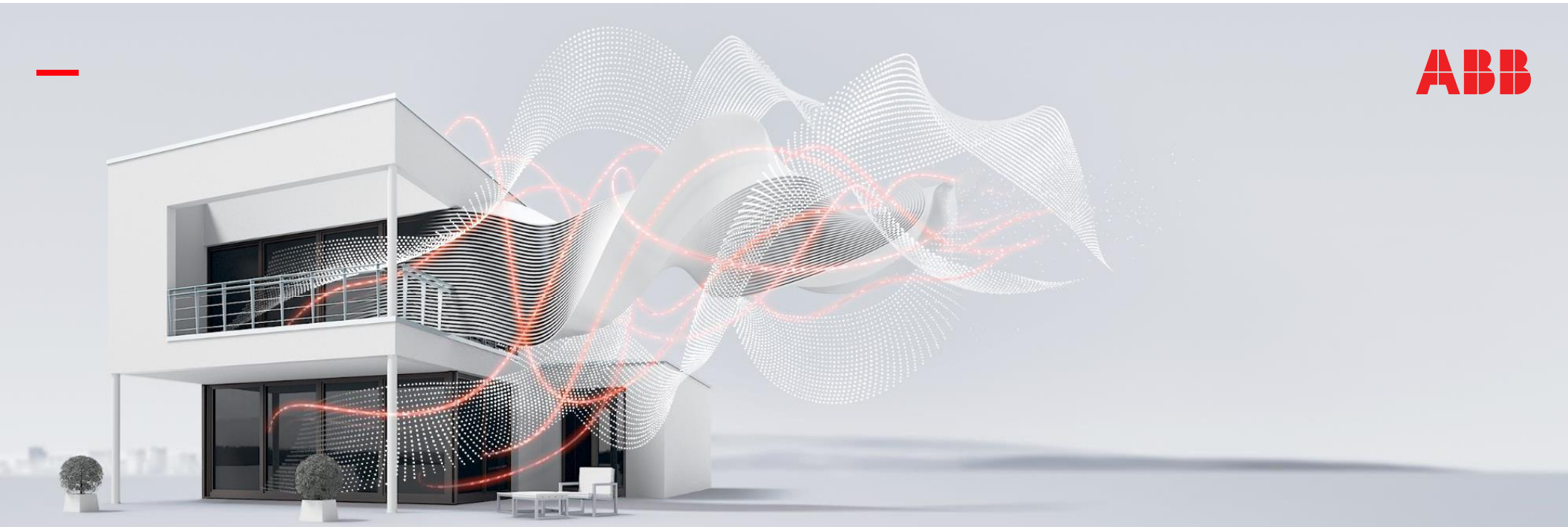


SINGAPORE 21ST MARCH 2017 NS KOH

Extra Safety with ABB

Protect your life and property

New review of SS97 - RCCB

SS97: 2016 – IEC61008-1: 2010

SS97 : 2005

Table 1 – Standard values of break time and non-actuating time

Type	I_n A	$I_{\Delta n}$ A	Standard values of break time (s) and non-actuating time (s) at a residual current (I_Δ) equal to:				
			$I_{\Delta n}$	2 $I_{\Delta n}$	5 $I_{\Delta n}$ [a]	5 A, 10 A 20 A, 50 A, 100 A, 200 A[b], 500 A	
General	Any value	≤ 0.030 *	0.1	0.1	0.04	0.04	Maximum break times
		> 0.030	0.3	0.15	0.04	0.04	Maximum break times
S	≥ 25	> 0.030	0.5	0.2	0.15	0.15	Maximum break times
			0.13	0.06	0.05	0.04	Minimum non-actuating times

* the maximum break times of the RCCB of the general type with $I_{\Delta n}$ ≤ 0.030 A is drawn to comply with the safety requirements of SS CP 5 and other statutory requirements.

[a] For RCCBs of the general type with $I_{\Delta n}$ ≤ 0.030 A, 0.25 A may be used as an alternative to 5 $I_{\Delta n}$

[b] The tests at 5 A, 10 A, 20 A, 50 A, 100 A and 200 A are only made during the verification of the correct operation as mentioned in 9.9.2.4

New review of SS97 - RCCB

SS97: 2016 – IEC61008-1: 2010

SS97 : 2016

Type	I_n A	$I_{\Delta n}$ A	Limit values of break time and non-actuating time (s) for type AC and A RCCB in event of alternating residual currents (r.m.s. values) equal to: $I_{\Delta n}$	$2\ I_{\Delta n}$	$5\ I_{\Delta n}$	$5\ I_{\Delta n}$ or 0,15 A[a]	5 A - 200 A[b]	500 A	
General	Any	≤0,03*	0,1	0,1		0,04	0,04	0,04	Maximum break times
		> 0,03	0,3	0,15	0,04		0,04	0,04	
S	≥ 25	> 0,03	0,5	0,2	0,15		0,15	0,15	
		> 0,03	0,13	0,06	0,05		0,04	0,04	Minimum non-actuating times

* The maximum break times of the RCCB of the general type with $I_{\Delta n}$ ≤0,03A is to comply with the safety requirements of SS CP 5 and other statutory requirements.

a Value to be decided by the manufacturer for this test.

b The tests are only made during the verification of the correct operation as mentioned in 9.9.2.4.

