



EDITION 5
VOLUME 1

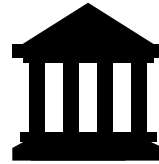
20 TOP REASONS TO CONVERT TO SIMpull® CABLE-IN-CONDUIT (CIC)

Written by Dr. Yuhsin Hawig, VP of Applications Engineering and Erika Akins, Chief Applications Engineer



ONE-STOP SHOP

Southwire is the **only** North American supplier that manufactures a full line of wire and cable products pre-assembled in an HDPE conduit and equipped with couplers and fittings, if required.



2021 INFRASTRUCTURE BILL

Southwire's versatile SIMpull® Cable-In-Conduit (CIC) products can make a tremendous impact on many future projects covered by the 2021 Infrastructure Bill, which includes energy electrification, EV charging, airports, water systems, electrical grid upgrades, and more.



QUALITY SOURCING & MANUFACTURING

A premium grade of HDPE resin and other raw materials are sourced from quality vendors. Southwire utilizes continuous

improvement of manufacturing processes to extrude a ruggedized HDPE conduit over a single conductor or an assembly of different types of cables. Our HDPE exhibits an excellent flexural modulus, ultimate tensile strength, and slow crack growth resistance.



ENHANCED JOBSITE SAFETY

The All-in-One CIC installation method minimizes field injuries and reduces loss time.



IMPROVED SYSTEM RELIABILITY

SIMpull® CIC reduces cable damage during shipment, handling, and installation; prevents the cable jacket from being punctured, torn, or ripped during cable pulls; and protects cables from weather, wildlife, accidental dig-ins, and nearby construction projects or utility repairs or upgrades.



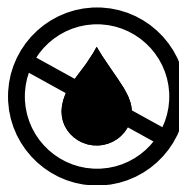
FULL QUALIFICATIONS

Mechanical properties before & after thermal aging, direct burial evaluations with crush and impact, deflection under heat and load, low temperature handling or drop, moisture penetration, and water absorption tests have been completed.



2 UL CERTIFICATIONS

Southwire's SIMpull® Cable-In-Conduit (CIC) has been tested and qualified to the applicable UL standards helping ensure that you receive UL certified cables in UL certified HDPE conduit.



HYDROPHOBIC

HDPE is hydrophobic in nature and repels water with a low moisture vapor transmission rate compared to PVC, which is much more hydrophilic and absorbs water quickly.



MULTIPLE INDUSTRY STANDARDS

Fully compliant with multiple industry standards including NFPA 70 NEC®, UL-1990, UL-651A, NEMA TC-7, ASTM D3350, ASTM D3485, ASTM F2160, and CSA C22.2 No. 327-18 for the conduit and UL 514B for the cable fittings.



100+ DESIGNS AVAILABLE

8 different trade sizes are available for HDPE conduit: 3/4", 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", and 4". There are 4 outside diameter (OD) wall thicknesses to choose from: Schedule 40, Schedule 80, EPEC 11 (SDR 11), and EPEC 13.5 (SDR 13.5). More than 10 color customization options are available using a solid color or 3 extruded color stripes to create the best visual identification for unique government or utility applications.



Southwire®



EDITION 5
VOLUME 1

20 TOP REASONS TO CONVERT TO SIMpull® CABLE-IN-CONDUIT (CIC)

Written by Dr. Yuhsin Hawig, VP of Applications Engineering and Erika Akins, Chief Applications Engineer



IMPROVED JOBSITE EFFICIENCY

Pulling using a single reel saves labor and reduces installation time. Up to 25-45% time savings can be achieved. CIC can be direct buried in the ground or encased in concrete.



**REINFORCED
RESILIENT
RELIABLE**

ADVANCED ELECTRICAL MODELING

CableTechSupport™ Services provides Re3™ consultations about the custom design of reinforced cables and the support of critical infrastructure projects where resilience & reliability are non-negotiable. Ampacity calculations and advanced electrical modeling can be conducted to validate the maximum current carrying capacity and short circuit performance of the cables under different operating or ambient conditions.



REDUCED PROJECT COSTS

Shorten outage durations, accelerate repair or upgrade efforts, extend system performance and life expectancy, and reduce cable replacement frequencies. Up to 30-50% improvement in the overall life cycle cost can be obtained.



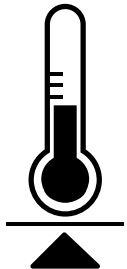
END USER APPROVALS

Southwire's SIMpull® CIC has been utilized by end users in various applications, including the US Department of Transportation (DOT), the US Department of Energy (DOE), commercial constructions, EV infrastructure expansions, Utility grid-hardening efforts, airports, mass transit, renewables, petrochemical, agriculture, and data centers.



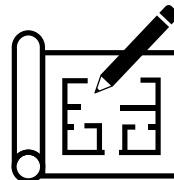
PRE-LUBRICATED

A low-friction lubricant is applied during the HDPE extrusion process to prevent the cables from adhering to the inside of the conduit wall and to ensure free cable movement.



EXCELLENT THERMAL STABILITY

Conduit is made of a high molecular weight and high-density polyethylene (HDPE) with a superior thermal resistance due to its higher melting point compared to rigid PVC pipes.



