Installation Manual

CABLEGUARD™ ELASTOMERIC WRAP

The Gold Standard in Bridge Cable Protection

Cableguard™ Elastomeric Wrap System installation on the 1915 Çanakkale Bridge spanning the Dardanelles Straight, Turkey

D.S. BROWN
A GIBRALTAR INDUSTRIES COMPANY

Manufactured by THE D.S. BROWN COMPANY, North Baltimore, Ohio 45872

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INTRODUCTION

Before installation is started, a few items of general nature should be considered. Please read the entire installation manual before beginning installation. The Cableguard™ Elastomeric Wrap System is designed to provide corrosion protection for civil structures. Cableguard™ material is helically wrapped about the structure for which corrosion protection is desired. The Cableguard™ wrap is then fused using a custom-built heating system to form a homogenous barrier between the ambient environment and the underlying structure. In addition to fusing individual layers into a sheath, the electrically operated heating system shrinks the wrap to the underlying structure. The heating system is controlled by an operator's panel located near the blanket, thus allowing the operator to match the temperature and timing with ambient conditions. Dura-Grip™ Walk Surface is applied after the Cableguard™ wrap has cooled.

HANDLING

When you receive the Cableguard™ wrap it will be packaged in plastic bags. Cableguard™ wrap is formulated to begin curing when it comes in contact with moisture, sunlight, and/or heat and must therefore be stored in a dry, dark, and cool area less than 26°C (78°F). Cableguard™ wrap has a 12-month shelf life when properly stored. Please contact D.S. Brown prior to installing any Cableguard™ wrap that is past its 12-month shelf life.

NOTE
Cableguard™ should <u>NOT</u> be installed in the rain. See Appendix F, "Weather Considerations," for information on installation in wet climates and in ambient temperatures below 5°C (41°F).

Installation on Suspension Bridges

INSTALLING THE WRAP USING THE SKEWMASTER™

The preferred method of Cableguard™ wrap installation is a custom-built wrapping machine called the Skewmaster™. After adjusting the Skewmaster™ for the correct overlap, begin installing the wrap by hand from the upper cable band (Figure 1) in a clockwise or counterclockwise direction as you look up the cable.

1. Beginning at the upper cable band, tape the loose end of a roll of Cableguard™ to the cable so the loose end is facing down in the 9 o'clock position (for clockwise wrapping) or 3 o'clock position (for counterclockwise wrapping). The wrap should come off the roll over the top, with the roll between the cable and the wrap being installed.
2. Wrap around the cable parallel to the cable band until the wrap laps over itself. After a complete double wrap is made at the cable band, begin moving the wrap up the cable while wrapping, gradually working out to the project specific triple overlap through several rotations.
3. Wrap the first full roll onto the cable by hand. The second roll and subsequent rolls should be installed using the Skewmaster™.

INSTALLING THE WRAP BY HAND WRAPPING

Hand wrapping is necessary on each panel to start and finish the wrapping process where the upper and lower cable bands interfere with the Skewmaster. Hand wrapping is also an acceptable alternative to use of the Skewmaster™ for wrapping entire panels. The subsequent procedures should be followed to properly install Cableguard™ by hand wrapping.

1. Beginning at the upper cable band, tape the loose end of a roll of Cableguard™ to the cable so the loose end is facing down in the 9 o'clock position (for clockwise wrapping) or 3 o'clock position (for counterclockwise wrapping). The wrap should come off the roll over the top with the roll between the cable and the wrap being installed.
2. Wrap around the cable parallel to the cable band until the wrap laps over itself. After a complete double wrap is made, begin moving the wrap up the cable while wrapping, gradually working out to the project specific triple overlap through several rotations.
3. The wrap should be consistently tensioned as it progresses up the panel. The downhill operator will be able to provide the most tension and should consistently pull the wrap tight as it is passed to the uphill operator. The uphill operator also has a responsibility to tension the wrap.
4. Consistent overlap and tension are key to prevent bulging and sagging of the wrap.

