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Edition 1

NRS 057:2005
Edition 1

SOUTH AFRICAN NATIONAL STANDARD

Code of practice for electricity metering

This national standard is the identical implementation of NRS 057:2005 and is adopted in terms of a Memorandum of Agreement between the Electricity Suppliers Liaison Committee and Standards South Africa.

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Edition 1
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Table of changes

Change No.	Date	Scope

Abstract

Specifies procedures and standards to be adhered to by electricity licensees and their agents in operating and servicing new and existing metering installations that are to be used for billing purposes. Applicable to metering installations in their entirety, including all measuring transformers, wiring, cabling, metering panel construction, active and reactive meters, data loggers and associated test facilities.

Keywords

code of practice, current transformers, electricity billing, electricity metering, electricity metering installations, electricity meters, instrument transformers, voltage transformers.

National foreword

This South African standard was prepared by a working group of the Electricity Suppliers Liaison Committee and adopted by National Committee TC 62, *Electrical measurements,* in accordance with procedures of Standards South Africa, in compliance with annex 3 of the WTO/TBT agreement.

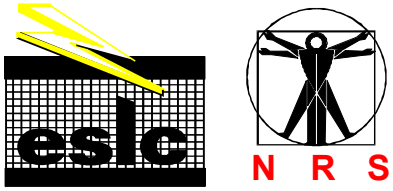
The adoption has been done in terms of a Memorandum of Agreement between the Electricity Suppliers Liaison Committee and Standards South Africa.

ICS 91.140.50

NRS 057:2005

Edition 1

CODE OF PRACTICE FOR ELECTRICITY METERING



This rationalized user specification is issued by
the Technology Standardization Department (TSD), Eskom,
on behalf of the
User Group given in the foreword
and is not a standard as contemplated in the Standards Act, 1993 (Act No. 29 of 1993).

Table of changes

Change No.	Date	Text affected

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Foreword

This code of practice was prepared on behalf of the Electricity Suppliers Liaison Committee (ESLC).

This code of practice was prepared by a working group which, at the time of publication, comprised the following members:

E Louw (Chairman)	Eskom (Distribution)
J Belgrove	Eskom PTM (Witbank)
H Essop	City of Cape Town
F Fryer	Ekurhuleni Municipality
H Groenewald	Eskom (Pretoria Distributor)
P Johnson (Project Leader)	Technology Standardization, Eskom
M Lewis	City Power Johannesburg
S Makhathini	National Electricity Regulator
MG Mashinin	eThekwini Electricity
SJ van den Berg	Mangaung Municipality
C van der Westhuizen	Mangaung Municipality
J Westenraad	City of Tshwane

An Interest Group (IG) was consulted on the contents of this code of practice and the comments were incorporated where the working group was in agreement. The IG comprised the following members:

H Hayes	Landis and Gyr S.A. (Pty) Ltd
D Henriksen	Elster Kent Metering
G Mellis	Power Meter Technics
I Mohamed	Actaris Measurement
C Nell	IST OTOKOV (Pty) Ltd
M Phaloane	SANAS
M Pillay	SANAS
V Rengecas	Valucal Test & Measurement
E Smit	SANAS
N Tayler	SANAS
H Visagie	IST OTOKOV (Pty) Ltd

This edition cancels and replaces the first editions of NRS 057-1, NRS 057-2 and NRS 057-4.

A reference is made in **C.2.2.2** and **C.2.3.2(a)** to “legislation”, in **4.6.6.2** to "statutory regulations" and in **annex C** (see definition of “point of supply”) to “Regulation R1 to relevant legislation”. In South Africa this is the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) (as amended from time to time) and the regulations promulgated in terms of the Act.

This code of practice might be referenced in codes issued by the National Electricity Regulator (NER). Therefore, compliance with such codes, and hence this code of practice, could be a licence condition.

NOTE The NER advised a change in license conditions in December 2005, to include compliance with NRS 057:2005.

Annexes A, B and C form an integral part of this code of practice. Annex D is for information only.

Introduction

This code of practice has been prepared to establish and promote uniform requirements for application in the South African Electricity Supply Industry.

This code of practice contains requirements that licensees might only be in a position to conform to progressively. Engagement with other stakeholders including the NER will be required to formulate and agree an implementation plan which could evolve over several years. Notwithstanding the requirement to structure and agree on an implementation plan, the Electricity Suppliers Liaison Committee expresses the wish that all supply authorities will adopt the requirements of this code of practice insofar as their particular conditions will permit. Any differences between the requirements of this code of practice and the licensee's requirements should be submitted for consideration in future revisions of this code of practice.

The following role players can be identified in the metering function:

- the National Electricity Regulator (NER);
- customers;
- licensees;
- metering service providers;
- auditors;
- testing and calibration laboratories; and
- The South African National Accreditation Service (SANAS).

The National Electricity Regulator (NER)

The NER is the statutory body that oversees the electricity market and the regulations that control it. The NER has issued a distribution metering code and a transmission code [grid code] which contain the regulations that require compliance with NRS 057.

Customers

Customers' rights and obligations have been defined in the distribution metering code and the transmission code. Procedures for customers to follow in cases of complaints of the level of service provided by a licensee are covered in NRS 047.

Licensees

Licensees, as part of their licence conditions, are required by the NER to comply with either the metering code of the transmission code [grid code] or the distribution code. These codes require compliance with NRS 057.

Metering service providers

A Metering Service Provider (MSP) is a legal entity that has been contracted by one or more licensees to perform specific work on the licensee's metering installations. It is envisaged that the industry might maintain a register of MSPs that have demonstrated their competence to perform specific work in compliance with NRS 057. MSPs are required to employ staff who have been appropriately trained, as set out in this code of practice.

Auditors

The NER's distribution metering code covers the requirements for auditing of customers' metering installations.

The South African National Accreditation System (SANAS)

SANAS has been established by Government as the single national accreditation body that gives formal recognition that laboratories, certification bodies, inspection bodies, proficiency testing scheme providers and good laboratory practice (GLP) test facilities are competent to carry out specific tasks.

SANAS certificates are a formal recognition that an organization is competent to perform specific tasks.

SANAS is responsible for the accreditation of certification bodies to ISO/IEC Guides 62, 65 and 66 (and the International Accreditation Forum interpretation thereof) and the accreditation of laboratories (testing and calibration) to SANS 17025. Inspection bodies are accredited to SANS 17020.

The process of registering laboratories either as accredited test laboratories (involving manufacturers and their testing agents), or as accredited calibration laboratories (involving licensees or their calibration agents) will need to be agreed upon with SANAS. Such an agreement will involve all stakeholders, including the relevant local authorities. This will be an integral part of the progressive implementation of NRS 057.

For more information concerning SANAS accreditation, visit the SANAS website www.sanas.co.za.

Keywords

code of practice, current transformers, electricity billing, electricity metering, electricity metering installations, electricity meters, instrument transformers, voltage transformers.

Contents

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CODE OF PRACTICE FOR ELECTRICITY METERING

1 Scope

1.1 This code of practice specifies the procedures and standards to be adhered to by electricity licensees and their agents in operating and servicing new and existing metering installations which are to be used for billing purposes. The code of practice is applicable to metering installations in their entirety, including all measuring transformers, wiring, cabling, metering panel construction, active and reactive meters, data loggers, and associated test facilities.

1.2 This code of practice sets out best practices to be adopted by electricity licensees, wherever practicable. (See NOTES 1 and 2.)

NOTE 1 Some requirements might be the subject of mandatory compliance through reference in codes regulated by the NER. In cases where compliance with mandatory requirements will not be practicable, the NER should be approached for exemption.

NOTE 2 This code of practice should be interpreted as applicable to new and refurbished metering systems. Practices in place before the publication of this code of practice might be deemed to be acceptable for an agreed time frame.

1.3 This code of practice specifies requirements for the initial calibration and certification of metering equipment and compliance testing of metering installations. It describes procedures to ensure that metering installations continue to comply with standards and sets out steps to be taken to reconfirm compliance after any modifications to the metering installation or when certification of any equipment has expired.

1.4 This code of practice specifies procedures for the manipulation and storage of metering data. Metering installations are categorized, and for each category the qualifications required for meter workers are specified.

1.5 This code of practice specifies a standard format for the unique numbering of meters.

1.6 This code of practice does not attempt to cover all possible variations in metering installations. Where features additional or alternative to those specified in this code of practice are required, they will be appropriately tested or inspected (or both) to confirm the integrity of the overall metering installation.

NOTE This code of practice does not specify procedures and standards for prepayment metering installations; these are under consideration.

2 Normative references

The following documents contain provisions which, through reference in this text, constitute provisions of this code of practice. All documents are subject to revision and, since any reference to a document is deemed to be a reference to the latest edition of that document, parties to agreements based on this code of practice are encouraged to take steps to ensure the use of the most recent editions of the documents listed below. Information on currently valid national and international standards and specifications can be obtained from Standards South Africa.

NRS 047-1, *Electricity supply – Quality of service – Part 1: Minimum standards.*

NRS 071, *Automated meter reading for large power users.*

SANS 1799, *Watt-hour meters – AC electronic meters for active energy.*

SANS 7812-1/ISO/IEC 7812-1, *Identification cards – Identification of issuers – Part 1: Numbering system.*

SANS 15417/ISO/IEC 15417, *Information technology – Automatic identification and data capture techniques – Bar code symbology specification – Code 128.*

SANS 60044-1/IEC 60044-1, *Instrument transformers – Part 1: Current transformers.*

SANS 60044-2/IEC 60044-2, *Instrument transformers – Part 2: Inductive voltage transformers.*

SANS 60044-3/IEC 60044-3, *Instrument transformers – Part 3: Combined transformers.*

SANS 60044-5/IEC 60044-5, *Instrument transformers – Part 5: Capacitor voltage transformers.*

SANS 62051/IEC 62051(SABS IEC 62051), *Electricity metering – Glossary of terms*.

SANS 62052-11/IEC 62052-11, *Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 11: Metering equipment.*

SANS 62053-11/IEC 62053-11, *Electricity metering equipment (a.c.) – Particular requirements – Part 11: Electromechanical meters for active energy (classes 0,5, 1 and 2).*

SANS 62053-21/IEC 62053-21, *Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2).*

SANS 62053-22/IEC 62053-22, *Electricity metering equipment (a.c.) – Particular requirements – Part 22: Static meters for active energy (classes 0,2 S and 0,5 S).*

SANS 62053-23/IEC 62053-23, *Electricity metering equipment (a.c.) – Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3).*

3 Terms, definitions and abbreviations

For the purposes of this code of practice, the terms, definitions and abbreviations given in SANS 62051 and the following apply.

NOTE 1 Some terms or definitions from other standards or documents have been repeated in 3.1 for the sake of convenience. Reference to such publications is given in square brackets after the definition.

NOTE 2 NRS 057-1:2001 included a glossary of metering terms. Terms and definitions from that glossary that have not been used normatively in this edition of NRS 057 have been appended (see annex D). Their inclusion in SANS 62051 is under consideration.

3.1 Terms and definitions

accreditation
procedure by which an authoritative body gives formal recognition that a body or person is competent to carry out specific tasks

[ISO/IEC Guide 2]

accredited calibration laboratory
laboratory that has been accredited by the government endorsed national accreditation body (SANAS) in accordance with SANS 17025 for calibration of metering equipment.

NOTE Laboratories can be accredited by SANAS anywhere in the world through mutual recognition schemes.

accredited test laboratory
laboratory that has been accredited by the government endorsed national accreditation body (SANAS) in accordance with SANS 17025 for type testing of metering equipment.

