IEEE C37.13, Low-Voltage AC Power Circuit Breakers Used in Enclosures

Meeting Minutes

Meeting Date: 01 April 2024
Meeting Time: Session #1: 8:00 AM – 9:45 AM;
Session #2: 10:15 AM – 12:00 PM
Location: Westin Beach, Fort Lauderdale, Florida

A. Call to order

The meeting was called to order at 7:02 AM PST.

B. Approval of agenda

The meeting agenda was reviewed. Motion to approve the agenda was made by Mike Lafond and seconded by Christo Thomas. The agenda was approved by unanimous consent

C. Attendance

Introductions were made of all attendees. Attendees are listed below. Quorum was confirmed with 17 of 20 members present and a total of 43 attendees.

First Name	Last Name	Affiliation	Member Type
Jesus	Avilo Escelente	ABB	Guest
Dan	Benedict	PPL	Guest
Randy	Blake	Schneider Electric	Member
Chris	Bohrer	Utility Relay Co.	Guest
Robert	Burns	Eaton Corporation	Member
Ted	Burse	Powell Industries, Inc	Member
Sudarshan	Byreddy	Burns & McDonnell	Guest
Clint	Carne	Schneider Electric	Secretary
Daniel	Delfino	ABB	Member
Doug	Edwards	Siemens Industry, Inc.	Guest
Keith	Flowers	Siemens Industry, Inc.	Chair
Marc	Foster	Schneider Electric	Guest
Lou	Grahor	Eaton Corporation	Member
Erin	Hardy	Eaton	Member
Tom	Hawkins	Siemens Industry, Inc.	Guest
Mark	Heiny	ABB	Guest
Dan	Hrncir	Eaton	Member
Umer	Kahn	ABB	Guest
John	Kaminski	Siemens Industry, Inc.	Guest
Michael	Lafond	Underwriters Laboratories	Member
William	Lee	Powell	Guest
Albert	Livshitz	CE Power Engineered Services	Guest
Adrian	Lopez	Powell Industries	Guest
Vincent	Marshall	Southern Company	Guest
Shaun	Miller	Meramel Instrument Transformer	Guest
Jeff	Mizener	Siemens Industry, Inc.	Member
Darryl	Moser	ABB	Member
Robato	Oleteres	Siemens Industry, Inc.	Guest
Owen	Parks	ABB	Member
Albert	Pruitt	Durham	Guest

Paul	Rakus	Eaton	Member
Daneil	Rivera Moraks	Hydro-Quebec	Guest
Amy	Rowell	Schneider Electric	Guest
Kathryn	Sakarapanee	Schneider Electric	Guest
Wahaj	Saleem	Siemens Industry, Inc.	Guest
Todd	Sauve	Rockwell Automation	Guest
Kevin	Sippel	Eaton Electric	Member
Bryan	Tatum	Underwriters Laboratories	Guest
Christo	Thomas	Schneider Electric	Member
Timothy	Tillery	Howard Industries	Guest
John	Webb	ABB	Guest
Will	Weishuhn	ABB	Guest
Danish	Zia	Underwriters Laboratories	Member

D. Approval of Fall 2023 Meeting Minutes

Fall 2023 IEEE C37.13 Working Group meeting were reviewed. Motion to approve the minutes was made by Mike Lafond and seconded by Jeff Mizener. The meeting minutes were approved by unanimous consent.

E. Rules and guidelines for conducting working group meetings

The attendees were reminded of IEEE's Code of Ethics and Conduct guidelines, as well as the IEEE Copyright Policy.

Also noted was that when following the "Individual Method" the attendees are to vote based on their own engineering judgement and not as a directed vote or representing their employer or client(s).

The IEEE Patent Policy and Business Conduct slides may be reviewed at the following website:
https://mentor.ieee.org/myproject/Public/mytools/mob/slideset.pdf

F. **Working group P&Ps**

The attendees were reminded of the Switchgear Committee Working Group Policies and Procedures – Individual Method. The approved template for the Switchgear Committee is:
https://www.ewh.ieee.org/soc/pes/switchgear/O-and-P/PES_SWG_WG_PnP_Final_2019-03-19.pdf

G. Document status report

- PAR request date: 07 May 2019
- PAR approval date: 05 Sep 2019
- PAR expiration date: 31 Dec 2025 (Document also expires 31 Dec 2025)

H. New business

- The first ballot of PC37.13 Draft 12 had closed just prior to the meeting. The following topics from the ballots were reviewed during the WG meeting.
  - Annex E for Documentation of time-current curves was partially reviewed.
    - Mike Lafond presented slides around time-current curves, which outlined numerous standards requiring time-current curve documentation be published. Slides will be published with meeting minutes.

- **WG Consensus**: It was identified that adding some definitions for or something similar would be of benefit. Strawman wording for the definitions below will be added in the next recirculation.
  - time current curve (of a mechanical switching device)
  - time-overcurrent characteristic curve (of a direct-acting overcurrent trip system to trip device):
  - trip system response curve
- A hand vote on whether to hyphenate "time current" was performed. 8 affirmative, 0 negative, 8 abstentions.
- **LVSD Topic**: Question was raised if Indirect acting trip systems were in scope. If in scope, discussion was held around how to best identify which requirements are specific to direct, vs indirect, vs both.
  - **Action**: Request C37.17 to consider this topic in their WG meeting. Jeff Mizener.

