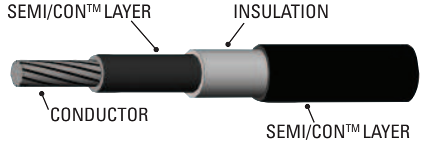
Semi/Con™ high voltage (HV), semi-conductive (semicon) silicone cables have a distinct advantage over standard HV cables in that they are more resistant to electrical stress and exhibit very little or no corona at the rated voltage. Corona is an ionization of gas molecules that occur in voids of a cable and along the outside of the cable insulation when near a ground plane. The damage to the wire insulation from corona is proportional to the number of discharges per unit time and the energy of each discharge. Reducing or eliminating these discharges, commonly referred to as partial discharge, should be a design goal in any high voltage system design. Standard high voltage cables are very reliable in service when installed in equipment and physically separated from grounded structures, especially sharp edges. When these requirements cannot be met, and the need is still present for a high voltage cable that exhibits little to no corona discharge, along with a long operating life, **Semi/Con™ cable is the solution**.



Semi/Con™ cable's high performance attributes stem from the fact that air voids are eliminated along the inner conductor and the semi-conductive outside surface prevents the occurrence of external discharges. Also, the electro-static field within the insulation of the cable is more evenly distributed thus eliminating non-uniform voltage gradients. For comparison, we will consider two types of cable configurations: unshielded cable and shielded cable.

Unshielded Cable:

Figures 1 and 2 illustrate the difference in construction between an unshielded cable and a Semi/Con™ cable construction. When the voltage is high enough, corona can be initiated in air pockets between the stranded conductor and insulation, as well as on the outside surface of the wire insulation in regions close to ground. To help prevent this, the cable needs to be physically separated from the ground plane at a distance where corona will not initiate on the surface or around the conductor. This distance can be several inches depending on the voltage and cable construction.

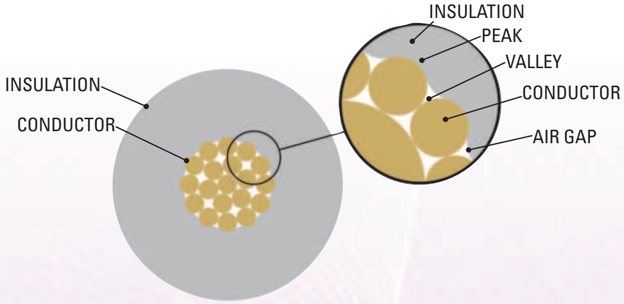


Figure 1 – Unshielded Cable Adjacent to a Ground

An alternate solution is to have a semi-conductive layer around the conductor and the outside surface of the cable, as illustrated in Figure 2.

The semi-conductive layers do two things. The <u>inner layer</u> of semicon eliminates the effect of the air gap around the inner conductor and the <u>outer layer</u> of semicon minimizes the effect of making contact with a ground plane; eliminating the primary sources of corona. A second benefit is that the electrostatic field is more evenly distributed thus lowering the voltage stress within the cable, as shown in Figures 5b and 6.

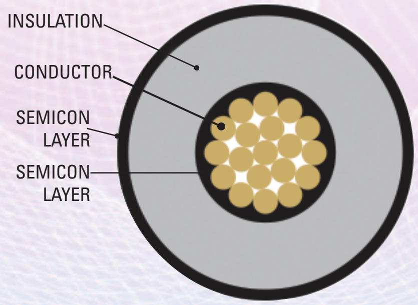


Figure 2 – Semi/Con™ Cable

Approved for Public Release: MP/022/15
Rev. 092515
TELEDYNE REYNOLDS
Everywhereyoulook™

Shielded Cable:

Basic shielded HV cables are made up of a conductor, core insulation, a braided shield over the outside surface of the insulation and an overall jacket. Figure 3 illustrates the construction of a shielded cable. In addition to the air gaps found between the center conductor strands and insulation, the shielded construction introduces additional air gaps between the outer diameter of the insulation and the inner surface of the metal shield.