NOTE Laboratories can be accredited by SANAS anywhere in the world through mutual recognition schemes.

accuracy class index
number that gives the limits of the permissible percentage error as defined in the applicable specification for a meter when the meter is tested under reference conditions

NOTE Multirange and multipurpose instruments may have more than one accuracy class index.

active energy
integral of the active power with respect to time

actual transformer ratio
ratio of the actual primary current to the actual secondary current

archived data
data from the operational metering database that was saved or stored on a storage medium

EXAMPLE Tape-drives, compact discs.

authorized maximum demand
AMD
maximum load that the customer is authorized by the licensee to take from that point of supply (POS)

auxiliary circuit
the elements (lamps, contacts, etc.) and connections of an auxiliary device within the meter case that are intended to be connected to an external device, for example a clock, a relay, an impulse counter

[SANS 62052-11]

back-up meter
additional meter installed on the same primary plant as the main meter for the purpose of storing back-up data in the event of failure of the main meter

billing
the process of producing and delivering a bill (an account) for payment by a customer, calculated from the tariff schedule, and for the majority of customers, the consumption measured and recorded by the metering system

[SANS 62051]

NOTE Bills are also calculated on estimated consumption and for unmetered installations. Customers are billed at regular cycles (e.g. monthly, bimonthly, quarterly or yearly) and when an account is finalized or when a special reading is requested.

burden
the value of the impedance of the secondary circuit expressed in ohms (or in volts per ampere at the rated secondary current) at the relevant power factor

calibration
set of operations that establishes, under specified conditions, the relationship between the values indicated by a measuring system and the corresponding values of a quantity realized by a reference standard or a working standard

calibration report
report that contains the results of all calibration tests carried out on a metering installation or a component of a metering installation by an approved laboratory as part of the certification process

capacitor voltage transformer
CVT
voltage transformer (VT) that comprises a capacitor divider unit and an electromagnetic unit so designed and interconnected that the secondary voltage of the electromagnetic unit is substantially proportional to and in phase with the primary voltage applied to the capacitor divider circuit

certification
procedure by which a third party gives written assurance that a product, process or service conforms to specified requirements

[ISO/IEC Guide 2]

check metering
dual-redundant metering system (a completely separate installation) that has two dedicated CT cores but might have only one dedicated VT winding

code of practice
document that recommends practices or procedures for the design, manufacture, installation, maintenance or utilization of equipment, structures or products

[ISO/IEC Guide 2]

NOTE A code of practice can be a standard, a part of a standard or independent of a standard.

compliance testing (of a metering installation)
procedure whereby a metering installation and its component parts are proved to comply with applicable requirements

NOTE The procedure includes the issuing of a compliance report.

current circuit
internal connections of the meter and part of the measuring element through which flows the current of the circuit to which the meter is connected

[SANS 62052-11]

current transformer
CT
instrument transformer in which the secondary current, in normal conditions of use, is substantially proportional to the primary current, and differs in phase by an angle which is approximately zero for an appropriate direction of the connections

[IEC Dictionary]

customer
organization or person that receives a product

NOTE For the purpose of this code of practice, a customer is a legal entity or a person that has entered into an electricity supply agreement with a utility.

data
information that is contained in electronic format

NOTE Data includes information regarding the quantity of energy used, the revenue due by the customer and the information about the metering installation.

data logger
device that is capable of registering meter data such as consumption and demand data referenced to time and date and that has the capability of communicating data to a central point by means of an electronic interface

demand
average value of power or a related quantity over a specified interval of time

demand integration period
interval of time on which the demand measurement is based

EXAMPLE 15 min, 30 min.

[SANS 62051]

electricity meter
device that measures and registers the integral of an electrical quantity with respect to time

electromechanical meter
metering device that measures active or reactive energy consumption electromechanically by means of the Ferraris principle

NOTE The product of voltage and current magnetic fields causes a torque proportional to the active or reactive power on a rotating metallic disc. Integration of power is achieved by registering the number of revolutions of the disc through a gear ratio.

electronic meter
meter that converts voltage and current inputs into signals, via VTs, CTs and electronic circuits, and where the consumption is displayed through an LCD display

estimation
process whereby values are inserted into the set of energy usage data for a customer and where such data is not available through maloperation of equipment or failure to retrieve it within a specified performance period or when metering is deliberately not reading at every billing interval

in situ testing
testing done under live conditions in a non-intrusive way to verify the accuracy of a metering installation

instrument transformer
CT or VT that is used to reduce the value of currents or voltages, respectively, applied to a meter in known and definite ratios that bring the current and voltage to within the range of the meter having normal current and voltage ratings

kVA (demand)

$$\frac{\text{kVAh}}{T} = \frac{\sqrt{\text{kWh}^2 + \text{kvarh}^2}}{T} = \sqrt{\text{kW}^2 + \text{kvar}^2}$$

where

T is the integration period in hours

kW (demand)

$$\frac{\text{kWh}}{T}$$

where

T is the integration period in hours

licensee
recipient of a licence issued by the NER that authorizes the generation or transmission or distribution or supply (or more than one of these) of electrical energy

NOTE A licence is renewed on a periodic basis.

main and check metering
dedicated metering system with two active energy and two reactive energy meters fed from two dedicated CT cores and two (or maybe only one) dedicated VT winding(s)

NOTE The recording equipment should also be duplicated.

main metering
dedicated metering system with one active energy meter, and, depending on the tariff in use, one reactive energy meter and one recorder (where applicable)

NOTE This assembly of meters is fed from one dedicated current instrument transformer core and one dedicated voltage instrument transformer winding.

meter
device for measuring and totalling the variable consumption of a product

NOTE In general a meter consists of a sensor and an integrating device that displays the total consumption in metrological units.

[SANS 62051]

meter type
designation that is used for defining a particular design of meter, manufactured by one manufacturer, that has similar metrological properties, the same uniform construction of parts determining these properties, the same number of ampere turns for the current winding at the basic current and the same number of volt turns for the voltage winding at the reference voltage, and the same ratio of the maximum current to the basic current

metering element
device in a meter that carries out the required functions of multiplication of the voltage and current in order to obtain electrical power and integration to obtain energy

metering equipment
collection of components in the metering installation, i.e. the instrument transformers, cables, meters, recorders and any housing and ancillary equipment such as test blocks

metering information
data (unprocessed information), processed information and stored information that relate to metering equipment at the metering point or the POS

NOTE Metering information includes the following:

a) configuration data. It relates directly to the metering device itself. It uniquely describes the processing inherent in the device that converts secondary electrical quantities (voltage and current) into the required measurand.

b) status data. It relates to the condition of the metering device and the validity of the metering information that originates from it. It could be contained in the information presented at the site interface, or elsewhere in the metering system.

c) metering data. It refers to the measurands of energy values (active, reactive and apparent), and the instantaneous values that may be available from the meter.

metering installation
all meters, fittings, equipment, wiring and installations, used for measuring the flow of electricity, and that comply with standards

periodic testing
testing done according to a predetermined maintenance schedule, with reference to standard maintenance procedures and with the aim of ensuring correct operation of the metering installation

portable working standard
standard instrument that has been calibrated at an accredited calibration laboratory or an accredited test house and is designed for calibrating metering equipment in the field

programmable metering device
device that is capable of calculating, storing and displaying active and reactive energy values according to a user-defined configuration

pulse device
functional unit for initiating, transmitting, retransmitting or receiving electric pulses, representing finite quantities, such as energy, normally transmitted from some form of electricity meter to a receiver unit

pulsing meter
unit that forms part of the metering device that houses the metering element and performs the integration function to generate proportional pulses for the measured active energy or reactive energy (or both)

rated burden
the value of the burden on which the accuracy standards are based

raw meter data
any unprocessed information that is received directly from a metering installation

reactive energy
product of voltage and current and the sine of the phase angle between them integrated over a time period, and that is normally measured in kilovar-hours

reactive energy meter
meter that is used for the measurement of reactive energy

reference standard
measuring instrument that has been calibrated by an approved calibration laboratory

solid state meter
meter that converts voltage and current inputs into signals, through VTs, CTs and electronic circuits that drive a stepper motor which in turn drives the rolling register of the meter

test block
device that permits access to voltage and current circuits for testing purposes while the metering installation is in normal service

traceability
process whereby the indication of a measuring instrument can be compared, in one or more stages, with a national standard for the measurand in question

type testing
compliance testing on the basis of one or more specimens of a product representative of their production

[ISO/IEC Guide 2]

NOTE For the purpose of this code of practice, type testing is carried out on equipment to prove compliance with certain specifications and hence its acceptability for the purpose for which it was intended as part of a metering installation.

uncertainty
parameter, associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the quantity being measured

var hour meter
reactive energy meter
electricity meter that measures and registers the integral, with respect to time, of the reactive power of the circuit in which it is connected

NOTE The unit in which this integral is measured is usually the kilovar-hour.

voltage transformer
VT
instrument transformer in which the secondary voltage, in normal conditions of use, is substantially proportional to the primary voltage, and differs in phase from it by an angle which is approximately zero for an appropriate direction of connections

[IEC Dictionary]

watt-hour meter
active energy meter
instrument that is intended to measure active energy by integrating active power with respect to time

[IEV 301-04-17]

3.2 Abbreviations

AMD: authorized maximum demand
AMR: automated meter reading
CT: current transformer
ESLC: Electricity Suppliers Liaison Committee
ICASA: Independent Communications Authority of South Africa
LPU: large power user
MD: maximum demand
MCB: miniature circuit breaker
MSD: maximum simultaneous demand
NER: National Electricity Regulator
POS: Point of supply
SANAS: South African National Accreditation System
SD: simultaneous demand
SMS: system master station
VT: voltage transformer

4 Requirements of metering installations

4.1 Equipment standards

Equipment shall comply with the standards applicable when originally installed or with an alternative standard, confirmed in writing by an accredited test laboratory as being equivalent to, or better than, the specified standard.

4.2 Metering system

The metering system consists of various components that are illustrated in figure 1 below.

NOTE Some installations only consist of one part in which case there will typically be a meter only, such as in the case of a small domestic type of supply.

Each of the components has an influence on the total integrity of the installation and shall therefore comply with the requirements as listed in this code of practice. The compliance of the metering installation as a whole shall also be tested. (See 4.7.)

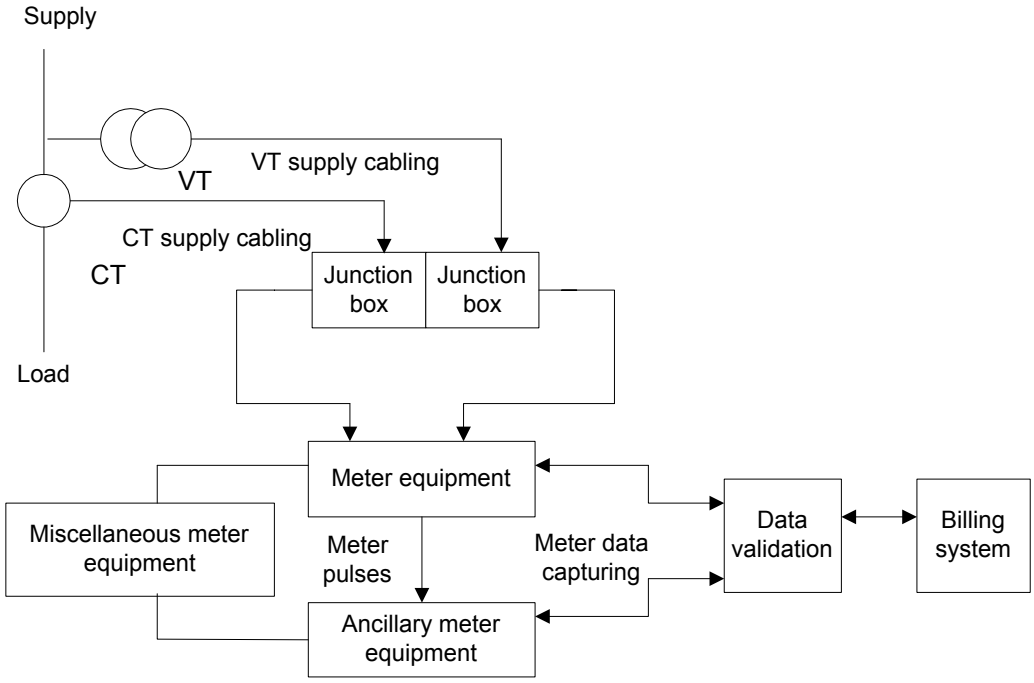

Figure 1 — Metering system diagram

4.3 General requirements

4.3.1 The metering equipment shall preferably be installed at the point of supply which defines the commercial boundary between the licensee and the customer. Where this is not possible, verifiable procedures shall be used to meter energy flows, adequately reflecting the flows at the point of supply.

4.3.2 Although this code of practice identifies separate items of equipment, items may be ombined to perform the same task as in the case of the equipment specified, provided that the requirements of this code of practice are met.

4.3.3 Main and check metering equipment shall be installed in the case of all metering installations where the planned demand exceeds 10 MVA.

