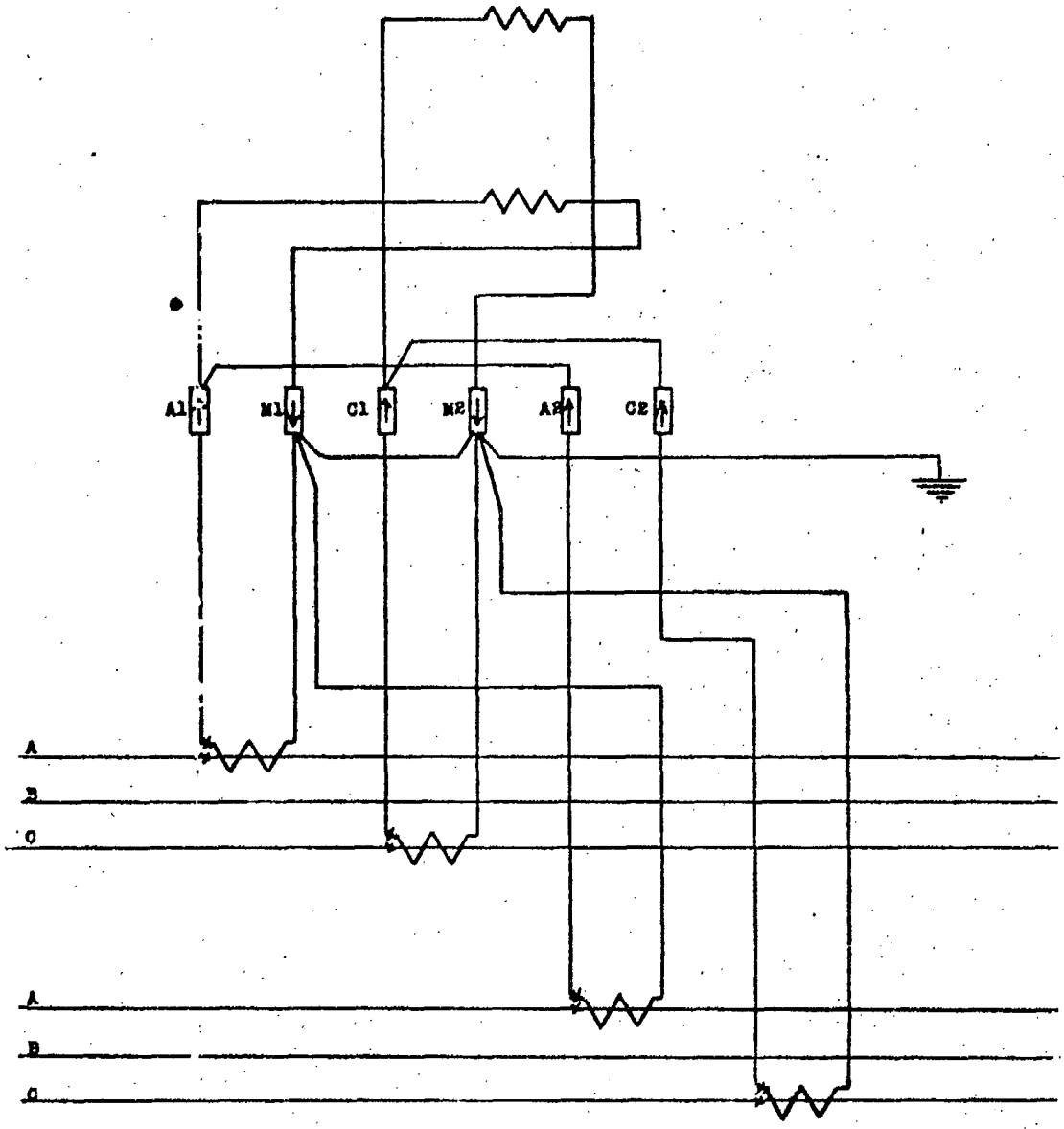
PART VII

MONTHLY REPORT OF ELECTRIC INSTALLATIONS INSPECTED
(LIST EACH UTILITY SEPARATELY)