New review of SS480 - RCBO

SS480: 2016 – IEC61009-1: 2010

SS480 : 2005

Table 2 – Standard values of break time and non-operating time for operating under residual current conditions

Type	I_n A	$I_{\Delta n}$ A	Standard values of break time and non-operating time at a residual current (I_Δ) equal to: s					
			$I_{\Delta n}$	2 $I_{\Delta n}$	5 $I_{\Delta n}$ [a]	5 A, 10 A [b] 20 A, 50 A, 100 A, 200 A, 500 A	$I_{\Delta t}$ [c]	
General	Any value	≤ 0.030	0.1	0.1	0.04	0.04	0.04	Maximum break times
		> 0.030	0.3	0.15	0.04	0.04	0.04	Maximum break times
S	≥ 25	> 0.030	0.5	0.2	0.15	0.15	0.15	Maximum break times
			0.13	0.06	0.05	-	0.04	Minimum non-actuating times (no tripping)

[a] For RCBOs of the general type with $I_{\Delta n} \leq 0.030$ A, 0.25 A may be used as an alternative to 5 $I_{\Delta n}$.

[b] The tests at 5 A, 10 A, 20 A, 50 A, 100 A, 200 A and 500 A are only performed during the verification of the correct operation as mentioned in 9.9.1.2. d), but in any case values exceeding the lower limit of the overcurrent instantaneous tripping range are not tested.

[c] The test is made with a current $I_{\Delta t}$ equal to the lower limit of the overcurrent instantaneous tripping range according to type B, C or D , as applicable.

Singapore Standard CP 5

Explanation:
The maximum break times of the RCBO of the general type with $I_{\Delta n} \leq 0.030$ A is drawn to comply with the safety requirements of Singapore Standard CP 5.

New review of SS480 - RCBO

SS480: 2016 – IEC61009-1: 2010

SS480 : 2016

			Limiting values of break time and non-actuating time (s) for type AC and A RCBOs in event of alternating residual currents (r.m.s. values) equal to						
Type	I_n A	$I_{\Delta n}$ A	$I_{\Delta n}$	2 $I_{\Delta n}$	5 $I_{\Delta n}$	5 $I_{\Delta n}$ or 0,15 A[a]	5 A – 200 A, 500 A[b]	$I_{\Delta t}$[c]	
General	Any	≤0,03*	0,1	0,1		0,04	0,04	0,04	Maximum break times
		>0,03	0,3	0,15	0,04		0,04	0,04	
S	≥25	>0,03	0,5	0,2	0,15		0,15	0,15	
		>0,03	0,13	0,06	0,05		0,04	0,04	Minimum non-actuating times

* The maximum break times of the RCBO of the general type with $I_{\Delta n}$ ≤0,03A is to comply with the safety requirements of SS CP5 and other statutory requirements.

[a] Value to be decided by the manufacturer for this test.

[b] The tests are only made during the verification of the correct operation as mentioned in 9.9.12 d) but in any case values exceeding the lower limit of the overcurrent instantaneous tripping range are not tested.

[c] The test is made with a current $I_{\Delta t}$ equal to the lower limit of the overcurrent instantaneous tripping range according to type B, C or D, as applicable. For the tests of 9.9.1.3 and 9.9.1.4 b), the current $I_{\Delta t}$ is established so that the vector sum $I_{\Delta t}$ + I_n is equal to the lower limit of the overcurrent instantaneous tripping range, according to type B, C or D, as applicable.

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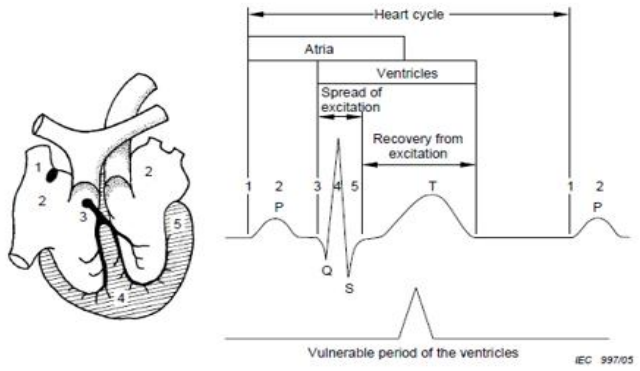
IEC/TS 60479-1: 2005

Effects of current on human beings and livestock – Part 1: General aspects

Ventricular fibrillation is fatal because it denies blood flow which transports required oxygen. Electrical accidents that do not involve ventricular fibrillation can also be fatal. Other effects may affect respiration and might prevent the person from shouting for help. These related mechanisms include functional disturbance of respiratory control, paralysis of respiratory muscles, damage to the neural activation pathways for these muscles, and damage to the respiratory control mechanism within the brainstem. These effects, if permanent, lead inevitably to death. If a person is to recover from a reversible respiratory effect, prompt artificial respiration is mandatory. Nonetheless, the person may still die. If current flows through critical parts such as the spinal cord or the respiratory control centre, death can occur. These effects are under consideration and thresholds are not yet defined.

Extra Safety with ABB

IEC/TS 60479-1: 2005



NOTE The numbers designate the subsequent stages of propagation of the excitation.

Figure 17 – Occurrence of the vulnerable period of ventricles during the cardiac cycle

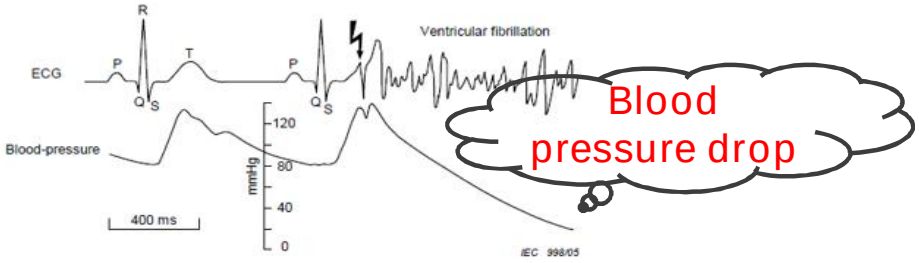


Figure 18 – Triggering of ventricular fibrillation in the vulnerable period – Effects on electro-cardiogram (ECG) and blood pressure

