



Cable Systems

Cable Sizing - Phase

Cable Sizing - Grounding/PE

Cable Ampacity

Electric Shock Calculation

Grounding & Earthing Color Themes

Underground Thermal Analysis

Cable Pulling



Power System Enterprise Solution

ETAP is the most comprehensive analysis platform for the design, simulation, operation, control, optimization, and automation of generation, transmission, distribution, and industrial power systems.

Customize ETAP to fit your needs, from small to large power systems

ETAP Enterprise Suite provides one solution to your power system design, analysis, and operation needs. ETAP offers a comprehensive suite of analysis modules that can be configured to suit your specific needs. This modular approach allows you to purchase only the modules you need.

◆ Featured in this brochure



Cable Systems

Design, Operate, Expansion

Powerful & Easy Tools for Cables Systems



A Dynamic Approach to System Analysis

ETAP Cable Systems help engineers design cable systems to operate to their maximum potential while providing secure and reliable operation. The process is systematic and simple. ETAP contains Cable Thermal Analysis Software, Cable Pulling Software, automatic Cable Ampacity Software, Cable Phase and Grounding/PE Sizing Software, and Electric Shock Software calculations for a complete and wide solution for your cable system needs.

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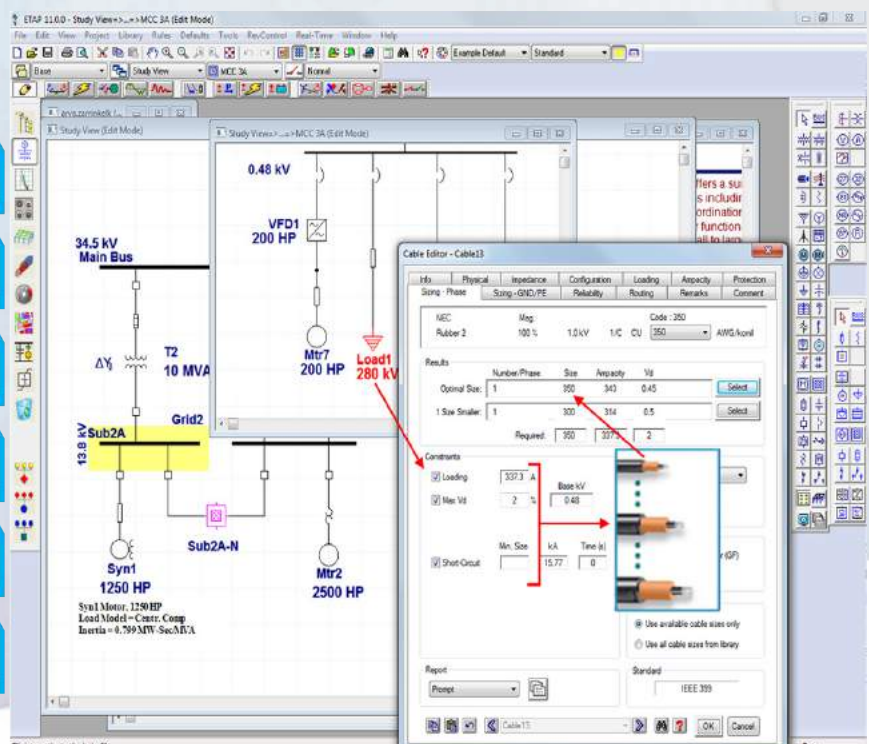
Grounding & Earthing Color Themes

Key Features

- Ampacity, voltage drop, & short circuit options
- Overload protection and Harmonic options
- Optimal & alternative sizes
- Size based on actual loading and/or ratings
- Model Forms and Reports
- Grounding/PE conductor sizing
- Electric shock calculation