CABLE COMPATIBILITY

Any wet-rated cables, including USE-2, RHW/ RHW-2, XHHW-2, underground MV & 600V cables, power and control, grounding cables, etc., can be extruded with an HDPE conduit to create cable-in-conduit (CIC).

CIC is suitable for secondary (600V) and primary (5-46kV) undergrounding in the USA, Canada, and Central and South America.



CERTIFIED TESTING FACILITY

Qualifications were performed at Southwire's D.B. Cofer Technology Center, an ISO-17025 accredited facility and a UL and CSA certified laboratory, specializing in electrical, mechanical, thermal qualifications, and accelerated aging tests.



**RESPOND
RECTIFY
RESTORE**

FIELD & EMERGENCY SERVICES

CableTechSupport™ Services delivers Re3™ field assistance to respond to jobsite emergencies and helps to rectify or restore interruptions through cable inspections, diagnostic testing, Go vs. No-Go determinations, or hands-on cable repairs.



ENVIRONMENTAL SUSTAINABILITY

HDPE conduit is made of a simple and pure formulation with a neat polyethylene-based resin. HDPE is lead-free and naturally halogen-free with a zero-acid gas emission.





EDITION 16
VOLUME 1

15 THINGS TO KNOW ABOUT

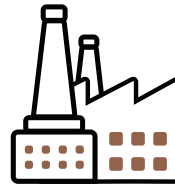
SUSTAINABLE ATTRIBUTES AND PRODUCTS

WRITTEN BY: Dr. Yuhsin Hawig, VP of Applications Engineering | Erika Akins, P.E., Applications Engineering Manager



DELIVER POWER RESPONSIBLY

Southwire is committed to providing the highest quality products and we are dedicated to protecting the well-being of our communities and the environment. The life cycle of products is scrutinized from the extraction of raw materials, manufacturing processes, designs, code & standard compliance, installation efficiency, performance, to the energy consumption and the final disposal. We lead the deployment of renewable technology to achieve zero carbon. We also reinforce the electrical grid to withstand more frequent occurrences of extreme weather as a result of climate change.



MANUFACTURING & ASSEMBLY

Southwire has invested in multi-year modernization projects to make a 70-year-plus company sustainable for the next 100 years. During manufacturing & the final assembly of finished goods, we seek every opportunity to reduce hazards, which can be anything that poses a threat to the safety and the health of workers or the environment. Removing waste and recycling scrap to attain the best output have been the top priority for decades. We put heavy emphasis on economically-sound processes that are vertically integrated to conserve energy as well as natural resources to make each product.



**STRONG.
SUSTAINABLE.
SOUTHWIRE.**

5 ATTRIBUTES OF SUSTAINABILITY

Many organizations around the world define sustainability differently as there are goals

and governance that are more important to a specific industry. This engineering whitepaper outlines five critical attributes which span the entire product life cycle and enable Southwire to innovate and to offer sustainable solutions. These products can be implemented in more than 10 diverse applications including data centers, utility, mass transit, factory automation, renewables, telecom, healthcare, automotive electric vehicles, ports & terminals, residential, and commercial buildings.



INSTALLATION

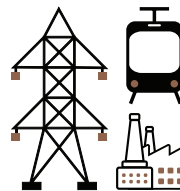
Once the wire and cable products are delivered to the job site, they will be unloaded, unreeled, pulled, bent, and laid at the final destination. Every step of the way could be labor-intensive, time-consuming, and error-prone to trigger severe physical damage to products and cause injuries if not handled appropriately. Safer, more ergonomic, and more effective installations can be executed by reducing hazards or waste, renewing packaging or reel handling systems, raising flexibility, reducing pull tension, and more. Southwire has sold many patented inventions that yielded sustainable installations globally.



RAW MATERIALS

Sustainable materials can be achieved by creating safer chemical formulations with less hazardous

substances to lessen the environmental footprint or with "Living Building Challenge Red List" approved compounds to prevent serious risks to human health. It can also be accomplished by adopting renewable energy, such as solar, to power raw material productions. Furthermore, increasing the recyclability of all components and upgrading packaging designs are commonly utilized. Finally, sustainable procurement, which integrates social, ethical, and environmental requirements into the qualification of suppliers is a must.



USE PHASE

Multiple factors will determine the sustainability of wire and cable products after the system has been energized. Firstly, using sustainable materials designated low-smoke and/or zero-halogen reduce hazard that compromises the health, safety, and the environment. In the event of overheating due to short-circuit or fire, these products generate fewer toxic gases. Secondly, products can be designed to carry a greater ampacity with less energy loss. Lastly, these products can also boost grid resiliency in case of natural disasters such as hurricanes or severe environmental conditions such as corrosive saltwater, heavy UV rays, or wildlife attack.



Southwire®

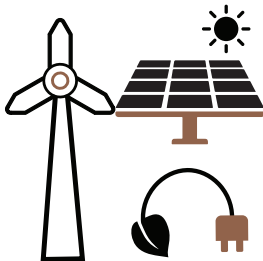
15 THINGS TO KNOW ABOUT

SUSTAINABLE ATTRIBUTES AND PRODUCTS



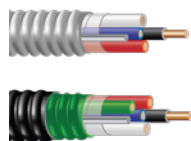
END OF LIFE

The wire and cable products manufactured today can achieve an average life of 40 years if designed, installed, and operated properly. Using ruggedized systems can extend the ultimate service life, which, in turn, delays replacement. A shorter downtime and less likelihood of worker injuries during cable replacement should be considered. Southwire offers field repair and cable rejuvenation services to further extend the life of cables. When aging assets need to be disposed of, better recyclability can be found on cables extruded with thermoplastic or non-crosslinked insulations and jackets or conductors containing a single metal instead of mixed metals.



