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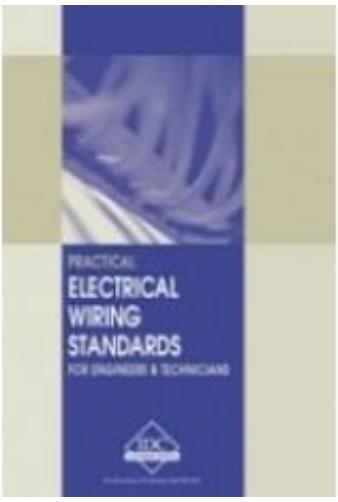
IW-E - Practical Electrical Wiring Standards - National Rules for Installations - ET 1012008



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Short Description

This manual provides in-depth information on all aspects of the national rules and their application, along with many practical examples and sample design calculations. It also includes references to safety, maintenance, inspection and testing, and provides a summary of some of the basic principles necessary for a good understanding of electrical installation technology. Note: This manual is NOT the standard itself, it is a guide to the implementation of the standard.

Description

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First Chapter
Practical Electrical Wiring Standards - National Rules for Electrical Installations - ET 101:2008 - An overview

1 Overview

This chapter provides overview on the contents of the manual and provides introductory information on the necessity, layout and scope of the manual.

Learning objectives

- To familiarize the readers with the contents of the manual and explain its necessity.
- To familiarize the readers with the objectives, scope and exclusions of the rules.
- To familiarize the readers with the fundamental principles and organization of the rules.

1.1 Introduction

The objective of this course is to familiarize the participants with the National Rules for Electrical Installations Fourth Edition ET 101: 2008 published by ETCI, the Electro-Technical Council of Ireland, which covers the requirements for electrical installations of nominal voltages up to and including 1000 V ac or 1500 V dc. It contains stipulations covering issues of safety, selection and installation of electrical equipment including those in special locations. The topics contained in the standard are of interest and relevance to all practitioners of electrical technology whether they are designers of electrical installations, erection engineers or personnel responsible for operation and maintenance of the installations.

In order to appreciate the requirements and stipulations contained in the standard better, it is necessary to have a clear understanding of the fundamental principles that the standard aims to address. In preparing this manual an attempt has been made to give the reader an insight into the relevance of the stipulations of the standard by first touching upon the basics of the relevant aspects of electrical theory and then go on to the requirements contained in the standard.

1.2 An Overview of the Contents of the Manual

After this overview we will start with the evolution and growth of electrical power distribution systems. We will touch upon the reasoning behind the adoption of 3 phase AC as the worldwide standard in electrical power generation, transmission and distribution.

We will cover the basics of neutral earthing of electrical systems at the source and the need for protective earthing of electrical installations to ensure safe operation of electrical systems. The need for establishing earth continuity and equipotential bonding of all building services will be explained. The incidence of voltage surges in electrical systems due to atmospheric factors and switching of equipment and the need for lightning protection systems in building and surge protective devices for equipment will be discussed briefly. We will also go through in detail the types of electrical distribution configurations depending on the type of earthing adopted.

We will discuss the hazards of electricity, primarily electric shocks in detail. This topic is of importance since safety is the essence of the ETCI National Rules. The topic of electrical conductors and cables will be taken up as these components form the backbone of any electrical distribution system.

The control of electrical power and the need for proper isolation of electrical systems for safety will be touched upon. This again is a topic which the ETCI standard discusses in detail being an issue related to safety of personnel operating not only the electrical systems but also those involved in the operation and maintenance of the mechanical equipment powered by the distribution system.

Of the ET 101 standard itself (referred in this manual as the Rules), we will cover the scope of the standard as well as the exclusions as a part of this overview. The Rules are broad based and cover every conceivable condition of electrical installations some of which are not usually encountered in general domestic or industrial installations. It will be impossible to cover all such stipulations in this manual. We will therefore focus our discussions on the most common types of installations and study the recommendations of the Rules as applicable for such installations.