- Thermal comments
  - Draft 12 contained an alternate thermal test method: A.6.3 Method B
    - Concern was raised that it was unclear if the new method more accurately represented the conditions of C37.20.1 equipment. The testing requirements in many ways were more severe, but at the same time the terminal rise allowance was raised from 55°C to 65°C.
    - A motion by Ted Burse to remove Method B from the draft. 2nd Darryl Moser. 9 affirmative, 6 negative, 0 abstentions, Motion carries.
- Insulation comments – a few comments reviewed.
- Grounding comments
  - 6.10 Circuit breaker ground connection
    - Topic 1: No grounding resistance test to verify performance is defined. Strawman text to be added to next draft.
    - Topic 2: Dielectric tests do not clearly state that they need to be performed in the test and connected positions of the adapter, however C37.20.1 does have this requirement. Strawman text to be added to next draft.

I. Next steps

- A doodle poll to setup a virtual meeting to address the remaining comments for Annex E will be scheduled.
- An updated draft with today's comments will be created.
- Comment resolution and meeting minutes will be shared.
- After completion of all comment resolutions and dispositions are made, the responses will be loaded into myProject. With the intent to allow negative votes to be changed into affirmative.
- Target is to recirculate the next ballot no later than August 2024 to allow for comment discussion in Fall meeting in Oklahoma City.
- The next planned in-person meeting: Fall 2024, OMNI Hotel, Oklahoma City, OK

J. Adjourn

Meeting adjourned at 10:57 AM PST

Meeting minutes respectfully submitted by Clint Carne

Time Current Curves & Clearing Time

Overview of Term Use

M. Lafond 3/19/2024

LVSD (Published Docs)

8	(TOC) Requires or states mfg'r to supply publised curve with breaker opening time
8	(TOC) S/C type testing based on trip unit curves
1	(TOC) Calibration/Conformance testing based on trip unit curves
14	(TCC) Type testing based on LVPCB clearing time
33	(TCC) Requires mfg'r claim or mfg'r to supply published TCC with min/max LVPCB clearing times

(#) = Term count usage in published documents
(TOC) = time-overcurrent characteristic curve (trip system + breaker opening time)
(TCC) = time-current curve (circuit breaker clearing time + trip system + breaker opening time)

Document #	Title	Specific Term	Term Count	Total Usage	Reference Type	Usage Type	Clause References	Topic Area
C37.17-2022	IEEE Std for Trip Systems for Low-Voltage (1000 V and below) AC and General Purpose (1500 V and below)	time-current curve	1	3	Normative	3	7.1	Mfg shall publish TCC
		time-current characteristic	2				7.1	Mfg state which frequency and TCC apply to 50 and 60 Hz applications
		time-overcurrent characteristic	4	7	Informative	4	Annex A	TOC documentation including breaker opening time
		clearing time	3			3	Annex B	Methods to reduce LVPCB clearing time during maintenance/inspection (NFPA)
C37.13-2015	IEEE Std for Low-Voltage AC Power Circuit Breakers Used in Enclosures	time-current curve	2	20	Normative	8	5.6.3 a)	S/C testing of LVPCB based on TCC frequency response of Trip Unit
		time-current curve	2				5.6.3 b)	S/C testing of LVPCB based on TCC frequency response of Trip Unit
		clearing time	1				5.6.3 b) 1)	S/C testing based on LVPCB clearing time
		clearing time	1				5.6.3 b) 2)	S/C testing based on LVPCB clearing time
		clearing time	1				5.6.3 b) 3)	S/C testing based on LVPCB clearing time
		clearing time	1				5.6.3 b) 4)	S/C testing based on LVPCB clearing time
		time characteristic	1		Informative	12	A.1.4.7	Non-integral protection from LVPCB ; operating time of LVPCB
		clearing time	1				A.1.4.7	Non-integral protection to not exceed LVPCB clearing time or short-time rating
		time-current characteristic	4				A.3.2.3	TCC clearly show min/max clearing time of the device and any modifiers
		clearing time	1				A.3.2.3	TCC clearly show min/max clearing time of the device and any modifiers
		time-current characteristic	2				A.3.4	TCC should not overlap for selectivity
		time-current characteristic	2				A.3.5.3	Coordination of fuse clearing time & LVPCB coordination
		time-current characteristic	1				A.3.5.4	Coordination of fuse clearing time & LVPCB coordination
C37.50-2012	NEMA Std for Switchgear - Low Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures	time-current characteristic	1	16	Normative	16	4.4.1	TCC of particular device complies with C37.17
		clearing time	1				Table 1 Note 5	If LVPCB clearing time < 83ms then test 1 sequence II (c) omitted
		time-current characteristic	1				Table 4 Note 7	Optional test omission if LVPCB clearing time less than total clearing time of fuse
		clearing time	4				Table 4 Note 7	Optional test omission if LVPCB clearing time less than total clearing time of fuse
		time-current curve	2				4.9.3.5.3 1)	S/C testing of LVPCB based on TCC frequency response of Trip Unit
		time-current curve	2				4.9.3.5.3 2)	S/C testing of LVPCB based on TCC frequency response of Trip Unit
		clearing time	1				4.9.3.5.3 2) a)	S/C testing based on LVPCB clearing time
		clearing time	1				4.9.3.5.3 2) b)	S/C testing based on LVPCB clearing time
		clearing time	1				4.9.3.5.3 2) d)	S/C testing based on LVPCB clearing time
		clearing time	1				4.9.3.5.3 2) d)	S/C testing based on LVPCB clearing time
		time-current characteristic curve	1				7.2.2	Direct-acting trip production testing for conformance testing to published TCC
C37.27-2015	IEEE Guide for Low-Voltage AC (635 V and below) Power Circuit Breakers Applied with Separately-Mounted Current-Limiting Fuses	time-current characteristic	3	18	Normative	18	4	LVPCB TCC limits to fuse selection
		clearing time	3				5.1.3	Fuse clearing time less then minimum total clearing time of LVPCB
		instantaneous tripping characteristic	1				5.1.3	Since max clearing time of LVPCB has only maximum subtract 1 cycle to estimate minimum
		circuit breaker curve	1				5.2.1	avg. fuse melting time does not overlap circuit breaker clearing time in LT curve
		clearing time	2				5.2.1	avg. fuse melting time does not overlap circuit breaker clearing time in LT curve
		time-current characteristic	2				Figure 2	Total clearing time of LVPCB w/ max fuse rating
		clearing time	3				Figure 2	Min and Max Clearing time of LVPCB
		time-current characteristic	2				Figure 3	Total clearing time of LVPCB w/ min fuse rating
		clearing time	1				Figure 3	Total clearing time of LVPCB

