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Standards and Specially Focused on Electricity Metering Standards

by – B.M.Vyas

A specifically designed programme for

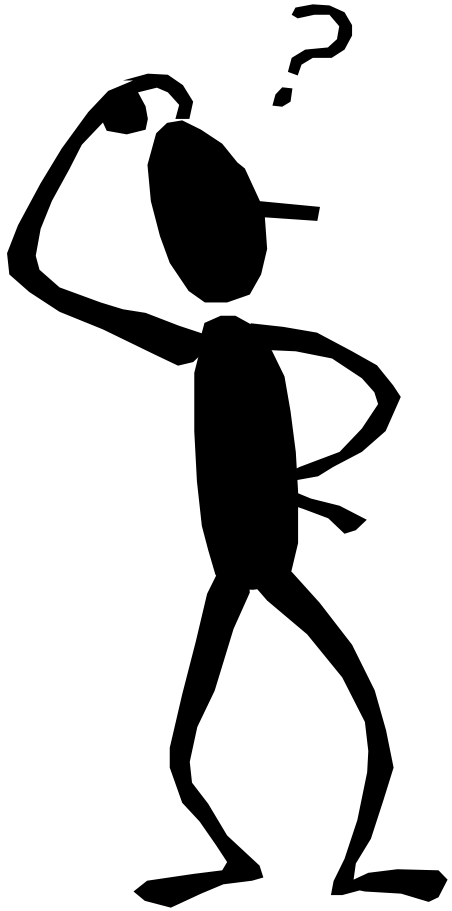
Da Afghanistan Breshna Sherkat (DABS)
Afghanistan

Areas Covered Under this Module

1. Why standards?
2. How standards are made?
3. What is an standard?
4. Changes in standards
5. Metering standards
6. Various requirements of metering standards

Why standards?

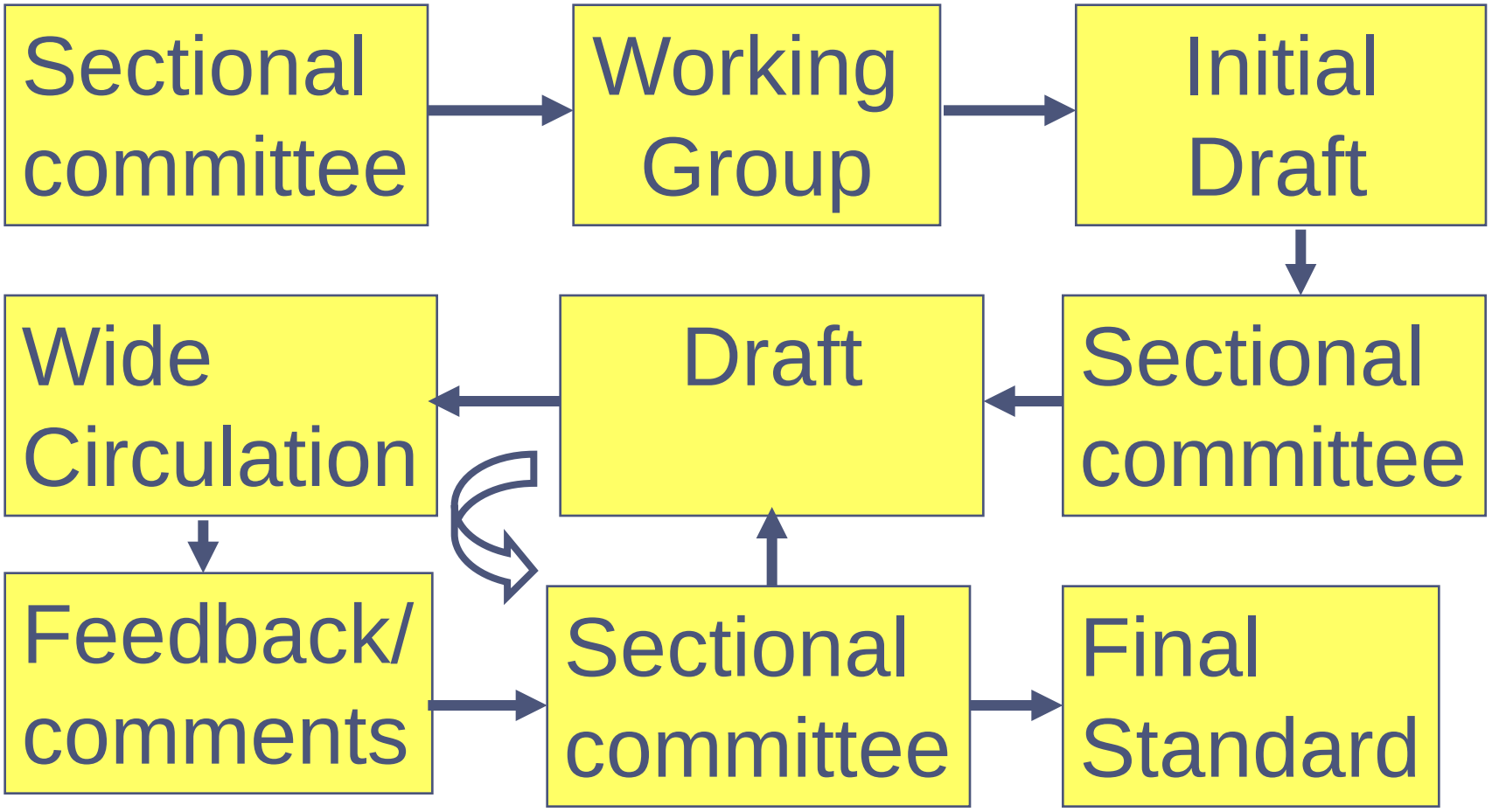
- Standardization
- Interchangeability
- Fitting
- Manufacturability
- Economy
- Quality control
- Safety