SUSTAINABLE PRODUCTS

Southwire offers over 180 different sustainable products and many of those are deployed specifically for the explosive growth of renewable industries including electric vehicle (EV), wind and solar power, battery energy storage systems (BESS), and mass transit. Our sustainable solutions can also be seen at residential homes, commercial developments, industrial and OEM applications, as well as utility grid projects. This technical document showcases six product examples, and more can be found on the Southwire website. [CLICK HERE TO VIEW.](#)



MCAP[®] TYPE MC ALL PURPOSE CABLES

MCAP[®] Type MC Cable was invented based on electricians' feedback to reduce terminations per box and to declutter the wiring. Therefore, this is one of the best examples of a sustainable product due to user advantages during installation. These include simplifying grounding connections with fewer parts, boosting grounding reliability with the patented integral ground laid under the armor, and less mechanical connections. Eliminating one termination in every outlet with less room for error and cutting up to two minutes of installation time per connection could lower the overall project cost by up to 50%.



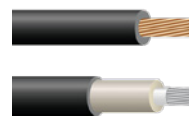
SIMpull[®] COILPAK[™] WIRE PAYOFF AND SIMpull BARREL[™] CABLE DRUM

A SIMpull[®] CoilPAK[™] Wire Payoff paired with a low-friction SIMpull THHN[®] wire is sustainable as it lessens the physical burden of material handling with a major reduction in pulling tension. It is a space saving design when bundling multiple wires in a single package. SIMpull Barrel[™] Cable Drums allow branch circuit installations to be completed with the utmost safety and productivity. No need to worry about broken reels, flanges, or torn arbor holes. A variety of products can be shipped in SIMpull Barrel[™] Cable Drums including type MC cables. The drum holds longer lengths, which shortens time to change over and reduces wire remnants on site.



EV CHARGING

With a growing interest in clean energy coupled with the advancement of lithium battery production, electric vehicle adoption for residential, commercial, and government entities is happening at a record speed. The rapid EV expansion can also be attributed to the investment in building out the grid infrastructure through Electrify America and the Bipartisan Infrastructure Law (BIL). Southwire's EV charging cables, building wires, and medium voltage cables that power the pedestals play a critical role in the supply chain to fulfill the enormous demand in the years to come. These products to support EV are sustainable due to the reduction of greenhouse gas emissions from transportation.

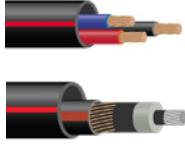


LOW SMOKE ZERO HALOGEN (LSZH)

Safer and environmentally friendly modes of public transportation are a necessity as urbanization stresses existing traffic corridors. Heavy smoke and toxic gases are harmful, making low smoke zero halogen (LSZH) materials the best choice for public safety in the event of a fire in less ventilated spaces such as tunnels used for mass transit. LSZH designs are commonly specified for manholes and underground installations located in densely populated areas. Southwire's sustainable SOLONON[®] LSZH and SOLONONplus[®] LSZH product lines include XHHW-2, RHH/RHW-2, traction power cables, medium voltage cables, as well as multiconductor tray cables with an overall LSZH jacket.



15 THINGS TO KNOW ABOUT SUSTAINABLE ATTRIBUTES AND PRODUCTS



SIMpull® CABLE-IN-CONDUIT (CIC)

In recent years, widespread power outages caused by natural disasters have expedited the hardening of our electrical grid. This can be accomplished in several ways. One is to convert critical overhead lines to below grade networks either by using cable-in-conduit (CIC) or ruggedized underground cable constructions. Pulling a single reel containing cables protected by a durable high-density and halogen-free polyethylene (HDPE) duct not only saves labor and reduces installation time, but also prevents field injuries due to material handling. CIC is sustainable because it is safer than direct burying cables and it also extends life, lowers cable replacement frequencies, and shortens outage duration.



TREE WIRE (COVERED CONDUCTOR)

Tree wires are sustainable alternatives compared to bare conductors as the added covering improves resiliency of overhead lines in tree crowded areas prone to major weather events including storms and wildfires. The robust covering can prevent direct shorts and instantaneous flashovers when tree limbs or other objects such as wildlife contact conductors in close proximity. The abrasion, track, and UV resistant high-density crosslinked polyethylene (XL-HDPE) outer layer minimizes power outages and sparks due to conductor slapping during windy conditions. Tree wires or covered conductors require less frequent tree trimming compared to bare their overhead counterparts.



Southwire

CABLETECH SUPPORT™

Services

CABLETECHSUPPORT™ SERVICES

Southwire's CableTechSupport™ services offer many reference documents and whitepapers to help end users with the selection of products for the most challenging applications. Our Re3™ mission statement, is based on sustainability: to design Reinforced, Resilient, Reliable products and provide services to Respond, Rectify, and Restore. You can access the publications directly from the website. **CLICK HERE TO VIEW.** We have a track record of successful custom engineering solutions and, not only meeting sustainable criteria, but also exceeding long-term electrical, thermal, mechanical, and environmental performance.