We will discuss the need for systematic assessment of system requirements while planning an installation. We will cover the stipulations of the standard in respect of electrical hazards, the various protective measures recommended and how they are to be applied in different situations. This is the central issue of the wiring rules being related to human safety. We will review the recommendations of the standards in regard to selection and installation of equipment including

those in special locations. The subject of initial verification of any installation for conformity with the rules, the periodic inspection and certification requirements will also receive due mention.

1.3 Why is Such a Standard Necessary

A standard for equipment, appliance, device or an installation is necessary for the following reasons.

- To ensure proper interfacing between equipment and systems designed/ manufactured/installed by different agencies.
- To ensure manufacturing/installation quality and the application of a reasonable standard of safety, commensurate with available technology and experience.

We will illustrate these concepts further.

Ease of Interfacing

Imagine for a moment, that there are no standards for electrical appliances. The result would be that each product manufacturer might choose a different voltage rating for his product. Which means that we will have electrical heaters, ovens, toasters etc. that cannot work on a common electrical system. Your power supply company might have a distribution voltage that is unsuitable for any or all of your gadgets. This obviously is not a helpful situation.

Thus a standard has to be established and its adherence made mandatory within a national or geographical entity so that generation, transmission, distribution and utilization of electrical energy are done at stipulated voltages and frequency which will vary only within bands specified for each parameter.

Such a standard enables the designer of an appliance to select a suitable voltage and frequency at which the appliance can function and also the variations of these parameters which have to be taken care of in the design for the operational range of the appliance. It also allows the designer to select appropriate conductors and configuration of power supply connectors forming part of the appliance.

In turn, this enables you to buy an off-the shelf appliance and connect it to the electrical outlet at home and use it without worrying too much about the suitability of the appliance for the electric supply provided by the power company. Anyone who has traveled with a device made in one country and tried to use in another

where different standards prevail would certainly appreciate the convenience which uniform standards provide us with.

Also the use of standards reduces the number of variant appliance designs a manufacturer has to plan and manufacture; an issue which will have adverse cost implications to the manufacturer and hence to the buyer. Low cost mass production is thus a direct result of standards.

Ensuring Quality

Equipment and installations have to deliver functionalities for which they are designed without any undue hazards to the users or the environment for their entire design life under varying operating conditions. The provisions of a standard therefore define the parameters for functionality, safety and maintainability. They also contain stipulations that lay down the tests that the device has to withstand to either prove a design (by what are called Type tests conducted on prototypes or selected samples) or ensure that the output and quality parameters are met (by Routine Tests done on each piece manufactured). Thus when you buy an appliance or equipment that is declared as conforming to a particular standard, you have an assurance that it will perform under conditions defined by the standard, is safe to use and will deliver the output or functionalities which the manufacturer furnishes in accordance with the standard.

An installation standard has a similar objective too. When an installation is carried out in accordance with a standard, it has to follow the methodologies stipulated in the standard using recommended accessories which, in turn will ensure that the installation achieves the intended quality minima, is safe for personnel and environment, and will have adequate provisions for maintainability. An installation standard also usually lays down the procedures for initial inspection and testing for certifying that the installation is fit to be put in service and the periodicity and detail of subsequent inspections and testing to ensure that it is fit to remain in service till the next scheduled inspection.

1.4 Objectives of the Rules

The objective of the rules is to provide the rules for the design and erection of electrical installations covered under its scope to ensure safety and proper functioning of the installation.

When use of a new material or invention in an installation results in deviation from one or more stipulations of the rules, it should be ensured the degree of safety is not compromised by such use. The fact of such use shall also be

recorded on the electrical installation certificate.

1.5 Scope of the Rules

ETCI National Rules are applicable to the following installations:

- Industrial, commercial, residential, agricultural/horticultural premises
- Prefabricated buildings and caravans
- Temporary installations such as those encountered in construction sites, exhibitions, fares etc.
- Outdoor installations

The rules cover the requirements for

- Circuits supplied at nominal voltage up to and including 1000 V ac or 1500 V dc.
- Circuits of over 1000 V ac when derived from an installation of less than 1000 V ac, such as high voltage discharge lighting systems, electrostatic precipitators etc.
- Wiring and cabling systems not forming part of an appliance or equipment's internal wiring and not covered under the standard for the appliance
- All consumer installations external to the building
- All fixed and External wiring requirements for communication and information technology systems for power signaling and control
- Additions and alterations to an existing installation

The rules may have to be supplemented by the requirements of other Standards that may be applicable for an equipment or installation (e.g., neon signs, emergency lighting, installations in environment containing explosive gases or conductive dust) or by the specified requirements of the agency ordering the installation.