Making of an standard

- National committee
  - ANSI, BS, DIN
- International committee
  - ISO, IEC
- Who forms committee?
  - Users
  - Manufacturers
  - Renowned specialists
- Circulation of draft and feedback
- Releasing final standard

Making of an standard

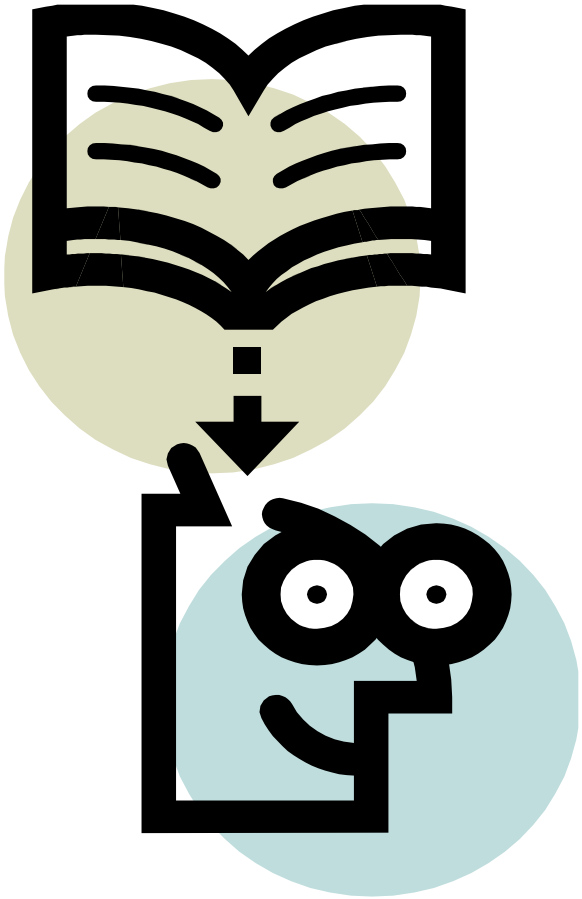


Standards – counterpoints

- Impedes innovations
- Satisfying standards – Not a performance guarantee
- Standards Jungle

Contents of an standard

- First page
- Foreword
- Introduction
- Scope
- References
- Definitions
  - e.g. Meter type
- Requirements
- Appendixes

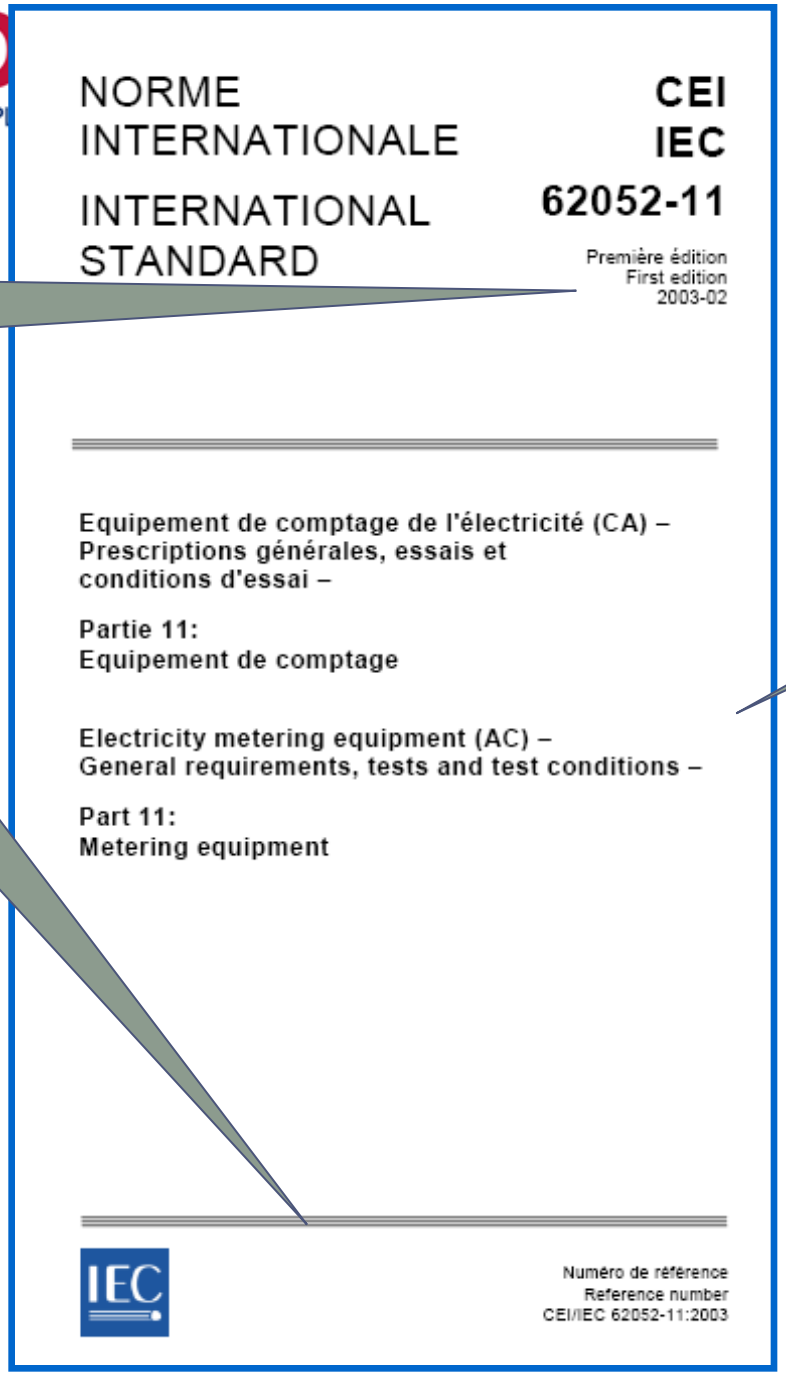


Year of Publication and edition

Number

Name

Publisher


NORME INTERNATIONALE
INTERNATIONAL STANDARD

CEI
IEC
62052-11

Première édition
First edition
2003-02

Equipement de comptage de l'électricité (CA) –
Prescriptions générales, essais et
conditions d'essai –