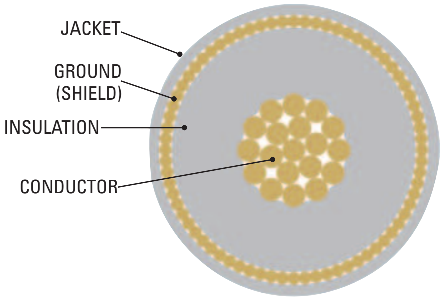


Figure 3 – Basic shielded silicone cable

It is within these air gaps that corona can initiate depending on the voltage, geometry and the operating environment of the cable. Along the inner conductor gap, the voltage gradient is the highest and in turn, so is the amount and amplitude of partial discharges. In the air gap between the insulation and shield, the gradient is not as high, but is a source of discharges nonetheless.

Figure 4 depicts a shielded cable, this time, with a semi-conductive layer around the inner conductor and around the outer diameter of the insulation. As in the preceding non-shielded example, the air gap around the conductor is eliminated, as well as the gap between the insulation and the shield. Again, the electrostatic field is more evenly distributed thus lowering the voltage stress within the cable.

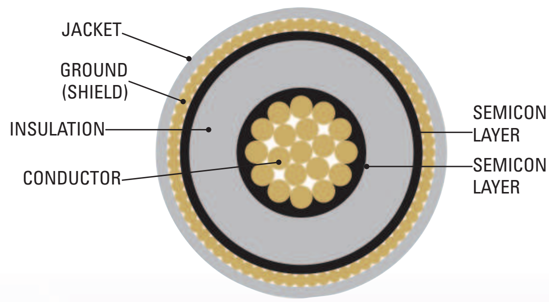


Figure 4 – Shielded Semi/Con™ cable

Semi/Con™ Silicone Rubber Wire Attributes

Part Number	Operating Voltage (kVDC)	Conductor			Insulation		Shielding			Jacket		Imp. (Ohms)	Atten. dB/100 ft @ 400 MHz	Cap. pF/ft @ 1 kHz
		AWG	Strands	Plating	Material	Diameter in/mm	AWG	Plating	Diameter in/mm	Material	Diameter in/mm			
178-6529	25	22	19/34	SPC	SIL	.180 / 4.57	†	†	.200 / 5.10	†	†	†	†	†
178-6236	30	18	19/.010*	SPC	SIL	.235 / 5.96	34	TPC	.332 / 8.43	SIL	.420 / 10.66	45	†	60
178-6300	40	16	19/29	SPC	SIL	.295 / 7.49	†	†	.365 / 9.27	†	†	†	†	†
178-6427	50	16	19/29	SPC	SIL	0.30/7.62	†	†	†	†	†	†	†	†
178-6301	55	12	19/25	SPC	SIL	.375 / 9.62	†	†	.465 / 11.81	†	†	†	†	†

† Not applicable
* Consists of 19 strands of ø .010 inch nominal diameter conductor.

When ordering, use part number and specify length in feet.

Shielded Cable (continued)

Figures 5a and 5b show the electrostatic field in a shielded cable with and without semi-conductive layers. Note the even field distribution of the Semi/Con™ cable as compared to a shielded cable without the semi-conductive layers.

