Arc Flash Incident Energy (IE) and Arcing Current (I_{arc}) Calculators User Manual

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1.0 Files

The calculator files are as follows:

1) "IEEE ExcelCalculator_V 2.6.6__mm_08_29_2019.xlsm" estimates the **Average Arcing Current**, Incident Energy, and Protection Boundary based upon your input information.
2) "IEEE ExcelCalculator_V 2.6.6_M_mm_08_29_2019.xlsm" estimates **Lower Bound Arcing Current**, Incident Energy, and Protection Boundary based upon your input information.

2.0 Abstract

The Excel spreadsheet files provide access to a functional Arc Flash Calculator that includes various equipment configurations, Incident Energy and voltage ranges. The following five equipment configurations are provided:

1) Vertical Configuration, Electrodes in the Box (VCB)
2) Vertical Configuration with Barrier. Electrodes in the Box (VCBB)
3) Horizontal Configuration, Electrodes in the Box (HCB)
4) Vertical Configuration, Electrodes in the Open Air (VOA)
5) Horizontal Configuration, Electrodes in the Open Air (HOA)

As equipment's configuration and input fields are presented, the user will be able to key entry-specific data using the proper input fields and/or pull down menus provided. All variables and constants are defined. When input for all of the variables has been entered, and the proper equipment configuration has been selected, the Calculator will solve the equations and the answer is returned.

The Calculator function within the spreadsheets provides quick access to data analysis that could increase the productivity for the user.

3.0 Instructions

When using this calculator, the user accepts the assumption that a sustainable arc happens in the user's defined configuration(s). There is a total of three TABs in the excel spreadsheet files, which are as follows:

1) Base Information:
This TAB includes all the detailed information about the Excel calculator, such as Release Date, Version, and Range of Models, etc.

2) Arc Flash Calculator:
This TAB provides the Incident Energy (IE), Arcing Current (I_{arc}), and Protection Boundary estimation for a single case based on user input data.

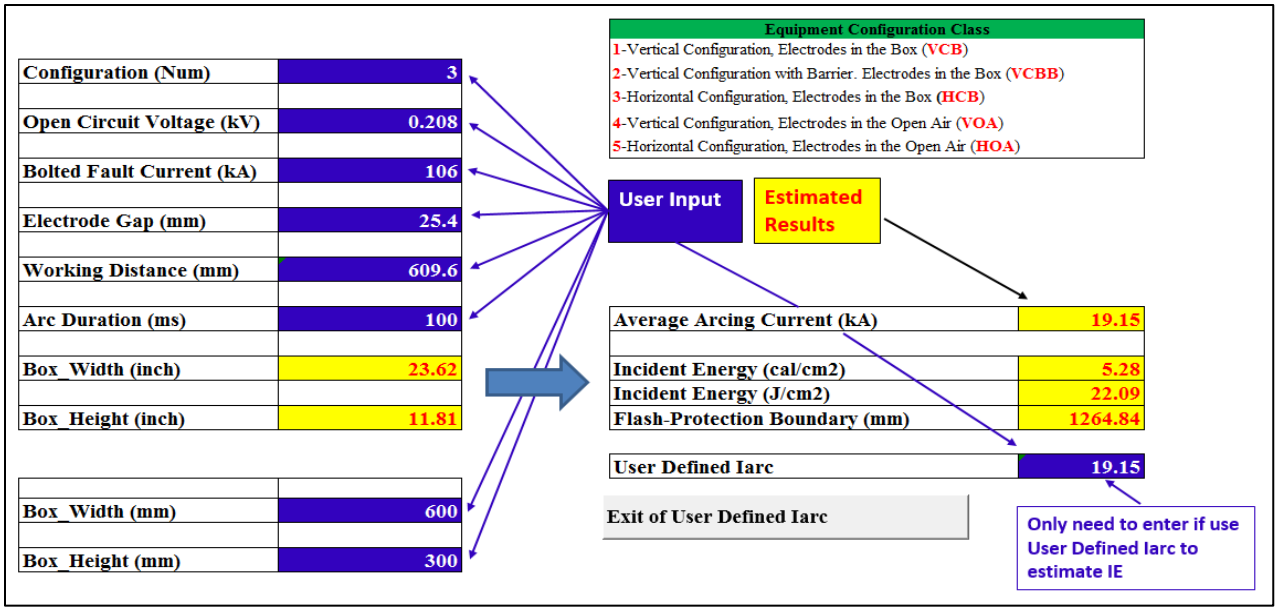
Please enter data in the Blue Cells (see diagram below), and please follow the description in the Base Information TAB.