4.3.4 Back-up meters of the same class may be installed for other points at the discretion of the licensee.

4.4 Requirements of metering equipment

4.4.1 General

4.4.1.1 Equipment used in the metering installation shall be certified as compliant with the relevant standards and approved by the licensee.

4.4.1.2 Licensees should maintain a list of approved metering equipment, which can be used by licensees to purchase metering equipment of acceptable quality and standards.

NOTE It is recommended that licensees collectively maintain a national register of approved metering equipment. Approved equipment will have been type tested and certified for compliance with relevant standards and have met the quality assurance requirements of the licensees.

4.4.1.3 Metering equipment used for revenue purposes (except measurement transformers and junction boxes) shall be accommodated in a clean and dry environment. The specified operating range of the equipment shall be commensurate with the environmental conditions.

4.4.1.4 The accuracy of equipment shall be as specified in this code of practice, and the equipment shall be capable of the measurement of energy variables as required by the applicable tariff.

4.4.2 Accuracy class requirements

The accuracy class requirements for a metering point that consists of a meter(s) and associated instrument transformers are determined by the nominal size of the load, expressed in terms of apparent power, and are as specified in table 1.

Table 1 — Requirements for meter and instrument transformer accuracy class requirement

1	2	3	4	5
Load	**Accuracy class**			
	Active energy meter	**Reactive energy meter**	**Current transformer**	**Voltage transformer**
> 100 MVA	0,2 S	1[a]	0,2[b]	0,2
10 MVA to < 100 MVA	0,5 S	2	0,2[b]	0,2
1 MVA to < 10 MVA	1	2	0,5	0,5
100 kVA to < 1 MVA	1	3	0,5	0,5
< 100 kVA and whole current	2	3	1 (Where applicable)	-

[a] No type test standard yet available.
[b] Class 0,5 is acceptable at the lowest ratio of a multiratio current instrument transformer.

4.4.3 Calibration of metering installation components

4.4.3.1 New or replacement components of a metering installation shall be individually calibrated by an accredited calibration laboratory before their installation.

4.4.3.2 The competence of a calibration and test laboratory shall be judged against SANAS requirements for the accreditation of calibration and test laboratories.

4.4.3.3 Calibration of a component shall be indicated by the attachment to the component of a calibration sticker that bears the following information:

a) the date of calibration;

b) the name of the accredited test laboratory that carried out the calibration;

c) the reference number of the calibration report; and

d) the initials of the person who carried out the certification.

4.4.3.4 Subsequent recalibration of metering system components requires the same full laboratory process as for new components. On-site testing and calibration is acceptable for this purpose as long as the requirements of this code of practice are complied with.

4.4.3.5 Where it considers such action appropriate, the calibration laboratory may calibrate a component for shorter periods than originally specified.

4.4.3.6 Copies of the calibration reports shall be held by the accredited calibration laboratory that carries out the certification.

4.4.3.7 Calibration certificates shall be made available to the person responsible for the meter installation.

4.4.4 Instrument transformers

4.4.4.1 Test certificates

4.4.4.1.1 Each certification report shall, where relevant, include a calibration report that confirms compliance with the requirements of the relevant part of SANS 60044 and confirms that the component complies with the requirements of its accuracy class.

4.4.4.1.2 Where a combined unit measurement transformer (CT and VT) is provided, the tests for accuracy covered in 11.4 of SANS 60044-3:2004, which deals with mutual influence effects, shall be met.

4.4.4.2 Current transformers

4.4.4.2.1 Where CTs are required for metering purposes they shall comply with the requirements of SANS 60044-1. Proof of compliance with SANS 60044-1 shall be provided by the supplier of current transformers.

4.4.4.2.2 Calibration reports for CTs shall be traceable to national standards and shall indicate the CT error at the current and burden values specified in SANS 60044-1. Multiratio CTs shall be tested at all ratios.

4.4.4.2.3 CTs shall be of an accuracy class appropriate for the required load of the metering installation as specified in table 1.

4.4.4.2.4 The total burden on each current transformer shall not exceed the rated burden of the CT.

4.4.4.2.5 The current transformer cores shall be dedicated to metering purposes only.

4.4.4.2.6 CTs shall preferably be of a multiratio construction so that possible increases in load can be accommodated. The CT ratio shall closely match the maximum load of the metering installation. The CT ratio setting used shall be appropriate for the maximum demand (MD).

4.4.4.2.7 Where the condition or accuracy class (or both) of CTs already on site are unknown or the accuracy class is insufficient to meet the required overall accuracy requirements, and the cost of replacing them is substantial (particularly if it would require replacement switchgear), the following procedures shall be applied:

a) their replacement shall be at the discretion and financial responsibility of the licensee, by applying generally accepted engineering or other criteria; and

b) the CT accuracy shall be checked in situ by an appropriate method as part of the initial certification procedures for the metering installation.

4.4.4.3 Voltage transformers

4.4.4.3.1 Where VTs are required for metering purposes they shall comply with the requirements of SANS 60044-2 or SANS 60044-5, with a minimum standard of accuracy class as specified in table 1. Proof of compliance with SANS 60044-2 or SANS 60044-5 shall be provided by the supplier of the voltage transformers.

4.4.4.3.2 A calibration report for VTs shall be traceable to national standards and shall indicate the VT error at the rated voltage and at the rated burden.

4.4.4.3.3 The voltage transformer supplies to the meters shall be protected against the effects of short circuits by the use of fuses or miniature circuit breakers (MCBs). Any additional burdens shall be protected separately.

4.4.4.3.4 Voltage transformers may be used for other purposes, such as protection, provided the overall accuracy and burden requirements are met.

4.4.4.3.5 On low-voltage installations, the voltage supply to the metering equipment shall be protected as close as practicable to the point of supply.

4.4.4.3.6 Where the condition or accuracy class (or both) of existing VTs are either unknown or the accuracy class is insufficient to comply with the required overall accuracy requirements, and the cost of replacing them is substantial (particularly if it would require replacement switchgear), the procedures outlined for CTs (see 4.4.4.2) shall be followed for the VTs.

4.4.4.4 Voltage transformer burdening

The burden and wiring arrangement (cabling) of the voltage transformer circuits shall be such that the associated voltage drop on the voltage transformer circuit wiring shall not contribute to the overall measurement error by more than the accuracy class of the installed meter as shown in table 1. For example, the maximum allowable error shall be 0,2 % for a class 0,2 installed meter.

The operating point of the VT shall be at least 25 % of the rated burden.

4.4.5 Meter panel ancillary equipment

4.4.5.1 General

The metering installation shall cater for test facilities that will allow for easy and safe maintenance activities.

Table 2 — Guide to voltage drop limits

1	2
Class of energy meter	**Voltage drop limit** (same as energy meter class)
	Phase-to-neutral voltage (63,5 V)
0,2	127 mV (0,2 %)
0,5	318 mV (0,5 %)
1	635 mV (1 %)

4.4.5.2 Test blocks

4.4.5.2.1 All metering installations using instrument transformers shall be fitted with test blocks on the current transformer (CT) and voltage circuits that shall be installed close to the meter(s).

4.4.5.2.2 Separate test terminal blocks or equivalent facilities shall be provided for the main meters and for the check meters of each circuit.

4.4.5.2.3 The test blocks shall allow the following operations to be performed without disturbing the current or voltage transformer circuit wiring:

a) isolation of the meter from the current transformer circuit while short-circuiting the current transformer secondary terminals;

b) isolation of the meter from the voltage transformer circuit while open-circuiting the voltage transformer secondary terminals;

c) installation of an additional burden such as a check meter into the current and voltage transformer circuits; and

d) secondary injection of current and voltage into the meter circuit.

4.4.5.2.4 Test blocks shall comply with appropriate standards and shall be insulation tested.

4.4.5.3 Voltage selection circuitry

The use of voltage selection circuitry is common at substations with dual busbar arrangements.

Where more than one set of voltage transformers can be used at a metering point of supply to supply a metering circuit, a selection relay scheme shall be installed that will direct the correct voltage supply to the meter at all times.

4.4.6 Meters

4.4.6.1 General requirements

4.4.6.1.1 All meters shall comply with the relevant standards as specified in table 3.

4.4.6.1.2 Active energy meters shall be configured such that the number of measuring elements is equal to or one less than the number of primary system conductors. These include the neutral conductor or the earth conductor (or both) where system configurations enable the flow of zero sequence energy.

Table 3 — Energy meter standards and requirements for meter accuracy class

1	2	3
Meter accuracy class	**Applicable standard: Active energy meters**	**Applicable standard: Reactive energy meters**
0,2 S	SANS 62052-11 SANS 62053-22	Not available
0,5 S	SANS 62052-11 SANS 62053-11 SANS 62053-22	Not available
1	SANS 1799 SANS 62052-11 SANS 62053-11 SANS 62053-21	Not available
2	SANS 1799 SANS 62052-11 SANS 62053-11 SANS 62053-21	SANS 62052-11 SANS 62053-23
3	Not applicable	SANS 62052-11 SANS 62053-23

4.4.6.1.3 Meters are classified according to meter type as given in table 4.

4.4.6.1.4 The basic current and maximum current for each type of meter shall be in accordance with the relevant standards.

4.4.6.1.5 Where a pulse output from a meter is to be used to derive loading information, the accuracy of the pulse output shall be included in the calibration.

Table 4 — Meter types and configuration

1	2	3
Meter type	**Configuration**	**Nominal voltage** V
Single-phase, whole current	Single-phase, two-wire	230
Single-phase, CT connected	Single-phase, two-wire	230
Three-phase, whole current	Three-phase, four-wire	230/400
Three-phase, CT connected	Three-phase, four-wire	230/400 63,5/110
Three-phase, CT connected	Three-phase, three-wire	110

4.4.6.2 Meter type testing

4.4.6.2.1 Each type (model) of meter used in a metering installation shall be type tested by an accredited test laboratory to confirm its specific characteristics and to prove that it complies with the requirements of the relevant standards and accuracy class as specified in table 3 for active and reactive energy meters, respectively. Proof of compliance shall be provided by the supplier of the meters.

4.4.6.2.2 If, at any time, there are any modifications to the specification, hardware or resident (ROM) software of a particular type and model of meter, it shall be regarded as a new model and then require repeat type tests to be satisfactorily carried out before it may be considered to be certified. Where the modifications affect only part of the device, it may be sufficient to perform only limited tests on the characteristics affected by the modifications. The extent of such tests shall be decided by the accredited test laboratory that carries out the type tests.

4.4.6.2.3 The licensee shall ensure that only meter types that have proof of compliance are used in the metering installation. It is intended that the same requirements should apply to sub-metering. Licensees should make the requirements of NRS 057 known to the relevant parties responsible for sub-metering.

4.4.6.3 Meter calibration

4.4.6.3.1 All meters shall be calibrated at an accredited calibration laboratory indicating the error in measurement at different load points and power factors in accordance with the relevant standard.

4.4.6.3.2 Where a pulsing meter is used in the metering system, the output of the pulse device may be used for calibration. The characteristics of the pulse device need not be verified during calibration.

4.4.6.3.3 Where the condition of meters already on site is unknown, the following procedures shall be applied:

a) their replacement shall be at the discretion and financial responsibility of the licensee, by applying generally accepted engineering or other criteria; and

b) the meter accuracy shall be checked in situ by an appropriate method as part of the initial certification procedures for the metering installation.

4.4.6.4 Meter numbering

Meters shall be identified with a meter number as specified in annex A.

4.5 Metering installation design

4.5.1 General

A design report shall be prepared by the metering designer in the case of a new metering installation and in the case where an existing metering installation is modified.