Partie 11:
Equipement de comptage

Electricity metering equipment (AC) –
General requirements, tests and test conditions –

Part 11:
Metering equipment

IEC

Numéro de référence
Reference number
CEI/IEC 62052-11:2003

Definitions

- ***meter type (for static meter)***
  - *term used to define a particular design of meter, manufactured by one manufacturer, having:*
    - *a) similar metrological properties;*
    - *b) the same uniform construction of parts determining these properties;*
    - *c) the same ratio of the maximum current to the reference current.*

Changes in standards

- Reviewed by committee
- Changes issued in capsules
- How do we know?
  - Hand books
  - Magazines
  - Various companies
  - Internet

IEC TC13

- **Scope:**

  To prepare international standards for equipment for electrical energy measurement, tariff- and load control, customer information, payment, local and/or remote data exchange, using electromechanical and/or electronic technologies, for applications ranging from electrical energy generation to residential.

- **The standards may include requirements and test methods to cover mechanical, environmental, electrical, safety, metrology, dependability aspects, as well as functional requirements and data models.**

IEC standards for Static Meters

IEC 62052-11	Electricity metering equipment (AC)-General requirements, tests and test conditions Part 11: Metering equipment
IEC 62053-21	Static meters for active energy (Class 1 & Class 2): Particular requirements
IEC 62053-22	Static meters for active energy (Class 0.2S & Class 0.5S): Particular requirements
IEC 62053-23	Static meters for reactive energy (Class 2 & Class 3):Particular requirements
IEC 62055-31	Electricity metering - Payment systems - Part 31: Particular requirements - Static payment meters for active energy (classes 1 and 2)

Requirements for static meters

- Standard electrical values
- Tests of accuracy requirements
- Insulation requirements and tests
- Climatic requirements and tests
- Electrical requirements and tests
- Electromagnetic compatibility
- Mechanical requirements and tests

Standard electrical values

- Standard reference voltage
  - e.g. 120-230-277-400-480 V
- Standard reference current
  - e.g. 1, 2 and 5 A
- Maximum current
- Standard reference frequency

Class index

(As per IEC 62052-11)

- Number which gives the **limits** of the **permissible percentage error**, for all values of current between **0.1 *I*b and *I*max**, or between **0.05 *I*n and *I*max**, for the **unity power factor** (and in the case of polyphase meters with balanced loads) when the meter is tested under **reference conditions** (including permitted tolerances on the reference values)….
- Class 2,1,1s,0.5s,0.2s

Class Index – Example - IEC

Table 6 – Percentage error limits
(single-phase meters and polyphase meters with balanced loads)

Value of current		Power factor	Percentage error limits for meters of class	
for direct connected meters	for transformer operated meters		1	2
$0,05\ I_b \le I < 0,1\ I_b$	$0,02\ I_n \le I < 0,05\ I_n$	1	±1,5	±2,5
$0,1\ I_b \le I \le I_{max}$	$0,05\ I_n \le I \le I_{max}$	1	±1,0	±2,0
$0,1\ I_b \le I < 0,2\ I_b$	$0,05\ I_n \le I < 0,1\ I_n$	0,5 inductive 0,8 capacitive	±1,5 ±1,5	±2,5 -
$0,2\ I_b \le I \le I_{max}$	$0,1\ I_n \le I \le I_{max}$	0,5 inductive 0,8 capacitive	±1,0 ±1,0	±2,0 -
When specially requested by the user: From $0,2\ I_b \le I \le I_b$	$0,1\ I_n \le I \le I_n$	0,25 inductive 0,5 capacitive	±3,5 ±2,5	- -

Tests of accuracy requirements

- Accuracy with variation in load conditions
- Test of meter constant
- Test of starting conditions
- Test of no load conditions
- Test of influence quantities

What is an influence quantity?

- any quantity, generally external to the meter, which may affect its working performance

reference conditions

- appropriate set of influence quantities and performance characteristics, with reference values, their tolerances and reference ranges, with respect to which the intrinsic error is specified

variation of error due to an influence quantity

- difference between the percentage errors of the meter when only one influence quantity assumes successively two specified values, one of them being the reference value

Influence Quantities

Table 8 – Influence quantities

Influence quantity	Value of current (balanced unless otherwise stated)		Power factor	Mean temperature coefficient %/K for meters of class	
	for direct connected meters	for transformer-operated meters		1	2
Ambient temperature variation [9]	$0,1\ I_b \le I \le I_{max}$	$0,05\ I_n \le I \le I_{max}$	1	0,05	0,10
	$0,2\ I_b \le I \le I_{max}$	$0,1\ I_n \le I \le I_{max}$	0,5 inductive	0,07	0,15
				Limits of variation in percentage error for meters of class	
				1	2
Voltage variation ±10 % [1) 8)]	$0,05\ I_b \le I \le I_{max}$	$0,02\ I_n \le I \le I_{max}$	1	0,7	1,0
	$0,1\ I_b \le I \le I_{max}$	$0,05\ I_n \le I \le I_{max}$	0,5 inductive	1,0	1,5
Frequency variation ±2 % [8)]	$0,05\ I_b \le I \le I_{max}$	$0,02\ I_n \le I \le I_{max}$	1	0,5	0,8
	$0,1\ I_b \le I \le I_{max}$	$0,05\ I_n \le I \le I_{max}$	0,5 inductive	0,7	1,0

Influence Quantities

Reversed phase sequence	0,1 I_b	0,1 I_n	1	1,5	1,5
Voltage unbalance [3]	I_b	I_n	1	2,0	4,0
Harmonic components in the current and voltage circuits [5]	0,5 I_{max}	0,5 I_{max}	1	0,8	1,0
DC and even harmonics in the a.c. current circuit [4]	$\frac{I_{max}}{\sqrt{2}}$ [2]	–	1	3,0	6,0
Odd harmonics in the a.c. current circuit [5]	0,5 I_b [2]	0,5 I_n [2]	1	3,0	6,0