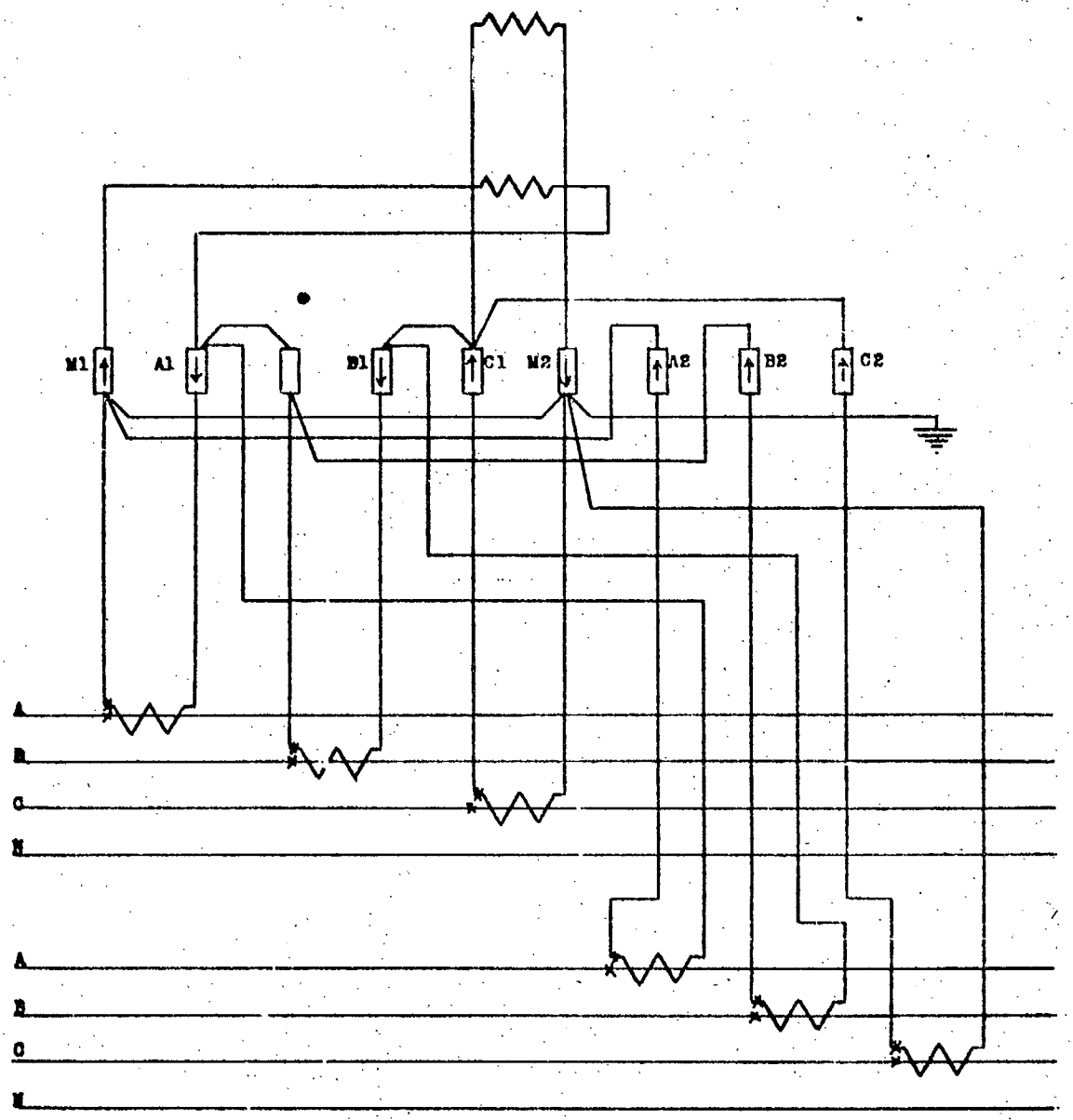
DISTRICT _____ MONTH _____

Utility	Total No. of Installations Inspected	Accepted Standard	Accepted Non-Standard	Corrected & Verified	Rejected	Of Those Inspected How Many were Previously Rejected	Complete These Columns for Installations Rejected or Corrected & Verified									Remarks
							Measurement or Billing Correct			Measurement or Billing Incorrect						
							Seal	Equ't not Approved or not Correct Type	Other	Error Penalizes Customer	Error Penalizes Utility	Multiplier	Defective Equip't.	Incorrect Connections	Other	

Details of Rebates, Billing Adjustments or Other Special Information. _____



TOTALIZING 2 3-PHASE, 3-WIRE CIRCUITS



TOTALIZING 2 3-PHASE, 4-WIRE CIRCUITS

(ii) When an installation is rejected, the inspection is to be recorded on the field note.
When the condition is corrected, another inspection is to be made, at which time the installation will be verified. A field note entry is to be made for this inspection also, which is to be recorded and designated as "corrected and verified". An explanatory note should be inserted on the monthly return.

(iii) An installation may be rejected and yet rated "Standard" if the cause for rejection is one of the following:
- Seal overdue
- Meter cover cracked or broken
- Blown fuse which cannot be replaced immediately.

8. RECORDS AND REPORTS

8.1 District Office Records

(i) An entry is to be made on the field note for each installation test or inspection.

(ii) Results of inspections and tests on simple installations may be summarized on the back of Form CCA 636, but for totalizing, telemetering and some polyphase installations a more detailed report will be required.