Southwire®



EDITION 18

VOLUME 1

17 INTERESTING FACTS THAT BOOST THE DEPLOYMENT OF CABLE-IN-CONDUIT (CIC)

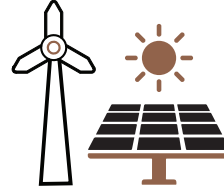
WRITTEN BY: Dr. Yuhsin Hawig, VP of Applications Engineering | Erika Akins, P.E., Applications Engineering Manager



SIMPULL® CABLE-IN-CONDUIT (CIC)

Southwire's SIMpull® Cable-In-Conduit (CIC) solutions enhance jobsite

efficiency, reduce project costs, leverage sustainability, and more. This engineering whitepaper outlines 17 interesting facts about CIC including 8 market trends and 6 of the most frequently requested designs specified by end users in recent years. You can also learn more about the 20 engineering benefits of CIC by scanning the QR code.



IRA & CLEAN ENERGY

The Inflation Reduction Act (IRA) of 2022, with provisions becoming effective in early 2023, is one of the most crucial climate legislations in U.S. history, offering funding and incentives to advance the deployment of clean energy. IRA's \$370 billion in investments will lower energy costs for homes and small businesses, accelerate private investment in clean energy technology, reinforce supply chains, and create ample economic opportunities for American workers. Southwire's CIC products for renewable power generation are designed, certified, manufactured, and quality tested in the U.S. meeting Build America, Buy America Act (BABA) per the Infrastructure Investment & Jobs Act (IIJA).



UTILITY'S STRATEGIC UNDERGROUNDING

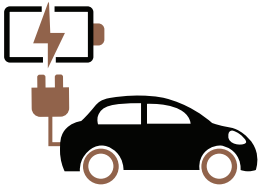
Recent widespread power outages caused by natural disasters have expedited the hardening of our electrical grid. This can be accomplished in several ways, one of which includes

the conversion of critical overhead lines to a below grade network via CIC. Pulling a single reel containing cables protected by an impact-resistant high-density polyethylene (HDPE) duct saves labor, shortens installation time, and prevents field injuries due to an all-in-one material handling system. CIC is more robust than direct buried cables and can extend service life, lower cable replacement frequencies, and lessen outage interruptions. It is also a proven solution to mitigate wildfires.



DOT PORTS & TERMINALS

In 2022, the U.S. Department of Transportation (DOT) announced more than \$700 million will be funded to support 41 projects in 22 states to improve port facilities through the Maritime Administration's Port Infrastructure Development Program. This funding will benefit coastal seaports, Great Lakes ports, and inland river ports by improving the supply chain through increased port capacity and efficient operations. CIC is an approved product for DOT applications, including ports and terminals, and is more reliable due to the ruggedness of HDPE duct that prevents damage from accidental dig-ins. HDPE conduit also serves as a continuous physical barrier deterring copper theft and terrorist activities compared to direct buried power cables.



EV INFRASTRUCTURE

With a heightened interest in clean energy coupled with the advancement of lithium battery production, electric vehicle (EV) adoption is occurring at a record speed. The rapid EV expansion

can also be attributed to the investment in grid infrastructure through Electrify America and the Bipartisan Infrastructure Law (BIL). Southwire's building wires, 600V underground service entrance, medium voltage cables, and more can be paired with CIC to power EV charging stations. These CIC assemblies to support EV infrastructure have gained much traction due to the elimination of separate packages and the avoidance of cable damage from onsite pulling.



DOE'S GRID RESILIENCE PROGRAM

The Department of Energy (DOE)'s Grid Deployment Office is launching a \$10 billion Grid Resilience and Innovation Partnerships (GRIP) program as part of the infrastructure law to enhance grid flexibility and the resiliency to fight against climate change and extreme weather events such as wildfires, hurricanes, storms, and flooding. Medium voltage cables in CIC are proven to be an excellent underground distribution solution to support the critical DOE initiative to modernize the electrical grid and reduce natural disaster impact.



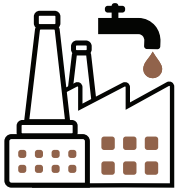
17 INTERESTING FACTS THAT BOOST THE DEPLOYMENT OF CABLE-IN-CONDUIT (CIC)



MULTI-FAMILY HOMES

Our CIC products have won several Project of the Year awards from Plastic Pipe Institute (PPI). One of the largest CIC implementations, featuring 8,700

feet of CIC, was completed in Southern Texas to power temporary housing for oilfield workers. More than 1.5 miles of power cable in conduit were trenched and multiple runs of CIC laid next to each other in the hard Texas ground. Pulling cables during summer months in this area can be deadly, exposing the crews to over 100°F of dry heat. Having a single cable assembly eliminates the hours to pull cables through conduit therefore minimizing the heat exposure time and lowering the risk of heat strokes for workers.