Cable Sizing Requirements

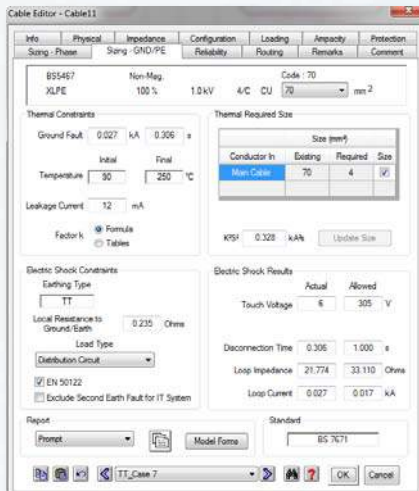
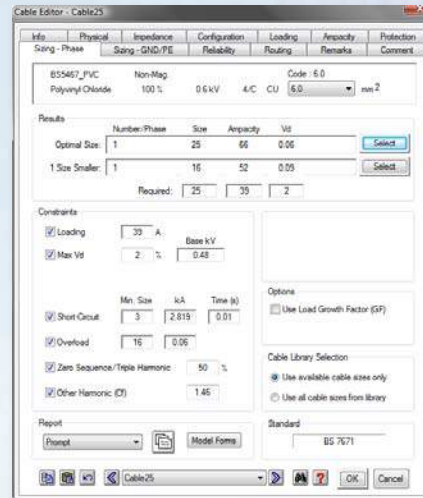
- Ampacity
- Voltage Drop
- Short Circuit
- Motor Start Voltage
- Protective Device
- Harmonics



Cable Sizing - Phase

ETAP Cable Sizing for phase conductor provides various options which can be used as design requirements. These design requirements can be user-defined or automatically determined from load flow, short circuit, and protective device calculation results.

- Cable load ampacity requirement based on operating current (Average or Phase Maximum), FLA of load, branch, or user-defined values
- Maximum voltage drop requirement
- Minimum starting voltage requirement for motor feeder cable
- Short circuit requirement based on system calculation
- Requirement to be compatible with protective devices
- Harmonic requirements



Cable Sizing - Grounding/PE

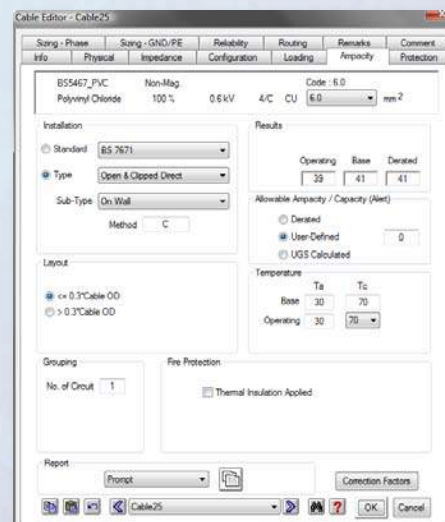
ETAP Cable Sizing for Grounding/PE conductor provides various options which can be used as design requirements. These design requirements can be user-defined or automatically determined from short circuit and protective device calculation results.

- Ground fault current and fault clearing time
- Initial and final conductor temperature
- Impedance from library or typical data
- Material Factor from standard tables or by calculation
- Leakage current consideration

Cable Ampacity

With the new addition of British Standard 7671 and IEC 60364, ETAP 11 now calculates the current carrying capacity of cables under various cable installations and operating conditions based on a number of standards:

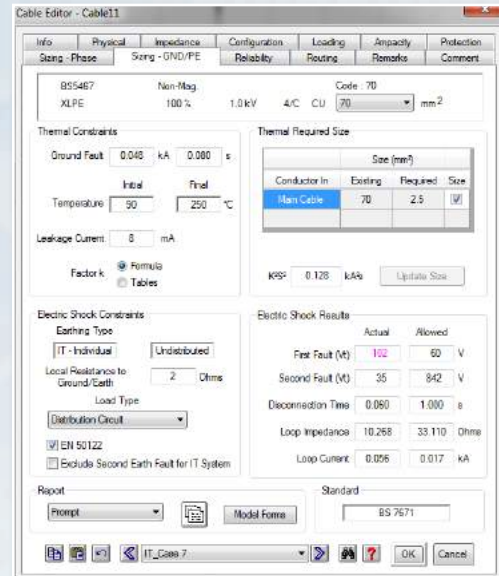
- IEEE 399 IEEE Recommended Practice for Industrial & Commercial Power Systems Analysis
- ICEA P-54-440 Ampacities of Cables in Open-Top Cable Tray
- NEC NFPA 70, National Electrical Code
- BS 7671, British Standard 7671, Requirements for Electrical Installations
- IEC 60364, Electrical Installations of Buildings



Electric Shock Calculation

ETAP Electric Shock calculation provides loop impedance and touch voltage calculation results which are compared with allowed values based on BS 7671, IEC 60364-4-41 or EN 50122. The calculation is for all types of earthing systems: TN-C, TN-C-S, TN-S, TT and IT. Electric Shock calculation considers a variety of design requirements.