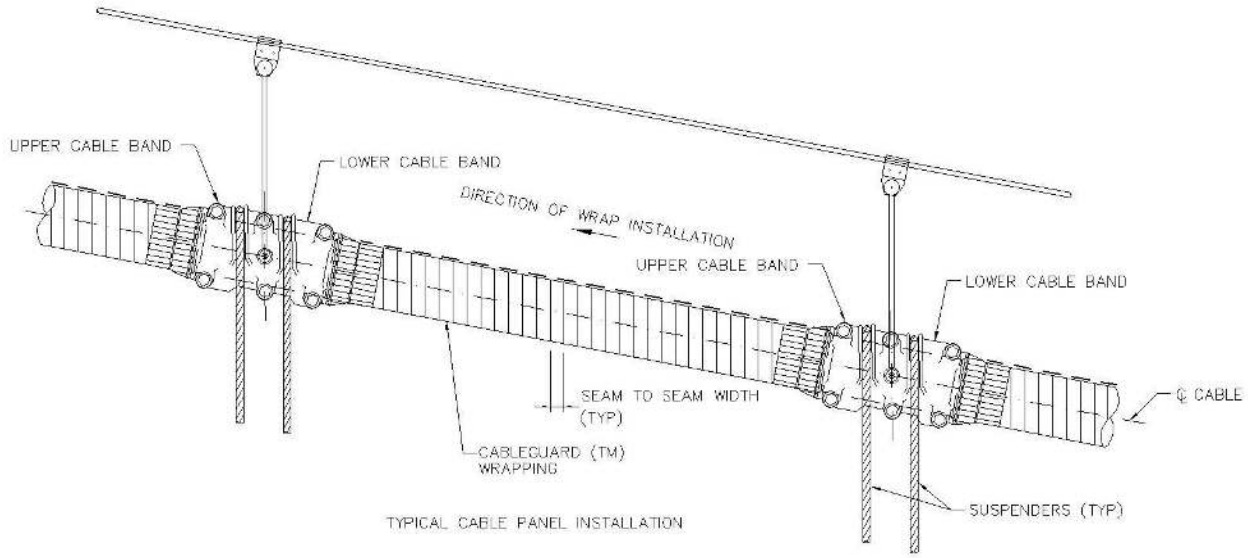

FIGURE 1: CABLE SECTION SHOWING LOWER AND UPPER CABLE BANDS ON A SUSPENSION BRIDGE

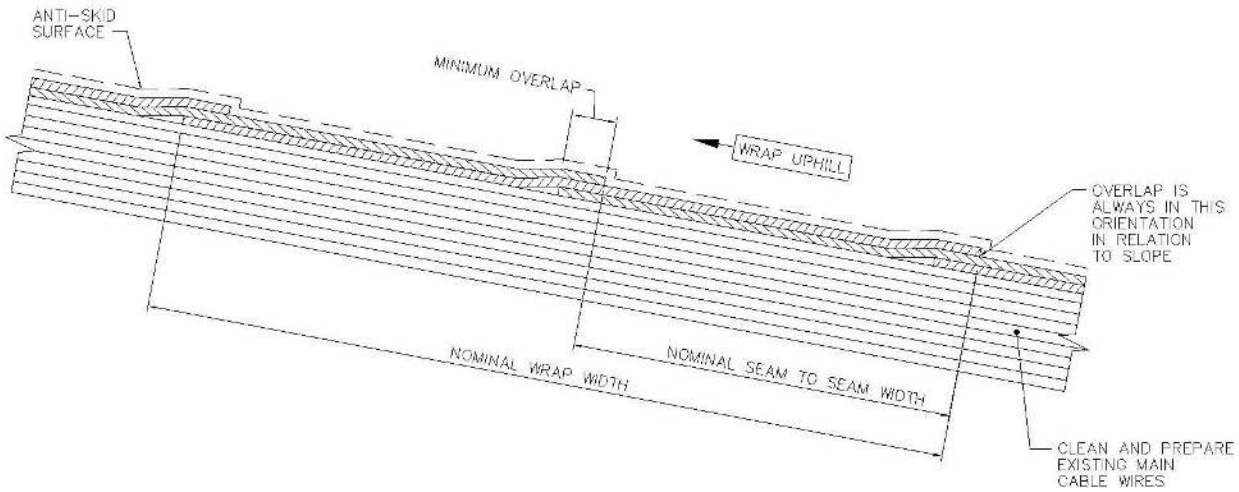

FIGURE 2: CABLEGUARD™ OVERLAP

TABLE 1: CABLEGUARD™ MINIMUM TRIPLE OVERLAP TOLERANCES

Nominal Wrap Width	Nominal Seam to Seam Width	Minimum Overlap	Maximum Overlap
150 mm	72 mm	3 mm	Per Job Specification
200 mm	97 mm	3 mm	
250 mm	122 mm	3 mm	
300 mm	147 mm	3 mm	

