



International Telecommunication Union

# ITU-T Study Group 5

## Safety limits & Sharing responsibility

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Workshop on:  
EMC, safety and EMF effects in telecommunications



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# Safety limits & Sharing responsibility

- o Rec. K.33 "LIMITS FOR PEOPLE SAFETY RELATED TO COUPLING INTO TELECOMMUNICATIONS SYSTEM FROM A.C. ELECTRIC POWER AND A.C. ELECTRIFIED RAILWAY INSTALLATIONS IN FAULT CONDITIONS"
- o Rec. K.53 "VALUES OF INDUCED VOLTAGES ON TELECOMMUNICATION INSTALLATIONS TO ESTABLISH TELECOM AND A.C. POWER AND RAILWAY OPERATORS RESPONSIBILITIES"
- o AMENDMENTS TO THE DIRECTIVES VOL. VI



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Recommendation

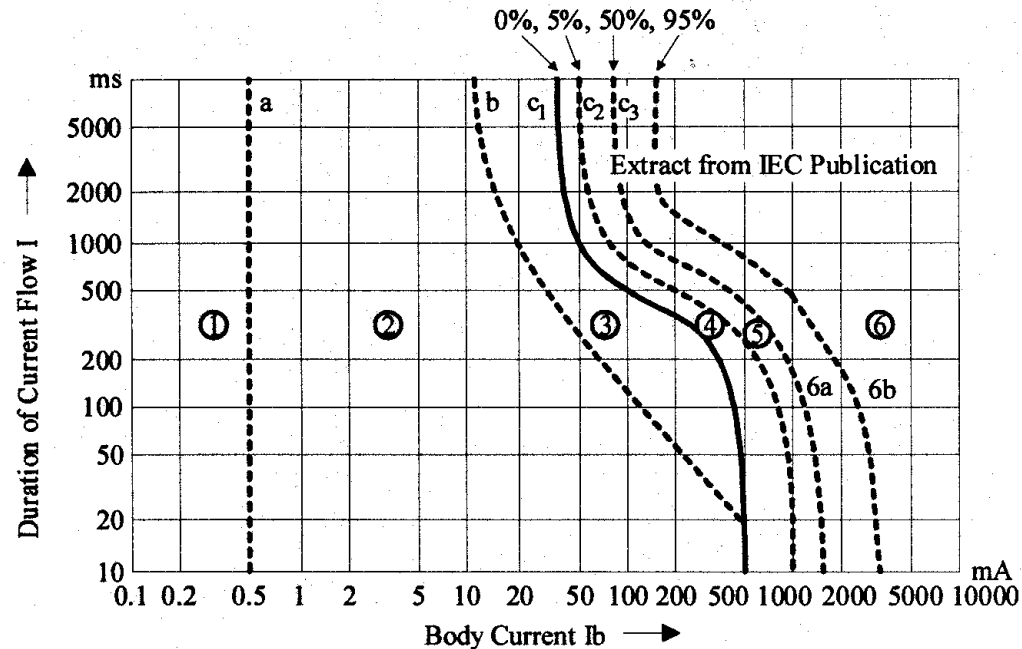
K.33

07.11.01

## Recommendation K.33

Considering the effects of a.c. currents on the human body

IEC 60479-1 "Effects of current on human beings and livestock"





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The danger depends on the current path expressed as a Heart current factor, F.

Current path	F
Left hand to left or right foot or both feet	1,0
Both hands to feet	1,0
Left hand to right hand	0,4
Right hand to left or right foot or feet	0,8
Back to right hand	0,3
Back to left hand	0,7
Chest to right hand	1,3
Chest to left hand	1,7
Seat to left or right hand or both hands	0,7