Time Current Curve Use

LVSD Summary of Use (Current Published Docs)

All “curve” or “characteristic” references

Sum of Term Count	Column Labels				
Row Labels	IEEE Std C37.13-2015	IEEE Std C37.17-2022	IEEE Std C37.27-2015	IEEE Std C37.50-2012	Grand Total
circuit breaker curve			1		1
clearing time	6	3	9	9	27
instantaneous tripping characteristic			1		1
time characteristic	1				1
time-current characteristic	9	2	7	2	20
time-current characteristic curve				1	1
time-current curve	4	1		4	9
time-overcurrent characteristic		4			4
Grand Total	**20**	**10**	**18**	**16**	**64**

Normative “curve” or “characteristic” references

Sum of Term Count	Column Labels				
Row Labels	IEEE Std C37.13-2015	IEEE Std C37.17-2022	IEEE Std C37.27-2015	IEEE Std C37.50-2012	Grand Total
circuit breaker curve			1		1
clearing time	4		9	9	22
instantaneous tripping characteristic			1		1
time-current characteristic		2	7	2	11
time-current characteristic curve				1	1
time-current curve	4	1		4	9
Grand Total	**8**	**3**	**18**	**16**	**45**

LVSD (Pub./Draft Docs)

7	(TOC) Requires or states mfg'r to supply publised curve with breaker opening time
8	(TOC) S/C type testing based on trip unit curves
1	(TOC) Calibration/Conformance testing based on trip unit curves
14	(TCC) Type testing based on LVPCB clearing time
44	(TCC) Requires mfg'r claim or mfg'r to supply published TCC with min/max LVPCB clearing times

(#) = Term count usage in published documents
(TOC) = time-overcurrent characteristic curve (trip system + breaker opening time)
(TCC) = time-current curve (circuit breaker clearing time + trip system + breaker opening time)