NOTE

Triple overlap (TO) may be calculated using the following formula:
TO = Wrap Width – (Seam-to-Seam Width 1 + Seam-to-Seam Width 2)

SPLICES

When coming to the end of a roll, a splice must be made in the wrap using the following procedure:

1. While maintaining tension on the wrap that is in place, unwind the remaining wrap.
2. Cut the wrap so that the splice will occur 90° to the top of the cable.
3. Tape the loose end in place using masking tape or heat seam the loose end to the overlapping tail using a heat gun and stitching roller.
4. Begin wrapping with the new roll making a 50 mm overlap. The lap should be made so that the exposed end faces down (Figure 3 Splice Overlap).
5. If the loose end was held in place with tape, remove the masking tape that held the splice together after making approximately three wraps with the new roll.

NOTE

Rolls may contain factory splices, which may be installed in any position.

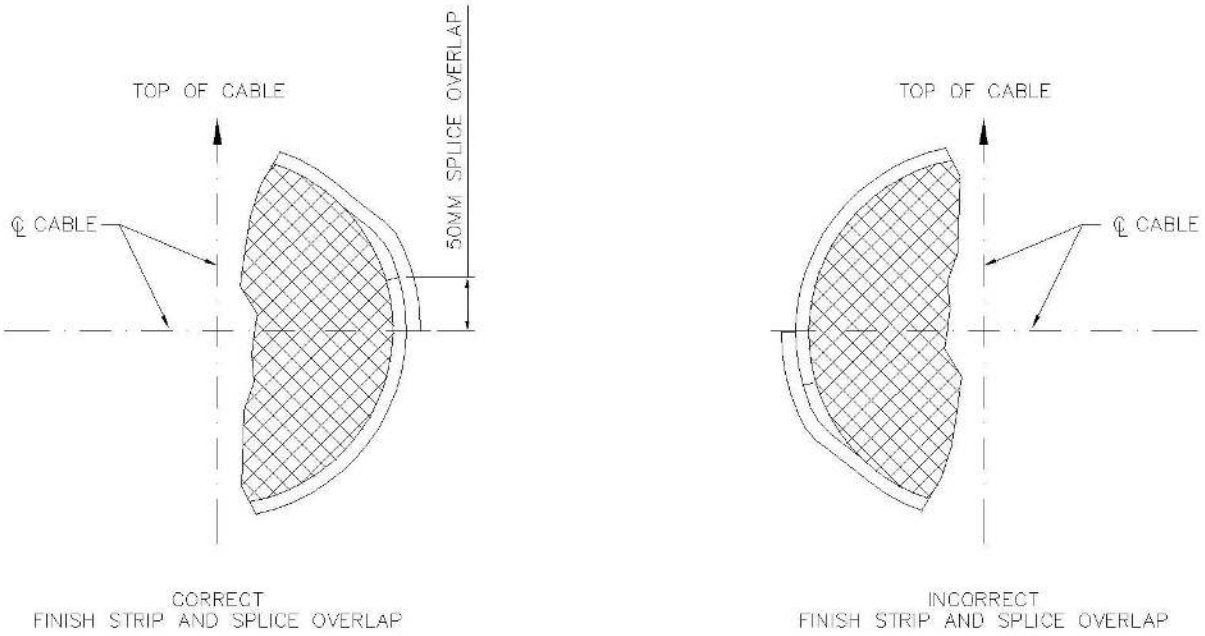

FIGURE 3: SPLICE OVERLAP

(shown for clockwise installation)

HEATING THE WRAP

NOTE

It is important that the wrap to be heated within 24 hours of installation. Follow "Weather Considerations" provided in Appendix F if the wrap is left unheated overnight or is not heated within 24 hours of installation.

WARNING

Do not connect the control box directly to a power source. You must provide a fusible disconnect at the power source rated for the blanket current and voltage that will provide overcurrent/short circuit protection!

WARNING

Connecting the blanket and controller to improper voltage can cause serious damage. Have a qualified electrician verify that the supply voltage matches the blanket voltage!

NOTE

See chart in Appendix A-1 for power supply cable sizing.
See chart in Appendix A-2 for generator sizing.