Influence Quantities

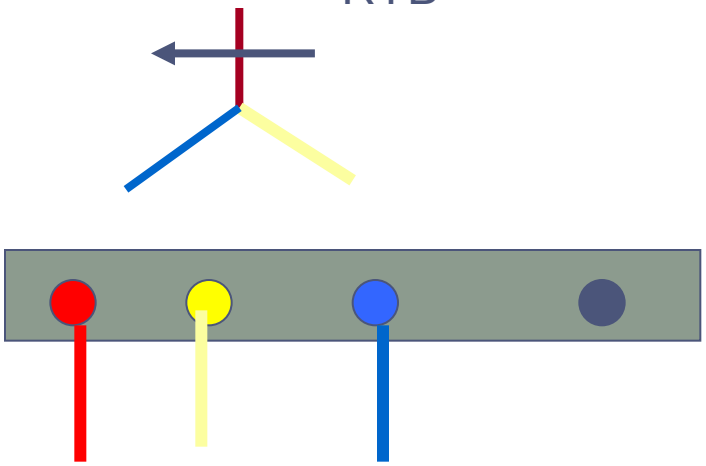
Operation of accessories [7)]	0,05 I_b	0,05 I_n	1	0,5	1,0
Conducted disturbances, induced by radio-frequency fields	I_b	I_n	1	2,0	3,0
Fast transient burst	I_b	I_n	1	4,0	6,0
Damped oscillatory waves immunity [10)]	–	I_n	1	2,0	3,0

Reverse phase sequence

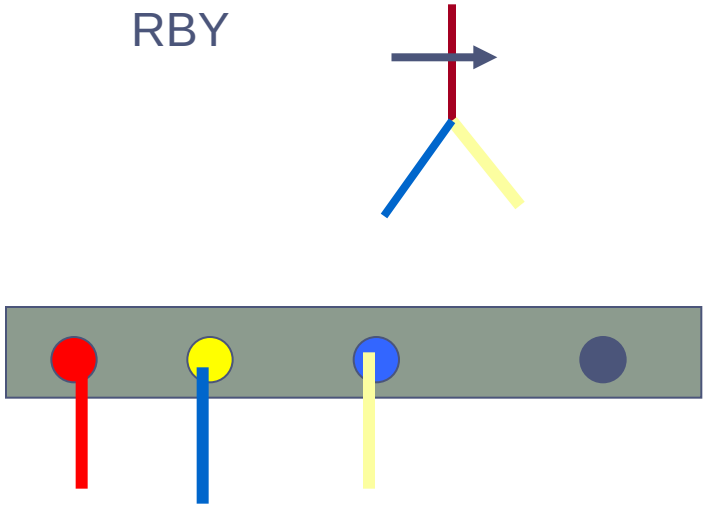
Reversed phase sequence	0,1 I_b	0,1 I_n	1	1,5	1,5

- On actual physical network, phases are not identified.
- No Change in Phase association