- Grounding/PE conductor in main cable
- Auxiliary grounding/PE conductor
- Armor and Structure effect
- Overcurrent Protection and GFI/RCD effect
- Local and source resistance to ground
- First and second fault for IT (Individual, In Group and Collective) earthing systems

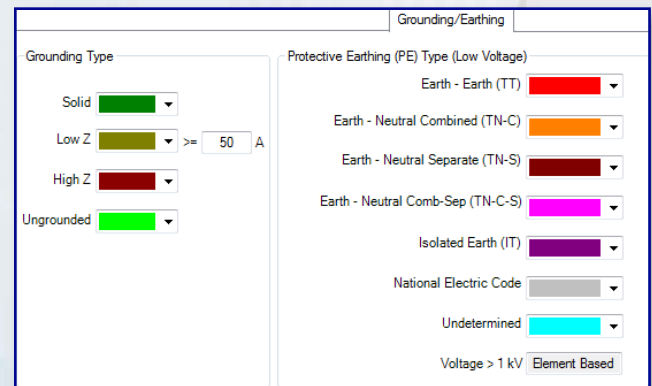


Grounding and Earthing Color Themes

Theme manager gives the ability to quickly determine system neutral grounding and equipment earthing types through pre-defined color codes.

Theme manager will display system neutral grounding colors based on the following grounding types:

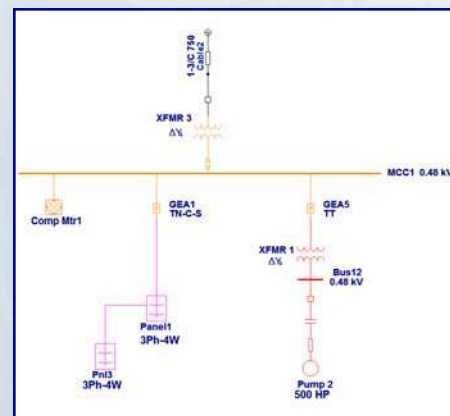
- Solid Grounded
- Low Impedance Grounded
- High Impedance Grounded
- Ungrounded



Theme Manager will also display system equipment earthing colors based on the following earthing types:

- TN-C
- TN-S
- TN-C-S
- TT
- IT

Earthing types can be changed at any point of the low voltage system using an earthing adapter.



Underground Thermal Analysis

The Underground Cable Thermal Analysis module helps engineers to design cable systems to operate to their maximum potential while providing a secure and reliable operation. The advanced graphical interface allows for design of cable raceway systems to meet the existing and future needs by using precise calculations to determine the required cable sizes, their physical capabilities, and maximum derated ampacity. In addition, transient temperature analysis computes temperature profiles for cable currents, reducing the risk of damage to cable systems under emergency conditions.

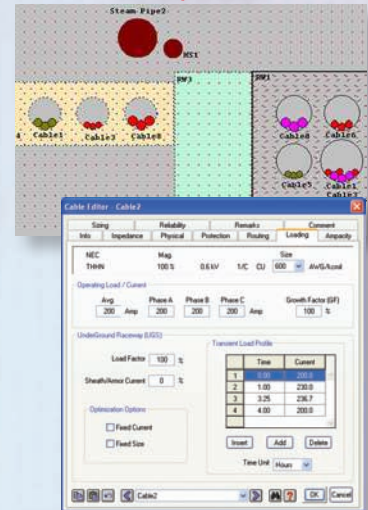
Key Features

- Neher-McGrath Method
- IEC 60287 Method
- Steady-state temperature
- Ampacity optimization
- Automatic cable sizing
- Transient temperature

Reporting

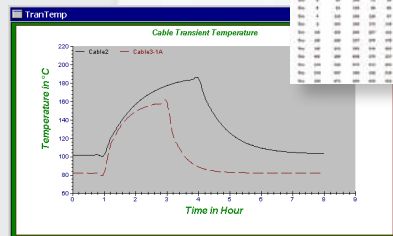
- Flags critical & marginal cable temperatures
- Reports all physical & calculated data
- Use Crystal Reports® for full color, customizable reports
- Export output reports to your favorite word processor
- Graphical display of raceway results

