Enhancing Compliance
To MS IEC 60364 – Standards for Residential Wiring

Ir. K.T. Lim (Lim Kim Ten)
The Institution of Engineers, Malaysia

(9th November 2015: 3:00 pm to 3:45 pm)
Electrical Accidents in Malaysia

Source: Energy Commission, Malaysia

Green = Electrical Accident Fatalities USA
Source: Electrical safety Foundation International (ESFI), USA

Electrical Consumption per Capita Malaysia

Electricity Consumption per Capita Malaysia

EC - National Conference on Electrical Safety 2015- 9 Nov 15
Causes of Electrical Accidents

- Lack of Maintenance: 37.2%
- Safety Procedures Not Complied with: 30.1%
- Illegal Modification: 10.2%
- Working Near Electrical Installation: 6.4%
- Unauthorized Works on Electrical Installations: 3.1%
- Use of Defective Electrical Equipment: 2.8%
- Others: 10.2%

Source: Energy Commission, Malaysia
Have You Ever Test RCCB in Your House ??
Locations Electrical Accidents Occur

Source: Energy Commission, Malaysia

Sites of Electrical Accidents
Years: 2002 – 2012

- High Voltage Overhead Lines: 57.0%
- Substations: 21.0%
- Underground Cabling Works: 13%
- Agriculture: 10%
- Mining: 8%
- School: 3%
- Institution of Higher Learning: 3%
- Factories (Industries): 2%
- Municipal Council: 2%
- Government Buildings: 1%
- Commercial Buildings: 1%
- Construction Sites: 20.0%
- Residential: 16.0%

EC - National Conference on Electrical Safety 2015- 9 Nov 15
Main LV Electrical Systems of Fixed Buildings

1. Electricity supply reticulation
2. Electrical installations of buildings: MS 1979
3. Protection against Lightning
4. Earthing
5. Equipment
Low Voltage Electrical Installations:

- Fixed Installations
  - Energy Commission
- Special Installations or Locations
  - Energy Commission
- Explosive Atmospheres
  - Energy Commission: On Shore
  - Off–Shore
- Others Installations
  - ???
Standards

Fixed Buildings

Low Voltage Reticulation
- EC: Grid Code
- TNB: Electricity Application Handbook

Electrical Installation of Buildings
- MS IEC (IEC) 60364 / MS 1936 / MS 1979

Protection Against Lightning
- MS IEC 62305

Earthing
- BS 7430

Electrical Equipment
- MS Standard
- MS IEC / IEC Standards / Approval of Electrical Equipment
Categorization of Electrical Installations

- Fixed Installations: IEC 60364–1/6, MS 1936 / MS 1936
- Special Installations or Locations: IEC 60364–7
- Explosive Atmospheres: IEC 60364 / IEC 60079
- Others Installations: Various
Electrical Installations of Fixed Buildings

- **MS IEC (IEC) 60364 Series**
  - **Non – Residential**
    - **MS 1936: Guide to IEC 60364**
  - **Residential / Un–Informed User**
    - **MS 1979: Code of Practices**
      - Guidelines for Electrical Wiring in Residential Buildings
      - Code of Practices: Water Heater
Fixed Buildings: MS IEC 60364 / MS 1936/79

- Commercial Buildings
- Outdoor: Carpark / Guard House
- Condominiums
- Schools
- Factories
- Residential
Special Installations or Locations: IEC 60364–7

- Hospitals
  MS IEC 60364–7–710

- Swimming Pool
  IEC 60364–7–702

- Water Features and Fountains
  IEC 60364–7–702

- Marina’s:
  IEC 60364–7–709

- Bath room:
  IEC 60364–7–701

- Agriculture & Horticulture
  IEC 60364–7–705

Masuk Sakit, Keluar Mati
Masuk Lebih Kurang Mati, Keluar Sahat
Explosive Atmospheres: IEC 60364 / IEC 60079

Chemical Complex

Tank Farm

Oil & Gas Platform

Chemical Store

Oleo Refinery

Grain Silos
Others Installations

- Ships: IEC 60092
- Illegal Settlements: MS IEC 60364
- Assembly Equipment: MS 60364 / MS 1936 / MS IEC 60204
- Aviation & Aerospace
- Military
- Ponds, Rivers, Seas & Oceans
Scope of MS 1936 and MS 1979

LV Supply to Fire Protection Systems (Exclude Equipment)

MS 1936:
- UPS
- SSB (E)
- EMSB
- G
- N
- MSB

MS 1979:
- Consumer Unit Residential

Final DB \approx Consumer Unit
Residential Buildings: MS IEC 60364 / MS 1979

- Apartments
- Fishing Villages
- Condominiums
- Illegal Settlements
- Rural Houses
- Residential
Residential Buildings: MS IEC 60364 / MS 1979

Residential Solar PV:  
IEC 60364–7–712

Guard House:  
MS IEC 60364

Water Heater: Code of Practice

Fountain: IEC 60364–7–702

Bathroom: IEC 60364–7–701

Electric Vehicle Charging:  
IEC 60354–7–722

Fish Tank:  
IEC 60364–7–702

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ELECTRICAL INSTALLATIONS OF BUILDINGS - CODE OF PRACTICE

Rm.20–00

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DEPARTMENT OF STANDARDS MALAYSIA

ICS: 91.140.50; 29.020
Descriptions: practice, electrical installations, buildings, residential houses, dwellings

PEMASANGAN ELEKTRIK DALAM BANGUNAN - KOD AMALAN

Rm.20–00

© Hak cipta 2011
DEPARTMENT OF STANDARDS MALAYSIA

ICS: 91.140.50; 29.020
Perthal: amalan, pemasangan elektri, bangunan, rumah kediaman, lampu tinggal
GUIDELINES FOR ELECTRICAL WIRING IN RESIDENTIAL BUILDINGS

