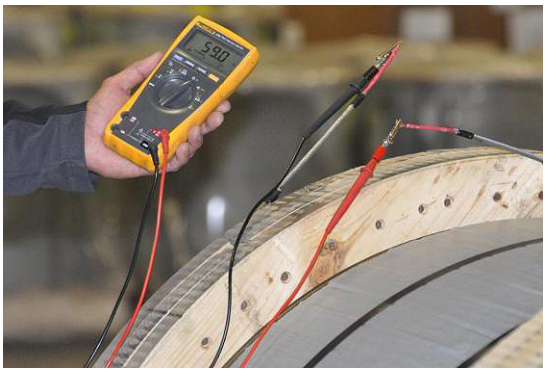
QUALITY WIRELINE

Cable Length Determination

There are many times when there is a need to verify the cable. Some reasons include:

- when removing the cut cable, being unclear about its length,
- verification of the cable record book,
- checking a cable length in the yard or
- just being sure you have enough line to get to the bottom.

Whatever the reason, having a quick, easy, and accurate means of determining the cable length is invaluable. This technical bulletin outlines the formulae for accurately determining the length using only an ohm meter and access to both ends of the cable.



For best results, use a good quality meter with 5-digit resolution, and follow these steps:

- Short the meter test leads and record this resistance: R_L (Ω).
- Measure end-to-end cable conductor resistance plus the test leads resistance: R_M (Ω).
- Total cable conductor resistance is $R_T = (R_M - R_L)$ at shop temperature (Ω).
- Listed on the final inspection report supplied with cable is R_K, which is the cable resistance /1000 ft. @ 68°F.

Calculate cable length:

$L = (R_T / R_K) \times (458 / (390 + T)) \times 1000$

L = Length of the cable in feet

-390°F is the inferred zero resistance temperature

T = Shop temperature at the cable location (°F)

Metric Formulae:

$L = (R_T / R_K) \times (254 / (234 + T)) \times 1000$

L = Length of the cable in meters

T = Shop temperature at the cable location (°C)

R_K = is the resistance of the center conductor per km at 20°C

Example: 1-A-224-12/18-G (Sample Cable)

R_L = 1.50 Ohms

R_M = 64.65 Ohms

R_T = 64.65 - 1.50 = 63.15 Ω

R_K = 4.11 Ω/1000 ft.

T = 42°F

$L = (R_T / R_K) \times (458/(390+T) \times (1000)$

$L = (63.15/4.11) \times (458/(390+42)) \times (1000)$

L = 16,280 feet, length of the cable

The component of the imperial formulae (458/(390+T)) is used to temperature compensate the resistance back to 68°F where "R_K" was calculated. The cable length error could be very significant if the temperature compensation was not performed. The graph on the following page shows the error in cable length that could occur due to not temperature compensating. The example is a 7/32-in. mono-conductor, 25,860 ft. in length. Determining the length if temperature compensation was not accounted for would range from 23,000 ft. at 110°F in the summer heat to 33,000 ft. in northern winters. Clearly, the error is not insignificant.

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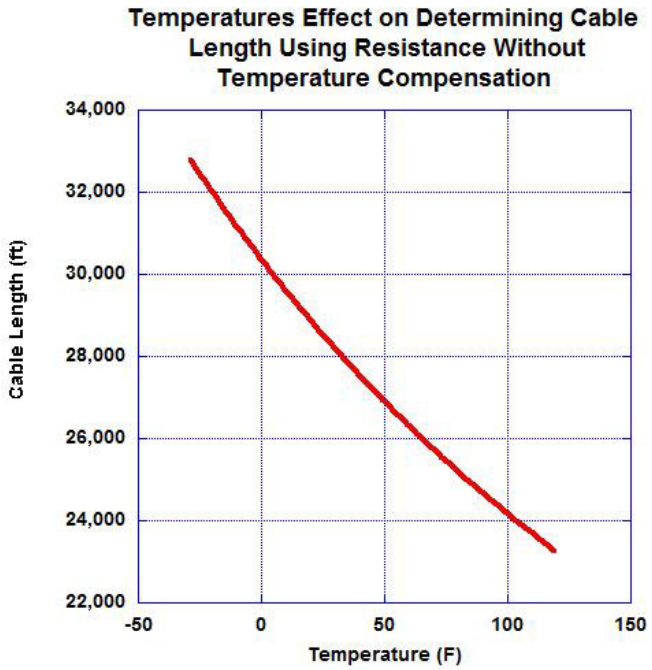

"R_K" can be found from three sources:

1) An average value of "R_K" (DC Conductor Resistance) found on the cable spec sheet should only be used if the actual calculated values cannot be found.

2) Each Quality cable comes with a Quality Certificate which contains the actual value of "R_K" as determined at the manufacturing plant.

3) When the cable is first purchased and installed, the resistance (R_i), length (L_i), and temperature (T_i) should be recorded in the cable record book, and "r" should be calculated using the following formulae:

$R_K = (R_i / L_i) \times 458 / (390 + T_i) \times 1000$

Example:

L_i = 25,100 ft R_i = 260.2 Ω T_i = 77°F
$R_K = (R_i / L_i) \times 458 / (390 + T_i) \times 1000$
R_K = 10.1 Ω/kft (this is the value of "R_K" that should be recorded in the cable record book)

Metric Formulae:

$R_K = (R_i / L_i) \times 254 / (234 + T_i) \times 1000$

T_i = T°C, L_i = m, R_i = Ω, R_K = Ω/km

You can go online to the FET|Quality Wireline resources page to find two applications under "Cable Specifications & Calculators" that will be useful to you with your calculations:

1) The Unit Converter converts any engineering units desired.

2) The Cable Length calculator allows you to select the cable type and input the resistance and ambient temperature to calculate the cable length. For better accuracy, over-ride the cable type and directly input the value of "R_K" as explained above.

Calculate Cable Length Using the **Average Theoretical Resistance per Thousand Feet (meters)**

Imperial Units			Metric Units		
SELECT CABLE SIZE	.224 Alloy		SELECT CABLE SIZE	0.224	
INPUT CABLE RESISTANCE	168.3	Ω ohms	INPUT CABLE RESISTANCE	88	Ω ohms
INPUT AIR TEMPERATURE	85	° F	INPUT AIR TEMPERATURE	24	° C
CONVERTING FACTOR	0.9642		CONVERTING FACTOR	0.9845	
AVERAGE CABLE RESISTANCE PER 1000 FT	6.7	Ω/Kft	AVERAGE CABLE RESISTANCE PER 1000 METER	13.1	Ω/Km
CALCULATED LINE LENGTH	24221	Ft	CALCULATED LINE LENGTH	6614	Meters

Calculate Cable Length Using the **Actual Resistance per Thousand Feet (meters)**

Imperial Units			Metric Units		
INPUT CABLE RESISTANCE	88	Ω ohms	INPUT CABLE RESISTANCE	110	Ω ohms
INPUT AIR TEMPERATURE	85	° F	INPUT AIR TEMPERATURE	-28.89	° C
CONVERTING FACTOR	0.9642		CONVERTING FACTOR	1.2378	
INPUT CABLE RESISTANCE PER 1000 FT at 68°F	4	Ω/Kft	INPUT CABLE RESISTANCE PER 1000 METER at 20°C	9.2	Ω/Km
CALCULATED LINE LENGTH	21213	Ft	CALCULATED LINE LENGTH	14800	Meters