IMPORTANT NOTE—The width of the enclosure must be larger than four times the gap.

The estimated results corresponding to each title are shown in the Yellow Cells, please DO NOT EDIT THOSE FIELDS.

For VCB, VCBB and HCB configurations, the model is designed for IE estimation outside of the enclosure.

The IE can be estimated either by calculated I_{arc} or User Defined I_{arc}. The user will have to click "Exit of User Defined I_{arc}" to use calculated I_{arc} after entering User Defined I_{arc}. The User Defined I_{arc} allows the user to enter the let-through current of current limiting fuse when performing arc flash hazard analysis.



3) Calculate Table:
This TAB provides the Incident Energy (IE), Arcing Current (I_{arc}), and Protection Boundary estimation for **multiple cases** at the same time based on user input data.

Please enter the data from column A to H (see diagram that follows) and select proper enclosure depth (Typical or Shallow) at column K as needed. The estimated Arcing Current (I_{arc}), Incident Energy (IE), and Protection Boundary (PB) are shown from column IK to IP.

Column A – H: User Input;
Column K: Select the Depth (Typical or Shallow) from Pull-Down Menu as Needed
Column IK – IP: Estimated Results

A	B	C	D	E	F	G	H	K	IK	IN	IO	IP
Required Inputs									Estimated Results			
Configuration	Open Circuit Voltage	Bolted Fault Current	Electrode Gap	Working Distance	Arc Duration	Box Width	Box Height	Box Depth	Average Arcing Current	Incident Energy		Flash-Protection Boundary
(Num)	(kV)	(kA)	(mm)	(mm)	(ms)	(mm)	(mm)	(inch)	(kA)	(cal/cm2)	(J/cm2)	(mm)
3	0.208	106	25.4	609.6	100	600	300		19.15	5.28	22.09	1264.84
2	0.208	20	12.7	457.2	100	500	500	Shallow(<=8 inch)	11.79	2.75	11.49	722.56
4	0.25	20	12.7	457.2	100	507	507		11.18	1.10	4.59	432.30
1	0.25	20	12.7	457.2	100	500	500	Typical	12.16	2.35	9.85	697.07
2	0.25	20	12.7	457.2	100	400	500	Shallow(<=8 inch)	13.19	3.04	12.73	764.58
5	0.25	20	12.7	457.2	100	1016	500		9.23	1.92	8.05	579.47
4	0.25	20	12.7	457.2	100	1016	500		11.18	1.10	4.59	432.30
5	0.25	20	12.7	457.2	100	1016	500		9.23	1.92	8.05	579.47
3	0.25	20	12.7	457.2	100	1016	500		11.86	4.08	17.05	835.00

4.0 Tips for calculator use

STEP 1: Perform Short Circuit Analysis

1) Short circuit analysis is beyond the scope of this calculator. It is the user's responsibility to obtain the short circuit current.

2) Since the level of the short circuit current configuration is a crucial dependent, the user may want to investigate possible short circuit current with different system configurations.