RYB



RBY



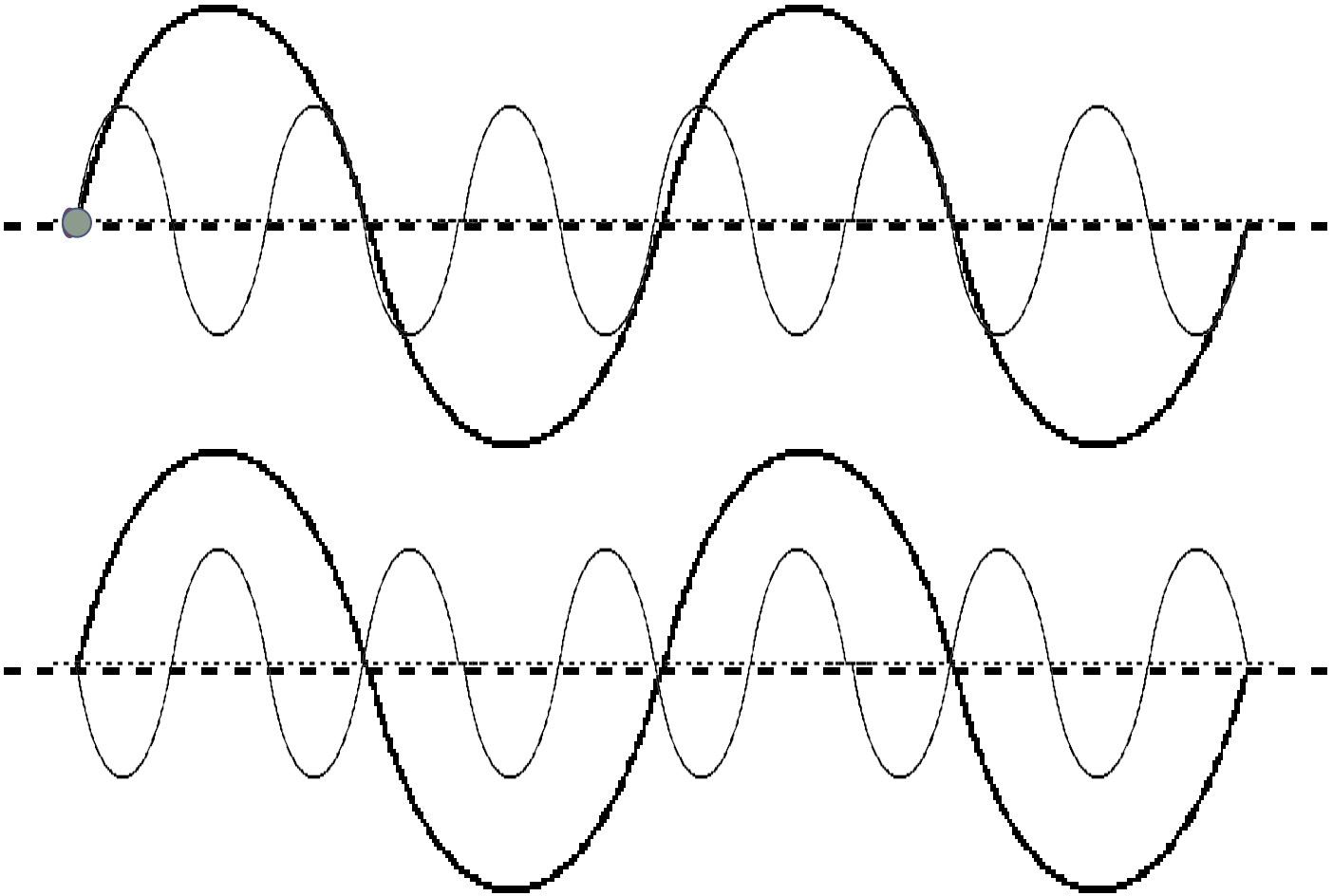
Harmonics

- Harmonics in current circuit only
  - Does not result in harmonic power
  - Meter performance will depend on how correctly its processor/ current circuit is able to measure fundamental current
    - Third Harmonic
    - Odd harmonics
    - Even harmonics
    - Sub Harmonics

Harmonics in both voltage and current circuit

- Does result in harmonics power
- IEC requires total power to be measured
  - 5^{th} Harmonic : 10% in V and 40% in current
    - Resulting in 4% harmonic power