Note:

Various definitions contained in part 2 of the Rules have been reproduced in this manual at the appropriate chapters.

1.6 Exclusions

The following are some of the installations to which the rules are NOT applicable.

- Public or private supply systems for the distribution of electricity to consumers
- Railway traction, rolling stock and signaling systems
- Motor vehicles and equipment on board ships, off shore installations and aircraft
- Mines and Quarry equipment covered by other statutory rules
- Lightning protection installations on buildings

The standard does NOT cover the requirements for design/manufacture of electrical equipment but limits itself to their selection and application in electrical installations.

The Rules are non-statutory in nature. In some cases, the requirements of the Rules will be supplemented by other codes of practice approved under acts such as The Safety Health and Welfare Act 2005 and the supporting Rules 1993 - part VIII (described briefly in the following paragraphs).

For premises on which a Licensing or Statutory authority exercises control, the requirements of such authorities should be complied in the design and execution of the installation.

1.7 Safety Health and Welfare Act

The Safety Health and Welfare Act covers all work activity and places duties on employers, the self-employed and employees. The Act is very general in its requirements and is an umbrella act under which the General Application Rules of 1993 set out specific requirements summarized as follows

- Part I Interpretation and General
- Part II General Safety and Health Provisions
- Part III Workplace
- Part IV Use of Work Equipment
- Part V Provision of Personal Protective Equipment
- Part VI Manual Handling of Loads
- Part VII Work with Display Screen Equipment
- Part VIII Electricity
- Part IX First Aid
- Part X Notification of Accidents and Dangerous Occurrences

Contravention of these rules is a criminal offence and persons can be prosecuted personally, not just their employers. Employees are duty bound to co-operate

with their employers in helping them fulfill their duties under the Act.

1.8 Part VIII Electricity

With few exceptions, these Rules covers every aspect of the design, construction, maintenance, and use of electricity, whatever the voltage. They include all workers, from electricians and engineers to teachers, typists, doctors etc.

Some important rules are:

- **35**Employers have a duty to comply with Part VIII and any relevant code of practice
- **36**All electrical equipment shall at all times be so constructed, installed, maintained, protected and used as to prevent danger.
- **41**Specific essential requirements for protection of persons against electric shock to be provided. Protective device for automatic disconnection of supply should be provided for voltages exceeding 50 V a.c. or 120 V d.c..
- **45**Adequate precautions shall be taken to prevent danger arising from electrical equipment, which has been made dead becoming live while work is carried out on or near that equipment and any electrical equipment becoming live.
- **46** includes: A person shall not be engaged in any work activity on or near any live part where danger may be caused unless –
    1. It is unreasonable in all the circumstances for it to be dead; and
    2. It is reasonable in all the circumstances for such person to be at work on or near it while it is live; and
    3. Suitable precautions are taken to prevent the danger.
- **48**Persons to be competent to prevent danger

Persons must possess such technical knowledge and experience or be under supervision as is appropriate having regard to the nature of the work

1.9 Fundamental Principles of the Rules

The fundamental principles contained in chapter 13 of the Rules are essentially an outline of the issues it addresses. These will be individually covered in this manual in the coming chapters and therefore not being given in detail here. The issues are:

- Ensuring basic and fault protection (i.e. safety against direct and indirect

shocks), protections against thermal effects, over current, fault current and over voltage.

- Aspects that need to be considered in the design such as characteristics of available supply, nature of demand, emergency supplies for safety services, environmental considerations, conductors to be used, type of wiring, protective equipment, emergency control, isolation and switching, accessibility for operation etc.
- Selection of electrical equipment in order to suit the voltage, current capacity and frequency of the supply system.
- Erection of equipment using good workmanship and proper materials, use of conductors with proper sizing and rating, proper jointing and connections at terminal points, installations in a manner not to cause temperatures in excess of the design temperatures and verification and testing of equipment periodically to avoid degradation.