Extra Safety with ABB

IEC/TS 60479-1: 2005

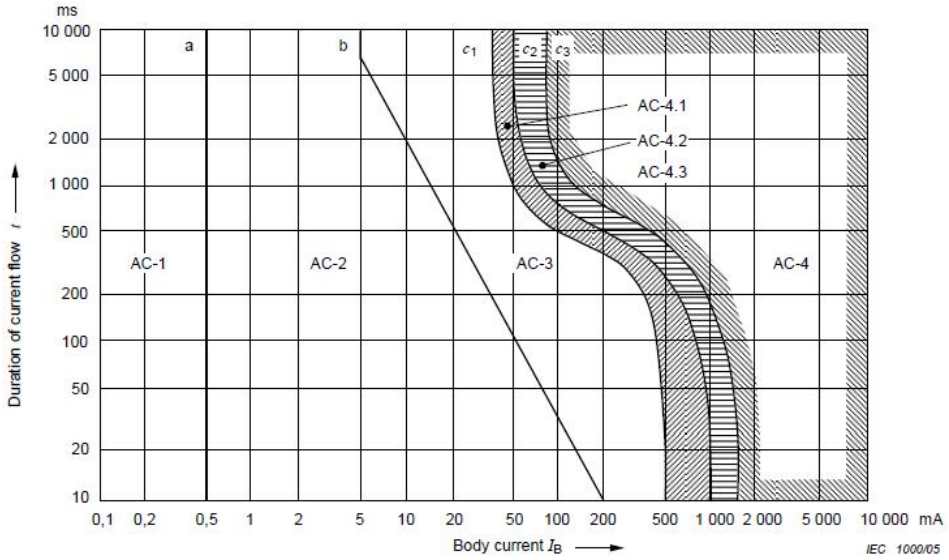


Figure 20 – Conventional time/current zones of effects of a.c. currents (15 Hz to 100 Hz) on persons for a current path corresponding to left hand to feet (for explanation see Table 11)

5.8 Description of time/current zones (see Figure 20)

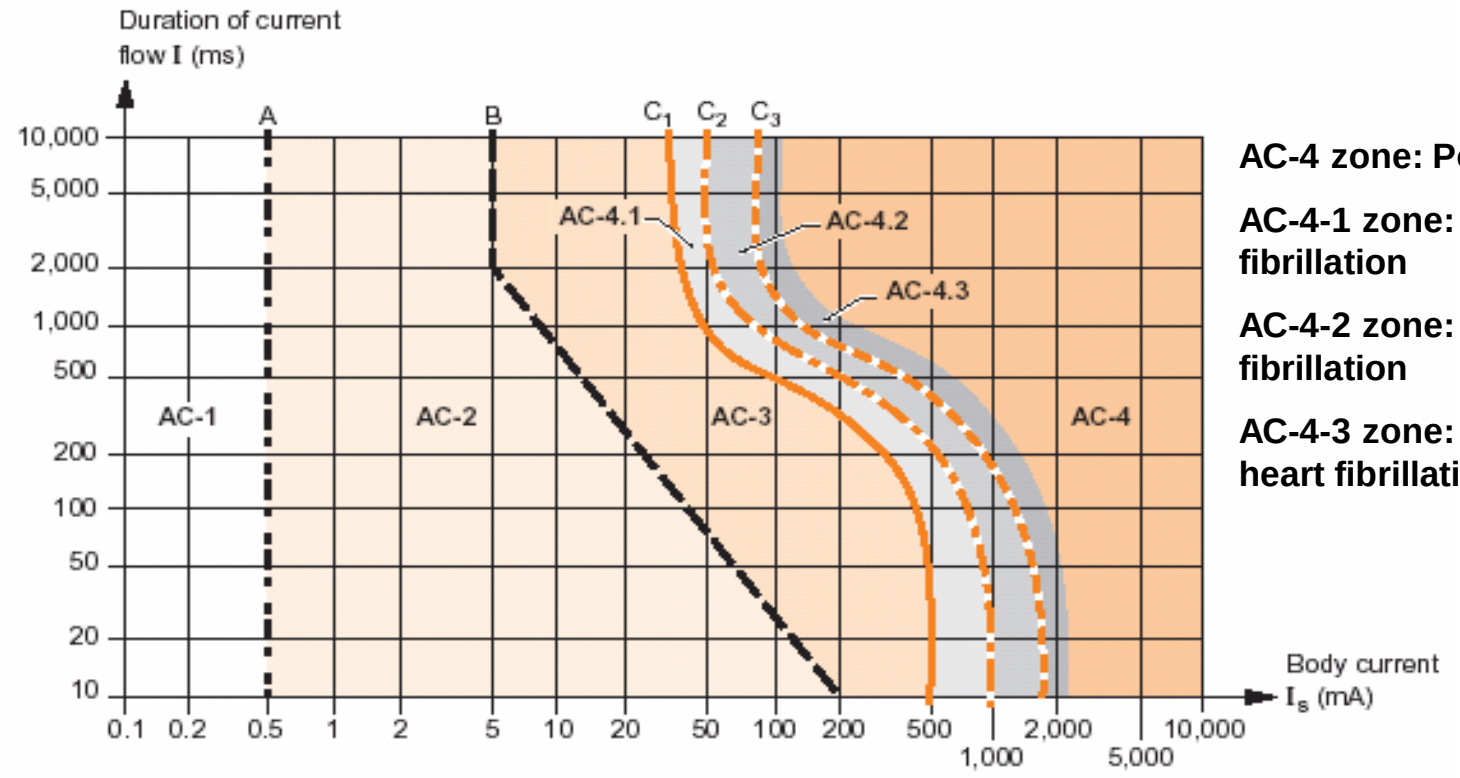
Table 11 – Time/current zones for a.c. 15 Hz to 100 Hz for hand to feet pathway – Summary of zones of Figure 20