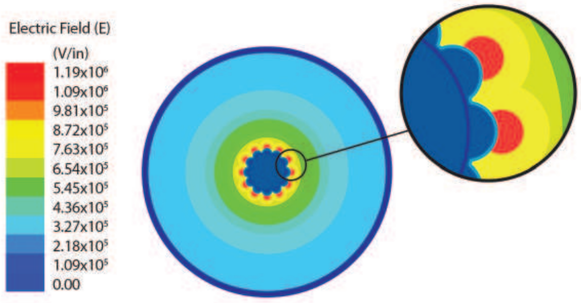


Figure 5a – E-field in a basic coaxial silicone cable

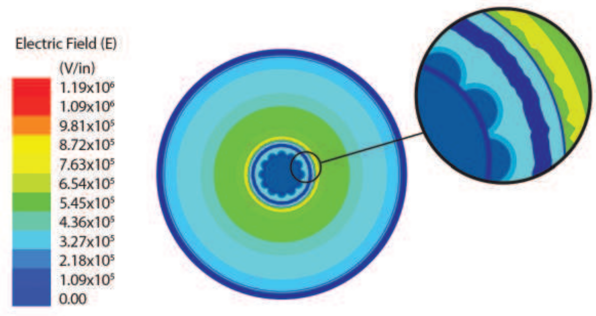


Figure 5b – E-field in a Semi/Con™ cable

Figure 6 shows the electrical stress comparison between standard coax wire and Semi/Con™ wire. As depicted in Figure 1, what's being referred to as a "valley" is the area between conductors and "peak" is the individual conductor peaks.

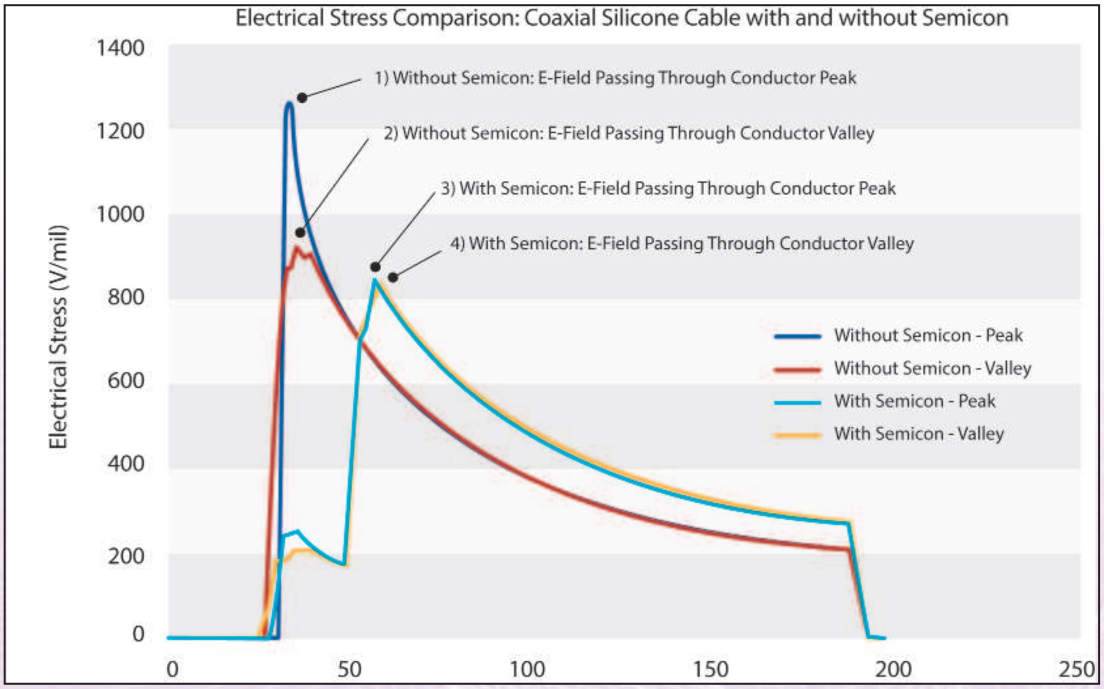


Figure 6 – E-field comparison of basic coax cable and Semi/Con™ cable

For a more detailed white paper on the comparison of the performance of standard wire construction and Semi/Con™, please contact Teledyne Reynolds' Customer Service department.

Recommendation: It is essential that corona resistant cable be combined with compatable termination processes and connectors, so that a high reliability corona resistant cable assembly will result.