4.5.2 Design report

4.5.2.1 In the case of a new metering installation, the design report shall contain the following information, where applicable:

a) the initial load of the metering installation;

b) the expected authorized maximum demand (AMD) of the metering installation;

c) the maximum permitted error per component;

d) the CT accuracy class and the VA rating;

e) the CT ratio;

f) the selected CT ratio;

g) the CT circuit burden;

h) the VT accuracy class and the VA rating;

i) the VT circuit burden;

j) the CT and the VT earthing details;

k) the measured voltage drop across the secondary terminals of the VT to the test block;

l) the make, the model and accuracy of the meter;

m) the expected duration before register roll-over;

n) the make and model of the data logger, if separate;

o) confirmation by the designer of the metering installation that the data logger is compatible with the meter to which it is connected;

p) external alarm points (e.g. main power supply failure) to be monitored by the data logger;

q) means of monitoring unauthorized attempts to connect to the data logger;

r) the make and model of the modem, if separate;

s) confirmation that the modem is approved by ICASA for use on the communications network;

t) the calculated overall measurement uncertainty of the metering installation, and the method of calculation;

u) compensation arrangements, if any;

v) fusing details;

w) standards complied with (electrical and communications);

x) types of enclosure (including IP rating, where appropriate);

y) confirmation of component compatibility (e.g. that the secondary current of a CT matches the meter input);

z) steps taken to minimize electromagnetic interference;

aa) special tests required;

bb) non-metering equipment (distributor's equipment only) connected to measurement circuits;

cc) confirmation that equipment is suitable for the environment in which it will operate; and

dd) other relevant information.

4.5.2.2 Where an existing metering installation is being modified, the design report may contain only relevant topics from the above.

4.5.2.3 The report shall be accompanied by a drawing of the system for use by installation personnel. Both the design report and the drawing shall identify and be signed by the designer. The design report and the drawing shall be checked to ensure that the proposed metering installation will function correctly and that it complies with the requirements of this code of practice and any other relevant codes.

4.5.2.4 The person who carries out these checks shall sign the design report and the drawing to confirm that the checks have been carried out.

4.5.2.5 Installation personnel shall use a design checklist (see annex B) to record metering installation information and to confirm that the installed equipment complies with the design.

4.6 Metering equipment installation

4.6.1 General

4.6.1.1 Except as otherwise provided for in this code of practice, only employees of licensees or authorized agents who have been certified as meter workers (see annex C) shall be permitted to carry out any work on, or make direct connections to, components of a metering installation or to take any action which might have an effect on any such components. Such work shall be restricted to the class of meter worker applicable to the category of metering installation. This requirement shall not include visual inspections of categories 1 and 2 metering installations.

4.6.1.2 When a metering installation is certified, the certification shall apply to the functional integrity of the metering installation as a whole.

4.6.1.3 Metering equipment shall be installed to comply with the requirements of this code of practice.

4.6.2 Meter panel (enclosure)

4.6.2.1 Metering equipment shall be housed in a suitable enclosure to minimize the ingress of dust, moisture and vermin.

4.6.2.2 In both indoor and outdoor situations, unauthorized access to wiring terminals and equipment shall be prevented. Access to the components of the metering equipment shall be suitably restricted by means of locks and seals.

4.6.2.3 The meter panel shall be situated such as to allow safe access to the components of the metering circuit.

4.6.3 Instrument transformer earths

4.6.3.1 Earthing of secondary instrument transformer circuits shall be in accordance with the earthing requirements of the metering configuration used.

4.6.3.2 Wherever practicable, all CT secondary wiring shall be terminated in the metering panel.

4.6.3.3 Wherever practicable, all VT secondary wiring shall be terminated as near as possible to the VT, usually in the VT junction box.

4.6.4 Wiring loom

4.6.4.1 The wiring loom shall be cabled as directly as practicable and shall, wherever possible, be without intermediate terminations for all CT and VT wiring.

4.6.4.2 Where intermediate terminations are unavoidable, they shall be housed within sealable enclosures.

4.6.4.3 Wiring terminations between the test block and the meters shall be kept to a minimum.

4.6.4.4 The wiring shall be suitably rated and of such length that the maximum burden capabilities of the measurement transformers are not exceeded. See the guide in table 2 for requirements.

4.6.5 Measurement of current

In the case of low-voltage supplies where CTs are located within a switchboard, CTs shall be mounted securely within an enclosure that can be sealed against interference and unauthorized access. If the switchboard does not have a separate enclosure for the CTs, the CTs shall be fitted with sealable terminal covers.

4.6.6 Measurement of voltage

4.6.6.1 All meter potential supplies shall be adequately protected by appropriate fuses or circuit-breakers dedicated to the metering circuit.

4.6.6.2 Circuits shall be capable of withstanding fault levels that exist at the metering installation, and shall comply with all relevant statutory regulations (see foreword).

4.6.6.3 Where a VT supplies loads external to the metering installation, these loads shall not be added to or be modified without the prior approval of the approved test laboratory or the institution responsible for the metering installation. The total burden on any VT shall not exceed its rating at the rated secondary current.

4.7 Compliance of the entire metering installation

4.7.1 General requirements

4.7.1.1 Commissioning report

4.7.1.1.1 Every metering installation that is to be used for billing shall be tested for compliance with the relevant requirements of this code of practice by the licensee or its agent. This testing shall be confirmed by the compilation of a comprehensive commissioning report. See annex B for a list of the information to be recorded in a commissioning report.

4.7.1.1.2 The commissioning report of the metering installation will be valid as long as the calibration of all components of the metering installation remains current. Where it considers such action appropriate, the licensee or its agent may set a review period for the verification of compliance of the installation which is shorter than any period dictated by the calibration periods of any of its components.

4.7.1.1.3 Calibration reports for each of the applicable components of the metering system are required from an accredited calibration laboratory as part of the input to the commissioning report for the entire metering installation. These reports shall give both the error and the uncertainty in that error for an adequate number of points of the full range of use of any component of a metering installation and shall demonstrate compliance with the requirements for the maximum permitted percentage of error of each of the components of the metering installation.

4.7.1.1.4 All outputs that may be used in the metering installation shall be included in the calibration process.

4.7.1.2 Initial compliance requirements

4.7.1.2.1 In the case of a new metering installation that has all new components, the design shall be checked to ensure functionality and compliance with this code of practice.

4.7.1.2.2 Where required under the provisions of 4.4.2, components shall first be individually certified by an accredited test laboratory.

4.7.1.2.3 In the case of an existing installation that is to become a metering installation for billing, all components shall be individually certified.

4.7.1.2.4 The information in the completed design checklist (see annex B) shall be used to provide the detailed record of the components of the metering installation.

4.7.1.3 Recommissioning of an installation

4.7.1.3.1 When the commissioning report of a metering installation becomes invalid, re-commissioning is required, and a new commissioning report shall be issued. The commissioning report of the overall metering installation becomes invalid when the individual certification of any one of its components expires. Any such component would be recertified by either removal and tests, or testing in situ, or replacement, as appropriate.

4.7.1.3.2 If any part of the wiring of the metering installation is modified, or if additional components are connected to the metering installation (other than testing or monitoring equipment temporarily connected via the test block), the commissioning report of the metering installation shall be deemed to be invalid. A new commissioning report shall be issued after the tests and checks required by this code of practice have been satisfactorily carried out.

4.7.1.4 Records

Records of all tests carried out under the provisions of this subclause shall be kept in accordance with the relevant requirements in annex C.

4.7.1.5 Failure of tests

Once a fault is identified, it shall be comprehensively documented for future reference before it is rectified. If the metering installation fails the commissioning tests or recommissioning tests, the faulty component or components shall be identified and replaced with equivalents which have been recently calibrated and certified as compliant with the requirements of this code of practice.

The tests shall then be repeated to confirm that the faulty component or components have been eliminated.

4.7.2 Requirements for the calibration and on-site verification of electricity meters

4.7.2.1 General

Meters shall be calibrated and verified to the standards specified in this code of practice. Whenever a meter is calibrated or verified, the relationship between the test output(s) of that meter and the meter register shall be shown to comply with the marking on the meter nameplate.

4.7.2.2 Calibration

Components of metering installations shall be calibrated and adjusted under the appropriate physical and electrical reference conditions or under conditions that shall permit the calculation of the results and their uncertainty at the reference conditions. The individual calibration points shall be as described in the relevant component standard, for example, SANS 62052-11 for electricity metering equipment.

The calibration procedures shall be referenced to these documents and included as part of the formal procedures of the accredited calibration laboratory.

4.7.2.3 In-situ accuracy tests

If any in-situ verification test shows that a meter is outside the required error limits, the meter shall be returned to an accredited calibration laboratory for calibration at reference conditions. If it can be shown that the prevailing influence quantity conditions are sufficiently different to the reference conditions to have caused the meter to be outside of the required error limits, the meter may be left in operation as long as these influence quantity conditions are temporary. A permanent signed record shall be kept and shall contain the calculations and observations to justify this and shall state that the influence quantities are temporary. If the meter is found to exceed the accuracy limits at reference conditions, it shall be adjusted. Records shall be kept of pre-adjustment and post-adjustment readings.

4.7.3 Testing and inspection of measurement transformers

In-situ accuracy testing is not normally required. Periodic visual inspection of the installation is recommended.

Capacitive voltage transformers (CVTs) shall be periodically tested in accordance with the manufacturer's specifications.

The ratios of CTs and VTs shall be verified.

4.7.4 Frequency of calibration and testing of metering equipment

4.7.4.1 Periodic calibration of meters

Meters shall be calibrated and refurbished, as necessary, at intervals not exceeding those specified in table 5.

In the case of whole current (direct connected) meters, the calibration intervals specified for calibration need not apply, provided that the utility has in place a sampling plan based on industry standards (e.g. BS 6001-4), which can demonstrate the statistical confidence that the calibration of the meter population for that category of meters is within limits. It is recommended that such sampling plans be part of an obsolescence strategy, if replacement of meters is being considered. The results of such sampling plans shall be kept for at least five years and made available to the NER on request.

Table 5 — Intervals for periodic calibration of meters

1	2
Load	**Calibration interval** (years)
> 100 MVA	5
10 MVA to < 100 MVA	5
1 MVA to < 10 MVA	10
< 1 MVA (electronic)	10
< 1 MVA (electromechanical)	20

4.7.4.2 In-situ accuracy checks on meters

In addition to the requirements to calibrate as discussed above, in-situ accuracy checks shall be performed as follows:

a) for electromechanical meters, the following:

1) active energy meters of accuracy class 0,5 S shall have in-situ accuracy checks performed at intervals not exceeding five years; and

2) in-situ accuracy checks are not required for all other types of electromechanical meters.

b) for solid state and electronic meters, the following applies:

1) in the case of metering installations that employ class 0,2 S or 0,5 S meters and where the main and check meters are of the same manufacture and type (i.e. where the meters are likely to have the same failure/fault characteristics), in-situ accuracy checks are required to be performed at intervals not exceeding five years for active energy meters and reactive energy meters; and

2) in the case of metering installations that employ class 0,2 S or 0,5 S meters and where the main and check meters employed are of different manufacture or type, no in-situ accuracy checks are required.

c) the accuracy class index of the reference test instruments used in verifying the accuracy of installed meters shall, as a minimum, be twice better than that of the installed meter.

4.7.4.3 Measurement transformers

The ratios of CTs and VTs shall be verified. Periodic and in-situ checks shall be done at the same intervals as specified in table 5.

NOTE Measurement transformer errors are the major cause of metering errors in the metering installation.

4.7.5 Overall accuracy requirements for metering installations

Generally it is impracticable to accurately determine the overall metering installation accuracy from the errors of its components. It is accepted that it is a minimum requirement that every component shall meet the required accuracy and that the installation is constructed, commissioned and maintained in such a manner as to ensure metering accuracy.

4.8 Automated meter reading (AMR) for large power users

When AMR systems are utilized for large power users, they shall comply with the requirements of NRS 071.

4.9 Sealing of metering equipment

Access to any equipment that makes up part of a metering system shall be restricted through the use of appropriately controlled locks and seals.

4.10 Time offset

Any type of metering equipment used where energy usage or demand (or both) based on fixed time intervals are determined, shall maintain time offsets of exceeding 5 min from South African Standard Time (SAST) at any moment.

NOTE The time offset for certain customer metering equipment may be stricter and should be determined through relevant customer contracts.

5 Billing data collection and transmission

5.1 Frequency of meter reading

The licensee shall be accountable for meter reading of credit meters at minimum intervals as listed in table 6.

NOTE Prepayment metering is excluded from this subclause, but some AMR systems might include meters that can be configured as both credit meters and prepayment meters.

Table 6 — Periodic meter reading intervals

1	2
Load	**Meter reading interval**
> 100 MVA	Daily
10 MVA to < 100 MVA	Weekly
1 MVA to < 10 MVA	Monthly
100 kVA to < 1 MVA	Monthly
< 100 kVA	Three monthly

5.2 Meter data retention period

The licensee shall be accountable to retain meter billing information (historical billing information) for a period of at least five years.