Zones	Boundaries	Physiological effects
AC-1	Up to 0,5 mA curve a	Perception possible but usually no 'startled' reaction
AC-2	0,5 mA up to curve b	Perception and involuntary muscular contractions likely but usually no harmful electrical physiological effects
AC-3	Curve b and above	Strong involuntary muscular contractions. Difficulty in breathing. Reversible disturbances of heart function. Immobilization may occur. Effects increasing with current magnitude. Usually no organic damage to be expected
AC-4 [1)]	Above curve c_1	Patho-physiological effects may occur such as cardiac arrest, breathing arrest, and burns or other cellular damage. Probability of ventricular fibrillation increasing with current magnitude and time
	c_1-c_2	AC-4.1 Probability of ventricular fibrillation increasing up to about 5 %
	c_2-c_3	AC-4.2 Probability of ventricular fibrillation up to about 50 %
	Beyond curve c_3	AC-4.3 Probability of ventricular fibrillation above 50 %

[1)] For durations of current flow below 200 ms, ventricular fibrillation is only initiated within the vulnerable period if the relevant thresholds are surpassed. As regards ventricular fibrillation, this figure relates to the effects of current which flows in the path left hand to feet. For other current paths, the heart current factor has to be considered.

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IEC/TS 60479-1: 2005



AC-4 zone: Possibility of irreversible effects

AC-4-1 zone: Up to 5% probability of heart fibrillation

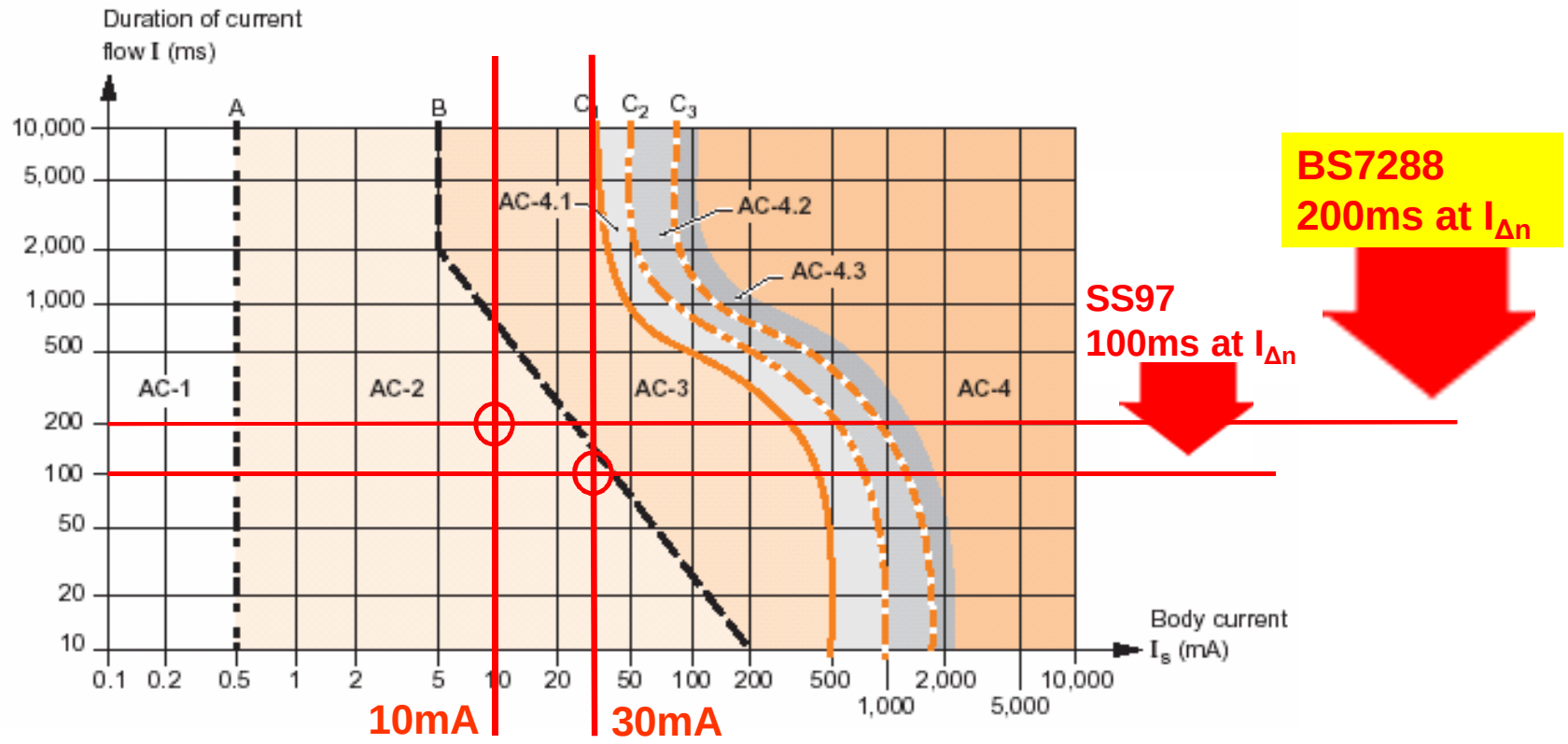
AC-4-2 zone: Up to 50% probability of heart fibrillation