1.10 Organization of the Rules

The Rules are organized into the following parts.

Part 1 covers the object, scope and fundamental principles, which we have briefly touched upon in the preceding paragraphs.

Part 2 contains definitions of the terms used in the Rules.

Part 3 sets out the assessment of general characteristics of an installation. The general purpose for which the installation is to be used, the maximum demand in amperes which it will draw from the supply, the earthing arrangement, the nature of power supply source/s and their parameters, ascertaining their suitability to the installation under consideration, special requirements for installations used for safety services or standby services, need for change over arrangements to a redundant source or considerations for parallel operation of sources etc. will be the prime characteristics that will receive due attention.

Part 4 deals with the issue of protection for safety. This part covers basic and fault protection (i.e. protection against direct and indirect shocks), thermal effects during normal operation, protection against over currents, over voltage, under voltage etc. The need for proper isolation and switching of installations and their role in safe operation of the installation are also covered.

Part 5 covers the rules for selection and erection of wiring systems, switchgear, earthing arrangements etc.

Part 6 deals with inspection and testing of installations. This includes the requirements for initial verification and testing after an installation is completed as well as after additions and alterations to an existing installation. Requirements for periodic inspection are also stipulated. Sample formats for the issue of Completion Certificates for different types of inspection carried out as per this part are also included in Annex 63A.

Part 7 contains the details of special installations where safety issues are of vital importance. This includes installations in baths, showers, swimming pools, saunas, construction sites, caravans and caravan parks and so on. In all these cases the environment with high humidity, presence of water, high temperature etc. occur and special steps need to be taken to ensure that the installation will remain safe and in good order over an extended period of time.

The arrangement of ET 101 may be better understood by considering the Plan illustrated below.

Part 1: Scope, Object and Fundamental Principles

Part 3:	**Part 4:**	**Part 5**:	**Part 6**:	**Part 7:**
Assessment of General Characteristics	Protection for Safety	Selection and Erection of Equipment	Inspection and Testing	Special installations or locations

Part 2: Definitions

Part 1 gives the overriding requirements and is therefore placed at the top.

Part 2 gives the underlying Definitions, and is therefore placed underneath.

Note that where Special Installations or Locations as described in Part 7 are involved the general requirements are supplemented or modified. At each stage the designer must therefore check for that involvement.

1.11 Annexes

The Rules also contain 24 annexes. The annexes do not form part of the Rules, but provide “need to know” information. Each annex takes the chapter number it

relates to followed by a letter A to F

Annex 41A	Measures for basic protection (Normative)
B	Measures for basic protection in certain types of locations (Normative)
C	Special measures for protection in case of fault (Normative)
Annex 43A	Protection of conductors in parallel against overcurrent (Normative)
Annex 51A	Statutory Rules (Informative)
B	Recommended graphical symbols (Informative)
C	IEC classification system for enclosures (Normative)
D	IEC classification system for external influences (Informative)
E	Multicore cable core colors (Normative)
Annexes 52 A-F	Cable capacities of conduit and trunking (Normative), bending radii (Normative), current carrying capacities (Normative) and voltage drops of cables (Informative) Standard types of cables (Informative)
	Summary of rules for concealed wiring
Annexes 53A	Residual current protective devices (Informative)
B	Overcurrent protection of meter tails (Normative)
Annexes 54A-C	Earthing information – derivation of k factors (Normative), SWA equivalents (Informative), Earthing arrangements for information technology installations (Informative)
Annex 55A	Final circuit arrangements (Normative)
Annexes 61A-G	Test methods (Normative)
Annex 62 A	Periodic inspection report (Normative)
Annex 63A	Completion certificates (Normative)
B	Procedure for certification of minor electric works (Normative)
Annexes 705A, B	Equipotential bonding in cattle sheds and milking parlours and installation of electric fences (Normative)

Annex 710 A	Classification of safety devices for medical locations	
B	Examples for allocation of group members and classification for safety services for medical locations	
Annex 721 A	Example of notice mounted in a caravan	
Annex 753	Floor and ceiling heating systems (Normative)	

Normative annexes contain necessary supplemental information.