1. Connect the controller to a power source matching the blanket's voltage and current ratings. The power source must be effectively grounded (National Electrical Code NFPA 70-250).
2. Attach the blanket to the section to be heated. The male power plug from the blanket plugs into the female plug on the controller.
3. The temperature sensing thermocouple coming from the blanket is integrated into the power plug. As supplied, the blanket temperature is regulated from the thermocouple located in the center heating element.
4. Turn the "Power" switch to the on position. Use the up/down arrows to set the initial temperature to 127°C (260°F) on the controller. Generally, 127°C (260°F) is a good starting temperature at which to adjust the controller's temperature set point. Actual temperature set point and heating cycle time balance needed to produce a quality bond between layers of Cableguard™ material will vary and should be determined by the contractor in the field.
5. Verify thermocouple operation by reading the "process" temperature. On initial startup, prior to applying power, process temperature on the controller should display ambient temperature. Thermocouple accuracy is relative to the thermocouple embedment location within the heating blanket and should be used as a reference point only. One thermocouple embedment is typically supplied for each element.

NOTE

On initial startup always verify proper thermocouple operation by reading ambient temperature on the controller. If ambient temperature is not displayed, switch to another thermocouple.

6. When using a bladder style heating blanket, the compressed air supply should always be connected to the pressure regulator shipped with the blanket controller. This regulator maintains 24 kPA (3.5 psi) on the blanket. After connecting the regulated air pressure to the blanket via the quick disconnect, inflate the blanket to 24 kPA (3.5 psi) by opening the 3-way valve. Verify correct pressure at the blanket. To deflate the blanket, turn the 3-way valve handle 90°.

To avoid damage to the inflatable blanket bladder, air regulator components shipped with the controller must be used.

To avoid damage to the inflatable blanket bladder, the blanket should never be inflated to a pressure higher than 34kPa (5 psi)

7. With the blanket in place, controller power on, and air pressure on the blanket, push the “Blanket #X Start” button. When the controller senses that air pressure is present on the blanket, it will make a short beep sound and power will be applied to the blanket. Depending on ambient conditions, it can take up to 10 minutes or more for the blanket to come up to temperature after power is applied to the blanket. The timer and temperature settings should be adjusted to obtain an optimum material bond without overheating. It is preferable to heat the Cableguard™ material for a longer time at a lower temperature than to try and turn the temperature up higher to achieve faster times. The temperature controller is limited to 150°C (302°F).

WARNING

The blanket should never be operated above 150°C (302°F). Operating above this temperature will damage the wrap.

WARNING

The blanket should always be in contact with the cable when the “Blanket” switch is turned on.

8. On the first heating cycle and with the blanket at ambient air temperature, the timer will begin when the blanket temperature reaches 5°C (10°F) of the temperature set point on the controller.
9. After the first heat cycle the exact time and temperature should be adjusted to obtain an optimum material bond without overheating.
10. An audible signal indicates cycle completion. When the cycle is complete, release the air pressure from the bladder, rotate the blanket approximately 20° on the cable, re-inflate the bladder, and push the start button.

FIGURE 4: BLANKET DOUBLE CONTROLLER

11. Place a mark on the Cableguard™ material at the unheated edge with an ink pen. Upon hearing the audible alarm, release the air pressure from the bladder, and move the blanket up the cable to the next unheated section. The lower edge of the heating element should have a small overlap with the mark indicating the unheated edge. Repeat steps 8 and 9 in this location.

FIGURE 5: INFLATABLE BLANKET

12. Verify that 4 minutes has been long enough to properly bond the material. If the material is not bonded, increase the time and/or temperature accordingly. If the material is burnt, decrease the time and/or temperature accordingly.
13. When approximately two blanket lengths remain to be heated, measure the distance from the end of the blanket to the cable band. If it is less than two times the blanket length minus 150 mm, skip to the end section, heat it first, then back up one blanket length to finish heating. This allows the section that would otherwise have been heated twice to cool before being heated again.
    a. Example: the blanket is 750 mm long and there are approximately two more heats to finish to the cable band. You measure 1,150 mm of unheated material. Two times the blanket length is 1,500 mm minus 150 mm = 1350 mm. Move the blanket to the very end, heat, and then move back 750 mm.
14. After the wrap has been heated, it needs to cool without being disturbed. This usually takes 10 to 15 minutes.