AC-4-3 zone: More than 50% probability of heart fibrillation

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IEC/TS 60479-1: 2005



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IEC/TS 60479-1: 2005

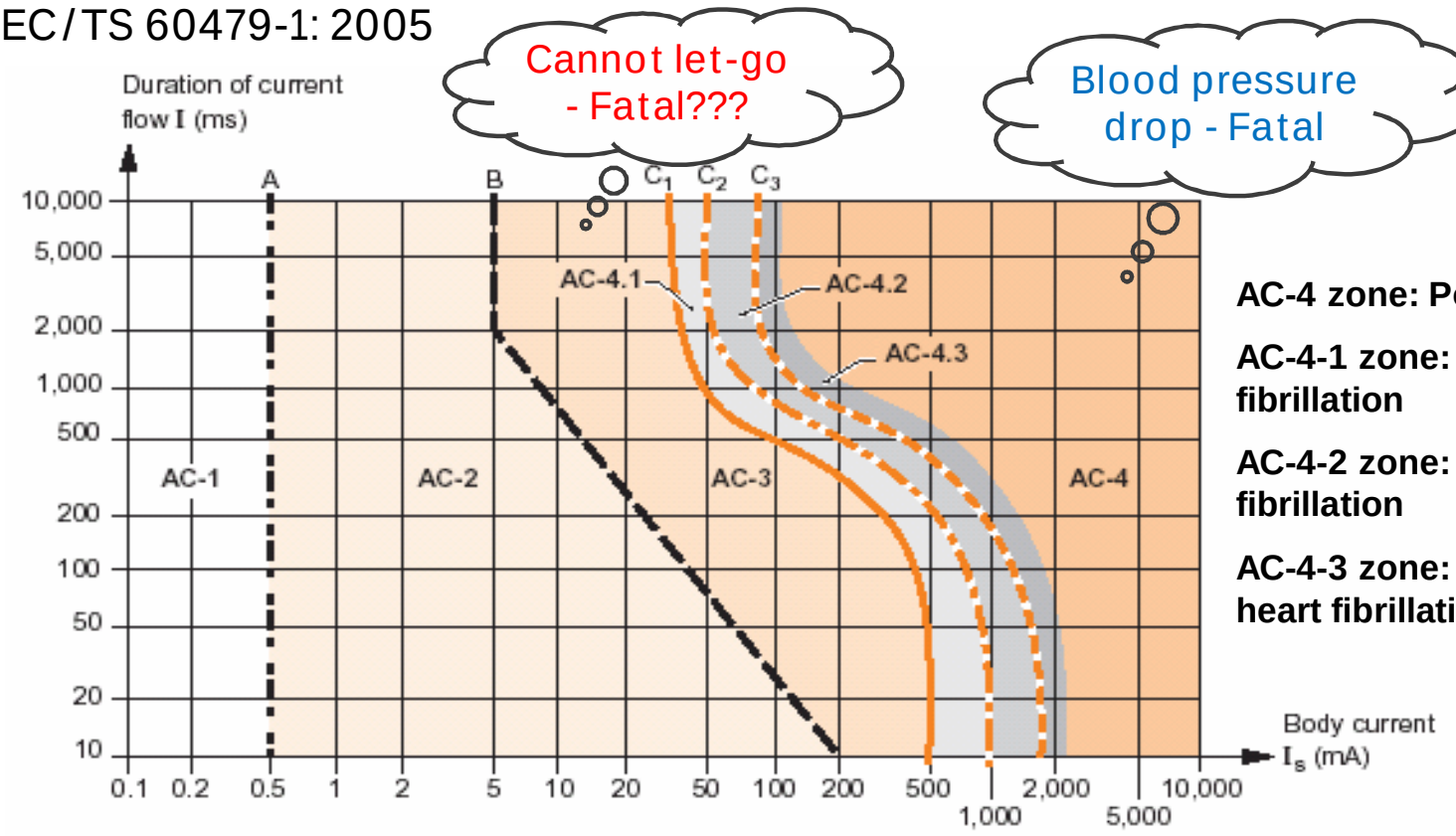
Effects of current on human beings and livestock

Body effect	Men (mA)	Women (mA)
Slight sensation on hand	**0.4**	**0.3**
Shock - not painful	**1.8**	**1.2**
Shock - painful, can let go	**9.0**	**6.0**
Shock - painful, let go threshold (median)	**16.0**	**10.5**
Severe shock - painful, breathing difficult	**23.0**	**15.0**
Possible ventricular fibrillation after 3sec.	**500.0**	**500.0**