Document #	Title	Specific Term	Term Count	Total Usage	Reference Type	Usage Type	Clause References	Topic Area
C37.17-2022	IEEE Std for Trip Systems for Low-Voltage (1000 V and below) AC and General Purpose (1500 V and below)	time-current curve	1	3	Normative	3	7.1	Mfg shall publish TCC
		time-current characteristic	2				7.1	Mfg state which frequency and TCC apply to 50 and 60 Hz applications
		time-overcurrent characteristic	4	7	Informative	4	Annex A	TOC documentation including breaker opening time
		clearing time	3			3	Annex B	Methods to reduce LVPCB clearing time during maintenance/inspection (NFPA)
PC37.13D12	IEEE Std for Low-Voltage AC (1058 V and Below) Power Circuit Breakers Used in Enclosures	time-current curve	2	46	Normative	23	5.7.3 a)	S/C testing of LVPCB based on TCC frequency response of Trip Unit
		time-current curve	2				5.7.3 b)	S/C testing of LVPCB based on TCC frequency response of Trip Unit
		clearing time	1				5.7.3 b) 1)	S/C testing based on LVPCB clearing time
		clearing time	1				5.7.3 b) 2)	S/C testing based on LVPCB clearing time
		clearing time	1				5.7.3 b) 3)	S/C testing based on LVPCB clearing time
		clearing time	1				5.7.3 b) 4)	S/C testing based on LVPCB clearing time
		clearing time	1				Table A.1 Note e	If LVPCB clearing time < 83ms then test 1 sequence II (c) omitted
		time-current characteristic curve	1				A.4.1	Direct-acting trip device calibration testing for conformance testing to published TCC
		time-current curve	2				A.9.3.5.3 a)	S/C testing of LVPCB based on TCC frequency response of Trip Unit
		time-current curve	2				A.9.3.5.3 b)	S/C testing of LVPCB based on TCC frequency response of Trip Unit
		clearing time	1				A.9.3.5.3 b) 1)	S/C testing based on LVPCB clearing time
		clearing time	1				A.9.3.5.3 b) 2)	S/C testing based on LVPCB clearing time
		clearing time	1				A.9.3.5.3 b) 3)	S/C testing based on LVPCB clearing time
		clearing time	1				A.9.3.5.3 b) 4)	S/C testing based on LVPCB clearing time
		time-current characteristic	1				Table A.8 Note h	Optional test omission if LVPCB clearing time less than total clearing time of fuse
		clearing time	4				Table A.8 Note h	Optional test omission if LVPCB clearing time less than total clearing time of fuse
		clearing time	1		Informative	23	D.2.2.6	Non-integral protection to not exceed LVPCB clearing time or short-time rating
		time-current characteristic	4				D.5.2.3	TCC clearly show min/max clearing time of the device and any modifiers
		clearing time	1				D.5.2.3	TCC clearly show min/max clearing time of the device and any modifiers
		time-current characteristic	2				D.5.4	TCC should not overlap for selectivity
		time-current characteristic	2				D.5.5.3	Coordination of fuse clearing time & LVPCB coordination
		time-current characteristic	2				D.5.5.4	Coordination of fuse clearing time & LVPCB coordination
		time-current curve	11				Annex E	Documentation of TCC
C37.27-D3	IEEE Guide for Low-Voltage AC (635 V and below) Power Circuit Breakers Applied with Separately-Mounted Current-Limiting Fuses	time-current characteristic	3	18	Normative	18	4	LVPCB TCC limits to fuse selection
		clearing time	3				5.1.3	Fuse clearing time less then minimum total clearing time of LVPCB
		instantaneous tripping characteristics	1				5.1.3	Since max clearing time of LVPCB has only maximum subtract 1 cycle to estimate minimum
		clearing time	2				5.2.1	avg. fuse melting time does not overlap circuit breaker clearing time in LT curve
		circuit breaker curve	1				5.2.1	avg. fuse melting time does not overlap circuit breaker clearing time in LT curve
		time-current characteristic	2				Figure 2	Total clearing time of LVPCB w/ max fuse rating
		clearing time	3				Figure 2	Min and Max Clearing time of LVPCB
		time-current characteristic	2				Figure 3	Total clearing time of LVPCB w/ min fuse rating
		clearing time	1				Figure 3	Total clearing time of LVPCB

Time Current Curve Use

LVSD Summary of Use (Draft/Published Docs)

All “curve” or “characteristic” references

Sum of Term Count	Column Labels			
Row Labels	IEEE Std C37.17-2022	IEEE Std C37.27-D3	IEEE Std PC37.13D12	Grand Total
circuit breaker curve		1		1
clearing time	3	9	15	27
instantaneous tripping characteristics		1		1
time-current characteristic	2	7	11	20
time-current characteristic curve			1	1
time-current curve	1		19	20
time-overcurrent characteristic	4			4
Grand Total	**10**	**18**	**46**	**74**

Normative “curve” or “characteristic” references

Sum of Term Count	Column Labels			
Row Labels	IEEE Std C37.17-2022	IEEE Std C37.27-D3	IEEE Std PC37.13D12	Grand Total
circuit breaker curve		1		1
clearing time		9	13	22
instantaneous tripping characteristics		1		1
time-current characteristic	2	7	1	10
time-current characteristic curve			1	1
time-current curve	1		8	9
Grand Total	**3**	**18**	**23**	**44**

Industry (Pub. Docs)

0	(TOC) Requires or states mfg'r to supply publised curve with breaker opening time
0	(TOC) S/C type testing based on trip unit curves
0	(TOC) Calibration/Conformance testing based on trip unit curves
0	(TCC) Type testing based on LVPCB clearing time
44	(TCC) Requires mfg'r claim or mfg'r to supply published TCC with min/max LVPCB clearing times

(#) = Term count usage in published documents
(TOC) = time-overcurrent characteristic curve (trip system + breaker opening time)
(TCC) = time-current curve (circuit breaker clearing time + trip system + breaker opening time)