Free Download:
Energy Commission

2008 EDITION
www.st.gov.my
Electrical Equipment: Standards and Information Booklet

Electrical Equipment
MS and MS IEC (IEC) Standards (Uninformed Users)

MS Standards:
For Example – Water Heater

Approval of Electrical Equipment (Electricity Regulations 1994) Information Booklet (For Uninformed Users)

34 Electrical Equipment Require Certificate of Approval (COA)
Approval of Electrical Equipment
(Target: Un-informed Users)

2014 Edition: 34 COA Equipment

Free Download:
Energy Commission
Information Booklet
2014 Edition

Energy Commission, Malaysia
<table>
<thead>
<tr>
<th>34</th>
<th>WIRE / CABLE/ CORD (non-armoured) 0.5mm² to 35mm²</th>
<th>• is unscreened and flexible; • is designed for use at low voltage; • consists of two or three elastomer or PVC insulated cores of multistrand construction; • has a cross-sectional area of each conductor from 0.5mm² not exceeding 35mm²</th>
<th>Polyvinyl chloride (PVC) Insulated flexible cord and cable</th>
<th>MS 2112-5:2009</th>
<th>BS EN 50525-2-11:2011 or IEC 60227-5:2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PVC-insulated cable (non-armoured) for electric power and supply: - non-sheathed</td>
<td></td>
<td>MS 2112-3:2009</td>
<td></td>
<td>IEC 60227-3:1997</td>
</tr>
<tr>
<td></td>
<td>PVC-insulated cable (non-armoured) for electric power and supply: - sheathed</td>
<td></td>
<td>MS 2112-4:2009</td>
<td></td>
<td>IEC 60227-4:1997</td>
</tr>
</tbody>
</table>
Approval of Electrical Equipment: Cable / Wire

Approval of Electrical Equipment: Cable / Wire

PEKELILING SURUHANJAYA TENAGA BIL. 03/2012
PENGUNGAAN KABEL KUASA BERSAIZ 1.5mm² JENIS KUPRUM BAGI TUJUAN PENDAWAIAN LITAR LAMPU
NO. RUJUKAN ST/IP/PK/JKKE/ Pk.03/2012

TUJUAN

Pekeling ini adalah bertujuan untuk menjelaskan kepada semua konsultan, kontraktor elektrik, orang kompeten, pengilang dan pengimport kabel, dan semua pihak lain yang terlibat dalam mereka bentuk dan memasang sistem pendawaian pepasangan elektrik, mengenai keperluan penggunaan kabel kuasa bersaiz sekurang-kurangnya 1.5 mm² jenis kuprum (Copper) bagi sistem pendawaian litar lampu di bangunan.

LATARBELAKANG

2. Kaedah pemasangan sistem pendawaian bagi litar lampu bersaiz 1.5 mm² jenis kuprum telah ditetapkan dalam Garis Pendiduan Pendawaian Elektrik di Bangunan Kediaman yang telah dikeluarkan oleh Suruhanjaya Tenaga (ST). Garis panduan tersebut telah dibangunkan selaras dengan kehendak-kehendak Standard Malaysia;

   i. MS IEC 60364 - Electrical Installations of Buildings
   ii. MS 1936:2006, Electrical Installations of Buildings- Guide to MS IEC 60364
   dan


3. Bagaimana pun ST mendapati bahawa masih wujud penggunaan kabel kuasa bersaiz kurang dari 1.5 mm² bagi tujuan pendawaian litar lampu di bangunan-bangunan. Sehubungan itu, ST juga mendapat terdapat pengilang kabel tempatan yang masih mengeluarkan kabel-kabel bersaiz 1.25 mm² jenis kuprum bagi tujuan pendawaian tetap.

TINDAKAN YANG PERLU DIAMBIL

4. Konsultan, kontraktor elektrik, orang kompeten dan semua pihak lain yang terlibat hendaklah memastikan kabel pendawaian bersaiz sekurang-kurangnya 1.5 mm² jenis kuprum sahaja digunakan bagi pendawaian tetap litar lampu.

5. Sumber maklumat dan pengenalan berikut boleh digunakan untuk mengenalpasti sama ada kabel yang digunakan adalah mematuhi standard dibatkan;

   i. maklumat mengenai kabel di label pada bungkus kabel;
   ii. tanda emboss pada kabel yang mencatikan saiz, standard dan maklul ulian kabel berkenaan yang dilikirkan; dan
   iii. pemeriksaan fizikal secara terus ke atas keratan rantai kabel yang menunjukkan bilangan lembar pengair (cable strands), jenis pengair dan penamannya.

6. Penggunaan kabel kuasa bersaiz sekurang-kurangnya 1.5 mm² jenis kuprum bagi tujuan pendawaian litar lampu adalah bagi mengetak daripada berlakunya kepanasan lampau, susutan voltan atau kecacatan pada penebat kabel.
Approval of Electrical Equipment: Cable / Wire

7. Sistem pendawai litar lampu menggunakan kabel bersaiz sekurang-kurangnya 1,5 mm² jenis kuprum tersebut perlu dipasang secara berterusan (dari komponen flus (MCB) di papan aghan hingga ke poim lampu) tanpa sebarang sambungan.

TINDAKAN PENGUATKUASAAN

8. Semua konsultan, kontraktor elektrik, orang kompeten, pengilang dan pengimport kabel, dan semua pihak yang terlibat dalam mereka bentuk dan memasang sistem pendawai litar disang elektrik adalah dilingatkan supaya selalu mematuhi Pekelling ST Bil. 2/2008 dan pekelling ini. Tindakan tegas boleh diambil terhadap mana-mana pihak yang gagal mematuhiannya.

Sekian, terima kasih.