Professor C.F. Dalziel 1961. 134 men & 28 women

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IEC/TS 60479-1: 2005



AC-4 zone: Possibility of irreversible effects

AC-4-1 zone: Up to 5% probability of heart fibrillation

AC-4-2 zone: Up to 50% probability of heart fibrillation

AC-4-3 zone: More than 50% probability of heart fibrillation

Extra Safety with ABB

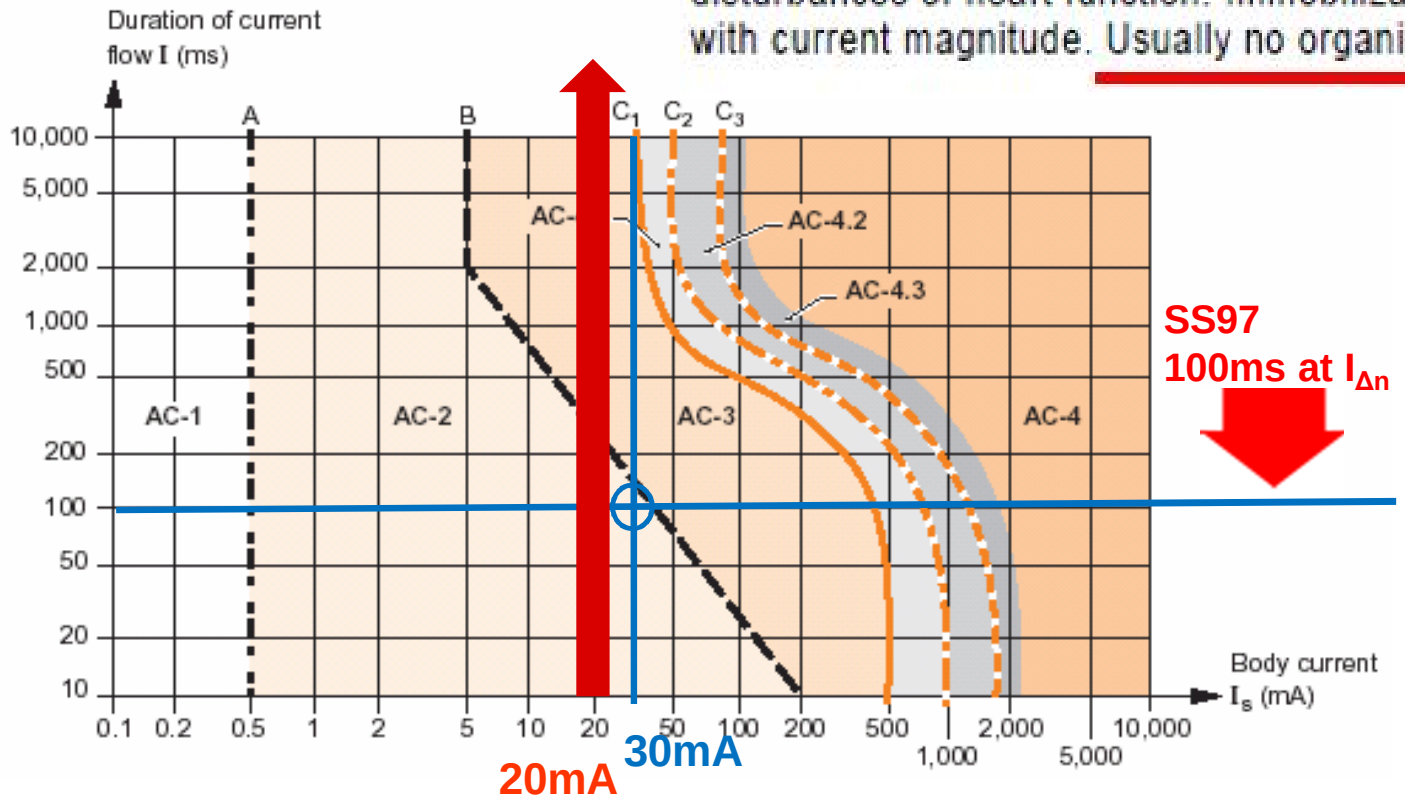
IEC/TS 60479-1: 2005

Ventricular fibrillation is fatal because it denies blood flow which transports required oxygen. Electrical accidents that do not involve ventricular fibrillation can also be fatal. Other effects may affect respiration and might prevent the person from shouting for help. These related mechanisms include functional disturbance of respiratory control, paralysis of respiratory muscles, damage to the neural activation pathways for these muscles, and damage to the respiratory control mechanism within the brainstem. These effects, if permanent, lead inevitably to death. If a person is to recover from a reversible respiratory effect, prompt artificial respiration is mandatory. Nonetheless, the person may still die. If current flows through critical parts such as the spinal cord or the respiratory control centre, death can occur. These effects are under consideration and thresholds are not yet defined.

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IEC/TS 60479-1: 2005

Strong involuntary muscular contractions. Difficulty in breathing. Reversible disturbances of heart function. Immobilization may occur. Effects increasing with current magnitude. Usually no organic damage to be expected



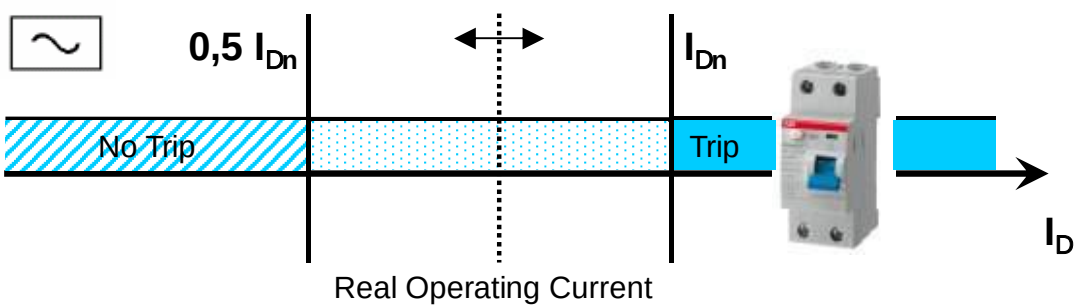
SS97
100ms at $I_{\Delta n}$

Extra Safety with ABB

IEC/TS 60479-1: 2005

Residual operating current limits

- Product Standard IEC 61008/9
- RCDs must intervene in presence of a residual current within defined current limit:
  - **Residual operating current (I_{Dn})**
    - Value of residual current which causes the RCD to operate under specified conditions
  - **Residual non-operating current (I_{Dn0})**
    - **Value of residual current (=0.5 I_{Dn}) at and below which the RCD doesn't operate under specified conditions.**



Real Operating Current

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IEC/TS 60479-1: 2005 - Let-go currents

§ Can 30mA RCCB protect you for inability of let go?
§ Threshold of let go
  § 10mA assumed of adult male
  § 5mA cover entire population