Temperature Analysis



Network Analysis

Line	From	To	Length	Capacity	Current	Temperature	Notes
1	1	2	1000	1000	1000	1000	
2	2	3	1000	1000	1000	1000	
3	3	4	1000	1000	1000	1000	
4	4	5	1000	1000	1000	1000	
5	5	6	1000	1000	1000	1000	
6	6	7	1000	1000	1000	1000	
7	7	8	1000	1000	1000	1000	
8	8	9	1000	1000	1000	1000	
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93	93	94	1000	1000	1000	1000	
94	94	95	1000	1000	1000	1000	
95	95	96	1000	1000	1000	1000	
96	96	97	1000	1000	1000	1000	
97	97	98	1000	1000	1000	1000	
98	98	99	1000	1000	1000	1000	
99	99	100	1000	1000	1000	1000	



Tension Analysis

Flexible Operations

- Multiple raceways
- Multiple external heat sources
- Optimization of new cables in existing raceways
- Cross-sectional analysis
- Duct banks & direct buried raceways
- Integrated with cables in one-line diagrams
- Integrated with load flow results
- Integrated with cable pulling analysis

Capabilities

- Graphical user interface
- Graphical manipulation of raceways, cables, conduits, etc.
- Drag & drop cables from one-line diagrams
- Cables of different sizes in the same raceway
- Separate phases into different conduits or locations
- Unsymmetrical positioning of raceways
- Transient calculations use a dynamic thermal circuit model
- Option to fix cable size and/or loading
- Grounded/ungrounded shielding
- Calculate thermal R, dielectric losses, Yc, Ys, etc.
- User-defined armor cables
- Unbalanced load factors
- Multiple duct banks & direct-buried conduits
- Place raceways in multiple cross-sections

Plotting

- Transient temperature calculations based on load profile
- Option to display multiple cables simultaneously
- Zoom to any detail level
- Export plot data to Microsoft Excel
- Line, bar, 3-D, & scatter plots
- Customize text & axes

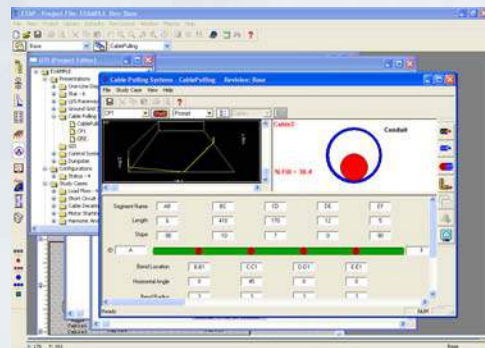
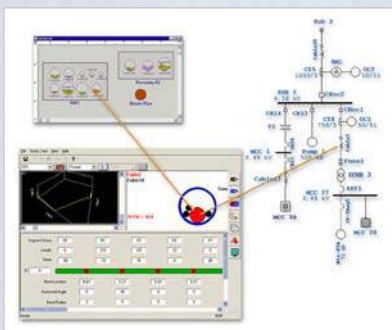
Detailed Modeling for Accurate Results

Cable Pulling

Accurate prediction of cable pulling forces is essential for the proper design of cable systems. This knowledge makes it possible to avoid under-estimated and/or over-conservative design practices to achieve substantial capital savings during construction. The Cable Pulling module accounts for multiple cables of different sizes and allows complex 3-D pulling path geometry. A point-by-point calculation method is performed at every conduit bends and pull points. Both the forward and reverse pulling tensions are calculated for determining the preferred direction of pull.