5.3 Data to be downloaded

5.3.1 Minimum data

Data downloaded on interrogation shall consist of the following, as a minimum:

a) a unique identification number;

b) the data logger ID, or meter point ID, or stand number;

c) the time and date from the data logger at the commencement of the download;

d) the energy data: this may be limited to the data accumulated since the last interrogation and download; and

e) the events log: this may be limited to the events information accumulated since the last interrogation and download.

5.3.2 Communication integrity

All data transmissions shall employ techniques to ensure the integrity of the data transmitted and received.

5.3.3 Archiving of metering information

All downloaded metering information shall be archived in such a manner that it cannot be altered without leaving a detailed audit trail, and that a copy of the raw meter data is kept by the electricity supply authority or independent meter operator for a minimum period of five years. This raw meter data shall be available on request.

The distributor licensee or independent meter operator shall ensure that procedures are in place to minimize the possibility of such raw meter data being accessed by unauthorized personnel, and to ensure that the raw meter data cannot be modified in any way. The means of storage of the raw meter data shall be such that any access to it is recorded.

5.3.4 Interrogation log

An interrogation log shall be generated to record details of all interrogations. This log shall form part of the interrogation audit trail and shall contain the following:

a) the date of interrogation;

b) the time of commencement of the interrogation;

c) the status of the interrogation attempt, i.e. attempt failed/was successful;

d) the operator ID (where appropriate);

e) the data logger ID;

f) clock updated (where appropriate) and extent of change;

g) clock errors outside the range specified;

h) the method of interrogation (e.g. automatically, handheld); and

i) the ID of the handheld computer used for interrogation (where applicable).

5.4 Data validation

5.4.1 General

All raw meter data shall be checked for validity at regular intervals or at a frequency that will allow a further interrogation of the meter (or both) before the data is overwritten within the meter and before this data can be used for any purpose.

Validity checks shall include the following, as a minimum:

a) checks for missing data;

b) checks for invalid dates and times;

c) checks of zero consumption levels;

d) comparisons with standard or previous consumption patterns;

e) checks of the sum of demand values against the register advance; and

f) investigations of any meter error codes.

Comparisons with meters and meter registers through to the billing system shall be made at intervals as specified in table 7.

Table 7 — Time intervals for meter and meter register comparisons to billing system

1	2
Load	**Meter and meter register comparison time interval**
> 100 MVA	yearly
1 MVA to < 100 MVA	Two-yearly
< 1 MVA	Five-yearly

5.4.2 Data estimation

Data estimation will be required where actual meter readings are not available. NRS 047-1 specifies the requirements for estimating meter readings.

5.4.3 Raw meter data integrity

In correcting any working data, the raw meter data shall be protected from being changed. In cases where raw meter data needs to be changed, it shall be archived.

5.4.4 Journals

In all cases where data is corrected or altered, a journal shall be automatically generated and archived with the raw meter data file. The journal shall contain the following, as a minimum requirement:

a) the date of the correction/alteration;

b) the time of the correction/alteration;

c) the ID of the operator;

d) the identification of the demand periods of data corrected/altered;

e) the technique used to arrive at the corrected/altered data; and

f) the reason for the correction or alteration.

5.5 Data transmission

5.5.1 General

Transmissions and transfers of metering information between parties and their agents (bureaux and test laboratories) shall be carried out electronically. The format and structure of transmitted files shall be agreed upon, in writing, by the parties before communications takes place.

Recognized and secure transmission media shall be used. Disks may be used only in emergency situations.

A complete audit trail shall exist for all data gathering, validation and processing functions. This audit trail shall apply to all archived data for a period of five years.

5.5.2 Logs

Logs of communications and processing activities shall form part of the audit trail. This shall apply most particularly where automated processes are in operation. Logs shall include the following, as a minimum:

a) an activity identifier;

b) the date and time of the activity; and

c) the operator identifier.

5.5.3 Storage media

Logs may be printed and filed as hard copy or maintained as data files, in a secure form, along with other archived information.

5.6 Confidentiality and security

5.6.1 General

The information is of an extremely sensitive nature, and security guidelines given below shall be observed. The requirements of this code of practice shall be complied with at all times.

5.6.2 Personnel

Only authorized personnel shall have access to meter data.

5.6.3 Networks

Processing and interrogation systems connected to local or wide area networks shall have strict controls placed on those authorized to have access to data.

5.6.4 Back-ups

Appropriate back-up routines shall be established to ensure that data is kept secure at all times. Security and confidentiality requirements for back-up files shall be the same as for the original raw meter data files.

The timing of back-ups shall be dependent on the frequency of data logger interrogation and the number of days of storage maintained by the data loggers.

5.6.5 Software

A register shall be kept of all copies of the software used in the data gathering or programming processes and the communication of meter data. All such software shall be password protected.

The register shall include a list of persons authorized to use each application.

5.6.6 Hardware

Appropriate security, such as a password in the basic input/output operating system (BIOS), shall be incorporated so that hardware cannot be operated should it be lost or stolen.

Hardware involved in interrogation shall be located in an access-controlled environment.

5.6.7 Passwords

Passwords shall be employed in such a manner that the password offered shall determine the level of access to the information or software within the interrogation and processing system.

It is preferred that a control register for the allocation of passwords is kept up to date by the licensee for auditing purposes.

5.6.8 Bureaux services

The use of bureaux by licensees to carry out installation, interrogation and processing functions is acceptable. However, the licensees remain responsible for compliance with the requirements of this code of practice, and, therefore, the compliance thereof by such agents.

Annex A
(normative)

Meter numbering format

NOTE It is intended that the meter numbering format in this code of practice be implemented through its incorporation in the labelling requirements in supply contracts for meters.

A.1 Meter number

The meter number shall contain 13 digits composed in accordance with table A.1.

Table A.1 — Meter number format

1	2
Description	**Number of digits**
Meter type (see A.2)	2 digits
Manufacturer code (see A.3)	2 digits
Meter serial number (see A.4)	8 digits
Check digit (see A.5)	1 digit
	13 digits

A.2 Meter type code (see table A.2)

The meter type code is a two-digit number that uniquely identifies the type of meter. (See the note under A.3 for allocation of these codes.)

Key for meter type code allocation:

Digit 1: Number of phase connections

Digit 2: 0 = electromechanical whole current
1= static whole current
2= programmable whole current
3= electromechanical CT driven
4= static CT driven
5= programmable CT driven

A.3 Manufacturer code (see table A.3)

The manufacturer's code is a two-digit number that shall be used uniquely to identify the manufacturer of the meter.

NOTE The manufacturer codes and meter type codes are allocated and administered by the NRS Projects Management Agency (PMA) on behalf of the Electricity Supply industry. The current list of meter manufacturer codes can be obtained from the NRS Projects Manager, or viewed on the NRS website www.nrs.eskom.co.za. When additional manufacturer codes are required, a licensee should apply to the NRS PMA.[1)]

1) Contact details for the NRS Projects Manager Agency (PMA) are:
Telephone +27 11 800 3786
Fax +27 11 800 2070
Postal Address:
Technology Standardization Department
Industry Association Resource Centre
PO Box 1091
Johannesburg 2000

Annex A
(continued)

A.4 Meter serial number

The meter serial number is an eight-digit, unique serial number that can be generated internally by the manufacturer. Each manufacturer is responsible for the uniqueness of the meter serial number with respect to his manufacturer code.

A.5 Check digit

The check digit shall be a modulus 10 check digit, calculated using the Luhn formula, as specified in annex B of SANS 7812-1:2004. This check digit shall be calculated on the concatenation of the 12 digits comprising the meter type, the meter manufacturer code and the serial number.

A.6 Format of the meter number on a meter

A.6.1 General

If so specified by the purchaser in a supply contract for meters, meter numbers shall be labelled on the front of the meter in numeric format in accordance with A.6.2 and in bar code format in accordance with A.6.3.

A.6.2 Numeric format

The shape of the characters is not specified, but the size of the characters shall be not less than 3 mm in height.

Each meter number shall consist of: 1 group of 4 digits followed by a space character, 1 group of 8 digits followed by a space character, and a single (check) digit.

Example

The meter number of a programmable whole current single-phase meter (meter type code 12) manufactured by Actaris (manufacturer code 01) with a serial number of 12345678, it will appear on the meter as follows:

1201 12345678 5,

where 5 is the Luhn check digit.

A.6.3 Bar code format

The bar code representation of the meter number shall be generated using the code 128 symbology as specified in SANS 15417. No space characters shall be inserted in the bar code.

Annex A
(concluded)

Table A.2 — Meter type codes

1	2	3
Meter type code	**Meter type**	**Remarks**
00	Reserved for prepayment meters	Prepayment only
10	Electromechanical whole current single-phase	
11	Static whole current single-phase	
12	Programmable whole current single-phase	
30	Electromechanical whole current three-phase	
31	Static whole current three-phase	
32	Programmable whole current three-phase	
33	Electromechanical CT driven three-phase	
34	Static CT driven three-phase	
35	Programmable CT driven three-phase	

Table A.3 — Meter manufacturer codes

1	2	3
Manufacturer code	**Name of manufacturer**	**Remarks**
00	Reserved	Special use only
01	Actaris	
07	Landis+Gyr	
11	Circuit Breaker Industries (Reunert)	Two-digit code 11 previously allocated
14	Elster Kent	
15	Mitsubishi	
16	Strike	
17	Iskra	
18	Power-Link	

Annex B
(normative)

Design checklist for recording of information during design, installation and commissioning

The following information, where applicable, shall be recorded during the design, installation and commissioning of a metering installation.

a) **Customer details**

1) name,
2) address,
3) metering point, physical location,
4) maximum demand,
5) date of commissioning, and
6) tariff.

b) **Current transformers (CTs)**

1) manufacturer,
2) serial numbers,
3) ratios available,
4) secondary current rating,
5) VA rating,
6) core configuration: # protection, # metering,
7) connected ratio,
8) class (on connected ratio),
9) accuracy, test certificates of CTs confirming compliance with SANS 60044-1,
10) dedicated cores for metering,
11) compliance with design report,
12) insulation test results,
13) recertification,
14) polarity test results, and
15) connected burden test results.

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(continued)

c) **Voltage transformers (VTs)**

1) manufacturer,
2) serial numbers,
3) primary and secondary voltages,
4) VA rating,
5) winding configuration: # protection, # metering,
6) class,
7) test certificates of VTs confirming compliance with SANS 60044-2,
8) fuse ratings – primary and secondary,
9) dedicated metering supply,
10) compliance with design report,
11) insulation test results,
12) ratio verification test results,
13) polarity test results, and
14) connected burden test results.

d) **Panel**

1) enclosure type,
2) panel earthing checked,
3) panel wiring verified against drawings,
4) wiring continuity tested,
5) appropriate type of termination used,
6) VT circuit fuse rating,
7) panel ancillary equipment verified against panel specification (design report),
8) tightness checks on all connections, and
9) labels according to design document or drawings.

e) **Cabling**

1) size,
2) cable and wire numbers checked against drawings,
3) insulation test results for all CT and VT cables,

Annex B
(continued)

4) CT star point earthed in panel,

5) VT neutral earthed as near as possible to VTs,

6) voltage drop test results for VT cables,

7) appropriate type of termination used, and

8) tightness checks on all connections.

f) **Meters**

1) manufacturer,

2) type/model,

3) software version,

4) serial numbers,

5) class,

6) single-phase/three-phase,

7) three-wire/four-wire,

8) auxiliary supply details,

9) voltage rating,

10) current rating,

11) meter VT ratio,

12) meter CT ratio,

13) initial reading,

14) meter reading multiplication factor (k-factor) internal/external meter constants,

15) pulse value (units per impulse (UPI)), (pulse constant),

16) test certificates of meters confirming compliance with relevant IEC standards,

17) certification sticker attached,

18) software configuration,

19) meter time set,

20) configured tariff scheme,

21) digit configuration (significant and decimal digits), and

22) digit scroll-over period.