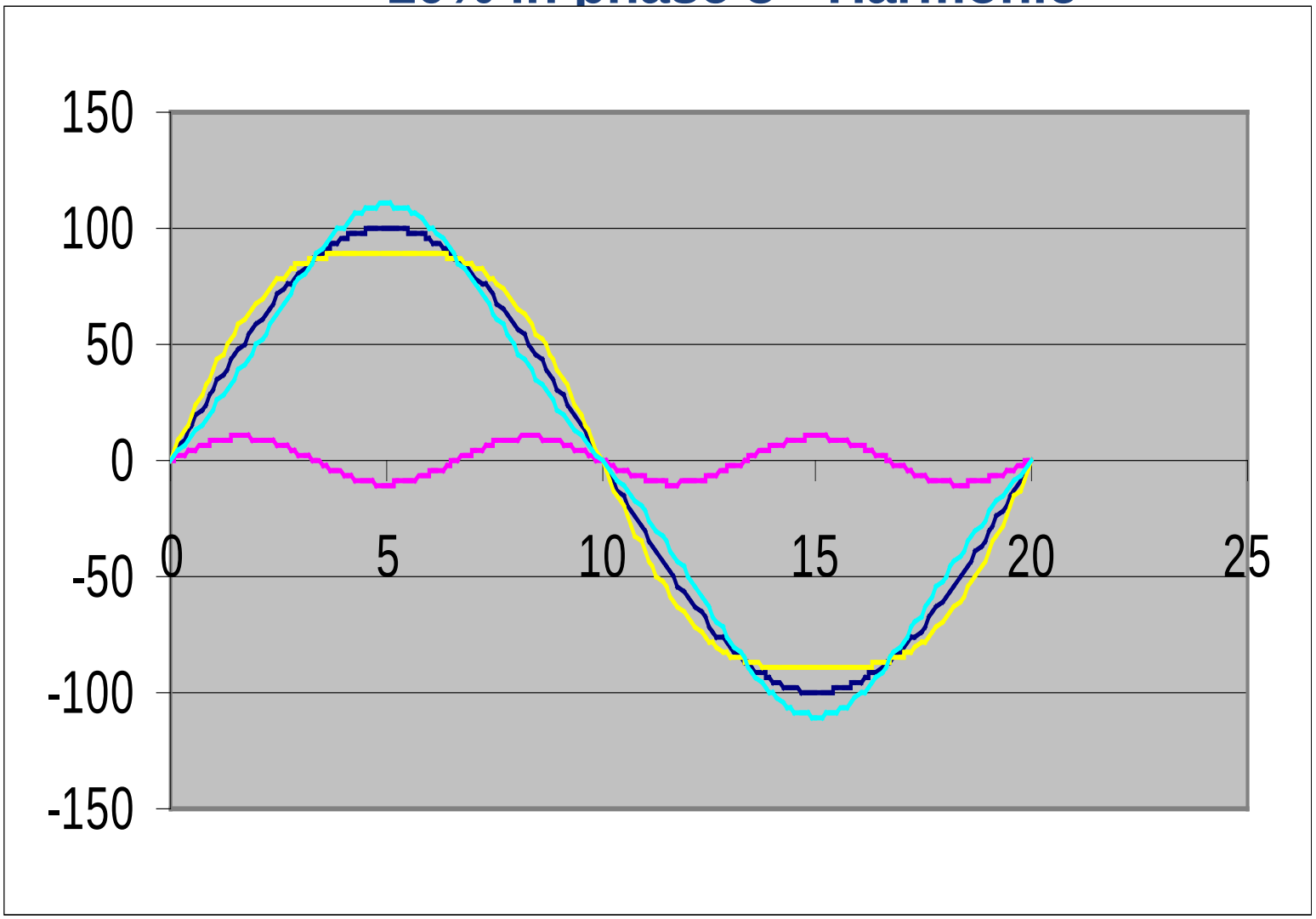
Third Harmonics



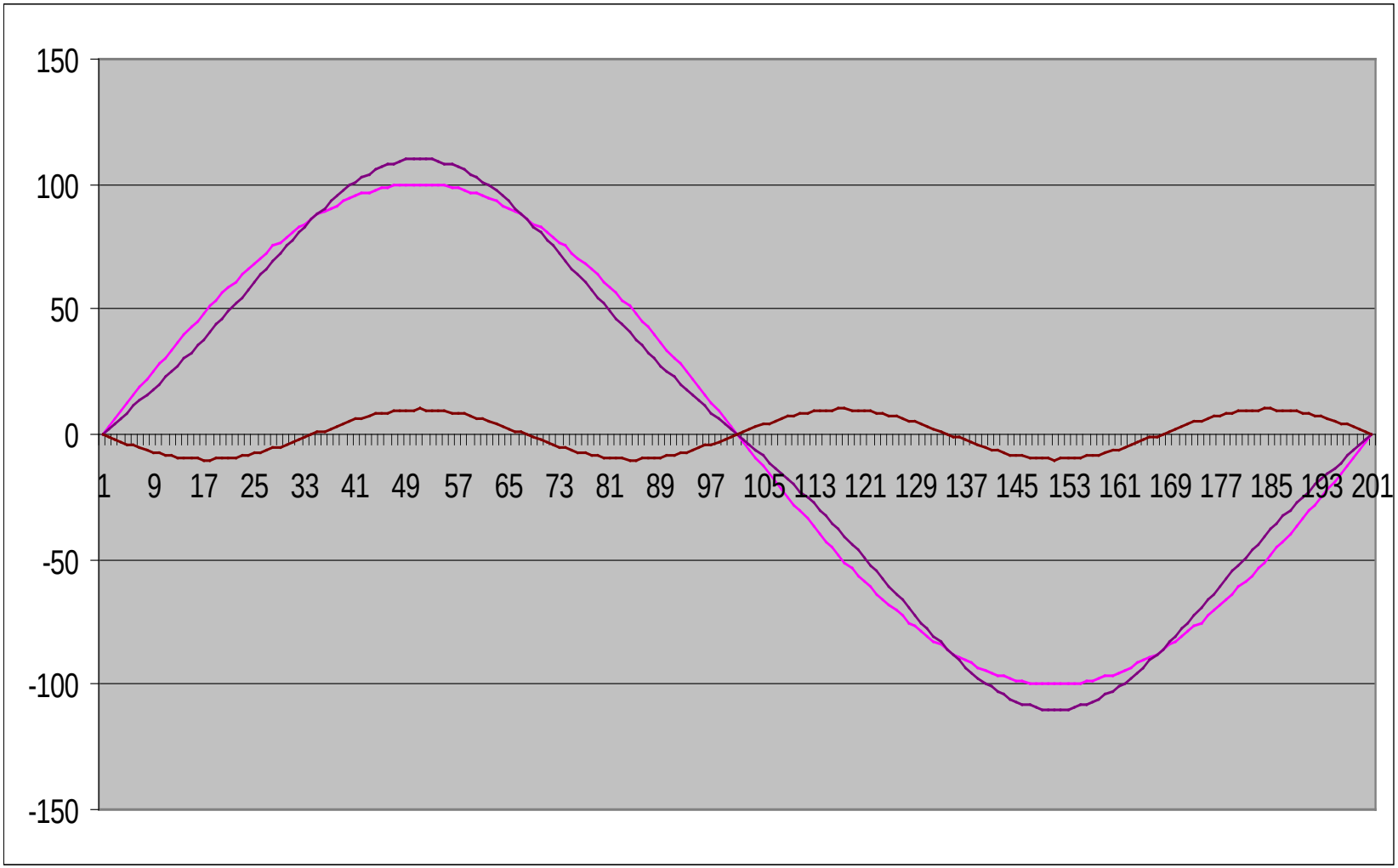
In Phase

Out of phase

10% in phase 3rd Harmonic



10% 3rd Harmonic – out phase



Safety of surroundings

- Personal safety against electric shock
  - Provide electrical insulation
    - Insulation tests
  - Provide earthing

- Personal safety against effects of excessive temperature
  - Test of heating
  - Less power consumption

Safety of meter

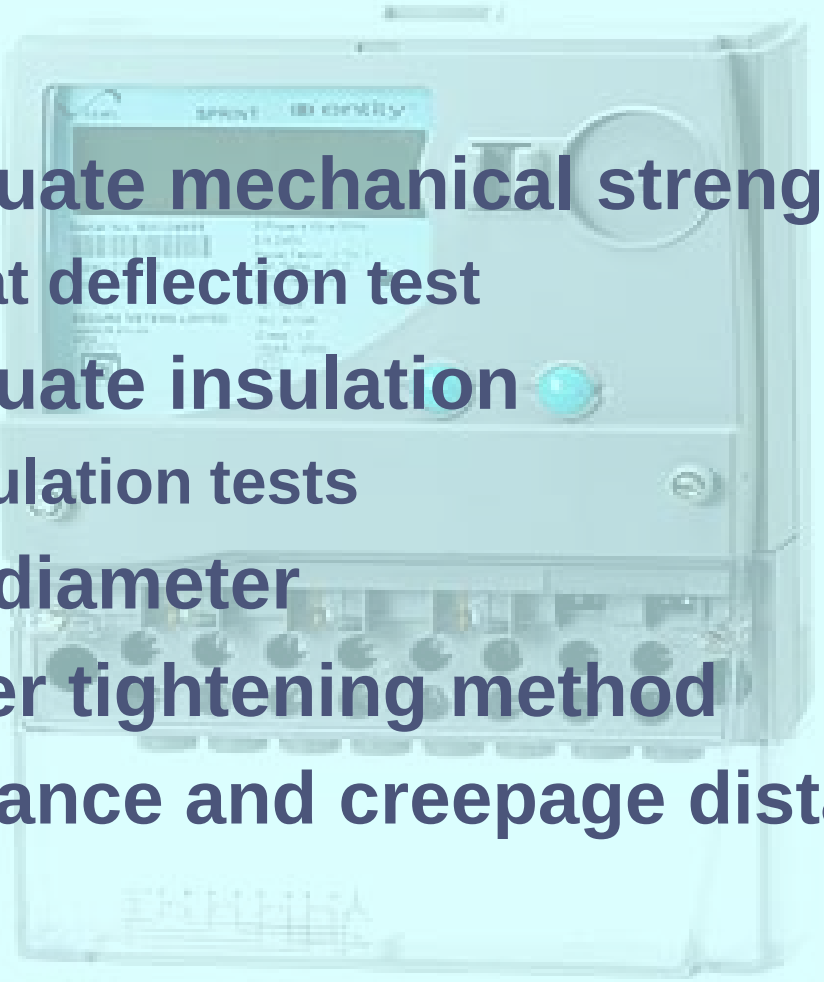
- Protection against spread of fire
  - Quality of plastic
  - Resistance to heat and fire test