(Datuk Ir. Ahmad Fauzi bin Hasan)
Ketua Pegawai Eksekutif
Suruhanjaya Tenaga

Tarikh: 6 Ogos 2012

s.k
Pengarah
Jabatan Penguatkuasaan & Penyelidikan Kawasan
Semua
Ketua Pejabat ST Kawasan, Suruhanjaya Tenaga
Case Study 1:
Adoption of International Standards
International Standards Harmonization:
LV Electrical Installations of Buildings

IEC

This map is for guidance only. Legrand as a company cannot be held responsible or liable for errors nor for changes that occur constantly with local standards.
IEC Standards Users

Full Members

Associate Members

Affiliates

ISO
Adoption of International Standards and Best Practices

- Malaysia adopts IEC & ISO standards as reference standards
- Adoption, national deviations, guides and code of practices
  - Documented in MS standards
- Example
  - MS IEC 60364: Electrical Installations of Buildings – Adoption of IEC 60364 with national deviations
  - MS 2979: Electrical Installations of Buildings: Code of Practice: Residential buildings
    - Code of practice for water heater
Other International & National Standards

- **IEE Wiring Regulations and BS 7671: Requirements of Electrical Installations**
  - Unique electrical standards for Malaysia
  - IEE Wiring regulations and BS 7671 can be used prior to year 2008 for new buildings
  - Sarawak still uses IEE Wiring Regulations and BS 7671

- **Elements of standards commonly used in Malaysia today**
  - IEE Wiring Regulations and BS 7671;
  - National Electrical Code (NEC);
  - JIS (Japan), GB (China), EN (European Union)
## Residential Building Standards Timeline

<table>
<thead>
<tr>
<th>Time Line</th>
<th>(Malaya), Peninsular, FT’s &amp; Sabah</th>
<th>The State of Sarawak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>BS 6651 / BS 7430</em></td>
<td><em>BS 6651 / BS 7430</em>.</td>
</tr>
<tr>
<td>Year 1991</td>
<td>IEE Wiring Reg. 1st – 16th Ed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>BS 6651 / BS 7430</em></td>
<td></td>
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<tr>
<td>Year 1992</td>
<td>IEE Wiring Reg. 16th Ed.: Harmonized with IEC 60364 and became with</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BS 7671:1992 <em>BS 6651 / BS 7430</em></td>
<td></td>
</tr>
<tr>
<td>Year 1991 – 2003</td>
<td>IEE Wiring Reg. / BS 7671</td>
<td>BS 7671 *BS 6651 /</td>
</tr>
<tr>
<td>Year 2003</td>
<td><em>BS 6651 / BS EN 62305 (1999) / BS 7430</em></td>
<td><em>BS EN 62305 / BS 7430</em></td>
</tr>
<tr>
<td>Year 2007</td>
<td><em>BS 6651 or MS IEC 62305:2007 / BS 7430</em></td>
<td><em>BS EN 62305 / BS 7430</em></td>
</tr>
<tr>
<td>Year 2008 – Now</td>
<td>IEC 60364 / MS 1979 *BS 6651 /</td>
<td>BS 7671</td>
</tr>
<tr>
<td></td>
<td><em>MS IEC 62305 (1 Sep 11) / BS 7430</em></td>
<td><em>BS EN 62305 / BS 7430</em></td>
</tr>
</tbody>
</table>

CAFEO 33, Penang Malaysia - 22 - 26 Nov 15
Case Study: 2

Low Voltage (LV)

Electricity Act and Regulations,

and

Electrical Safety Standards
Act and Regulations: Electrical

Free Download:
Energy Commission

Free Download:
Energy Commission

Act 447
ELECTRICITY SUPPLY ACT 1990
Incorporating all amendments up to 1 January 2006

PUBLISHED BY
THE COMMISSIONER OF LAWS REPRINT.
UNDER THE AUTHORITY OF THE REPRINT OF LAWS ACT 1989
IN COLLABORATION WITH
PERDANA PUBPLIK, MALAYSIA 2004
Electrical Safety Standards: Generic

1. **MS IEC 60335**: Household and similar electrical appliances;

2. **MS IEC 60065**: Audio, video and similar electronic apparatus;

3. **MS IEC 61010**: Equipment for measurement, control and laboratory use;

4. **MS IEC 60950**: Information and communication technology equipment;

5. **MS IEC 60601**: Medical electrical equipment;

6. **MS IEC 60204**: Safety of Machinery


➢ **IEC 62368 replacing IEC 60065; and IEC 60950**

○ No MS IEC adoption yet
Electrical Safety Standards: Specific

- **MS 556**: Specification for electrical safety code on private electric generator;
- **MS 949**: Code of practice for safety in welding and cutting;
- **MS 966**: Playground equipment: Part 2: General safety requirements;
- **MS 1597**: Part 2–73:2003 Household and similar electrical appliances–Safety–Part: 2–73: Particular Requirements for fixed immersion heaters (1st Edition);
- **MS 1992**: Electronic equipment for use in power installations;
- **Etc.,**
Case Study: 3

*Risk Management (Analysis)*
Moving Electrical Equipment: Motors

2/3 Consumed by Electric Motors

1 Hp motor can kill a person
Act & Regulations: Safety and Health

LAW OF MALAYSIA

ACT 139
FACTORIES AND MACHINERY ACT 1967 (REVISED - 1974)
Incorporating latest amendment - Act A1256 of the year 2006

First enacted: 1967 (Act No. 64 of 1967)
First: 1977
Second: 2000
Third: 2006

Revised up to:
Date of publication in the Gazette of Revised Edition: 1974 (Act 139 w.e.f. 1 July 1974)
Date of coming into operation of Revised Edition:
1 July 1974

ARRANGEMENT OF SECTIONS

PART I - PRELIMINARY
Section 1. Short title and application.
Section 2. Preceding laws.
Section 3. Interpretation.
Section 4. Objects of the Act.
PART II - SAFETY, HEALTH AND WELFARE
Section 10. Provisions relating to safety, etc.
Section 11. Persons exposed to explosive, inflammable, etc., substances.
Section 12. Lifting of weights.