Document #	Title	Specific Term	Term Count	Total Usage	Reference Type	Usage Type	Clause References	Topic Area
1584-2018	IEEE Guide for Performaning Arc-Flash Hazard Calculations	TCC = time current characteristic	1	15	Normative	8	3.2	Acronym and Abbreviation
		time-current curve	2				6.2	Collect published information on compoonents (infers LVPCB)
		clearing time	1				6.2	Poor maintenance may have increased fault clearing time.
		clearing time	1				6.8	Arc passing through each overcurrent protection device's clearing time is required
		clearing time	3				6.9.1	Typically, the last protective device clearing time will clear the arcing event.
		time-current curve	2				6.9.1	Use up-date TCC and when mfgr curves have tolerance use the longest time duration of curve
		clearing time	2				6.9.3	Mfgr TCC for LVPCB with integral trip device include both tripping time and clearing time
		time-current curve	2				6.9.3	Mfgr TCC for LVPCB with integral trip device include both tripping time and clearing time
		time-current curve	1				6.9.4	Non-integral trip device need to add protective device time and LVPCB operating time
		time-current curve	1		Informative	7	I.1	TCC not required for modeling arc flash. Data based on four mfgrs
		time-current characteristic curve	1				I.1	TCC not required for modeling arc flash. Data based on four mfgrs
		time-current curve	2				I.2	If TCC curves are available, this data is the preferred method for arc flash calcuations
		time-current curve	2				Table I.1	Use of the TCC end point data and if curve available to use TCC data
		time-current characteristic	1				Figure I.3	Typical TCC circuit breaker curve
		clearing time	2				G.7.8	Model based on arc sustained until clearing time is complete from LVPCB
1584.1	IEEE Guide for the Specification of Scope and Deliverable Requirements for an Arc-Flash Hazard	clearing time	1	6	Normative	2	8	Arc duration is equal to clearing time of protective device (LVPCB)
		clearing time	1				10	Identification of protective device (LVPCB) with its clearing time (AF Study Report)
		clearing time	1		Informative	4	Annex C	AF Study requires the clearing time of the protective device (LVPCB)
		time-current curve	3				Annex C	Use TCC data from LVPCB or protective devices for arc flash incident energy
70	NFPA 70 National Electric Code 2023 Edition	time and current curves	1	13	Normative	13	708.52 (C)	Verify GF coordination by using TCC and properly setting of the equipment
		time-current protection characteristic	1				240.92 (E)	Primary side of xfmr protection using TCC data with a multiplier
		time-current characteristic	1				450.5 (3)	Tie circuit protection: automatic circuit breakers having comparable TCC characteristics
		time-current characteristic	1				517.17 (C)	GF: separation of GF protection TCC characteristic shall conform to mfg recommendations
		time-current coordination	1				245.26 (A)	Alternate location of overcurrent protection when fault studies and TCC analysis supports
		documentation	1				240.67 (A)	Documentation shall be available to demonstrate a Arc Energy Reduction method
		clearing time	1				240.67 (A)	Documentation to reduce the clearing time along with value setting below arcing current
		clearing time	2				240.67 (B)	Method to Reduce Clearing Time ; allows worker to set disconnect switch to reduce clearing time
		documentation	1				240.87 (A)	Documentation shall be available to demonstrate a Arc Energy Reduction method
		clearing time	1				240.87 (A)	Documentation to reduce the clearing time along with value setting below arcing current
		clearing time	2				240.87 (B)	Method to Reduce Clearing Time ; allows worker to set disconnect switch to reduce clearing time
70E	NFPA Standard for Electrical Safety in the Workplace 2024	characteristic of the overcurrent protective device	1	5	Normative	5	130.5 (G)	Incident Energy Method Analysis:characteristic of the overcurrent device
		clearing time	4				130.5 (G)	fault clearing time used in calculations ; clearing time cant exceed AR equipment duration

Time Current Curve Use

Industry Use (Outside LVSD)

All “curve” or “characteristic” references

Sum of Term Count	Column Labels				
Row Labels	IEEE Std 1584.1-2022	IEEE Std 1584-2018	NFPA Std 70-2023	NFPA Std 70E-2023	Grand Total
characteristic of the overcurrent protective device				1	1
clearing time	3	9	6	4	22
documentation			2		2
TCC = time current characteristic		1			1
time and current curves			1		1
time-current characteristic		1	2		3
time-current characteristic curve		1			1
time-current coordination			1		1
time-current curve	3	12			15
time-current protection characteristic			1		1
Grand Total	**6**	**24**	**13**	**5**	**48**

Normative “curve” or “characteristic” references

Sum of Term Count	Column Labels				
Row Labels	IEEE Std 1584.1-2022	IEEE Std 1584-2018	NFPA Std 70-2023	NFPA Std 70E-2023	Grand Total
characteristic of the overcurrent protective device				1	1
clearing time	2	7	6	4	19
documentation			2		2
TCC = time current characteristic		1			1
time and current curves			1		1
time-current characteristic			2		2
time-current coordination			1		1
time-current curve		7			7
time-current protection characteristic			1		1
Grand Total	**2**	**15**	**13**	**5**	**35**