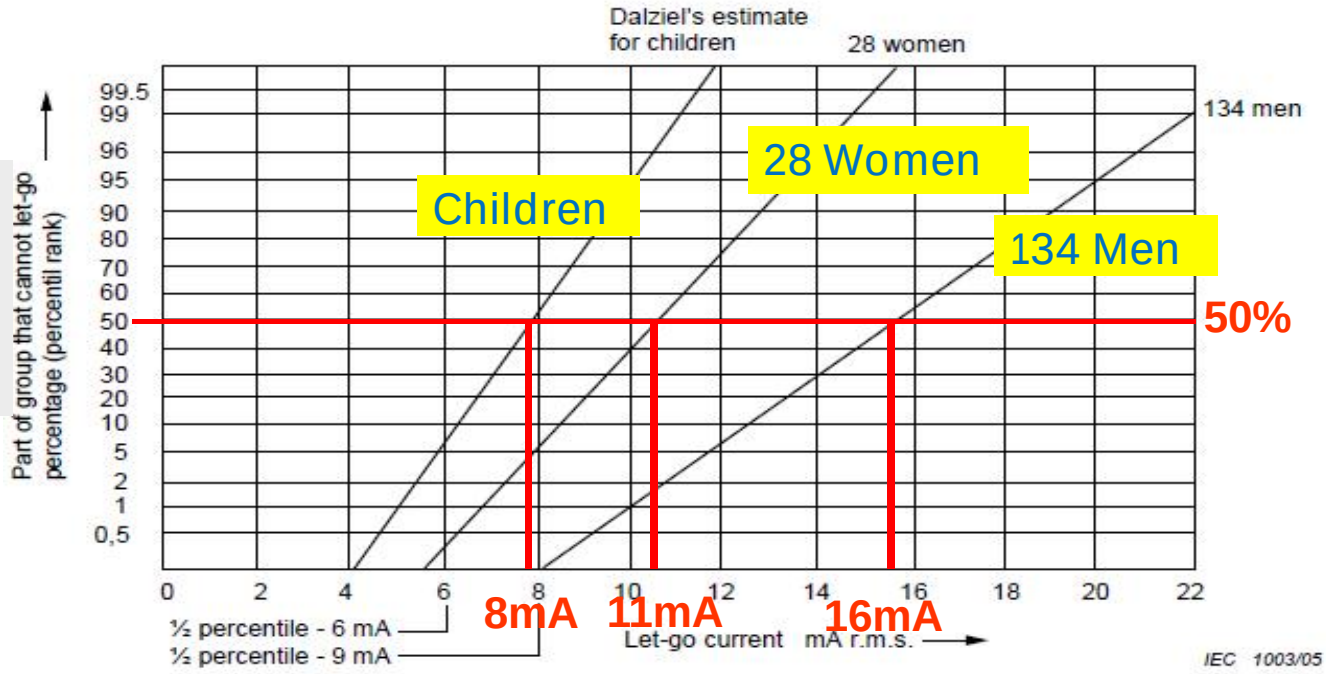


Figure 23 – Let-go currents for 60 Hz sinusoidal current

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IEC/TS 60479-1: 2005 - Let-go currents

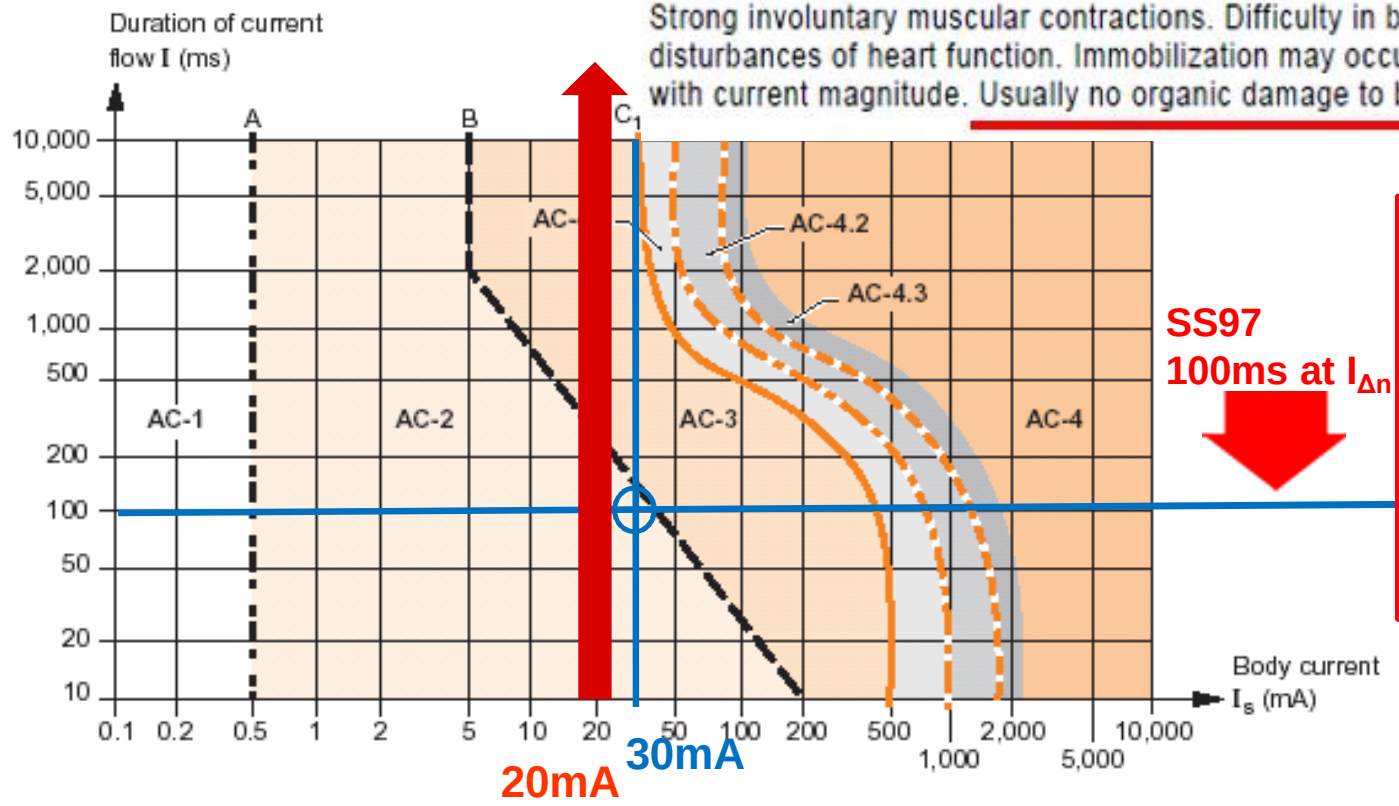
Most Ground Fault Circuit Interrupter GFCIs UL943 in United States are rated at 5mA to prevent inability to let go as well as ventricular fibrillation.