WASTEWATER TREATMENT & IRRIGATION

The Bipartisan Infrastructure Law (BIL) delivers more than \$50 billion to the U.S. Environmental Protection Agency (EPA) to improve drinking water,

wastewater, and stormwater infrastructure, which is the single largest federal investment in water ever implemented. Similar to irrigation sites, wastewater treatment plants (WWTP) typically have a more corrosive soil type compared to other commercial locations due to higher amounts of pesticides and fertilizers. CIC is produced with a high molecular weight HDPE resin, making it compatible with many common chemicals and aggressive soils. HDPE is hydrophobic, enabling the material to repel liquid or moisture. Schedule 80 HDPE duct, with the heaviest wall thickness, will not soften, degrade, or crack easily due to harsh environmental exposures in the ground.



FUTURE PROOFING

As we continue to upgrade our nation's grid to accommodate the surge in electricity demand, it is essential to future proof the electrical wiring designs. We recommend

upsizing the HDPE conduit and incorporating a pull tape in CIC. This provides a tool to remove faulty or aged circuits safely and it creates the extra space to pull in larger replacement cables promptly. The high-strength flat tape, best known as muletape, is made of a cut-resistant polyester woven material and is printed with sequential footage for easy locating of circuit length. We offer several grades of pull tape with a tensile strength up to 2,500 lbs.



XHHW-2

Southwire offers extensive SIMpull XHHW-2® cable options, with any color & size combination able to be bundled into a CIC assembly. HDPE conduit is made of a simple and pure formulation with a polyethylene-based resin. Both XHHW (crosslinked polyethylene) & HDPE (high-density polyethylene) are lead-free and naturally halogen-free with zero-acid gas emission compared to THHN/THWN pulled in a rigid PVC stick pipe. This is the most sustainable 600V/1kV wiring solution for any constructions requiring LEED building certifications, such as data centers. XHHW in CIC designs are also in great demand to power mega-scale EV infrastructure projects including level 2 and DC fast charging.



THHN/THWN-2

Southwire's copper SIMpull THHN/THWN-2® cable in 20 different solid or striped color combinations from 14 AWG to 1,000 kcmil can be produced in a CIC system at our factory. Schedule 40 HDPE is one of the most requested conduit types, and it can enclose building wire products rated for either 75°C or 90°C. THHN/THWN-2 in CIC is gaining popularity for EV infrastructure, data centers, and commercial building applications due to its short lead time and cost-saving benefits.



PV WIRES OR RHH-RHW-2

Copper or aluminum PV wires rated 600V or 2kV can be pre-bundled with or without an insulated green grounding conductor in a HDPE conduit prior to arriving at the solar farm. PV wires extruded with an XLPE insulation are dual marked as Type RHH-RHW-2 per UL-4703 and UL-44. One of the most common insulated equipment grounding conductor types is a green SIMpull XHHW-2® cable. Our patented low-friction technology allows the grounding conductor to be pulled out of the conduit efficiently to accelerate replacement in the future. Furthermore, extra PV wires can be incorporated into CIC as a backup power to shorten outage durations.



17 INTERESTING FACTS THAT BOOST THE DEPLOYMENT OF CABLE-IN-CONDUIT (CIC)



600V SECONDARY USE-2

Underground Service Entrance (USE-2) cables certified to UL-854, composed of 1 to 4 aluminum conductors, can be prefabricated into a CIC assembly. 600V secondary cables in conduit is the preferred wiring method to power multi-family homes, commercial buildings, and battery energy storage systems (BESS). The neutral conductor, full or reduced in size compared to the phase conductor, is typically marked with 3 yellow stripes for easy identification. The HDPE conduit can also be extruded with 3 continuous yellow stripes over the solid black color to signify the protective duct contains USE-2 phases with an insulated neutral.



MV PRIMARY

Any MV cable rated 15, 25, to 35 kV designed with copper or aluminum conductors, TR-XLPE or EPR insulation, concentric neutrals or longitudinally-applied copper tape shield, and an overall LLDPE, XLPE, HDPE, or PP jacket can be preassembled into a flexible HDPE conduit at our factory. The continuous CIC length can be installed with fewer joints and without labor-intensive splicing. CIC can be installed via a Horizontal Directional Drilling (HDD), plowing, or trenching technique. HDD minimizes the construction impact with less interruptions to residential neighborhoods or commercial districts with heavy traffic. The Coefficient of Friction (CoF) of HDPE conduit can be 30% lower than PVC pipe due to a lubricant applied in advance at Southwire's CIC extrusion line.



AIRPORT LIGHTING CABLE

Southwire's airport lighting cable meets FAA's AC 150/5345-7F entitled "Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits". These 2.4kV or 5kV non-shielded copper products, commonly known as L-824 Type C cables, are extruded with 110 mil of XLP insulation and are frequently used to power the lighting circuits for runways and control systems. The CIC options with 1, 2, or 3 airport lighting cables, pre-assembled at the factory, offer enhanced public safety and are the most efficient high-volume installation for critical infrastructure such as ports and terminals.