Informative annexes may indicate an acceptable method of compliance.

Normative references are given at the front of the Rules.

These are:

.

1.12 ETCI Publications

National Rules

ET 101	National Rules for Electrical Installations (3rd Edition 2000)	2008
ET 101A	Amendment to the National Rules for Electrical Installations, Third Edition	2001
ET 105	National Rules for Electrical Installations in Potentially Explosive Atmospheres, Second Edition.	2001
ET 106	(Part 10.1) National Rules for Electrical Installations in Medically Used Rooms1988	1998
ET 107	National Rules for Inspection and Certification of Existing Electrical Installations for Reconnection to the Distribution System. Publication date reserved.	------

Codes of Practice and Guides

ET 202	Guide to the Selection of Electrical Apparatus for Use in Potentially Explosive Atmospheres.	2001
ET 204	Code of Practice for Control Systems involving Programmable Electronic Products and Systems	1995
ET 205	Guide to the Installation of Extra-Low Voltage Lighting Systems-Guide to the Installation of Extra-Low Voltage Lighting Systems	1998
ET 206	Good Practice Guide on the Management of Electrical Safety at Work.	2009

ET 208	Code of Practice for the Design, Selection and Erection of LV Switchboards for Residential Applications	2000
ET 210	Code of Practice for the Selection and Installation of Low Voltage Generators Publication date reserved.	2003
ET 211	Code of Practice for Public Lighting Installations in Residential Areas. Publication date reserved.	2003
ET 212	Guidelines for Extensions, Additions and Alterations to Existing Electrical Installations.	2004
	Seminar Papers of Regional Seminars on National Rules for Electrical Installations, Third Edition	2000
	Seminar Papers of ATEX Seminar held in Cork, November 2001	2001

1.13 Harmonization with European Standards

Definition: Harmonized Standard

A Standard which has been drawn up by common agreement between national standards bodies notified to the European Commission by all member states and published under national procedures.

To comply with European Union directives, and thereby assist free trade without technical barriers, member states are required to harmonize their technical standards. To do this, committees are formed, drawn from the standards committees of the different states. The European standards body is CEN and the electrical part of this is CENELEC. The first step is a Harmonization Document (HD), which is a standard containing most of the general requirements of each state in a common format. There is provision for each state to have its own variations on this. At the next stage a Euro Norm is produced which must be identical in every country. An IS EN is an Irish Standard based completely on an EN. This will be identical in every respect with other European normalized standards. Many European electrical standards are based on international standards as produced by IEC the International Electro-technical Commission. If a CENELEC standard is based on an IEC standard it takes the number as its own:

E.g., IEC 61439 was adopted by CENELEC and became EN 61439. Thus IS 61439 became IS EN 61439.

Cenelec Harmonization Documents.(e.g. CENELEC HD 384.4.46) are

harmonized European standards which are not yet made Euro Norms but are generally accepted with some national differences. These are given at the start of each harmonized chapter and section where relevant

The National Rules are based on IEC 60364. It is in the process of being harmonized and its CENELEC number at present is HD 384. If it becomes a Euro Norm it will be called EN 60364.

Irish Standards eg IS 201:2005 are purely Irish standards.

1.14 Summary

We had an overview of the contents of this manual in this chapter. We discussed the need and relevance of standards for engineering products and installations. We also covered the objectives and scope of the Rules. We had a look at the fundamental principles and the organization of the Rules. The movement towards harmonization of the Rules with European Electrical standards was also brought out.

This manual is not intended to replace the Rules as a work of reference but is merely an introduction to it. In case further information is required it is recommended that the participants study the standards as well as other references such as the Management of Electrical Safety at Work ET206:200 published by the ETCI. A lot of published literature is available on these topics by industry bodies and reputed manufacturers of electrical equipment as well as on the Internet and can be referred for assistance in solving specific problems one may come across.