- Protection against penetration of solid objects, dust and water
  - Packaging design

Case and windows

- Case
  - Proper sealing
  - Cover not removable w/o tool
  - No effect of nonpermanent deformation
  - Earthing , if metallic
- Window
  - For display, operational indicator
  - Not removable w/o damage

Terminal block



- Adequate mechanical strength
  - Heat deflection test
- Adequate insulation
  - Insulation tests
- Hole diameter
- Proper tightening method
- Clearance and creepage distances

Mechanical requirements (contd.)

- Display of measured value
  - Identification of tarriffs
  - 1500 HOUR @ Imax, Vn, upf LOGGING
- Test output
- Marking of meter
  - Make, type, Number of phases, S. No. , year, rated voltage, basic current, imax, frequency, Meter constant, class, Reference Temperature
- Connection diagram and terminal marking

Mechanical Tests –

- Shock test
- Spring Hammer Test
- Vibration test
- Ingress protection
- Resistance to heat and fire

Electrical requirements

- Power Consumption
- Voltage dips and short interruptions
- Short time over current
- Influence of self heating
- Heating
- Immunity to earth fault

Insulation Test

- Safety First
  - Ac voltage
  - Impulse voltage
  - Insulation resistance measurement

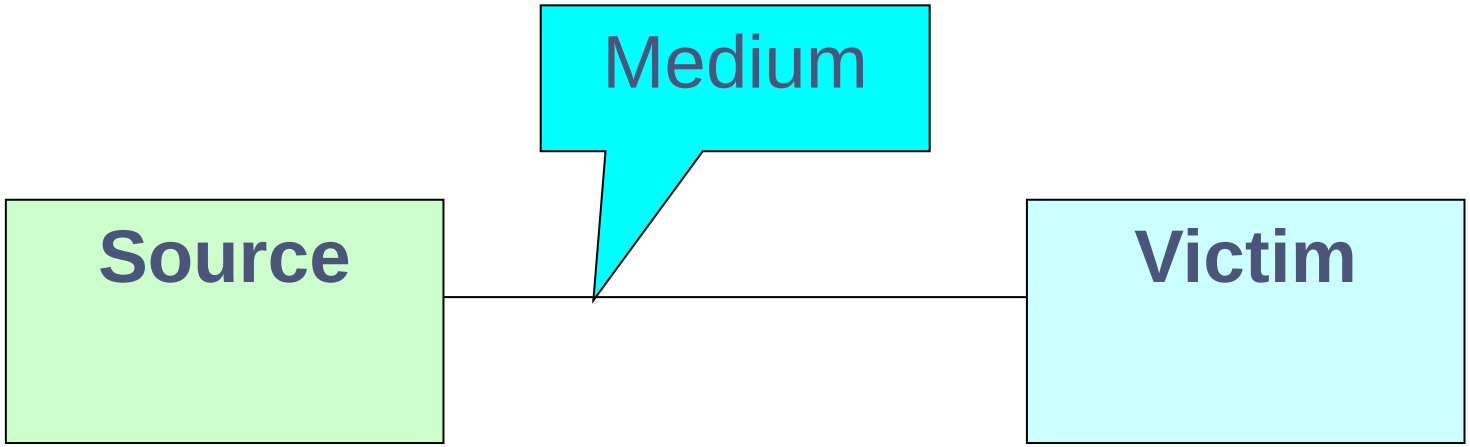
Climatic Tests

- Dry Heat Test : 70^0 C, 72 hours
- Cold Test : -25^0 C, 72 hours
- Damp Heat Cyclic Test, 6 days
- Solar radiation test – only for outdoor meters