PART IV - GENERAL DUTIES OF EMPLOYERS AND SELF-EMPLOYED PERSONS
Section 15. General duties of employers and self-employed persons to their employees.
Section 16. Duty to formulate safety and health policy.
Section 17. General duties of employers and self-employed persons to persons other than their employees.
Section 18. Duties of an occupier of a place of work to persons other than his employees.

Free Download: DOSH Malaysia

Free Download: DOSH Malaysia
DOSH Guidelines & COP: Safety and Health

Guidelines
for Hazard Identification, Risk Assessment and Risk Control
(HIRARC)

Free Download: DOSH, Malaysia

INDUSTRY CODE OF PRACTICE FOR SAFE WORKING IN A CONFINED SPACE 2010

Free Download: DOSH Malaysia

Department of Occupational Safety and Health Ministry of Human Resources Malaysia

2008
JKKP DP 127/788/4-47

DEPARTMENT OF OCCUPATIONAL SAFETY AND HEALTH MINISTRY OF HUMAN RESOURCES, MALAYSIA

JKKP DP(S) 127/3793-1
ISO 31000 standard recognized as national risk management standard, worldwide
DOSH, Malaysia, Others

ISO 31000

Risk Management

- Identify & Analyze Exposures
- Evaluate Risk Management Techniques
- Implement Techniques
- Monitor Results

Risk Management Cycle

ISO 31000

1. Risk identification
2. Risk evaluation
3. Risk treatment
4. Monitoring

Assess and analyze the risks
Communicate the action

Identify the current process
Monitor and evaluate the mitigation

Establish the context
MALAYSIAN STANDARD
MS ISO GUIDE 73:2010
RISK MANAGEMENT - VOCABULARY
(ISO GUIDE 73:2009, IDT)

Rm. 20-00 only

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MALAYSIAN STANDARD
MS ISO 31000:2010
RISK MANAGEMENT - PRINCIPLES AND GUIDELINES
(ISO 31000:2009, IDT)

Rm. 40-00 only

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MALAYSIAN STANDARD
MS IEC/ISO 31910:2011
Risk management - Risk assessment techniques
(IEC/ISO 31910:2009, IDT)

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Case Study: 4

Compliance with Standards and Requirements of Standards
Example: 1

RCD:
MS IEC 61008
MS IEC 61540
MS 62350

Plug:
BS 1363
MS 589

Fuse: BS 1362

13A Socket Outlet:
MS 589
BS 1363

Cable Management:
Trunking: MS 1777
Cable Ducting: MS 1777
uPVC Conduit: MS 1034
Conduit System:
MS IEC 61386

Cable: MS 2xxxx

MCB:
MS IEC 60898
MS IEC 60947

MCB – RCD:
MS IEC 61009

Plug:
MS IEC 60335 – 1
MS 589
BS 1363

RCB:
MS IEC 61008
MS IEC 61540
MS 62350

13A Socket Outlet:
MS 589
BS 1363

Cable Management:
Trunking: MS 1777
Cable Ducting: MS 1777
uPVC Conduit: MS 1034
Conduit System:
MS IEC 61386

Cable: MS 2xxxx

MCB:
MS IEC 60898
MS IEC 60947

MCB – RCD:
MS IEC 61009

Plug:
BS 1362

Comply with Acts and Regulations
Comply with Standards

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Example: 1A

Safety Standards

Competent Person
MS IEC (IEC) 60364 / MS 1936 /1979

User / Manufacturer

RCD:
MS IEC 61008
MS IEC 61540
MS 62350

Plug:
MS 589
BS 1363

MCB:
MS IEC 60898
MS IEC 60947

MS IEC 61009

Cable Management:
Trunking: MS 1777
Cable Ducting: MS 1777
uPVC Conduit: MS 1034
Conduit System:
MS IEC 61386

13A Socket Outlet:
MS 589
BS 1363

Cable: MS 2xxxx

MS IEC 60335 – 1

Plug:
MS 589
Plug: BS 1363
Fuse: BS 1362

MS IEC 60335 – 1

MCB:
MS IEC 60898
MS IEC 60947

MCB – RCD:
MS IEC 61009

User / Manufacturer
MS IEC (IEC) 60364 / MS 1936 /1979

Safety Standards

Competent Person
MS IEC (IEC) 60364 / MS 1936 /1979

User / Manufacturer
Example 2: Hospital: Pendant/Bedhead Trunking

- IEC 61534: Power Track Systems
- MS IEC 61008: RCD’s
- MS 589/BS 1363: Socket Outlets
Case Study 5:

Protection Against Electric Shock and Fire

at

Final Distribution Board / Consumer Unit

By Residual Current Device (RCD)
Example: 1

Electricity Regulations 1994
IEC 60364–7-701

IEC 60364–7-702

IEC 60364–Part 1 - 6

IEC 60364–Part 1 - 6

IEC 60364–Part 1 - 6

IEC 60364–Part 1 - 6

Water Heater

Water Features

Kitchen

Others

Others Above 2.5 m

Lighting / Air Conditioners / Others Above 2.5 m

13A S/S/O

13A S/S/O

13A S/S/O

13A S/S/O

13A S/S/O

13A S/S/O

13A S/S/O

13A S/S/O

30 mA RCD

30 mA RCD

30 mA RCD

30 mA RCD

10 mA RCD

10 mA RCD

10 mA RCD

10 mA RCD

40A 1P+N C

40A 1P+N C

40A 1P+N C

40A 1P+N C

20A 1P+N C

20A 1P+N C

20A 1P+N C

20A 1P+N C

40A 2P Type A

40A 2P Type A

40A 2P Type A

40A 2P Type A

40A 2P Type A

40A 2P Type A

40A 2P Type A

40A 2P Type A

40A 1P+N C

40A 1P+N C

40A 1P+N C

40A 1P+N C

6kA MCB

6kA MCB

6kA MCB

6kA MCB

6kA MCB

6kA MCB

6kA MCB

6kA MCB

63A 4P Type A

63A 3P+N C

100 mA RCD

6kA MCB

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Example: 2

Three Phase Loads

Single Phase Wet Loads

Single Phase Other Loads

4 Pole
$I_{An} = 100mA$

2 Pole
$I_{An} = 10mA$

(Malaysia)