Annex B
(continued)

g) **Data loggers**

1) manufacturer,
2) type/model,
3) serial numbers,
4) auxiliary supply details,
5) channel configuration,
6) channel multipliers,
7) battery checked,
8) meter units match data logger,
9) meter/data logger compatibility confirmed,
10) data logger time set,
11) data logger alarms working, and
12) certification report reference number.

h) **Communication device**

1) manufacturer,
2) type/model,
3) serial number,
4) auxiliary supply details,
5) communication number, and
6) communication network approved.

i) **Drawings**

1) adequacy of information,
2) scheme drawing number, and
3) as-commissioned mark-ups completed.

j) **Commissioning requirements**

1) polarity test results,
2) phase rotation test result,
3) meter on-load accuracy test results,

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(concluded)

4) meter dial to data logger verification results,

5) meter dial to master station data verification results,

6) alarms through to host test results,

7) pulsing through to customer tested,

8) set meter time,

9) set data logger time, and

10) commissioning data recorded at all stakeholders.

k) **Sealing details**

1) CT enclosure/terminals locked or sealed,

2) CT test blocks sealed,

3) VT enclosure/terminals locked or sealed,

4) VT test blocks sealed,

5) VT circuit fusing sealed,

6) meter covers sealed,

7) meter terminal covers sealed,

8) data logger covers sealed,

9) data logger terminal covers sealed, and

10) meter enclosure locked or sealed.

Annex C
(normative)

Categories of metering installations and classification of meter worker qualifications

C.1 Metering installation categories

Four categories of metering installations are defined as shown in table C.1, according to the classification of qualifications of meter workers required.

NOTE Where a licensee has an existing training scheme for meter workers that does not completely align with the scheme outlined in this annex, the licensee should use the requirements in this annex to align its training scheme with that specified, as far as is practicable. The scheme specified is intended to be used as the basis for a national scheme of meter worker training and certification in future.

Table C.1 — Metering installation categories

1	2	3	4
Metering installation category	**Voltage[a] and current**	**Measuring transformers**	**Class of meter worker**
1	1Ø, V ≤ 230 V *I* ≤ 100 A	None (whole current metering)	1
2	3Ø, V ≤ 400 V *I* ≤ 160 A	None (whole current metering)	2
3	3Ø, V ≤ 400 V	CT	3
4	3Ø, V > 400 V	VT and CT	4
[a] Voltages referred to are nominal Ø - Ø, where Ø is used to denote phase.			

C.2 Meter worker qualifications

C.2.1 General requirements

C.2.1.1 Due to varying levels of complexity, safety issues and training required, four classes of meter worker qualifications are specified according to the complexity of the metering installation.

C.2.1.2 Licensees shall be responsible for identifying and providing suitable training programmes on meter installation.

C.2.1.3 Licensees and registered metering service providers appointed as their agents shall identify which of the four meter worker classes each of their employees who perform meter work are qualified for.

C.2.1.4 The new meter worker certification requirements shall apply uniformly to any meter worker in the employ of any licensee or metering service provider. Procedures shall be adopted to ensure that meter workers remain qualified over time.

C.2.1.5 Licensees and metering service providers appointed as their agents shall issue appropriate means of identification to each of their meter workers or employees who perform direct access meter work and shall ensure that their workers carry this identification while performing meter work. This identification shall indicate the worker's employer and the class of meter work the worker is qualified to perform.

Annex C
(continued)

C.2.1.6 If a licensee subcontracts its meter work to an independent registered metering service provider, the subcontracting entity shall ensure that the metering service provider issues each meter worker or employee such identification.

C.2.1.7 Meter workers who perform work for a licensee or a registered metering service provider, and has been contracted by a licensee before the publication of this code of practice shall be considered qualified and certified for the level of work they have been trained for.

C.2.2 Qualifications of a class 1 meter worker

C.2.2.1 Class 1 meter workers shall be permitted to work on category 1 metering installations only.

C.2.2.2 Class 1 meter workers shall be permitted to install, remove and replace category 1 meters provided that they work under the supervision of a responsible person. Meters shall not be removed or installed without first isolating the supply.

NOTE "Responsible person" should be seen in the context of, and is defined in, applicable legislation (see foreword).

C.2.2.3 Essential technical skills for this class of worker are the following:

a) the ability to identify energy diversion or tampering related to this class of meter work,

b) the ability to install and remove damaged and undamaged meters,

c) understanding of the meter panel and socket layout for the metering conditions related to this class of meter work,

d) the ability to read meters used in this class,

e) the ability to properly use tools appropriate to the work in this class, and

f) the ability to correctly wire category 1 metering installations.

C.2.3 Qualifications of a class 2 meter worker

C.2.3.1 Type of work undertaken by class 2 meter workers

Class 2 meter workers shall be permitted to work on category 1 and category 2 metering installations.

Class 2 meter workers shall be permitted to install, remove and replace all direct-connected meters without supervision.

C.2.3.2 General skills and knowledge

The competency of a class 2 meter worker could be considered as having successfully completed a course in high-voltage regulations. In general, the following aspect shall be taken into account when the technical competency of a class 2 meter worker is being assessed:

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(continued)

a) a good understanding of the general requirements of health and safety legislation (see foreword) and how these translate into personal duties and obligations. This might include the need to report incidents or equipment found faulty;

b) adequate knowledge of electricity and experience of general electrical work. This could imply suitable tertiary education followed by work experience in a field related to meter installation, or extensive experience in such a field;

c) knowledge and experience of the specific work methods. This might have safety implications in that incorrectly performed work can cause danger, for example incorrect polarity or overheating caused by unsatisfactory connection; and

d) the ability to recognize conditions under which work shall not be commenced, or its progress curtailed or ceased. This can include recognition of the meter worker's own shortcomings, lack of experience or training, including the need for assistance, supervision or more information.

C.2.3.3 Essential technical skills

Essential technical skills for this class of worker include all skills for class 1 workers and the following:

a) wiring and circuit diagrams: familiarity with wiring and circuit diagrams and their interpretation;

b) meters: ability to install and maintain meters;

c) sealing: knowledge of this code of practice, together with special client requirements and in-house standards.

C.2.3.4 Specific safety criteria

The following are examples of the range of safety knowledge, acquired through training or experience (or both), which might be appropriate, depending upon the work that the worker is required to carry out.

a) **Work in proximity to service terminations**

1) a knowledge of the dangers that arise from damage to service terminations, and

2) familiarity with the use of correct tools and equipment and the need to apply mechanical protection where necessary.

b) **Removal of covers**

1) an awareness of the dangers such as those that can be caused by bare live conductors or terminals (or both) which might be exposed after removal of a cover,

2) knowledge of the precautions to be taken to screen or otherwise prevent injury, and

3) understanding that the work area shall not be left unattended whilst covers are removed.

c) **Work in the vicinity of live (low-voltage) conductors**

Knowledge of materials and techniques to adequately screen the work area from the danger, taking account of both electrical and mechanical considerations.

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(continued)

d) **Removal of cut-out fuses or circuit-breakers**

1) an awareness of the need to visually inspect the cut-out before removal of covers and before removal of fuses,

2) understanding of the dangers which such inspection might reveal and the steps which might then need to be taken,

3) familiarity with the removal and replacement of fuses in a safe manner, including insertion techniques and the use of protective equipment where necessary, for example, insulating gloves, fuse pullers, insulating sheets, additional phase barriers, terminal shrouds, eye protection,

4) understanding of additional precautions to ensure continuing safety such as the use of caution notices and safekeeping of removed fuses, and

5) knowledge of the use of voltage testing devices to prove “not live” before work commences and to check restoration on completion of work.

e) **Access to consumer stations**

1) understanding of the need for people of adequate authority to enter, and of the conditions under which access is allowed, which may include requirements to notify the parties affected and the consumer (where applicable), and to make suitable entries in a log book,

2) knowledge of basic precautions to be taken before and during entry, such as visual checks of surroundings and the equipment and tests for the presence of gas, including ensuring continuing safe egress, and

3) awareness of the dangers that might be inherent in equipment within the station and of the need to avoid actions which might lead to the operation of switches, circuit-breakers or protective devices.

C.2.3.5 Certification requirements

A worker can be certified as a class 2 meter worker if he qualifies for entry-level employment on the basis of being a journeyman level electrician, a technician or a graduate engineer and has successfully completed a metering training programme suitable for that level.

A meter worker who does not comply with the requirements as stated in the above paragraph can be certified as a class 2 meter worker, provided that

1) the worker has been qualified as a class 1 meter worker for at least six months;

2) the worker has completed at least thee months “on-job-training” working alongside a class 2 (or higher) meter worker;

3) the worker has successfully completed the metering training programme; and

4) a class 3 (or higher) meter worker has certified that the worker is competent to perform the tasks required for a class 2 meter worker.

Annex C
(continued)

C.2.4 Qualifications of a class 3 meter worker

C.2.4.1 Type of work undertaken by class 3 meter workers

Class 3 meter workers shall be permitted to work on category 1, category 2 and category 3 metering installations.

Class 3 meter workers shall be permitted to install, remove, and replace all meters in these three categories.

C.2.4.2 Essential technical skills

Essential technical skills for class 3 meter workers include all skills for class 2 meter workers and the following:

a) **current transformers:**

1) knowledge of principles of construction and operation;

2) appreciation of ratio and polarity; and

3) ability to verify CT ratios.

b) **secondary wiring:**

1) familiarity with wiring installation practices, with special reference to the functional identification of circuits; and

2) methods of testing insulation resistance and continuity.

c) **meters:**

1) understanding of the principles of measurement of kWh, kVAh and kvarh, and the use of three-element polyphase meters; and

2) the ability to install, maintain and programme meters including electronic multifunction meters.

d) **testing and test equipment:**

1) familiarity in the use of equipment for measurement of voltage and current, polarity and phase rotation, and active and reactive energy;

2) awareness of the accuracy limits of equipment and the requirement for regular calibration checks; and

3) ability to understand, interpret, identify, and take appropriate actions based upon diagnostics obtained from measurements to verify metering installations.

e) **specific safety criteria:**

examples of the range of additional safety knowledge, acquired through training or experience (or both), which might be appropriate for a class 3 meter worker, depending upon the work that the worker is required to carry out, are

Annex C
(continued)

1) connection of meters to test facilities;

2) understanding of the procedures to interrupt the potential supply by withdrawal of fuses and short out current transformers by means of suitable links;

3) ability to operate test bypass facilities or test blocks; and

4) familiarity with the practical methods of carrying out these precautions and steps to ensure that no unauthorized interference negates them.

C.2.4.3 Certification requirements

A worker can be certified as a class 3 meter worker if he qualifies for entry-level employment on the basis of being an electrical engineering technician or a graduate engineer and has successfully completed a metering training programme suitable for that level.

A meter worker who does not comply with the requirements as stated in the above paragraph can be certified as a class 3 meter worker provided that

a) the worker has been qualified as a class 2 meter worker for at least six months,

b) the worker has completed at least six months “on-job-training” working alongside a class 4 meter worker,

c) the worker has successfully completed an advanced metering training programme that covers CT connected meters (category 3), and

d) a class 4 meter worker has certified that the worker is competent to perform the tasks required for a class 3 meter worker.

C.2.5 Qualifications of a class 4 meter worker

C.2.5.1 Type of work to be undertaken by class 4 meter workers

Class 4 meter workers shall be permitted to work on categories 1, 2, 3 and 4 metering installations.

Class 4 meter workers shall be permitted to install, remove and replace all meters described in categories 1 to 4, and may perform in-field meter accuracy tests, calibrations, all types of meter maintenance and troubleshooting on all components of metering systems, including metering transformers and associated devices such as isolation relays and switches, and wiring between these transformers, associated devices, and meters. Class 4 meter workers may inspect wiring and instrument transformer ratios utilizing various apparatus as necessary.

C.2.5.2 Essential technical skills

Essential technical skills for class 4 meter workers include all those skills for class 3 meter workers and, in addition, the following:

a) **current transformers:**

understanding of the relationship between burden, ratio and phase angle errors.

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(continued)

b) **voltage transformers:**

1) knowledge of principles of construction and operation; and

2) understanding of the relationship between burden, ratio and phase angle errors.

c) **meters:**

1) understanding of the principles of the measurement of kWh, kVAh and kvarh, and the use of two and three-element polyphase meters; and

2) the ability to perform calibration, retrofit, troubleshooting, data collection of meters, and to install, maintain, and programme advanced metering technologies, including time of use metering, interval data, remote meter communication, and load control devices.

d) **calculation of overall measurement uncertainty:**

1) the requirements for overall uncertainty;

2) uncertainty of each calibration process undertaken by the calibration laboratory;

3) sources of uncertainty in day-to-day operation of metering installations;

4) standard uncertainty and coverage factor; and

5) method of combining uncertainties.

e) **specific safety criteria:**

1) broad knowledge of and familiarity with high and medium voltage electrical distribution systems and operating characteristics; and

2) broad knowledge of and familiarity with safety practices when working in high-voltage chamber environments.