8.2 Reports to Standards

(i) Details of the number of inspections, the number requiring correction, cause for rejection, etc., are to be submitted, separately for each utility, to Standards, on the monthly return form. A copy of the form is shown on Appendix III.
It is of particular importance to supply Standards with full details of all inspections which result in rebates or readjustments. In many cases it will not be possible to supply this information at the end of the month in which the inspection took place. However, it should be forwarded to Standards as soon as it is available.

(ii) Once per year, each District shall forward to Standards, copies of the complete inspection reports for all installations rejected or corrected and verified during the specified calendar month. The schedule for submitting this information is as follows:

Month	District
Jan.	Vancouver
Feb.	Toronto
Mar.	Montreal
April	Winnipeg
May	St. John's & Penticton
June	Edmonton & Charlottetown
July	Calgary & Thunder Bay
Aug.	Fredericton & Regina
Sept.	Halifax & Ottawa
Oct.	Hamilton & Trois Rivieres
Nov.	London & Quebec
Dec.	Belleville & Sudbury

MISCELLANEOUS ELECTRIC METERING DEVICES

1. SCOPE

1.1 Authorization

The meters covered by this Part are those that do not fit into the scope of any of the other Parts. Morever, it is not expected that any of the devices covered will be used to any great extent, otherwise it would warrant a Part of its own.

1.2 Classification

Since this Part is intended to take care of a miscellany of devices, no classification by type is possible. However, because the instruments covered will be uncommon and unusual, there is likely to be more detail given in the Approval of Type Notice and a special Technical Electric Circular issued for a specific device.

2. TRANSFORMER - LOSS COMPENSATORS

2.1 Description

Transformer-loss compensators provide a means of measuring the energy and demands of high-voltage services from the low-voltage side. They add to the registration of the watthour meter an amount that is equal to the sum of the iron and copper losses of the transformer bank. The method is intended primarily for use on customers' installations where the contract provides for supplying and billing for energy and demand at distribution or transmission voltages. The calibration of the compensators is based on test data obtained from the files of the manufacturer of the power transformers. Conductor losses on the low-voltage side between the transformers and the metering point may be included, and also if desired, losses on the high-voltage side to a designated point if no other loads are connected to the line.

2.2 Reference Data

Details of the principle of operation, applications and method of adjustment of an approved transformer-loss compensator is given in Technical Bulletin No. 4, a copy of which may be obtained from Standards. This bulletin includes more detail than an inspector would normally need. However, the inspector may be called upon to check installations, calculate setting points and have some idea of the adjustment procedure as well as make the final inspection of the device.

2.3 Test Points and Tolerances

The transformer-loss compensator should be tested in conjunction with the meter (watthour or varhour) with which it is to be used in service. Since the meter errors need to be known for the test loads which are to be applied, it is best to use the standard test points specified in these rules for the particular meter.

Given the percent iron loss and percent copper loss (as supplied by the utility) for which the device is supposed to compensate, the "desired registration," of the meter can be calculated for each test load, as described in Technical Bulletin No. 4. The applicable tolerance is then ±0.5% of the "desired registration" at each load.

It should not normally be necessary for the inspector to calculate the percent iron loss and percent copper loss from the basic service data. The procedure for this, however, is described in Technical Bulletin No. 4 and in case of a dispute the inspector may indeed need to make or check these calculations.

3. AMPERE-SQUARED-HOUR LOSS METERS

3.1 Description

The function of the Ampere-Squared-Hour Loss Meter is to provide an integration of the square of the line current over time. The resultant when applied to a specific part of the line, the resistance of which is known or calculated, can thus produce a value for the losses in the particular part of the line.

These meters may be fitted with double registers, marked IMPORT-EXPORT, to measure the losses on the line for either direction power flow. The register in use will be automatically indicated by some means.

The meter may also be fitted with transmitting contacts, the register and pulse output being in the same units. The units may be either ampere-squared hours or by a suitable combination of gear ratios and multipliers be converted to either primary or secondary watthours. In the latter cases, the specific line resistance must be marked on the nameplate either in ohms or watts at rated current together with the current transformer ratio when applicable.

When pulses are transmitted, the register constant of the associated receiver or summator devices must incorporate the value of the specific line resistance as well as the value of per output pulse as marked on the nameplate of the transmitting meter.

3.2 Reference Data

Before proceeding with tests, reference should be made to the Approval Notice for the type, applicable Technical Electric Circular, if any, and the Technical Training Manual for Electricity Meters.

3.3 Test Points and Tolerances

Tests shall be made at 5, 2.5 and 0.5 amperes. The error at each test point shall be within ±3.0%.

4. RECORDS AND REPORTS

Reports to Standards

In view of the fact that meters under this Part are unusual and uncommon the number tested is likely to be small. Special attention should be drawn to any such reported on the monthly consolidated meter report or a memo attached to the report.