In Europe, RCCB with rating as high as 30mA is considered suitable for people protection against ventricular fibrillation and electric shock but not against inability to let go.

By J. Patrick Reilly,
Electrical Stimulation and Electropathology

Extra Safety with ABB

IEC/TS 60479-1: 2005



SS97
100ms at $I_{\Delta n}$

AC-3 Zone

- Cannot let-go
- Muscular contraction
- Breathing difficulty
- If persist or permanent
- Lead inevitably to death

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RCCB – Test “T” button

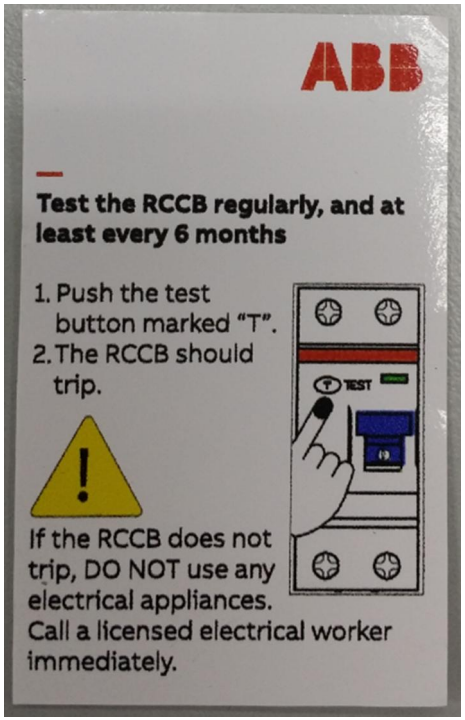


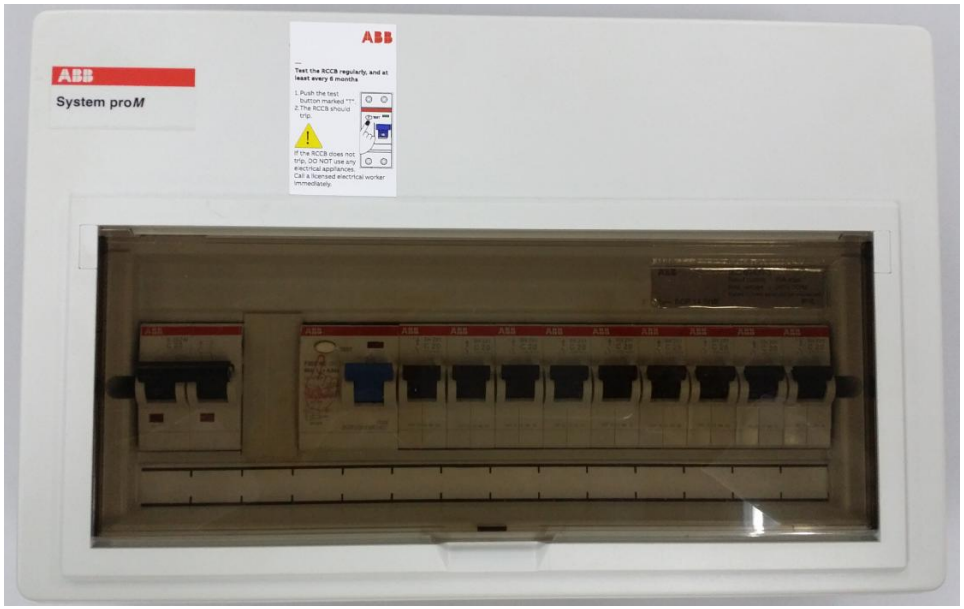


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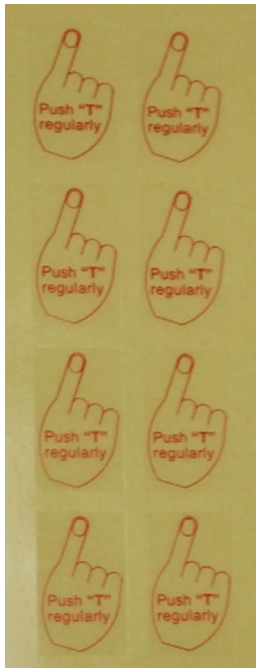
RCCB – Test “T” button

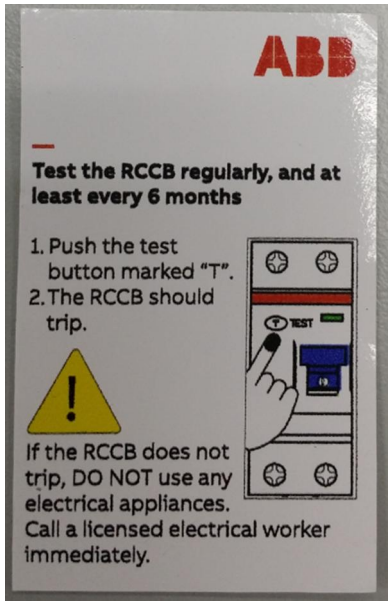




Extra Safety with ABB

Life saving Test “T” button sticker





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