C.2.5.3 Certification requirements

A worker can be certified as a class 4 meter worker if

a) the worker qualifies for entry-level employment on the basis of being an electrical engineering technician or a graduate engineer and has successfully completed an advanced metering training programme that covers CT and VT connected metering systems, or

b) the worker

1) has been qualified as a class 3 meter worker for at least one year,

2) has completed at least one year “on-job-training” working alongside a class 4 meter worker, and

3) has successfully completed an advanced metering training programme that covers CT and VT connected metering systems.

Annex C
(concluded)

C.2.6 Metering training programmes

A metering service provider (whether independent or a licensee) may develop and implement a training programme to train and certify their individual meter workers in any of the four metering worker classes. Where a licensee uses the services of a metering service provider, the licensee shall verify that all appropriate meter worker prerequisites are met before a meter worker is certified.

Annex D
(informative)

Glossary of terms for metering

absolute error
difference obtained by subtracting the true value of the quantity from the measured value

accredited inspection body
inspection body that has been accredited by the government endorsed national accreditation body in accordance with SANS 17020

accreditation body
body that conducts and administers an accreditation system and grants accreditation

[ISO/IEC Guide 2]

NOTE The authority of an accreditation body is typically derived from government.

accuracy class
designation that is assigned to an instrument transformer, the current or voltage error and phase displacement which remains within specified limits under prescribed conditions of use

[IEC Dictionary]

activation date
date on which a new tariff or season or year becomes active

NOTE All the rate period totals for the billing month up to the activation date should be saved and the new totals created and used for the remaining period of the billing month.

active energy
integration with respect to time, of active power measured in kilowatt-hours

active energy meter
SEE **watt-hour meter** (clause 3)

active power
time average of the instantaneous power over one period of the wave, measured and calculated in watts

NOTE In the case of sinusoidal quantities in a two-wire circuit it is the product of the voltage, the current, and the cosine of the phase angle between them. In the case of non-sinusoidal quantities it is the sum of the harmonic components, determined as above. In the case of a polyphase circuit it is the sum of the active powers of the individual phases.

active power transducer
transducer for the measurement of the active electrical power

actual transformer ratio
ratio of the actual primary current to the actual secondary current

adjustment
operation that is intended to reduce the differences between the values indicated by an instrument and the values realized by a reference standard to within a predetermined tolerance

Annex D
(continued)

analog representation (of a physical quantity)
representation of one physical quantity by another physical quantity in which the representing quantity may continuously assume any value between specified limits, when the physical quantity to be represented is varied continuously between corresponding limits

analog signal
signal in the form of a continuously variable value

[SANS 62051]

analog to digital conversion
transformation of an analog quantity into a digital representation by means of sampling, quantization and encoding, and the necessary auxiliary operations

analog to digital converter
electronic device for performing the analog to digital conversion of electrical signals, and for supplying the converted values in digital electrical form

apparent power
square root of the sum of the squares of the active and reactive powers, measured and calculated in volt-ampere, for sinusoidal quantities in either single phase or polyphase circuits

NOTE This is, in general, not true for non-sinusoidal quantities.

arithmetic simultaneous demand
simultaneous demand (SD) obtained by addition of the magnitudes of the kilowatt or kilovolt-ampere values for one group of supply points for each integrating period

audit
systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which audit criteria are fulfilled

[ISO 9000:2000]

auxiliary power supply
power supply that energizes the auxiliary circuit

average load
total kilowatt-hours or kilovolt-ampere hours divided by a selected time in hours

average power factor

$$\frac{\text{kWh}}{\text{kVA}} \times \frac{1}{T}$$

where T is the integration period in hours

back-up data
replica database of the on-line available data that can be used in the case of an emergency when the on-line available database fails or gets corrupted

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(continued)

basic current
I_b
r.m.s. value of current in accordance with which the relevant performance of a direct connected meter is fixed

[SANS 62052-11]

basic insulation
insulation that is applied to live parts to provide basic protection against electric shock

[SANS 62052-11]

NOTE Basic insulation does not necessarily include insulation used exclusively for functional purposes.

benefit of diversity
result of the operation of totalization and the possible flattening of the load curve that has an inherent benefit to the customers' maximum demand charge

bidirectional metering
meter that can measure import and export active energy or leading and lagging reactive energy (or both)

billing period
time between consecutive billing dates, nominally in months (e.g. one, three or six months) but in practice defined as a number of days (e.g. 28, 31, 60, 89, 90, 91)

[SANS 62051]

binary element
group of statements, each being realized by a digital signal, to represent information in digital electrical form

NOTE The meaning of each statement is determined by the code of the system and is represented by the position in time (or space) of the corresponding signal values. Each statement consists of either a logical "one" or a logical "zero", corresponding to the "one" level state or the "zero" level state of the representing signal. Each of these two values constitutes a binary element, and is represented by a binary digit, or bit.

carrier frequency coupling device
circuit element that is intended to permit the injection of carrier frequency current, and that is connected between the low-voltage terminal of a capacitor divider unit and earth

NOTE The coupling device has an impedance that is insignificant at power frequency but appreciable at the carrier frequency.

channel
input or a register for raw data that corresponds to a specific meter

NOTE If the encoder has built-in meters, the meter is considered to have four channels with values corresponding to kilowatt-hours (import and export) and kilovar-hours (leading and lagging).

channel multiplier
constant by which the channel readings are multiplied in order to obtain engineering units

character
member of the set of elements that is intended for use in conveying information, either when arranged together in an agreed fashion, or when isolated

Annex D
(continued)

class designation
maximum of the load range in amperes

NOTE This is usually applicable to meters of American origin.

class index
SEE **accuracy class**

clearance
shortest distance measured in air between conductive parts

[SANS 62052-11]

code
agreed set of unambiguous rules to specify the way in which data may be represented by the characters of a character set

conformity assessment
any activity concerned with determining directly or indirectly that relevant requirements are fulfilled [ISO/IEC Guide 2]

NOTE Typical examples of conformity assessment activities are sampling, testing and inspection; evaluation, verification and assurance of conformity (supplier's declaration): registration, accreditation and approval as well as their combinations.

credit dispensing unit
CDU
device used in the vending process to physically carry out the sale of electricity to the customer through the encoding of a token or a receipt (or both), which contains a token encryption device (TED) and a token issuing device (TID)

NOTE A CDU can vend different types of tokens (credit, reset, current limit, etc.).

creepage distance
shortest distance measured over the surface of insulation between conductive parts

[SANS 62052-11]

cumulative energy
quantity of energy (kilowatt-hour, kilovar-hour or kilovolt-ampere hour) over a period of time

demand interval
SEE **demand integration period** (clause 3)

demand meter
metering device that indicates or records either the demand, the maximum demand, or both

demand period
SEE **demand integration period** (see clause 3)

dielectric test
test of short duration which consists of applying a specified voltage to the insulation to prove that it is in accordance with the rated insulation voltage of the circuit, as stated by the manufacturer

Annex D
(continued)

digital representation (of a physical quantity)
representation of a physical quantity by discreet numerals of digital signals when the physical quantity to be represented is varied between specified limits

digital signal
signal which has a discreet number of ranges and values of the signal parameter, different information being associated with each of the ranges

direct acting indicating instrument
instrument in which the indicating device is mechanically connected to and actuated by the moving element

direction
<power> direction of power that is considered to be the direction of the corresponding energy transfer

direction
<reactive power> direction of reactive power where a capacitor produces it and an inductor absorbs it

distortion factor
ratio of the r.m.s. value of the harmonic content (obtained by subtracting from a non-sinusoidal alternating quantity and its fundamental term) to the r.m.s. value of the non-sinusoidal quantity

NOTE The distortion factor is usually expressed as a percentage. [SANS 62052-11]

distributor
entity that provides a physical supply (of electricity) to a customer on behalf of a supplier and that is contracted to do so through a connection agreement with that customer

[SANS 62051]

diversity
lack of coincidence in the time of consumer's individual maximum demand

double insulation
insulation which comprises both basic insulation and supplementary insulation

[SANS 62052-11]

document
information and its supporting medium

[ISO 9000:2000]

EXAMPLE Record, specification, procedure document, drawing, report, standard.

NOTE 1 The medium can be paper, magnetic, electronic or optical computer disc, photograph or master sample, or a combination thereof.

NOTE 2 A set of documents, for example, specifications and records, is frequently called "documentation".

NOTE 3 Some requirements (e.g. the requirement to be readable) relate to all types of documents, however there can be different requirements for specifications (e.g. the requirement to be revision controlled) and records (e.g. the requirement to be retrievable).

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(continued)

earthed neutral system
system in which the neutral is connected to earth, either solidly, or through a resistance or reactance of low enough value to reduce materially transient oscillations and to give a current sufficient for selective earth fault protection

earthed voltage transformer
single-phase VT that is intended to have one end of its primary winding directly earthed, or a three-phase VT that is intended to have the star-point of its primary winding directly earthed

electricity dispenser
ED
prepayment meter
electricity metering device that can (by means such as tokens, cards, and keypads) be programmed to allow the flow of a repurchased amount of energy through an electric circuit

[SANS 1524-1]

NOTE 1 An ED is a metering device that is installed at the customers' premises and allows the customer to consume the units (kilowatt-hours) of energy for which he/she has purchased credit.

NOTE 2 An ED comprises at least a token registering system, credit memory, a kilowatt-hour meter, a credit memory decrement system and a supply interruption breaker.

NOTE 3 The more generic term "prepayment meter" is the preferred term for an ED.

excess reactive energy
total reactive energy in excess of a certain percentage of the total active energy

NOTE This term is directly related to the implementation of Eskom time-of-use tariff option (Megaflex).

exposed conductive part
conductive part that can be touched and is not live but can become live under fault conditions

generator
authorized entity that is responsible for producing electricity and making it available to the power system

half-hour
period that ends on each hour and half-hour

impulse voltage test
test that consists of applying a specified impulse voltage to the insulation to prove the ability of a device to withstand, without damage, overvoltages of very high value and very short duration

induction meter
SEE **electromechanical meter** (clause 3)

input impedance
impedance of the input circuit that is measured between the input terminals of the apparatus under operating conditions.

inspection
conformity evaluation by observation and judgement accompanied as appropriate by measurement, testing or gauging

[ISO/IEC Guide 2]

Annex D
(continued)

inspection body
body that performs inspection

[ISO/IEC Guide 2]

instrument transformer accuracy class
SEE **accuracy class**

instrument transformer accuracy rating (for metering)
accuracy class together with a standard burden for which the accuracy class applies

integrating instrument
instrument that records the time integral of the measured quantity

integrating period
SEE **demand integration period** (clause 3)

intrinsic error
error that is determined when the instrument is under reference conditions

isolated neutral system
system that has no intentional connection to earth except through indicating, measuring or protective devices of very high impedance

kVAh

$$\sqrt{\text{kWh}^2 + \text{kvarh}^2}$$

kvar demand

$$\frac{\text{kvarh}}{T}$$

where T is the integration period in hours

load factor
factor that allows for the average period in which an appliance uses maximum load, derived by average load divided by the maximum demand

load range
maximum range in amperes over which the meter is designed to operate continuously with a specified accuracy under certain conditions

mass memory
memory in a meter that is used as a load profiling tool and that stores energy values, at regular specified intervals, for later retrieval

master station
device that is capable of accessing a number of encoders and transferring data from these encoders

Annex D
(continued)

maximum current
I_{max}
highest r.m.s. value of current at which a meter purports to meet the accuracy requirements of the relevant standard

[SANS 62052–11, modified]

maximum demand
highest registered electrical demand that is integrated for a specific period

maximum pulse rate
number of pulses per second at which a pulse device is nominally rated

maximum simultaneous demand
MSD
maximum kilowatt or kilovolt-ampere SD that is supplied to a group of supply points during a billing period

meter braking elements
that part of a meter that comprises one or more magnets and their adjusting devices, and that produces a braking torque by the action of its magnetic fluxes upon the currents induced in the moving elements

meter constants
values that are assigned to a specific meter that quantify the energy output values of that meter

NOTE These constants may apply to pulse outputs, calibration outputs or register values.

meter cover
enclosure on the front of the meter, made either wholly of transparent material or opaque material provided with window(s) through which the movement of the rotor can be seen and the register can be read

meter rotor
moving element of the meter on which the magnetic fluxes of fixed windings and of braking elements act, and that operates the registers

metering device
device that is capable of calculating, storing and displaying active or reactive energy values (or both) and real-time information

NOTE These functions may be performed in a single unit or in an assembly of modular components, such as time switches, termination blocks and individual energy meters. A common example is a large power user (LPU) board.

metering device configuration
settings of clocks, registers and memory that can be configured in any way by the user so as to implement switching times, rate registers, display sequences, integrating periods

NOTE This definition is included to address the confusion of terms. Reference is often made to "programming" the meters by users, whereas what actually occurs is the configuration of meters. The action of changing the configuration of the device is called "configuring".