Time Current Curve Use

Power Circuit Breaker Industry Examples

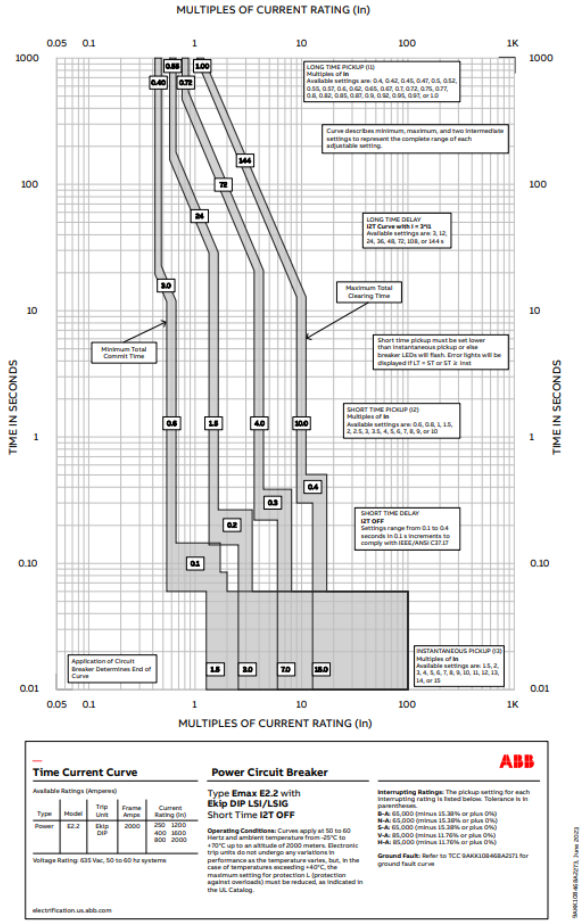


ABB: [E2.2 DIP: 250-2000A Time Current Curve (abb.com)]

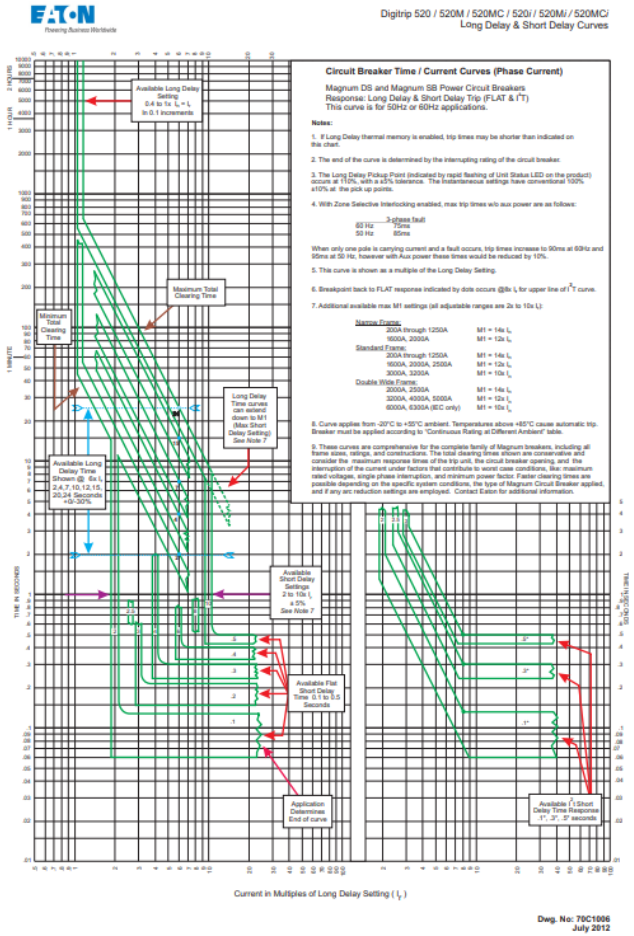
Term: Time Current Curve
Left Curve = Min. Total Commit Time
Right Curve = Max. Total Clearing Time

EasyPower & ABB Webinar:
[Molded Case Circuit Breaker Trip Units, Types and Applications (youtube.com)*]

*Discussion includes LVPCB products

~25:00-minute mark of webinar:

"…Some of you may not be familiar with the time current curve. Essentially all it is a graph that shows you what amperage and what time a circuit breaker is expected to trip…"

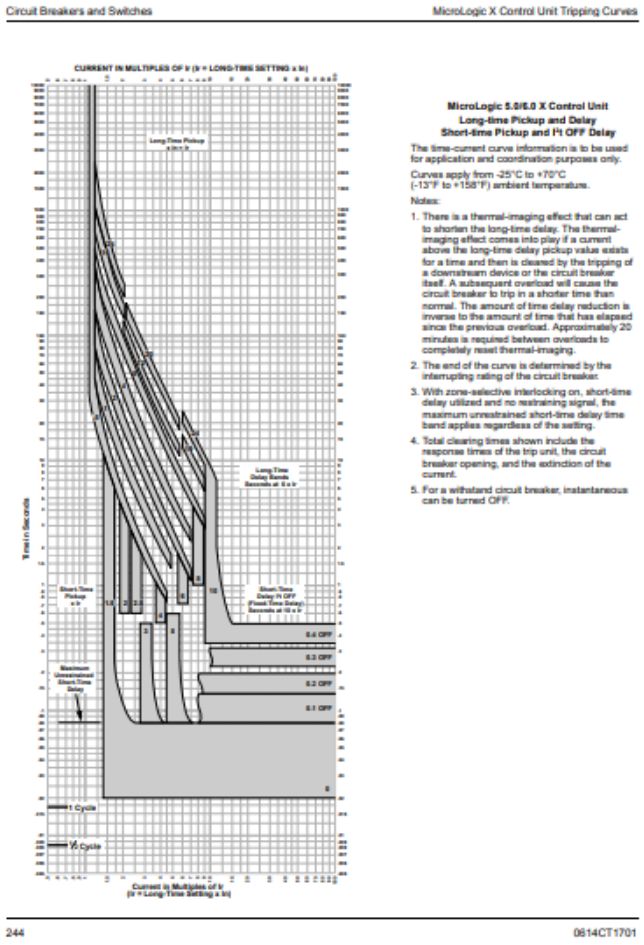


Eaton: [5720B80.cdr (eaton.com)]