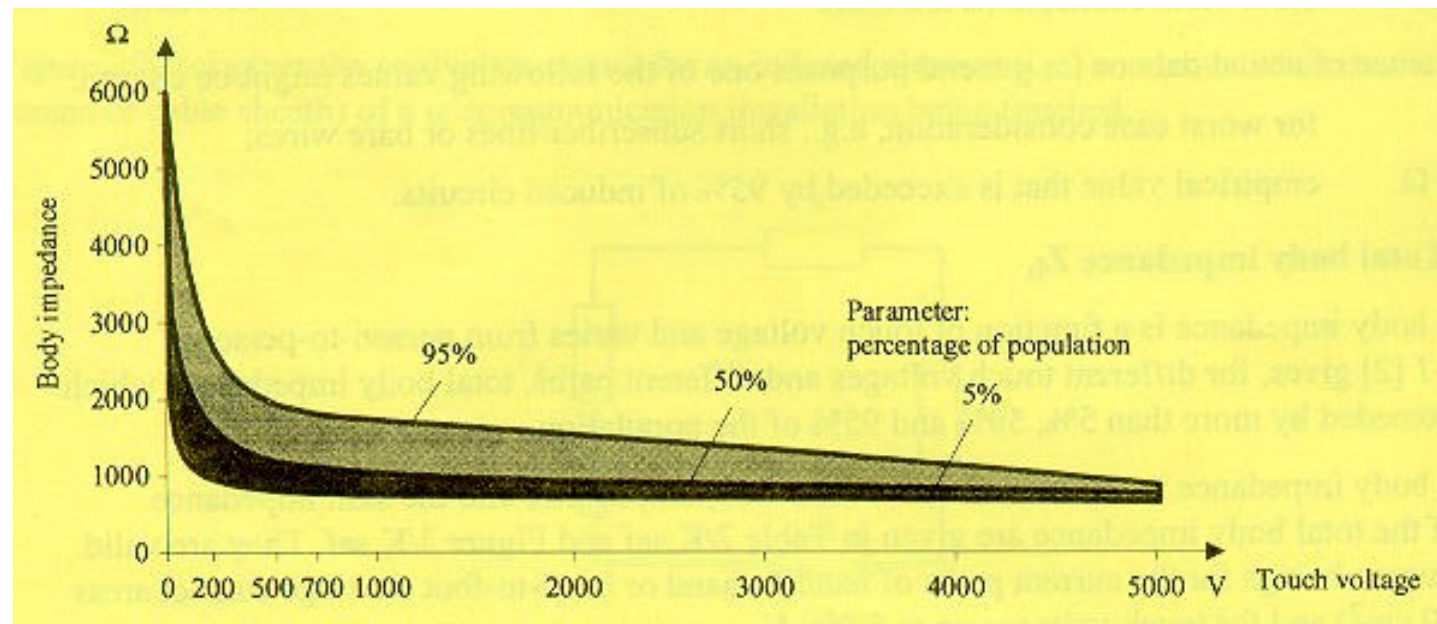


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The corresponding voltages are determined by the impedances of the circuit comprising

- the source impedance
  - $Z_s = 0 \Omega$  (worst case)
  - $Z_s = 180 \Omega$  (95 % probability)
- the total body impedance,  $Z_b$





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- the contact impedance assumed to be  $Z_c = 0 \Omega$
- the shoe impedance  $Z_{sh}$

Type of shoes State of shoes	Leather soles $\Omega$	Elastomer soles $\Omega$
Dry shoes	3 000	2 000
Wet or damp shoes, hard soil	5	30
Wet or damp shoes, loose soil	0,25	3



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- o the earthing resistance  $Z_e = 1,5 \rho$   
where  $\rho$  is the soil resistivity in  $\Omega\text{m}$

The admissible voltage limit is given by

$$U_{\text{adm}} = I_{\text{adm}} * ( Z_s + Z_b + Z_c + Z_{\text{sh}} + Z_e )$$

where  $I_{\text{adm}}$  is determined from the allowed body current  $I_b$  and the heart current factor  $F$ .

Two situations are calculated

- typical
- severe



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## TYPICAL SITUATION

Current paths: hand-hand, hand-feet

$$Z_b = 750 \Omega$$

$$Z_s = 180 \Omega$$

$$Z_{sh} = 3\,000 \Omega$$

$$Z_{ib} = Z_{ss} = 0 \Omega$$

Threshold current according to curve  $c_2$

Fault duration	$\leq 0,1$ s	$\leq 0,2$ s	$\leq 0,35$ s	$\leq 0,5$ s
Voltage limit calc	2092/3340 V	1395/2358 V	930/1572 V	465/786 V
Voltage limit adopt	2000 V	1500 V	1000 V	650 V

For  $0,5$  s  $\leq t \leq 1$  s voltage limit = 450 V





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## SEVERE SITUATION

Current paths:

hand-hand, hand-feet, hand-chest, hand-hip

$Z_b = 750 \Omega$  or less depend on current path

$Z_s = 0 \Omega$

$Z_{sh} = 3\,000 \Omega$

$Z_{ib} = Z_{ss} = 0 \Omega$

Threshold current according to curve  $c_1$

Duration	$\leq 0,06 \text{ s}$	$\leq 0,1 \text{ s}$	$\leq 1 \text{ s}$
Voltage limit	430 V	430 V	300 V
Voltage limit not hand - hip/chest	650 V	430 V	300 V