3 Pole MCB

Consumer Unit (Residential)
Final Circuit Distribution Board

Electricity Provider

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Notes:

MS IEC (IEC) 60364
RCD for Electric Shock Protection
Shall have Sensitivity of 30 mA or less
Notes:

Electricity Regulations 1994
RCD for Equipment such as Water Heater and Portable Equipment

*Shall have Sensitivity of 10 mA or less*
Notes:
Leakage Currents $\geq 260 \text{ mA} \approx 300 \text{ mA}$
can cause *Fire*
Notes:

Electricity Regulations 1994

RCD for Fire Protection

Shall have Sensitivity of 100 mA or less
Notes:

“Safe” AC Voltage \( \leq 50 \, V_{\text{rms}} \) at 50/60 Hz

“Safe” DC Voltage \( \leq 120 \, V_{\text{dc}} \pm 10\% \) Ripple

For Normal (Fixed) Installations only
Electric Shock & Fire Protection

Electricity Regulations 1994
IEC 60364–7-701

Protection Against Electric Shock

IEC 60364

Protection Against Fire

IEC 60364
RCD Standards

1. **IEC 61008**: Residual current circuit breaker without integral overcurrent protection for household and similar uses (RCCBs)

2. **IEC 61009**: Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules

3. **IEC 61540**: Electrical accessories – Portable residual current devices without integral overcurrent protection for household and similar uses (PRCDs)

4. **IEC 61543**: Residual current–operated protective devices (RCDs) for household and similar uses – Electromagnetic compatibility
RCD Standards

4. *IEC 62423*: Type B residual current operated circuit breakers without integral overcurrent protection for household and similar uses (Type B RCCBs and Type B RCBOs)

5. *IEC 62350*: Guidance for the correct use of RCDS for household and similar uses

6. *IEC 60364*: Electrical installations of buildings
Case Study 6:
Protection Against Overcurrent
For Final Circuits
Sizing of Conductors
Protection and Sizing of Conductors

- **Phase conductors (MS 1936 & MS 1979)**
  - To size with coordination with circuit breakers

- **Neutral conductors (MS 1936 & MS 1979)**
  - Similar to phase conductor

- **Protective earthing conductors**
  - By calculation; (MS 1936)
  - By selection (MS 1936 & MS 1979)
    - $1.5 \text{ mm}^2 \leq S \leq 16 \text{ mm}^2 \Rightarrow \text{Phase conductor}$
    - $25 \text{ mm}^2 < S \leq 35 \text{ mm}^2 \Rightarrow 16 \text{ mm}^2$
    - $S > 35 \text{ mm}^2 \Rightarrow S/2 \text{ mm}^2$

- **Equipotential earthing conductors (MS 1936 & MS 1979)**
  - By selection
Overload Protection & Sizing of Cables

Step 1: Determine the characteristics of load & Calculate $I_B$

- $V$, kVA, power factor, inrush current;
- Maximum demand and diversity factor: Refer to Tables A & B of Electricity Regulations 1994
- Calculate $I_B$: The current for which the circuit is designed

$\begin{align*}
I_B & \leq 1.35/1.45 I_n \leq I_Z
\end{align*}$
Overload Protection & Sizing of Cables

- **Step 2: Sizing protective BS 1362 fuse**
  - 1, 2, 3, 5, 7, 10, 13A

- **Step 3: Selecting power outlets**
  - 13A socket outlets (Usually de-rated to 10A load);
  - CEE sockets, MCB, MCCB termination box; etc.,
Overload Protection & Sizing of Cables

- Step 4: Selecting CB: Example MCB
  - Step 4A: Select the nominal current of the CB
    \[ I_B \leq I_n \]
    
    \[ I_n = \text{Nominal current of the CB, 6/10/16/20/30/40/50/63 A} \]
    \[ I_B = \text{Current for which the circuit is designed, full load current} \]
  - Step 4B: Select the type of MCB
    - Type B: Inrush < 3 x \( I_n \)
    - Type C: Inrush < 5 x \( I_n \)
    - Type D: Inrush < 8 x \( I_n \)
Step 5: Selecting the cable

Step 5A: Determine the continuous current of the cable

\[
\frac{1.35}{1.45} I_n \leq I_Z
\]

- \(I_n\) = Nominal current of the CB
- \(I_Z\) = Max. continuous current – carrying capacity of cable
Overload Protection & Sizing of Cables

Step 5: Selecting the cable (Continue)

Step 5B: Determine the nominal current of the cable

\[ I_{Z - nominal} \geq \frac{I_Z}{C_a \times C_g \times \ldots} \]

- \( C_a \) = Correction factor for ambient temperature;
- \( C_g \) = Correction factor for grouping; etc.,

Table 5. Required space factor for cable management system

<table>
<thead>
<tr>
<th>Cable Management System</th>
<th>Minimum Space Factor (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduit</td>
<td>40</td>
</tr>
<tr>
<td>Trunking</td>
<td>45</td>
</tr>
<tr>
<td>Others</td>
<td>Per Professional Electrical Design Engineer’s Instruction</td>
</tr>
</tbody>
</table>