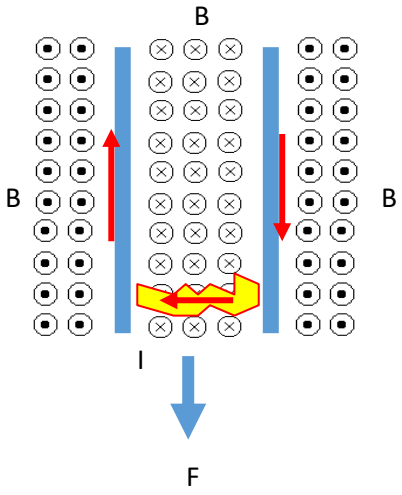
STEP 2: Determine the Configuration

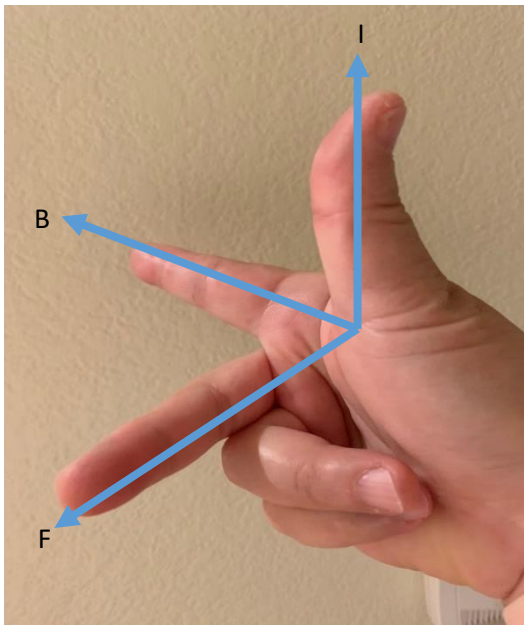
1) This calculator offers five (5) different electrodes configurations (VCB, VCBB, VOA, HCB, and HOA) for arcing current, incident energy, and protection boundary estimation.

2) It is the user's responsibility to determine which configuration best resembles the studied system. IEEE Std 1584-2018 provides guidelines for the selection process.

3) Trajectory of the plasma is one of the most important factors to select in the configuration. The user can refer to the following figure (Righthand rule) to determine the trajectory of the plasma where "B" is the flux, "I" is the arcing current, and "F" is the direction of the force.

4) Based upon the system configuration and equipment arrangement, it is the responsibility of the user to determine where the arc flash incident may happen.





STEP 3: Other Parameters

The user should enter other parameters in the designated fields such as open circuit voltage (line-to-line voltage), gap of the electrodes, working distance, and the dimension of the enclosure.

1) **Enclosure.** If the open circuit voltage is less than 600 V and both the enclosure width and height are less than 20 inches, the user will have to determine whether it is "Shallow" (if the enclosure depth is ≤8 inches) or "Typical" (if the enclosure depth is >8 inches).

2) **Bolted Fault Current.** The user should enter the value of the bolted fault current at the location of the arc flash incident.

3) **Arcing Current.** The following two calculators are provided in this package:

   — "IEEE ExcelCalculator_V 2.6.6__mm_08_29_2019.xlsm" to estimate the **Average Arcing Current**, Incident Energy, and Protection Boundary.

   — "IEEE ExcelCalculator_V 2.6.6_M_mm_08_29_2019.xlsm" to estimate **Lower Bound Arcing Current**, Incident Energy, and Protection Boundary.

   Since the level of arcing current may affect the operation time (Arc Duration) of the arc flash incident, lower arcing current does not translate into lower incident energy.

4) **Arc Duration.** Based upon the characteristics of the protective device, the user should use the value of the current passing through the protective device during the arc flash incident to determine the arc duration. Due to possible short circuit current contribution from other sources, the current passing through the protective device may not be equal to the estimated arcing current from the calculator.

STEP 4: User Defined I_{arc} (Option)

1) To study the performance of the current limiting fuse, the calculator offers the user the option to enter the value of the "Let-Through" current into the field "User Defined I_{arc}".

2) Instead of using the estimated arcing current, the calculator will use the User Defined I_{arc} Incident Energy and Protection Boundary estimation.

3) It is necessary for the user to click "Exit of User Defined I_{arc}" to end this mode of operation.