Southwire

CABLETECH SUPPORT™

Services

CABLETECHSUPPORT™ SERVICES

Southwire's CableTechSupport™ Services team has published

many whitepapers to help end users with the selection of products for the most challenging applications. Our Re³™ mission statement is based on sustainability: to Respond, Rectify, and Restore with



Reinforced, Resilient, and Reliable solutions. You can download engineering documents directly from the website by scanning the QR code:



Southwire™

SPEED™

Services

SOUTHWIRE SPEED™ SERVICES

Southwire SPEED™ Services focuses on expedited shipping

through our North American logistics footprint via our customer service centers and agent warehouses from coast to coast. We offer same day and next day shipping on stock items such as empty conduit and building wire in CIC. Delivering custom CIC products with the shortest lead time and below MOQ is one of the many dedicated



services celebrated by customers managing EV infrastructure, utility undergrounding, and DOT & DOE funded projects. You can learn more about Southwire SPEED™ Services by scanning the QR code:



Southwire®



EDITION 22

VOLUME 1

24 TOP CONSIDERATIONS FOR UTILITIES TO DEFEND AGAINST STORMS, MITIGATE WILDFIRES, AND MODERNIZE THE GRID

WRITTEN BY: Dr. Yuhsin Hawig, VP of Applications Engineering | Casey Spradlin, Principal Applications Engineer



WE DELIVER POWER...RESPONSIBLY®

This whitepaper outlines top considerations for utilities modernizing the transmission & distribution systems to defend against natural disasters and wildfires. Included in this article

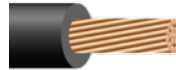
are 17 ruggedized cable designs, 4 calculation tools, and 3 services offered by Southwire. Discover our complete solutions by scanning the QR code.



COMPLETE SOLUTIONS



PROTECT EXPOSED GROUNDS USING COVERING



Protected Ground Wire (PGW), Covered Line Wire, and Covered Riser Wire are specified for applications where protection from momentary contact with wildlife is needed. Bare copper conductors are covered with either an extruded polyethylene (PE) or a crosslinked polyethylene (XLPE) layer to protect the exposed copper. Because the metallic appearance is concealed by a black covering, it also deters vandalism and copper theft. You can download our spec sheets by scanning the QR code.



SPEC SHEETS



SHIELD BARE WIRES WITH TRACK-RESISTANT COVERING



Tree wires are self-supporting overhead conductors covered with an extruded track, UV, and abrasion-resistant covering that provides protection against momentary contact between phases. Also known as CAMV™ (Covered Aerial MV) cable, it prevents direct shorts and flashovers should tree limbs or other grounded objects contact the conductor. Upgrading bare overhead conductors to CAMV™ products can reduce faults caused by trees and minimize fire ignition in dry areas with dense vegetation. You can review our spec sheets by scanning the QR code.



SPEC SHEETS



DELAY CORROSION USING COPPER

Copper is more corrosion-resistant than aluminum and steel, which are often used on overhead lines. A good practice in coastal areas, where weight is not a major concern, is to utilize hard-drawn copper wire as an overhead distribution conductor. Metallic corrosion can occur both above and underground, and there are methods to delay corrosion below grade, which are challenging to inspect. Replacement of corrosive native soil with an engineered backfill is a great option. Improvement of local drainage is also essential as it diverts water around the exposed wires and lowers concentration of the contaminated water.



UPGRADE CONDUCTORS OR UPSIZE MESSENGERS



To reinforce overhead systems against storms, many conductor types can be specified for bare transmission lines, CAMV™ distribution designs, or 600V service drop cables with a messenger. AAC containing 1350-H19, AAAC made of a 6201 alloy, and ACSR are standard options. Greased ACSR or mischmetal ACSR are frequently deployed to hamper steel corrosion in coastal areas. Additionally, ACSS with a higher thermal rating and C7® conductors with high-temperature & low sag are gaining acceptance for long span lengths located in hurricane-prone regions.



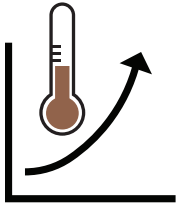
FIGHT WILDFIRES BY REPLACING BARE WIRES

The most successful wildfire mitigation solution for high fire risk areas is the conversion of overhead lines to below grade systems. There have been more intense wildfires due to climate change that are difficult to prevent. If undergrounding is not possible due to time, budget, or right-of-way, then bare overhead lines can be upgraded with tree wires to minimize arcing in drought regions. The 3-phase bare conductors can potentially collide with one another during windy conditions, which trigger sparks. Replacing bare wires with CAMV™ cable or covered conductors not only lessens the burden of vegetation management but also reduces the fire risk.



24 TOP CONSIDERATIONS FOR UTILITIES

TO DEFEND AGAINST STORMS, MITIGATE WILDFIRES, AND MODERNIZE THE GRID



CHOOSE XLPE TO BOOST THERMAL STABILITY

When considering dielectric materials for overhead or underground circuits, there are two designs that can impact the long-term performance due to a conductor's thermal rating. The standard option is a thermoplastic Polyethylene (PE or LLDPE) covering/insulation, while the premium grade is a thermoset or Crosslinked Polyethylene (XLPE). Replacing PE with XLPE raises the cable's normal operating temperature from 75°C to 90°C, emergency overload from 95°C to 130°C, and short circuit from 150°C to 250°C. A thermoset insulation will not soften or melt easily in comparison to a non-crosslinked material.