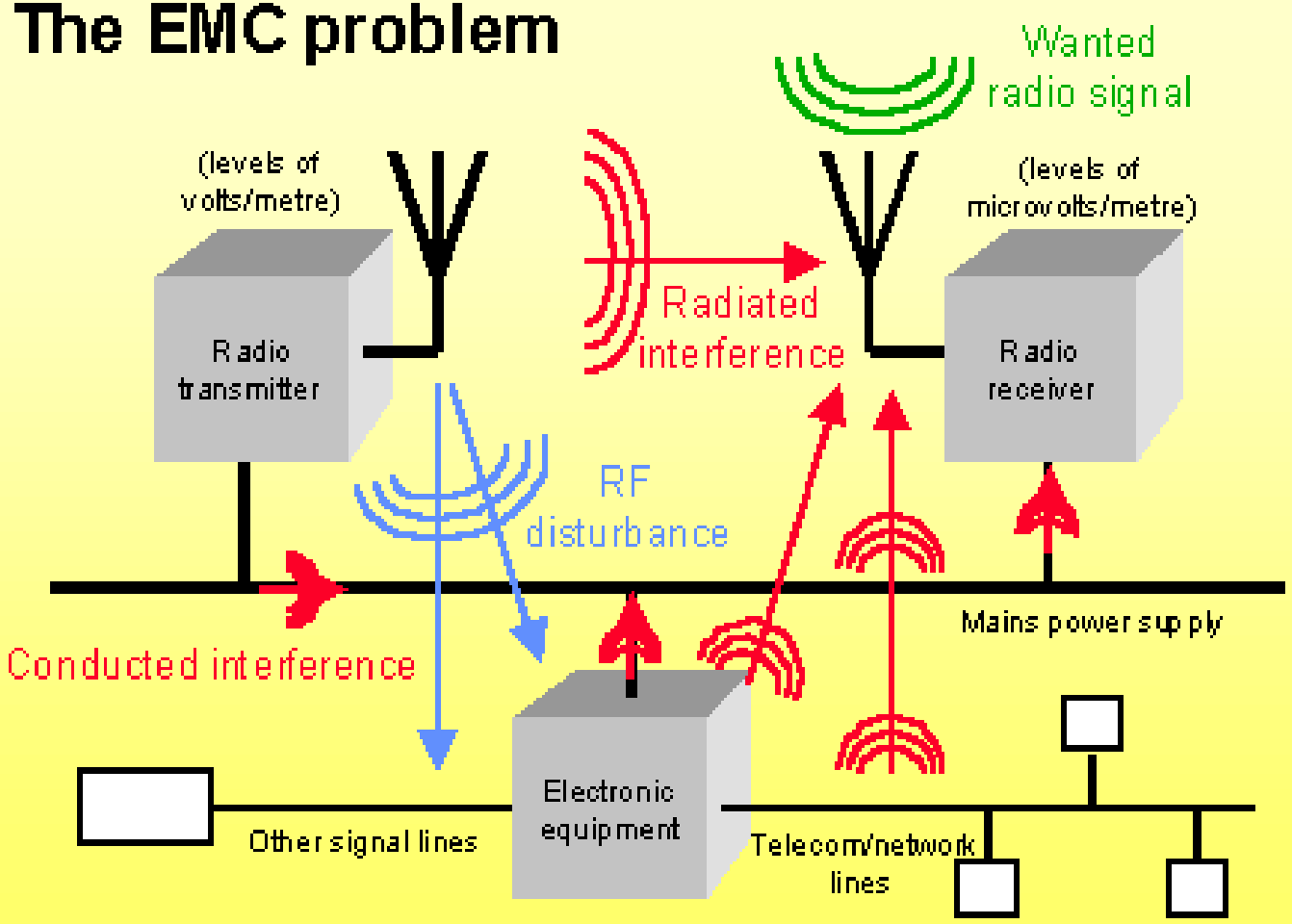
Electromagnetic compatibility

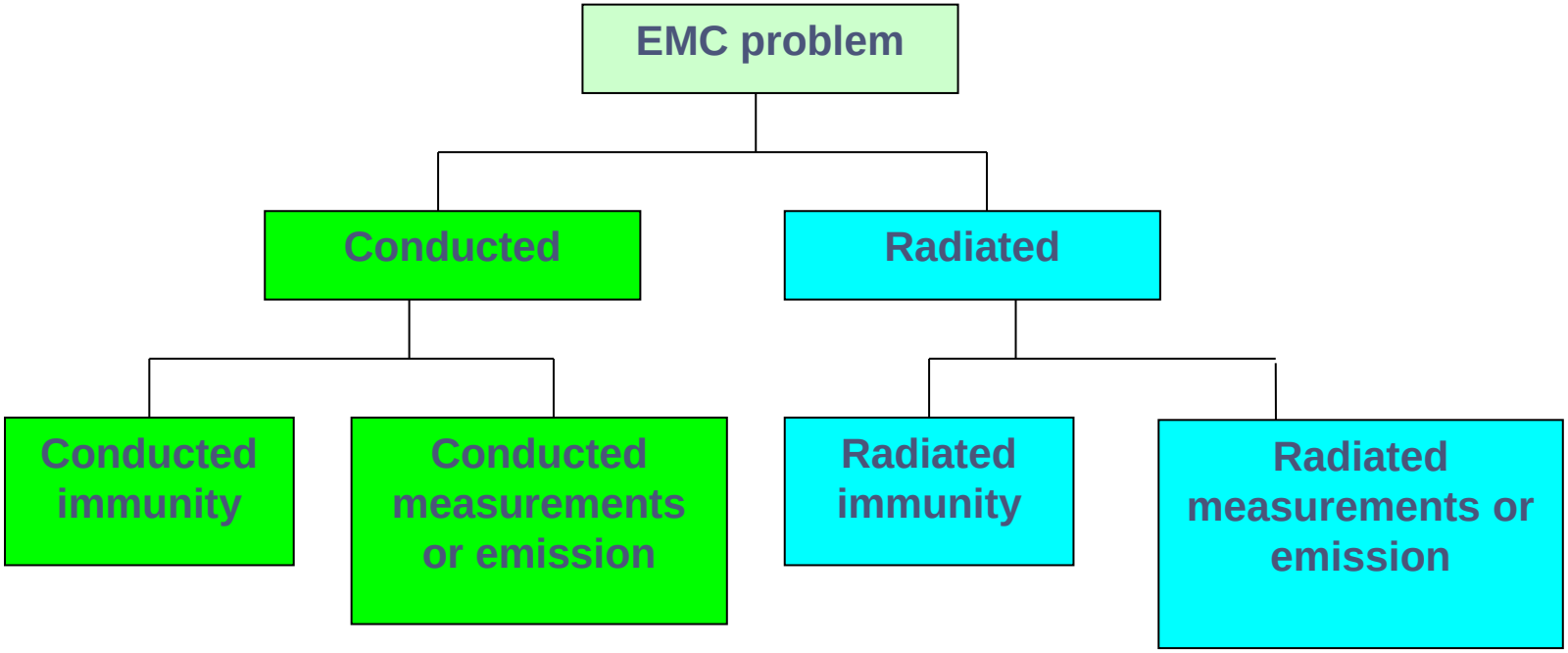
What is EMC?

- Ability to work in defined EMI environment
- Inherent property of not polluting environment



The EMC problem





EMC – Requirements For Static Meters

- Immunity
  - ESD
  - HF Fields
  - EFT
  - Damped Oscillatory
  - Surge
- Emission Measurements
  - Conducted Emission
  - Radiated Emission