Space factor is defined as follows:

\[
\frac{\text{Sum of cross section areas of cables (include insulation)}}{\text{Internal cross section areas of conduits/trunkings}}
\]
Overload Protection & Sizing of Cables

- **Step 6: Voltage drop calculation**

**Table 8. Allowable voltage drop**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Lighting</th>
<th>Other uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low voltage installation supply directly from a public low voltage distribution system.</td>
<td>3 %</td>
<td>5 %</td>
</tr>
<tr>
<td>Low voltage installation supplied from private LV supply (Note 1).</td>
<td>6 %</td>
<td>8 %</td>
</tr>
</tbody>
</table>

**NOTES:**

1. The voltage drop within final circuit shall not exceed that of 1 %.

2. Where the wiring systems of the installation are longer than 100 m, the voltage drop above may be increased by 0.005 % per meter of the wiring system beyond 100 m without this increase being greater than 0.5 %.

3. The voltage drop is determined from the demand of the current. By using equipment load current, applying diversity factors where applicable, or from the value of the design current ($I_d$) of the circuit.
Conductors in Parallel

- Not permitted
Protection Against Short – Circuit Current

- Short – circuit is a limiting conditions of overload where
  - The fault current is relatively high at kA;
  - The short – circuit protective CB shall clear the short – circuit fault within a short time

- Overload CB can protect against short – circuit fault provided it has a breaking capacity > perspective short – circuit current of the protected circuit

- Coordination of overload and short – circuit protection shall ensure the let through energy of the short circuit device does not exceed that which can be safely withstood by the overload devices
# Sizing PE and EB Cables

Table 11. Minimum cross-sectional areas of earthing conductors buried in the soil

<table>
<thead>
<tr>
<th>Type of earthing conductors</th>
<th>Mechanically protected</th>
<th>Mechanically unprotected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protected against corrosion</td>
<td>2.5 mm² Cu</td>
<td>16 mm² Cu</td>
</tr>
<tr>
<td></td>
<td>10 mm² Fe</td>
<td>16 mm² Fe</td>
</tr>
<tr>
<td>Not protected against corrosion</td>
<td>25 mm² Cu</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 mm² Fe</td>
<td></td>
</tr>
</tbody>
</table>
# Sizing PE Cables

Table 13. Minimum cross-sectional area of protective conductors

<table>
<thead>
<tr>
<th>Cross-sectional area of line conductor $S$ $(\text{mm}^2)$</th>
<th>Minimum cross-sectional area of the corresponding protective conductor $(\text{mm}^2)$</th>
<th>If the protective conductor is of the same material as the line conductor</th>
<th>If the protective conductor is not of the same material as the line conductor</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S \leq 16$</td>
<td>$S$</td>
<td></td>
<td>$\frac{k_1}{k_2} \times S$</td>
</tr>
<tr>
<td>$16 &lt; S \leq 35$</td>
<td>$16$</td>
<td></td>
<td>$\frac{k_1}{k_2} \times 16$</td>
</tr>
<tr>
<td>$S &gt; \frac{S}{2}$</td>
<td>$\frac{S}{2}$</td>
<td></td>
<td>$\frac{k_1}{k_2}$</td>
</tr>
</tbody>
</table>

where

$k_1$ is the value of $k$ for the line conductor, selected from Table A.54.1 of IEC 60364-5-54 or from the tables in IEC 60364-4-43, according to the materials of the conductor and insulation.

$k_2$ is the value of $k$ for the protective conductor, selected from Tables A.54.2 to A.54.6 of IEC 60364-5-54 as applicable.
## Sizing EB (Supplementary) Cables

**Table 12. Minimum CSA of Supplementary Equipotential Bonding Conductor (mm²)**

<table>
<thead>
<tr>
<th>Connecting</th>
<th>Sheathed or Mechanically Protected</th>
<th>Not Mechanically Protected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two (2) Exposed–conductive–parts</td>
<td>$\geq \frac{1}{2}$ of the smaller protective conductor connecting to the exposed–conductive–part</td>
<td>$\geq 4 \text{ mm}^2$</td>
</tr>
<tr>
<td>Exposed–conductive–part to extraneous–conductive–part</td>
<td>$\geq \frac{1}{2}$ of the smaller protective conductor connecting to the exposed–conductive–part</td>
<td>$\geq 4 \text{ mm}^2$</td>
</tr>
<tr>
<td>Two (2) extraneous–parts</td>
<td>$\geq 2.5 \text{ mm}^2$</td>
<td>$\geq 4 \text{ mm}^2$</td>
</tr>
</tbody>
</table>
Case Study 7:

Isolation, Switching and Control
Isolation, Switching and Control

Note: Coupling to Electricity Provider Shall be 2P/4P for 1P/3P Supply

Protection & Isolation (Normal)

Protection

Isolation & Switching

Protection (Fuse)
Isolation, Switching and Control

Note:
Coupling to Electricity Provider
Shall be 2P/4P for 1P/3P Supply
Isolation, Switching and Control

Note:
Coupling to Electricity Provider
Shall be 2P/4P for 1P/3P Supply

Protection & Isolation

Maintenance Isolation
(Outside Zone 2)

Isolation / Switching
(Normal)
(Outside Zone 2)

Outgoing:
Equipotential Bonding

EC - National Conference on Electrical Safety 2015- 9 Nov 15
Isolation, Switching and Control

Note:
Coupling to Electricity Provider
Shall be 2P/4P for 1P/3P Supply

Protection & Isolation

Protection

Isolation: Maintenance

Isolation: Maintenance

Emergency / Under-voltage Stop

EC - National Conference on Electrical Safety 2015- 9 Nov 15
Public Awareness and Training, Workshops and Seminars

*Target Audience Focus*
Energy Commission
Energy Commission – UMPEDAC

REGISTRATION FORM

I would like to attend the ONE (1) day Workshop on Inspection and Testing of Low Voltage Electrical Installation in Compliance to IEC 60364/BS 7671 Chapter 6 on 7th December 2015 at Auditorium, Suruhanjaya Tenaga, Putrajaya.