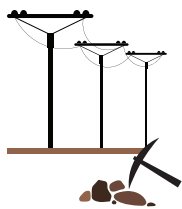
SELECT HDPE TO WITHSTAND ABUSIVE USAGE

If a more robust cable is desired, then a High-Density Polyethylene (HDPE) material should be selected instead of the common Linear

Low-Density Polyethylene (LLDPE). HDPE's excellent abrasion resistance protects cables from abusive tree limb contact or other grounded contact and can also minimize damage during shipment, handling, and installation. HDPE's superior durability compared to LLDPE can protect cables from wildlife attack and mechanical impact from backfill. You can download the whitepaper on HDPE by scanning the QR code here.



WHITEPAPER ON HDPE



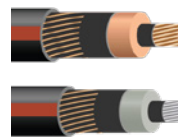
UNDERGROUNDING TO PREVENT OUTAGES

With the increasing frequency of natural disasters including hurricanes, tornadoes, wildfires, and winter storms, electric utilities have proactively transitioned overhead lines to underground circuits to boost reliability. Approximately 80% of power outages occur in distribution systems. For example, 15kV distribution conductors made of ACSR can be direct-buried by converting to a 15kV primary aluminum MV cable with a TRXLPE insulation, concentric neutrals, and an overall LLDPE jacket, which has become the preferred method for the upgrading of old lines overhead or underground and installation of new systems.



WATER-BLOCK TO DEFEND AGAINST MOISTURE

Water intrusion is one of the primary causes of cable system failures. Moisture accelerates the dielectric breakdown of insulation and triggers metallic corrosion. Corrosion-resistant designs such as solid conductors over stranded wires and copper tinning over uncoated counterparts have proven to be effective. A strand fill compound to water-block the conductor is frequently specified for underground MV cables. Water-swellable powder can be applied over shielding wires, under the jacket, to absorb and retain moisture, which hinders the water penetration between the layers of jacketing and shielding wires along the installed cable.

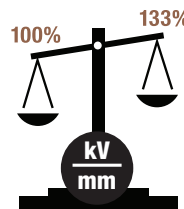


SPECIFY EPR OR TRXLPE FOR UNIQUE APPLICATIONS

MV cables rated 15-46 kV can be insulated with either EPR or TRXLPE depending on project requirements. EPR is a heavily-filled synthetic rubber formulation exhibiting excellent thermal stability, lower temperature flexibility, increased flexibility at low temperatures, and improved flame retardancy compared to the unfilled TRXLPE. Both designs can achieve the minimum 40-year service life and deliver excellent performance. However, installations in colder climates or locations requiring a UL optional flame rating can benefit from pairing EPR with a different shielding and jacket. You can access our whitepaper on EPR by scanning the QR code.



WHITEPAPER ON EPR



LOWER ELECTRICAL STRESS USING 133% INSULATION

The cable insulation level is dictated by how fast the protective equipment can de-energize the circuit in case of a fault. If a fault can be cleared within 60 seconds, then 100% insulation is sufficient. However, if a fault will sustain beyond 1 minute, but less than 1 hour, then 133% design is required. A 25kV 1/0 AWG cable insulated with a 133% wall yields a 15% reduction in electrical stress at the conductor shield and insulation interface compared to one with only 100% insulation. A thicker insulation is recommended for systems prone to electrical surges, and lowering electrical stress by using a heavier insulation can extend cable life.

24 TOP CONSIDERATIONS FOR UTILITIES

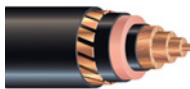
TO DEFEND AGAINST STORMS, MITIGATE WILDFIRES, AND MODERNIZE THE GRID



WITHSTAND SHORT CIRCUIT USING MORE NEUTRALS



The outer insulation shielding for many primary MV cables contain "one-third" neutrals relative to phase conductor size when used for a 3-phase supply, or "full-size" neutrals for a single-phase system. With modern rapid-switching equipment at substations, available short circuit current and duration are reduced compared to decades ago. Using a reduced possibly neutral rating ranging from 1/4, 1/6, to 1/12 saves material cost upfront but can pose significant risk due to an insufficient short circuit capacity. Southwire offers calculations to custom design cables with a reduced neutral to match any system requirements.



REDUCE DIAMETER VIA COMPACT STRANDS & FLAT STRAPS

PILC (Paper-Insulated Lead Cable) replacements typically require retrofitting new cables into an existing old conduit system with smaller size conduits than currently used. In order to reduce overall cable diameter and maximize flexibility utilities are using a full compact copper conductor insulated with the flexible EPR/EAM system shielded with flat strap neutrals with a ruggedized HDPE or PP jacket that have proven to be successful. A triplexed design with reduced insulation and/or jacket thickness helps to further lower the overall diameter to fit into a small conduit. HDPE or PP jackets also feature an improved oil resistance compared to LLDPE, which is critical if the cable will be subjected to oil residue leaked from old PILC cable.



USE LSZH TO BOLSTER SAFETY



Heavy-duty network cables rated 600V, 1kV, or 2kV are often installed in vaults or manholes located below congested downtown streets and are operated to meet peak power demand. They are designed to withstand high temperatures, moisture ingress, and chemical exposure and are flame-retardant and inherently abrasion-resistant. Insulation material options include leaded or lead-free EPR/EAM, Chlorinated Polyethylene (CPE), and Low Smoke Zero Halogen (LSZH). LSZH is ideal for use in establishments where reduced smoke and low acid emissions are desired for public health and safety.