15. Small areas of Cableguard™ wrap may fail to properly bond due to cable irregularities or other obstructions, such as wire repairs, over which Cableguard™ is wrapped. A bond is considered acceptable when the exposed edge of the wrap cannot be lifted by a finger or painters tool after cooling (Figure 6). In other words, the reveal edge has become bonded with the layer below. Areas that are not properly bonded should be reheated and seamed using a heat gun and stitching roller or a heating blanket. The selection of either a heat gun and stitching roller (Figure 7) or a heating blanket is left to the discretion of the contractor.

FIGURE 6: SEAM TESTING FOR ACCEPTABLE BOND

FIGURE 7: EDGE SEAMING WITH A HEAT GUN AND HAND ROLLER

16. **OPTIONAL**: Two heating blankets may be used simultaneously on a single panel. The first blanket is placed on the cable at the cable band with the restraining buckles facing the 3 o'clock position (positioning is given as a reference only; actual positioning is left to the discretion of the contractor). The section is heated for a single cycle and the blanket is moved to the next position up the panel without rotating. When the first blanket has reached its third position on the panel, the second blanket may be placed at the cable band with the restraining buckles rotated approximately 30° from the restraining buckles on the first blanket. The second blanket will follow the progress of the first blanket up the panel without rotating either blanket.
17. **OPTIONAL**: At the discretion of the contractor, the Cableguard™ abutting the lower cable band may be heated prior to working up the panel from the starting point. The Cableguard™ abutting the lower cable band should be heated using the end seal heating blanket for two cycles with a blanket rotation between the cycles prior to continuing work from the starting point up the panel. A standard blanket along with a heat gun may also be used to heat the lower cable band prior to working up the cable from the starting point. This would enable finishing work to be performed at the cable band locations while the balance of the panel is being heated.
18. **OPTIONAL FOR NON-DEHUMIDIFIED CABLES** (see job specifications): Locate the low point at the center of the bridge. A 25 mm diameter hole may be cut in the Cableguard™ material at the low point of the suspension bridge on the bottom side of the cable. This will allow any water that may have entered the cable to escape at the lowest point.

WRAPPING SUSPENSION CABLES THAT HAVE NO OUTER WRAPPING WIRE

Prior to wrapping directly over wire strands on a suspension cable, a stainless band and buckle are typically installed at intervals specified in the contract drawings. To protect the wrap from buckle abrasion, a purpose made cover can be installed over the buckle prior to wrapping. Contact D.S. Brown for more information.

NON-DEHUMIDIFIED CABLE BAND PREPARATION

On a suspension bridge there is an upper and lower part to each cable band. They are identified in Figure 1.

Lower Cable Band Preparation

1. The lower cable band area is prepared by cutting a neoprene sealing wedge to length and wrapping it around the cable close to the cable band. The wedge should fit snugly around the cable. The wedge is installed after the Cableguard™ wrap has been installed.

FIGURE 8: WEDGE INSTALLATION

NOTE
It is important to install the lower wedge with the joint 90° to the top of the cable (Figure 9).

2. The wedge ends are held together using part number 45-121S wedge glue supplied by D.S. Brown. Apply a small amount of glue to the cut edge, hold the parts together for approximately 20 seconds, and then release. A 9.5 mm (3/8”) wide stainless steel band is then installed in the groove on the wedge and snugged into place around the banding clip (Figure 10). Slide the clamp on the strap and bend the end under at the ear side of clamp (Figure 11). Do not tighten the banding clip at this time.

NOTE
It is important to make sure the banding goes under the clip (Figure 11).

