How to Properly Select Copperclad Steel

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Introduction

AFL Copperclad Steel (CCS) cables are a theft-deterrent alternative for traditional copper grounding cables. Copper is the preferred material of choice for grounding applications given its conductivity; but due to its high resale value, it is often the target of theft. Copperclad Steel provides a solution to this problem by combining the necessary electrical properties of copper, with the strength (and low resale value) of steel. When making the transition from copper to CCS cables, it can often be difficult to know which size to choose given the properties for a similar sized copper and CCS cable are not the same. A few methods exist to size CCS each with its own advantages and disadvantages, all of which are discussed below, in addition to the differences between Dead Soft Annealed (DSA) and High Strength (HS/EHS) options.

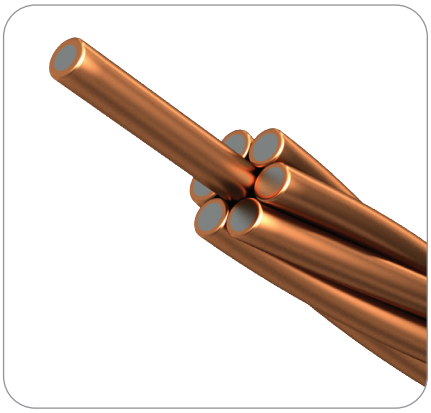


Figure 1 – 7-Strand Copperclad Steel

CCS Sizing Methods

Best: Fault Current Design

AFL recommends using the fault current of the system to select the properly sized CCS. Following this method ensures that the correct CCS is selected and that it is not oversized or undersized as with the next two methods. This method does require knowledge of the system's fault current rating which might not always be available, so in that case, use the fault current equivalent method.

Safest: Fault Current Equivalent

The safest method is to select a CCS cable based on the fault current rating of the existing copper cables in the system. While this method will maintain fault capability, there is one downside. Copper cables are often upsized to increase the strength of the cable which is no longer needed with CCS due to the inherent strength of the steel. The oversized copper cable will have a larger fault rating than what is needed for the system, and using that rating to determine a CCS size will result in a larger, oversized CCS cable. This method is effective in maintaining fault current capability, but it may result in oversized CCS cables.

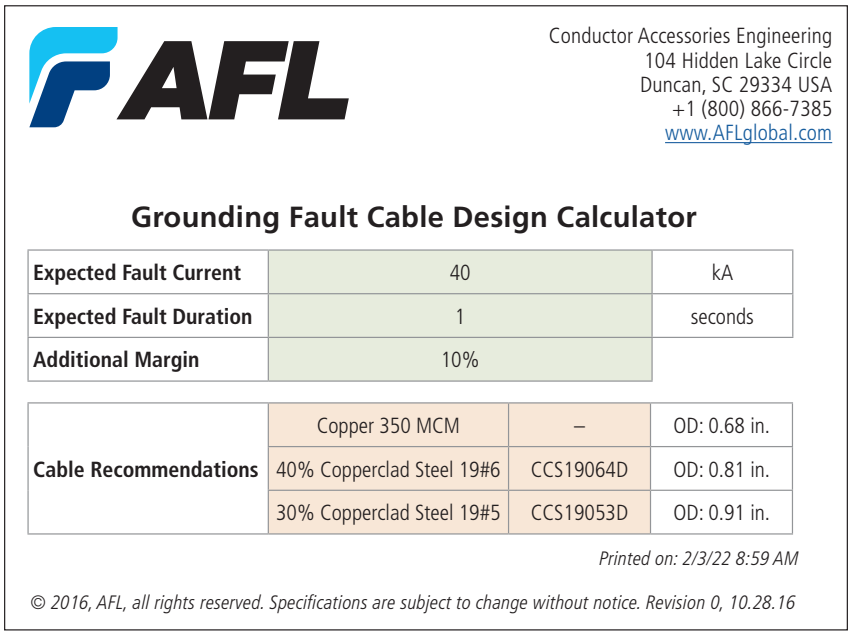
Simplest: Diameter Equivalent

The simplest method involves selecting the CCS cable based on the diameter of the copper cable. This will not require new connectors or accessories, but instead will result in a 30-40% reduction of fault capability. ***This method of CCS sizing is not recommended by AFL.***

An example of each sizing method is shown in the scenario below.
(Fault currents are based on 40°C ambient temperature and 1 second fault. All CCS cables are 40% DSA.)

A system with a 40 kA fault current is using 400 MCM (0.73") Cu cables for grounding. The 400 MCM copper has a fault rating of 56.6 kA, well above what is needed for the system. The diameter equivalent CCS cable would be 19#7 (0.72") with a 37.8 kA fault rating. The fault current equivalent would be 19#5 (60.1 kA) which has a diameter of 0.91". The diameter equivalent method results in a significant reduction in fault capability which may raise safety concerns. The fault current equivalent would have no fault current safety concerns, but the CCS cable would be much larger than what is needed for the system. The final and best method would result in a perfectly sized CCS cable based on the system's fault current rating. For this system, the ideal CCS cable would be 19#6 which has a fault current rating of 47.7 kA and a diameter of 0.81".

AFL offers a Grounding Fault Cable Design Calculator, a ZIP file that can be downloaded HERE. The ideal cable results based on the example above are shown in the calculator below (Figure 2).



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Grounding Fault Cable Design Calculator

Expected Fault Current	40	kA
Expected Fault Duration	1	seconds
Additional Margin	10%	

Cable Recommendations	Copper 350 MCM	–	OD: 0.68 in.
	40% Copperclad Steel 19#6	CCS19064D	OD: 0.81 in.
	30% Copperclad Steel 19#5	CCS19053D	OD: 0.91 in.

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Figure 2 – Grounding Fault Cable Design Calculator

Dead Soft Annealed vs. High Strength/Extra High Strength

It is also important to differentiate between Dead Soft Annealed (DSA) and High Strength/Extra High Strength (HS/EHS) cables when selecting CCS for an application. DSA cables are flexible and easy to handle during preparation and installation while HS/EHS cables are stiffer. HS/EHS cables are commonly used for tensioned applications such as overhead ground wire or messenger wire where the strong mechanical properties of steel are necessary. Both options are offered in 30% and 40% IACS conductivity with the only difference being the strength. Selecting between DSA and HS/EHS CCS cables ultimately depends on the requirements of the application.

For more information on AFL Copperclad Steel, please contact Andrew Leigh.