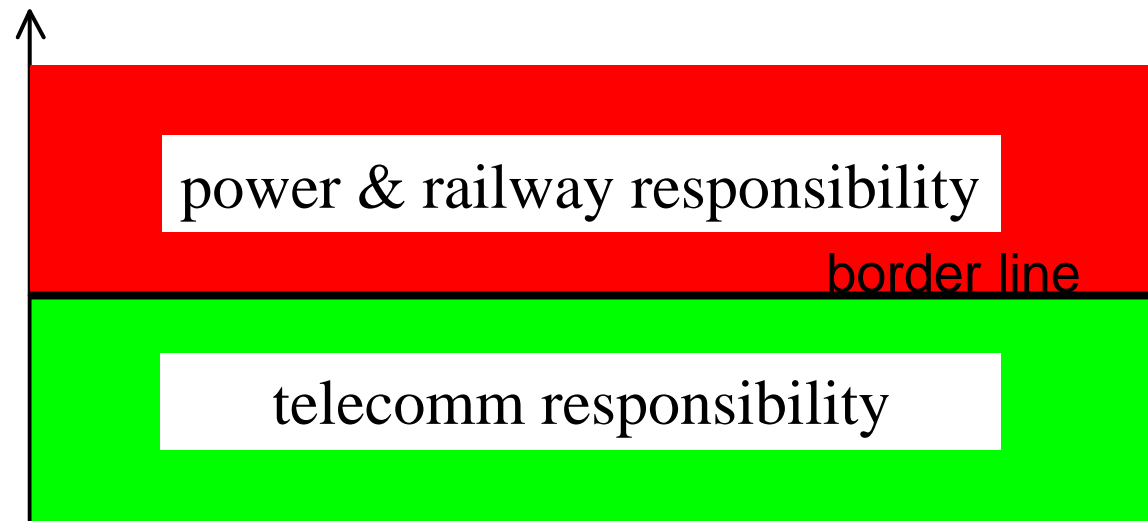


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## Recommendation K.53

- \* Permissible voltages on a telecommunications line caused by a.c. power or railway plant
- \* Normal operation and fault condition
- \* Border lines for responsibilities

voltage level





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### ⌘ LONG-TERM LEVELS (> 1 s )

\* Fundamental frequency 16<sup>2</sup>/<sub>3</sub>, 50, 60 Hz

Longitudinal **60 V<sub>RMS</sub>**

\* Noise, psophometric voltage

Transverse **0,5 mV**

Longitudinal **200 mV**

### ⌘ SHORT-TERM LEVELS

\* Typical situation

\* Severe situation



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## TYPICAL SITUATION

TABLE 1/K.53

Duration	$\leq 0,2$ s	0,2 - 0,35 s	0,35 - 0,5 s	0,5 - 1 s
Induced voltage	1030 V	780 V	650 V	430 V

Values derived from same dissipation in components

TABLE 2/K.53

Duration	$\leq 0,2$ s	0,2 - 0,35 s	0,35 - 0,5 s	0,5 - 1 s
Induced voltage	1500 V	1000 V	650 V	430 V

Applies when metallic elements are not transmitting signals or power supply



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## SEVERE SITUATION

Where severe situation is applied, the inducing party is responsible, when the limits for people safety are exceeded.

TABLE 3/K.53

<b>Duration</b>	$\leq 0,1$ s	0,1 - 1 s
<b>Induced voltage</b>	430 V	300 V



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## DIRECTIVES VOLUME VI

### DANGER AND DISTURBANCE

- Electrical safety considerations
  - Physiological Responses
  - Body Impedances
  - Operating Procedures
  
- Conditions resulting in Danger
  - Interfering Effects
  - Power Systems
  - Electrified Railways, AC and DC
  - Voltage levels
  - Current levels



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- Conditions resulting in Disturbances
  - Balance
  - Cable Screening
  - Sources and Levels of Harmonics
  - Effects on Telecomm systems
  
- Permissible levels to limit Danger
  - Voltage level in Normal Operation
  - Voltage level in Fault Condition
  - Current level
  
- Permissible levels to limit Disturbances
  - Voice transmission
  - Digital transmission



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## Amendments to section 5.4

“Permissible voltage and current levels to limit danger”

- No distinguish between
  - Human safety
  - Damage and disturbance to equipment
  
- Therefore
  - Amendment due to K.33 in 1997
  - Amendment due to K.53 needed now