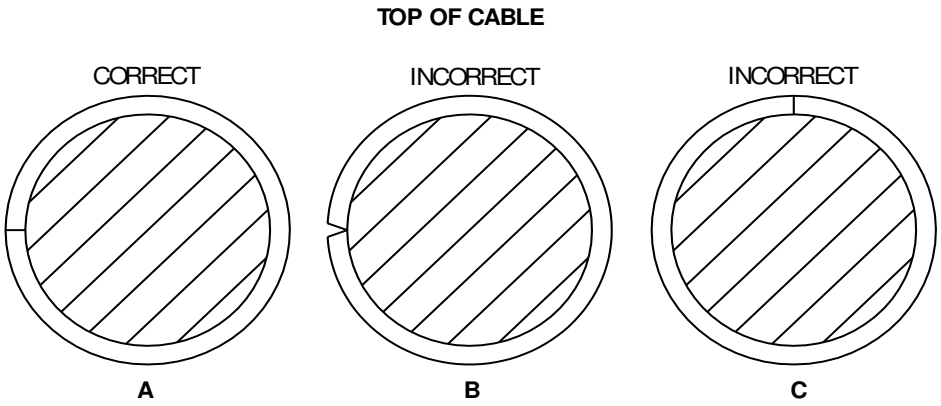

FIGURE 9: LOWER NEOPRENE SEALING WEDGE INSTALLATION

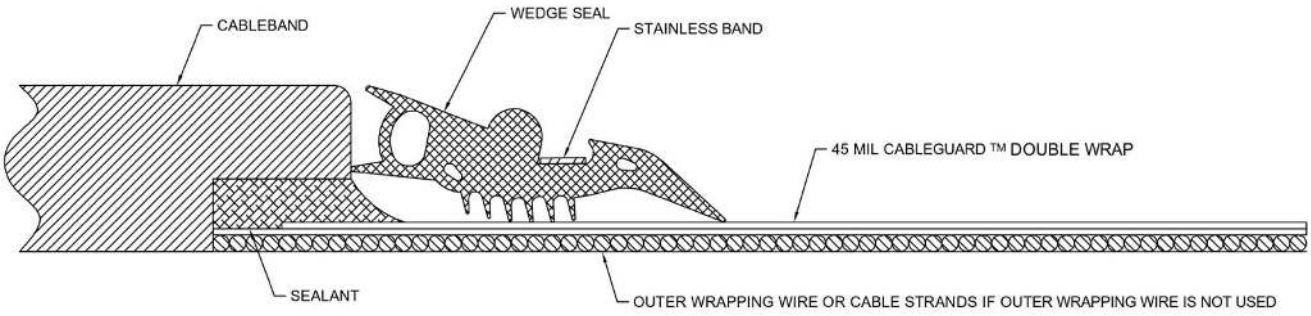

FIGURE 10: STAINLESS STEEL BAND INSTALLATION

3. Move the wedge to within 50 mm of the cable band. Apply a 6 mm bead of sealant around the cable band where the wedge will contact it. Slide the wedge until it is in intimate contact with the cable band. Using the band-tightening tool, tighten the band and cinch it with the banding clip by folding the retention ears over the band (Figure 11). It may be necessary to use a hammer to move the wedge tight to the cable band.

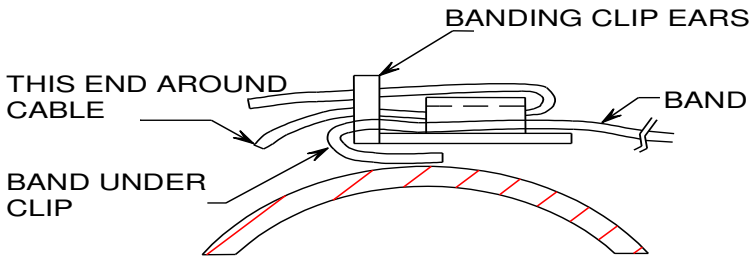

FIGURE 11: BANDING CLIP INSTALLATION

Upper Cable Band Preparation

1. The upper cable band area is prepared by cutting the sealing wedge to length and wrapping it around the cable so it fits snugly around the cable with a 12 mm gap at the bottom.

NOTE
It is important to install the wedge with the 12 mm open joint on the bottom side of the cable. Figure 12 shows what a correctly installed lower sealing wedge will look like in section.

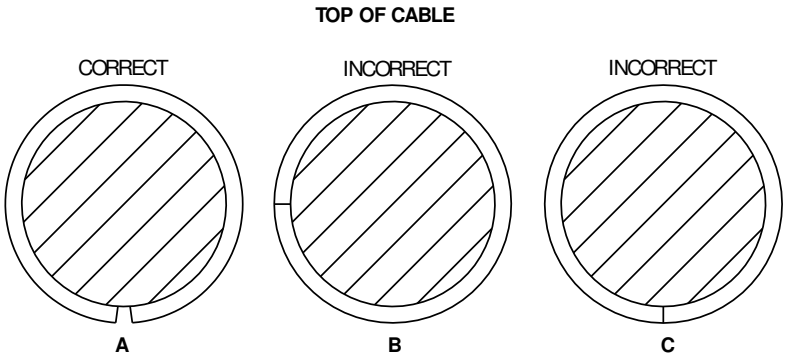

FIGURE 12: UPPER CABLE BAND NEOPRENE SEALING WEDGE INSTALLATION

2. The wedge ends are assembled using two 4.7 mm plastic barbs inserted into the holes in the end of the wedge. When the wedge is installed there should be a 12 mm gap between wedge ends as shown in Figure 13. A 9.5 mm stainless steel band is then installed in the groove on the wedge and snugged into place around the banding clip (Figure 10). Slide the clamp on the strap and bend the end under at ear side of clamp (Figure 11). Do not tighten the banding clip at this time.