Annex D
(continued)

metering device program
code that is executed on the embedded controller or other form of processor(s) that is(are) implemented in the metering device.

NOTE This code, usually referred to as the firmware of the meter, is produced by the meter manufacturer and cannot be changed by the user in any way

metering point
point where energy transfer is measured

NOTE 1 Each point can have kilowatt-hours (import and export) and kilovar-hours (leading and lagging).

NOTE 2 The metering equipment should preferably be installed at the POS.

multiple channel instrument
instrument, the input circuit(s) of which is/are intended for connection successively to different external circuits by cyclic switching

multiplication ratio
ratio that is used to transform a meter constant from a secondary to a primary quantity

NOTE A multiplication ratio is the product of the VT ratio and the CT ratio.

multi-rate meter
energy meter that is provided with a number of registers, each becoming operative at specified time intervals corresponding to different tariffs

[IEV 302-04-06]

nominal circuit voltage
circuit insulation voltage
highest circuit voltage to earth on which the instrument shall be used and that may be used to determine its insulation test

non-volatile memory
storage device that can retain information in the absence of power

[SANS 62052-11]

NOTE The information is retained for a period of at least three months.

on-line available data
data that is available in the active operational metering database

NOTE This data is normally part of the data acquisition system (DAS).

overall accuracy
difference between the measured energy and the true energy, expressed as a percentage of the true energy

Annex D
(continued)

percentage error
value that is obtained by the following formula:

$$\text{Percentage error} = \frac{E_m - E_t}{E_t} \times 100$$

where E_m is the energy registered by the meter and E_t is the true energy

[SANS 62052-11]

NOTE Since the true value cannot be determined, it is approximated by a value with a stated uncertainty that can be traced to standards agreed upon between the manufacturer and the user or to national standards.

point of supply
POS
point at which electricity is supplied to any premises by a supplier

[Regulation R1 to relevant legislation (see foreword)]

power factor
ratio of the watts in a system to the volt-ampere load

NOTE It is usual to calculate the average power factor using the equation $\frac{\text{kWh}}{\text{kVA}} \times \frac{1}{T}$

where T is the integration period in hours.

precision
repeatability of measurement data, customarily expressed in terms of standard deviation

prepayment meter
SEE **electricity dispenser**

prepayment metering
system whereby a prepayment meter is installed at the consumer's premises instead of the credit type Ferraris disc meter

procedure
specified way to carry out an activity or a process

[ISO 9000:2000]

NOTE 1 Procedures can be documented or not.

NOTE 2 When a procedure is documented, the term "written procedure" or " documented procedure" is frequently used. The document that contains a procedure can be called a "procedure document".

protective current transformer
protection current transformer
CT that is intended to supply electrical protective current

protective device
protection device
device that is incorporated in an instrument for the purpose of limiting overvoltage or overcurrent that can appear in one or more of its components

Annex D
(continued)

pulse
wave that departs from an initial level for a limited duration of time and ultimately returns to the original level

pulse initiator
device, mechanical or electrical, that is used with a meter to initiate pulses, the number of pulses which is proportional to the quantity being measured

NOTE It may include an external amplifier or auxiliary relay (or both).

pulse receiver
unit that receives and registers the pulses

NOTE It may include a periodic resetting mechanism, so that a reading proportional to the demand may be obtained.

pulse recorder
device that receives and records pulses over a given demand period

pulsing unit
unit that is mounted in the pulsing meter that generates the output pulses proportional to the measured active and/or reactive energy, and that is of a defined time/length

qualification process
process to demonstrate the ability to fulfil specified requirements

[ISO 9000:2000]

NOTE 1 The term “qualified” is used to designate the corresponding status.

NOTE 2 Qualification can concern the person, products, process or system.

EXAMPLE Auditor qualification process, material qualification process.

rate period
period of the day for which energy values are accumulated and recorded in a specific register

NOTE There are three rate periods for the time-of-use tariffs, namely peak, standard and off-peak.

rated primary current (of a CT)
value of the primary current that appears in the designation of a CT and on which its performance is based

[IEC 50 (321)-01-11]

rated primary voltage (of a VT)
value of the primary voltage that appears in the designation of a VT and on which its performance is based

[IEC 50 (321)-01-12]

rated transformer ratio
ratio of the rated primary current to the rated secondary current

rated value
value of the measured quantity that corresponds to the upper limit of the effective range

Annex D
(continued)

reactive power
product of the sinusoidal voltage, the sinusoidal current, and the sine of the phase angle between them in a two-wire circuit

NOTE In the case of non-sinusoidal quantities it is the sum of the harmonic components, each determined as above. In a polyphase circuit it is the sum of the reactive powers in the individual phases.

real-time clock
device that maintains, to an acceptable level of accuracy, information describing the date and time of day

NOTE 1 This information is maintained irrespective of whether power is supplied to the unit within which the clock is installed.

NOTE 2 In South Africa, the real-time clock should be set to Greenwich mean time plus two hours.

recorder
device that is installed at a metering point, and that is capable of receiving inputs from meters, accumulating these values over a user-defined time period, storing these accumulated values into memory and downloading these values into a metering master station

reference conditions
conditions under which meters are tested, for example, temperature, frequency, voltage and humidity

NOTE A more rigorous definition is given in SANS 62052-11.

reference direction
<current flow> direction for current flow that is fixed arbitrarily along a branch or around a mesh in a circuit, such that the current is considered positive when its direction corresponds to the reference direction

reference direction
<power> direction for power that is fixed arbitrarily, and that leaves or enters a delimited region, or is associated with a power line, such that the power is considered as positive when its direction corresponds to the reference direction

NOTE In circuits under sinusoidal conditions, the reference direction of power is so fixed that the instantaneous power is equal to the product of the instantaneous voltage and the instantaneous current. This reference direction is also the reference direction of the active and reactive power.

reference direction
<voltage> direction for voltage that is fixed arbitrarily from one point to another in a circuit, such that the voltage is considered as positive when the line integral of the corresponding electric field intensity, taken between the two points in the reference direction, is positive

reference point
specific busbar that is used as a reference point for the flow of active or reactive power

NOTE Export power from the reference busbar is defined as positive and import power to the busbar as negative.

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(continued)

refurbishment
replacement of a metering scheme or any part thereof with the purpose of retaining the functionality required by the metering installation and extending the life of that metering installation

register
allocated section of memory in the control and metering unit that records (and usually displays) details as determined by the programme in the unit

[SANS 62051]

relative error
ratio of the absolute error to the true value of the measured quantity

secondary injection
passage of a current into a metering circuit at a point beyond the instrument transformer

NOTE This is typically used for the calibration or verification of a metering installation.

shunt
resistor that is connected in parallel with an instrument in order to reduce the current that passes through it

NOTE The resistance may be so chosen that the reduction is a known ratio.

simultaneous demand
SD
arithmetic or vectorial sum of the kilowatt or kilovolt-ampere demand that is supplied at a group of supply points during the same integration period

split meter
split prepayment meter
prepayment meter that consists of a customer interface unit and a measurement unit

NOTE The intention of a split prepayment meter is to allow credit token interaction between the customer and the customer interface unit without allowing access to the mains conductors in order to minimize the possibility of tampering.

standard
document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context

[ISO/IEC Guide 2]

NOTE Standards should be based on the consolidated results of science, technology and experience, and aimed at the promotion of optimum community benefits.

supplementary insulation
independent insulation that is applied in addition to the basic insulation, in order to provide protection against electric shock in the event of a failure of the basic insulation

Annex D
(continued)

system master station
SMS
centrally located unit that collects, stores and processes data from, and transmits data to, CDUs and distributors' management computer systems

NOTE 1 An SMS is capable of producing, from the data collected, reports and information as defined from time to time by the supply authority.

NOTE 2 An SMS is also capable of transmitting processed data and control information to and from a supply authority's computer systems.

tariff module
device installed at a metering point, and which is capable of receiving inputs from meters, accumulating these values separately for various user defined rate periods and seasons, storing these totals in memory, and displaying the stored totals

terminal block
support that is made of insulating material on which all or some of the terminals of the meter are grouped together

[SANS 62052-11]

terminal cover
cover, enclosing the meter terminals and, generally, the ends of the external wires or cables that are connected to the terminals

[SANS 62052-11]

test
technical operation that consists of the determination of one or more characteristics of a given product, process or service according to specified procedure

[ISO/IEC Guide 2]

testing
action of carrying out one or more tests

[ISO/IEC Guide 2]

test current
current that is specified by the manufacturer for the main adjustment of the meter (full load adjustments)

test facility
device connected to the metering circuit that allows for the connection of a test instrument to measure burden, current or voltage

NOTE Such devices could be test blocks.

token
element that is used to transfer encrypted information between a CDU and an ED

NOTE 1 The information consists of credit information, instructions and any other information to be passed between the CDU and the ED.

NOTE 2 A group token is a token that is accepted by any one of a predefined group of EDs.

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(continued)

NOTE 3 An engineering token is a token used to initiate or perform specific engineering or management functions on an ED. Only installation or maintenance personnel normally use these tokens. A coding token is a particular type of engineering token used to set the ED key.

NOTE 4 A unique token will only be accepted by the dispenser for which it was issued.

NOTE 5 A token can act as a receipt.

token encryption device
TED
security module
physically and logically secure device that performs all tasks that have a security requirement

EXAMPLES Such tests are, for example, tests for token encryption, credit control, password control,
message authentication and verification

NOTE A security module can serve several CDUs.

totalization
operation of adding the energy usage from each feeder to a particular customer to obtain the total energy usage for that customer

traceability
process whereby the indication of a measuring instrument can be compared, in one or more stages, with a national standard for the measurand in question

vectorial simultaneous demand
sum of demands for a group of supply points, calculated according to the following formulae:

$$\text{kVA} = \sqrt{\left(\sum \text{kW}\right)^2 + \left(\sum \text{kvar}\right)^2}, \text{ and}$$

$$\text{kW} = \sum \text{kW},$$

where the sum of kW and kvar is for one group of supply points for each integrating period

verification
confirmation, through the provision of objective evidence, that specified requirements have been fulfilled

[ISO 9000:2000]

NOTE 1 The term “verified” is used to designate the corresponding status.

NOTE 2 Confirmation can comprise activities such as

a) performing alternative calculations,

b) comparing a new design specification with a similar proven design specification,

c) undertaking tests and demonstrations, and

d) reviewing documents before issue.

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(concluded)

validation
confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled

[ISO 9000:2000]

NOTE 1 The term “validated” is used to designate the corresponding status.

NOTE 2 The use conditions for validation can be real or simulated.

voltage circuit
shunt circuit
internal connections of the meter, part of the measuring element and power supply for the meter, supplied with the voltage of the circuit to which the meter is connected

[SANS 62052-11]

voltage monitoring
alarming facility
facility that monitors the measuring of voltage on the secondary part of the VT without circuit intrusion

voltage transformer
VT
instrument transformer in which the secondary voltage, in normal conditions of use, is substantially proportional to the primary voltage, and differs in phase from it by an angle which is approximately zero for an appropriate direction of connections

[IEC Dictionary]

winding
set of coils that is wound in series with a conductor for the transformation of current or in parallel to a conductor for the transformation of voltage

NOTE The number of rings in a coil determines the transformation value of voltage or current.

working standard
measuring instrument that has been calibrated by an approved calibration laboratory or an approved test laboratory, and that is used for the calibration of meters and metering equipment

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