Name & Designation: ...

Organization: ...

Correspondence Address: ...

Tel: .................. Fax: ..................

Email: ..............................

Crossed Cheque No. & Bank: ...

FEE & PAYMENT METHOD

• Fees: RM450.00 (inclusive of GST) per participant.
• The fees include course materials and meals only.
• All payment can be made via Crossed Cheque payable to “GLOBAL INSIGNIA SDN. BHD.” at UMPEDAC, Level 4, Wisma R&D, Jalan Pantai Baharu, University of Malaya, 59990 Kuala Lumpur.
• Payments can also be made by Bank Transfer to account CIMB Bank Berhad 80-012961-7 and submit the proof of payment to Pn. Arissa at arissa@um.edu.my
• Complete participation forms and full payments must be made before 16th November 2015.
• Kindly contact 03-22463551 (Pn. Liyana) for more information.

ORGANIZER

UM Power Energy Dedicated Advanced Centre (UMPEDAC) was established in 2000 as a research laboratory in University of Malaya to specialize in power and energy related fields. Founded by Prof Dr Nasrudin Bin Abd Rahim, UMPEDAC has grown rapidly over the years. From 2009, UMPEDAC has been consistently recognized as a Higher Institution Centre of Excellence (HiCoE) by the Malaysian Ministry of Higher Education. UMPEDAC is also the first HiCoE in Engineering Cluster. The core businesses of UMPEDAC include conducting high impact research (covering fundamental research, development of lab-scale prototype and commercializing the final product), offering consultancy services to the power and energy industry, organizing technical courses and trainings in engineering skills, conducting Postgraduate Programs (PhD, MPhil, and taught courses), and also offering Specialist Research Facilities in Solar Energy. This course will be organized by UMPEDAC through its spin-off company, Global Insignia Sdn. Bhd.

Co-ORGANIZER

The Energy Commission is a statutory body established under the Energy Commission Act 2001. The Energy Commission is responsible to regulate the energy sector, in particular the electricity supply and piped gas supply industries. The Energy Commission ensures that the supply of electricity and piped gas to consumers is secure, reliable, safe and at reasonable prices.

SUPPORTING ORGANIZATION

International Copper Association Southeast Asia

Headquartered in New York and with over 35 offices around the world, the International Copper Association (ICA) is a not-for-profit organization dedicated to promoting the correct application and efficient usage of copper, mostly used for its high electrical conductivity. ICA is also a knowledge partner for the upgrading of standards and skills of professionals in industry.

Venue: Auditorium, Suruhanjaya Tenaga, Putrajaya
Date: 7th December 2015
SIRIM: Public Comments

PUBLIC COMMENT CONSULTATION ON MS 1936 & MS 1979 FOR ELECTRICAL INSTALLATION OF BUILDINGS

SHAH ALAM CONVENTION CENTRE

Introduction

MS 1936:2007 ELECTRICAL INSTALLATIONS OF BUILDING – GUIDE TO MS IEC 60364 and MS 1979:2007 ELECTRICAL INSTALLATIONS OF BUILDINGS – CODE OF PRACTICE were first published in 2007 and have been cross-referred to in the Technical Instruction 1/2008 for electrical installations on buildings, issued by the Energy Commission (ST). Since their year of publication, MS 1936, MS 1979 and their mother-source MS IEC 60364 have been used as the mandatory standards for electrical installations on buildings in Malaysia. Any design and/or electrical wiring installation done by a designer/practitioner referring to other documents than those cross referred to in the ST Technical Instruction 1/2008 could be proven to be unlawful, it should come under the scrutiny of any form of legal or professional practice.

More than 5 years have lapsed and it is now time to review the two Malaysian Standards. The Technical Committee (TC) on Electrical Installation, Protection and Insulation Practice, intends to solicit designers/practitioners/stakeholders/professionals and parties involved in electrical installations on building in Malaysia. All views are welcomed as it has been recognized that various technical and engineering standards are the result of converged consensus among practitioners/stakeholders and the public.

TC on Electrical Installation, Protection and Insulation Practice which developed the MS referred to in this event was established within the Malaysian Standards Development System under the purview of Standards Malaysia, a government agency under the Ministry of Science, Technology and Innovation (MOSTI). TC on Electrical Installation, Protection and Insulation Practice which developed this Malaysian Standard was managed by The Electrical and Electronics Association of Malaysia (TEEAM) in its capacity as an authorized Standards-Writing Organization.

Tentative Program 16 JUNE 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0830 - 0900</td>
<td>Arrival and Registration</td>
</tr>
<tr>
<td>0900 - 0915</td>
<td>Opening remarks by YBhg. Datuk Fadillah Baharin Director General, Standards Malaysia</td>
</tr>
<tr>
<td>0915 - 0945</td>
<td>Overview on the Development/Review of MS 1979 &amp; MS 1936; by Ir Rocky H.T. Wong (Chairman of TEEAM’s BWD)</td>
</tr>
<tr>
<td>0945 - 1045</td>
<td>Presentation on MS 1979 by Ir Yau Chau Fong and Ir Lee Cheng Pay</td>
</tr>
<tr>
<td>1045 - 1100</td>
<td>Morning Tea</td>
</tr>
<tr>
<td>1100 - 1145</td>
<td>Continue with presentation on MS 1979 and Q &amp; A session</td>
</tr>
<tr>
<td>1145 - 1230</td>
<td>Presentation on MS 1936 by Ir Lim Kim Ten, Dr Che Hang Seng and Ir Lee Yuan How</td>
</tr>
<tr>
<td>1230 - 1400</td>
<td>Lunch Break</td>
</tr>
<tr>
<td>1400 - 1530</td>
<td>Continue with Presentation on MS 1936 and Q &amp; A session</td>
</tr>
<tr>
<td>1530 - 1600</td>
<td>Wrap-up of session by Ir Rocky H.T. Wong</td>
</tr>
<tr>
<td></td>
<td>Tea Break/Networking Session &amp; End</td>
</tr>
</tbody>
</table>