Key Features

- Integrated with one-line diagram cables
- Integrated with underground raceways cables
- Pull multiple cables
- Completely flexible pull geometry
- Full ETAP Cable Library integration
- Display 3-D pulling path geometry



Reporting


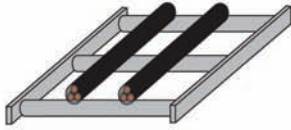
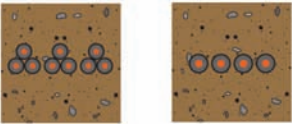
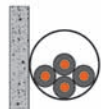


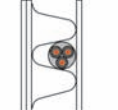
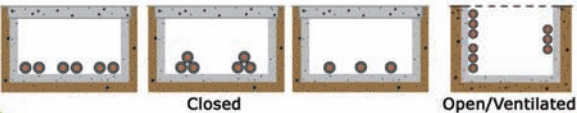
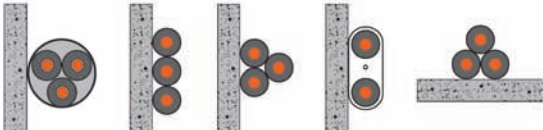
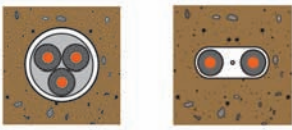

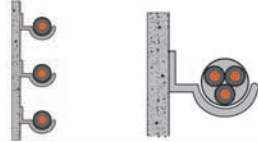
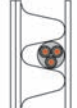

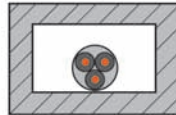
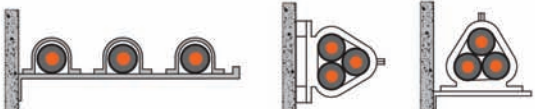





- Fundamental cable pulling results
- Flag cable tensions that exceed limits
- Flag conduit percent fill limits
- Flag non-conforming NEC code requirements
- Graphical display of cable pulling results
- Report sidewall tension, forward pull, & reverse pull including violation flags
- Pulling schematic showing segment & bend plots
- Conduit cross-section showing conduit & cable plots

3-D Graphical Display

Capabilities

- Calculate forward & reverse pulling tensions
- Calculate pulling tensions at all bend points
- Calculate the maximum tension limited by sidewall pressures
- Calculate the maximum allowable pulling tension
- Calculate the conduit percent fill
- Calculate the total length of run (pull)
- Compare the maximum tension limitations against the calculated pulling tensions
- Evaluate possible conduit jamming
- Allow segments to have non-zero slopes as well as horizontal bends (non-planer segments)
- Account for the equivalent tension for cables pulled from reels
- Provide tolerance for cable weights & outside diameters
- Provide reduction factors for calculating allowable tension when pulling multiple cables
- Cradled & triangular cable configurations
- Summary & alert windows

Cable Installations

<p>U/G Duct Bank</p> 	<p>Ladder</p> 
<p>U/G Direct Buried</p> 	<p>A/G Conduit</p> <div style="display: flex; justify-content: space-around;"> <div>  <p>Single Core Cable No Thermal Insulation</p> </div> <div>  <p>Multi Core Cable</p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div>  <p>Single Core Cable Thermal Insulation on One Side</p> </div> <div>  <p>Multi Core Cable Thermal Insulation on One Side</p> </div> </div>
<p>Trenches</p> 	<p>Open and Clipped Direct</p> 
<p>Embedded Direct</p> 	<p>Air Drop - Suspended</p> 
<p>Brackets</p> 	<p>Building Voids</p> <div style="display: flex; justify-content: space-around;"> <div>  <p>Thermal Insulation on One Side</p> </div> <div>  <p>No Thermal Insulation</p> </div> <div>  <p>No Thermal Insulation</p> </div> </div>
<p>Cleats</p> 	<p>Trunking</p> <div style="display: flex; justify-content: space-around;"> <div>  <p>On Wall or Suspended</p> </div> <div>  <p>Flush Floor</p> </div> <div>  <p>Skirting</p> </div> </div>
<p>A/G Trays</p> <div style="display: flex; justify-content: space-around;"> <div>  <p>Maintained Spacing</p> </div> <div>  <p>Without Tray Top Cover</p> </div> </div>	

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Quality Assurance Commitment

ETAP is Verified and Validated (V&V) against field results, real system measurements, established programs, and hand calculations to ensure its technical accuracy. Each release of ETAP undergoes a complete V&V process using thousands of test cases for each and every calculation module. ETAP Quality Assurance program is specifically dedicated to meeting the requirements of:



ISO 9001:2009

10 CFR 21

ASME NQA-1

CAN/CSA-Q396.1.2

10 CFR 50 Appendix B

ANSI/ASME N45.2

ANSI/IEEE 730.1

ANSI N45.22

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