Term: Circuit Breaker Time/Current Curve
Left Curve = Min. Total Clearing Time
Right Curve = Max. Total Clearing Time

Time Current Curve Use

Power Circuit Breaker Industry Examples



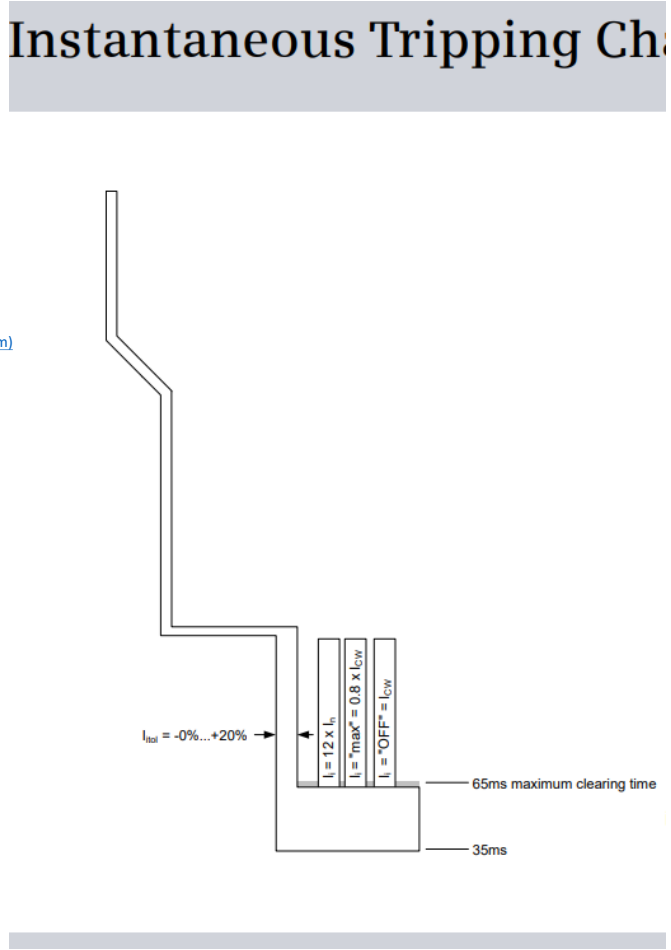
Schneider: [MasterPacT™ MTZ (schneider-electric.com)]

Term: Tripping Curves
Left Curve = Min. Total Clearing Time
Right Curve = Max. Total Clearing Time

Square D by Schneider Electric:
[Time Current Curve Basics: Determining Circuit Breaker Trip Times (youtube.com)]

~4:00-minute mark of webinar:

"…Using the logarithmic scale on time, we see a trip will happen sometime between 3 and 8 seconds…"

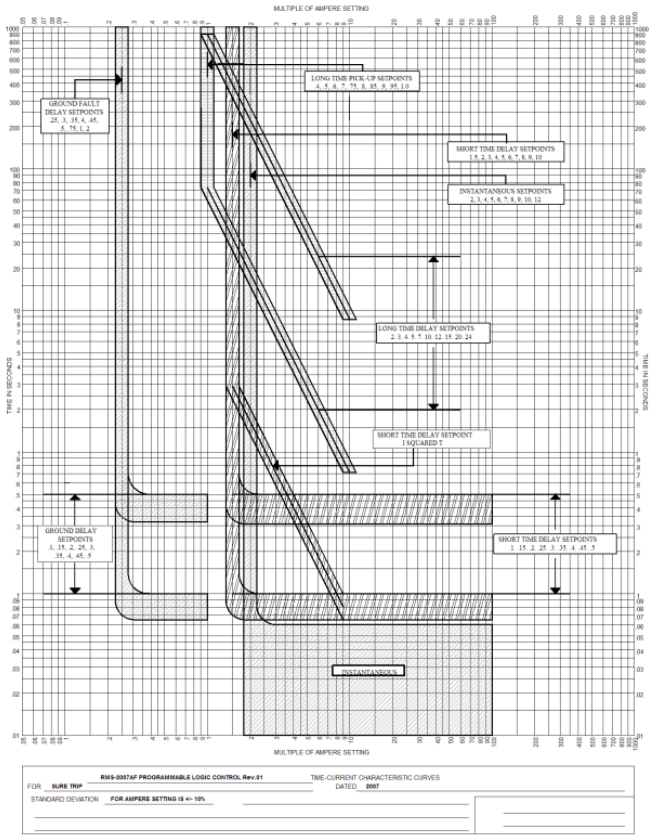


Siemens: [Microsoft Word - Instantaneous 2012-08-10c.doc]