Target groups

- Contractors
- Engineers
- Wiremen
- Chargemen
- Electricians
- Manufacturers
- Developers
- Academia
- Government agencies
- Local authorities

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FREE OF CHARGE

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Email: rohayah@sirim.my / asikhin@sirim.my

EC - National Conference on Electrical Safety 2015- 9 Nov 15

80
# 1 DAY COURSE ON “RCDs”

**Organised by:**
Electrical Engineering Technical Division

**THE INSTITUTION OF ENGINEERS, MALAYSIA**

Bangunan Inginieur, Lots 6602, Jalan 52/4, Petaling Jaya, Selangor Darul Ehsan Tel : 03-79684001/2 Fax : 03-79577678 E-mail : research@iemm.org.my IEM Homepage: http://www.myiem.org.my

## SYNOPSIS

This course will focus on all the relevant IEC/MS standards on RCDs (such like MS IEC 61008 RCCB and MS IEC 61009 RCB0) in design, technology, selection and installation.

## SPEAKER’S BIODATA

Mr. Dahari Mat Siran is currently the Managing Director of Hager Engineering, an international electrical company based in Germany and France. He graduated with degree in Electrical Engineering from Monash University, Melbourne, Australia in 1991. He has started his carrier with Schneider Electric as a Technical Engineer for 5 years. He has more than 20 years’ experience in electrical industry, with good knowledge of sales and marketing function, experienced presenter and trainer. He is familiar with LV electrical protection system, electrical control, wiring accessories and building automation system, especially the European Installation Bus (EIB/KNX). He is also involved intensively in the Working Group and Technical Committee for developing Malaysian Standard (MS) for LV electrical installation, distribution and switching. He also the Chairman for Electrical Safety and Quality Committee, TEAEM.

Ir. Yau Chau Fong
Chairman,
Electrical Engineering Technical Division

## Cancellation Policy

IEM reserves the right to postpone, reschedule, allocate or cancel the course. Full refund if cancellation is received in writing more than 7 days before start date of the event. No cancellation will be accepted prior to the date of the event. However, replacement or substitute may be made at any time with prior notification and substitute will be charged according to membership status.

**Date:** 13th November 2015 (Friday)  
**Time:** 9.00am to 5.30pm  
**Venue:** CSS & TUS Lecture Hall, 2nd Floor, Wisma IEM, PJ

## Programme

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Details</th>
</tr>
</thead>
</table>
| 9.00am - 10.30am | 1) Standards | a. All relevant IEC/MS standards  
   b. ST/SIRIM/JKR requirement |
| 10.30am - 10.45am | 2) RCD range | a. All types of RCDs |
| 10.45am - 12.00pm | 1) RCCB & RCB0 | a. Definition and introduction  
   b. Usage |
| 12.00pm - 12.30pm | 2) Selection guide | a. Important parameters of RCCB & RCB0  
   b. Labeling and Marking |
| 12.30pm - 1.00pm | LUNCH | - |
| 1.00pm - 3.00pm | Type and class | a. Types: AC, A, B & F  
   b. Class: G & S |
| 3.00pm - 3.45pm | TEA BREAK | - |
| 3.45pm - 5.30pm | Drawing and Symbols | 7. Common errors in circuit design  
   8. Tripping and the solutions  
   9. Testing methods  
   10. Conclusion |

## Registration Fees (Excluding GST)

<table>
<thead>
<tr>
<th>Category</th>
<th>Fee (RM)</th>
<th>(Including GST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEM Graduate Member</td>
<td>250.00</td>
<td>300.00</td>
</tr>
<tr>
<td>IEM Corporate Member</td>
<td>400.00</td>
<td>450.00</td>
</tr>
<tr>
<td>Non IEM Member</td>
<td>550.00</td>
<td>600.00</td>
</tr>
</tbody>
</table>

## PERSONAL DATA PROTECTION ACT

I have read and understood the IEM’s Personal Data Protection Notice published on IEM’s website at http://www.myiem.org.my and I agree to IEM’s use and processing of my personal data as set out in the said notice.
Audience Focus:

Permitted Voltages Drops

< 7 Volts (Single Phase Lighting Circuits)

Consultant: IEC 60364 Appendix 4 Section 6.4: ≤ 3%

< 11 Volts (Single Phase Power Circuits)

Consultant: IEC 60364 Appendix 4 Section 6.4: ≤ 5%
Audience Focus:

Permitted Voltages Drops

> 11 Volts (Single Phase)

FIRE
YOU are responsible

For

your Safety
“Survival” Voltage:
Guinness Book of World Records

- Harry F. Mcgre (Huntington Canyon, Utah, USA)
  - Direct contact with a 340,000 volt transmission line and survived
- Brian Latasa (Griffith Park, Los Angeles, USA)
  - Received a 230,000 volt shock and survived
“Survival” Voltage:
Guinness Book of World Records
“Survival” Voltage:

Guinness Book of World Records
Your Safety Depends on You:

*Your Choice*
Our Objective?
End of
Enhancing Compliance
To
MS IEC 60364 – Standards for Residential Wiring
Any Questions?