INCORPORATE SHIELDING TO DEFEND EMF



For substations containing a variety of extra high-voltage equipment, significant sources of electromagnetic interference (EMI) are present.

Shielded control and power cables are specified in transmission substations to mitigate EMI. The EMI shielding efficiency depends on electrical conductivity, cable coverage, and shielding thickness. Doubling the number of helically applied copper tape shield with a greater thickness and a higher percentage of overlap will improve shielding effectiveness compared to a thinner and single-wrapped tape shield.



ADD CONDUIT TO IMPROVE SAFETY



Many methods can be deployed to install cables underground, including the use of PVC pipes or HDPE conduit, installation of concrete duct banks, or direct burying cables in earth.

While direct burial is cheaper upfront, cables are susceptible to backfill damage and accidental dig-ins. Using conduit creates a durable barrier both electrically and physically to protect cables from mechanical forces and avoid electrocution. Pulling cable in conduit improves safety compared to direct burial as the protective plastic pipe can prolong cable life and lower replacement costs and frequencies.



ADOPT CIC TO SAVE TIME & LABOR



Adopting an all-in-one Cable-in-Conduit (CIC) system not only saves labor and shortens installation time, but also can help prevent field

injuries and is a proven solution to mitigate wildfires. Medium voltage and 600V cables can be preassembled in HDPE conduit at the factory. The long continuous CIC length provided on a standard reel can be installed with fewer or no joints which are labor-intensive to build. CIC can be deployed via Horizontal Directional Drilling (HDD), plowing, or trenching. HDD minimizes the construction impact with less interruptions to residential areas or busy commercial districts.

24 TOP CONSIDERATIONS FOR UTILITIES

TO DEFEND AGAINST STORMS, MITIGATE WILDFIRES, AND MODERNIZE THE GRID



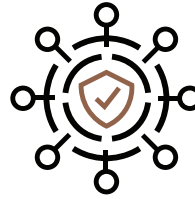
OPTIMIZE SAG & TENSION VIA SAG10® SOFTWARE

Southwire's SAG10® software is recognized as the industry's benchmark for overhead conductors' sag-tension

modeling based on the Alcoa Graphic method. It combines 70 years of conductor data, customer feedback, and field expertise into one powerful tool. Over 500 utilities and consultants rely on Southwire & SAG10® software to design overhead systems. Learn more by scanning the QR code.



LEARN MORE SAG10®



ASSESS GRID RESILIENCY DIGITALLY

Southwire offers Digital Grid Resiliency Assessments identifying areas for improvement by leveraging your outage and GIS data. This program locates problematic circuits at the device level and prioritizes maintenance actions.

It also provides recommendations with expected benefits and cost justifications. Assets are scored by an overall equipment ranking based on health and network criticality. You can learn more by scanning the QR code.



DIGITAL GRID RESILIENCY ASSESSMENTS

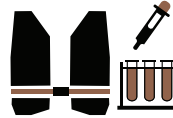


RUN VOLTAGE DROP TO SIZE CONDUCTORS

Do you need to calculate the voltage drop for a specific circuit length or size conductors to meet the voltage drop limit of 3% per NFPA 70® NEC®? Southwire's calculator tool includes copper & aluminum options, commercial & residential applications, 60, 75, or 90°C ratings, and single vs. 3-phase systems. Installation methods feature overhead lines, direct burial, and steel vs. non-steel conduit. You can access our free calculator by scanning the QR code.



USE CALCULATOR

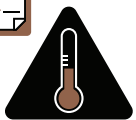


REJUVENATE CABLE TO EXTEND LIFE

Aging dielectric cables with growing water trees can be restored close to their original state by utilizing the one of the world's only cable rejuvenation services. Our patented rejuvenation technology injects silicone fluid into cables via the conductors. Then, the liquid migrates out to the conductor shield and insulation. This process raises the breakdown strength of the insulation, extends service life, and boosts reliability of old circuits without costly replacement. Learn more about this innovative process by scanning the QR code.



LEARN MORE



MODEL AMPACITY TO AVOID OVERHEATING

Recently, more copper conductors instead of aluminum have been specified due to the high ampacity required for infrastructure expansions, such as EV and data centers, to meet the growing power demand. Using general ampacity data from a code book might not be sufficient. Southwire offers comprehensive ampacity studies to verify the maximum current-carrying capacity for cables under complex installations and unique environmental conditions. Factors such as burial depth, cable layout, heat sources, and soil thermal resistivity play a critical role in ampacity.



CALCULATE PULLS TO PREVENT DAMAGE

Southwire's online calculators are free of charge for any user. We recommend conducting cable pull calculations in advance to evaluate the routings, coefficient of friction (CoF) for different jacket materials, pull distance, number of bends, and the angle of each bend. You can scan the QR code to access the SIMpull® calculator for 600V or medium voltage cables.



SIMPULL CALCULATOR

CONTACT

CABLETECHSUPPORT™ SERVICES



Southwire's CableTechSupport™ services, Re3™ mission statement signifies our commitment to Respond, Rectify, & Restore with Reinforced, Resilient, & Reliable solutions. We have published many whitepapers to help utilities and other industries in North, Central, & South America to plan the most challenging projects. You can access these articles online by scanning the QR code.



VIEW WHITEPAPERS