Term: Tripping Characteristic
Left Curve = Infers Min. Clearing Time
Right Curve = Max. Clearing Time

Time Current Curve Use

Trip System Industry Examples

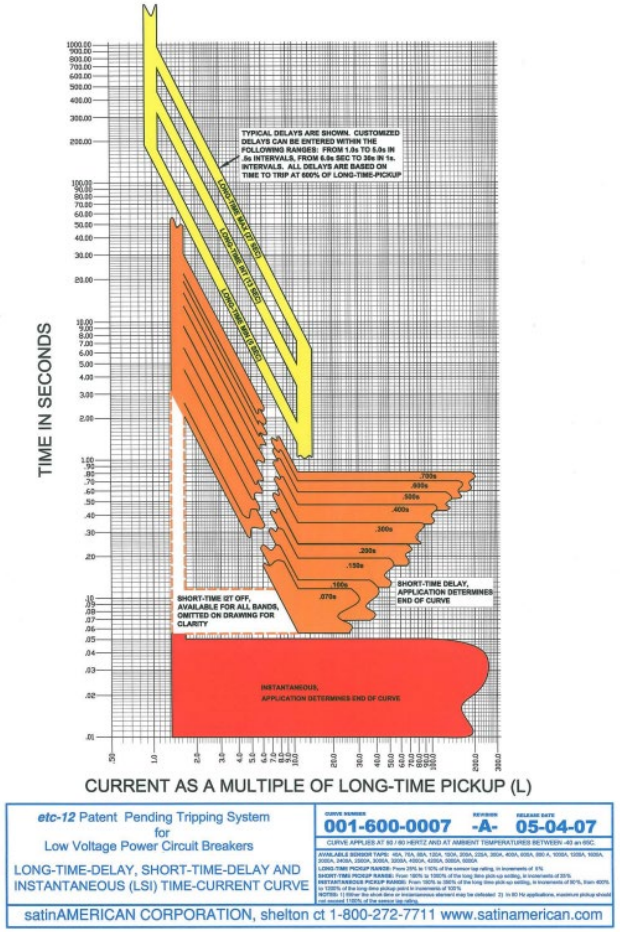


SureTrip:
Microsoft Word - RMS-2007AF Trip Curves.doc (suretrip.com)

Term: Time-Current Characteristic Curve
Left Curve = Min. Trip Unit Response?
Right Curve = Max. Trip Unit Response?

Breaker Clearing Time?
Breaker Opening Time?
Trip Unit Response Only?

Requires 20% current flowing thru LVPCB.
Does this mean clearing time included?



ETC Technologies:
lsi-tcc.pdf (etctech.com)

Term: Time-Current Curve
Left Curve = Min. Trip Unit Response?
Right Curve = Max. trip Unit Response?

Breaker Clearing Time?
Breaker Opening Time?
Trip Unit Response Only?

Time Current Curve Definition

IEEE Dictionary (searching for “curve”)

- **strength-duration curve**
- **strength-frequency curve**
- **temperature de-rating curve**
- **temperature derating curve**
- **thermal limit curve (cold)**
- **thermal limit curve (hot)**
- **time-current curve**
  - A graphical plot (in log-log format) of curve that indicates the opening time of the fuse for various values of current. The curve can be either average melt, minimum melt, or total clearing.

  FOUND IN

  IEEE Std 3004.3-2020 | View Definitions
- **track crest curve**
- **transfer curve**
- **transition curve**

45 terms using “curve”
None apply to LVSD TCC

Time Current Curve Definition

IEEE Dictionary (searching for “characteristic”)

- receiver operating characteristic (ROC) curves
- receiver operating characteristics curve (ROC)
- reset characteristics
- single-event characteristic
- system characteristic
- time-current-characteristic (TCC)

  - The correlated values of time and current that designate the performance of all or a stated portion of the functions of the fuse. The time-current-characteristics for fuses are generally presented as a curve. The most useful curves plot the minimum melting time and maximum (total) clearing time versus current. For some applications, average melting and maximum melting data may also be useful.

  FOUND IN

  IEEE Std C37.41-2016 (Revision of IEEE Std C37.41-2008) | View Definitions

34 terms using “characteristic”
None apply to LVSD TCC

Proposed Definitions for PC37.13

Time-current curve (of a mechanical switching device): The correlated values of time and current that designate the performance of all or a stated portion of the functions of a mechanical switching device. The time current curve for a mechanical switching device are generally presented as a curve and include the minimum and maximum clearing time of the switching device.

time-overcurrent characteristic curve (of a direct-acting overcurrent trip system to trip device): The correlated values of time and current that designate the performance of all or a stated portion of the functions of a direct-acting over-current trip device, or trip system, of a mechanical switching device. The time-overcurrent characteristic curve for a trip device or trip system are generally presented as a curve and include the minimum and maximum opening time of the mechanical switching device. *See:* **time current curve**.

trip system response curve: The correlated values of time and current that designate the performance of all or a stated portion of the functions of a direct-acting overcurrent trip device or trip device. The trip system response curve for a trip device or trip system are generally presented as a curve and does not include the opening or clearing times of the mechanical switching device. *See:* **time-overcurrent characteristic curve**.