FIGURE 13: WEDGE GAP AND PLASTIC BARBS

3. Move the wedge to within 50 mm of the cable band. Apply a 6 mm bead of sealant around the cable band where the wedge will contact it. Do not apply sealant to the bottom of the cable band at the 12 mm gap. Slide the wedge until it is in intimate contact with the cable band. Using the band-tightening tool, tighten the band and cinch it with the banding clip by folding the retention ears over the band. It may be necessary to use a hammer to move the wedge tight to the cable band.

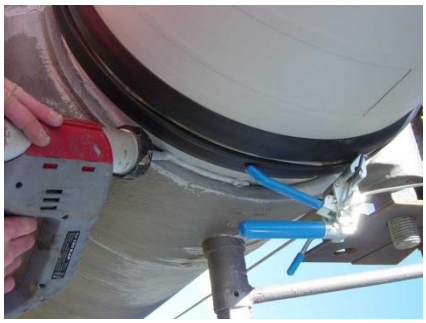

FIGURE 14: APPLYING SEALANT

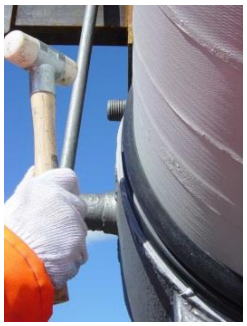

FIGURE 15: SLIDING WEDGE INTO PLACE

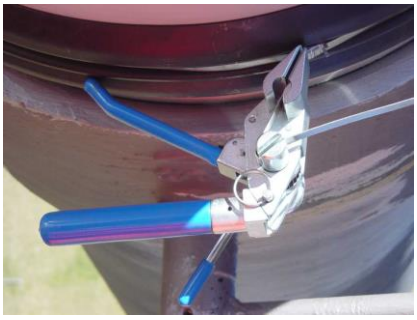

FIGURE 16: BAND TIGHTENING TOOL

FIGURE 17: BAND RETENTION CLIP

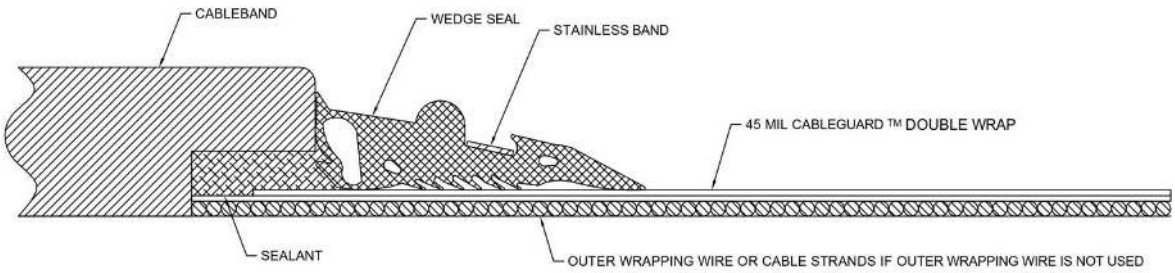

FIGURE 18: COMPRESSED WEDGE INSTALLATION

4. The finish strip is installed next over the wedge. Before installing the finish strip, the area where the strip will be applied must be cleaned with xylene. This procedure is the same for both upper and lower cable band locations. Wrap un-reinforced Cableguard™ finishing strip material around the cable and cut it to a single wrap length, leaving an extra 50 mm to 75 mm of overlapping material. The 50 mm to 75 mm overlap should be made so that the exposed end faces down (Figure 12). Prior to heating, place a thin sheet of aluminum between the 45 mil wrap and 30 mil finishing strip in the area where it the finishing strip will be heated to prevent the finishing strip from bonding to the wrap below. Finally, use a heat gun and roller to bond the finishing strip to itself (Figure 20).

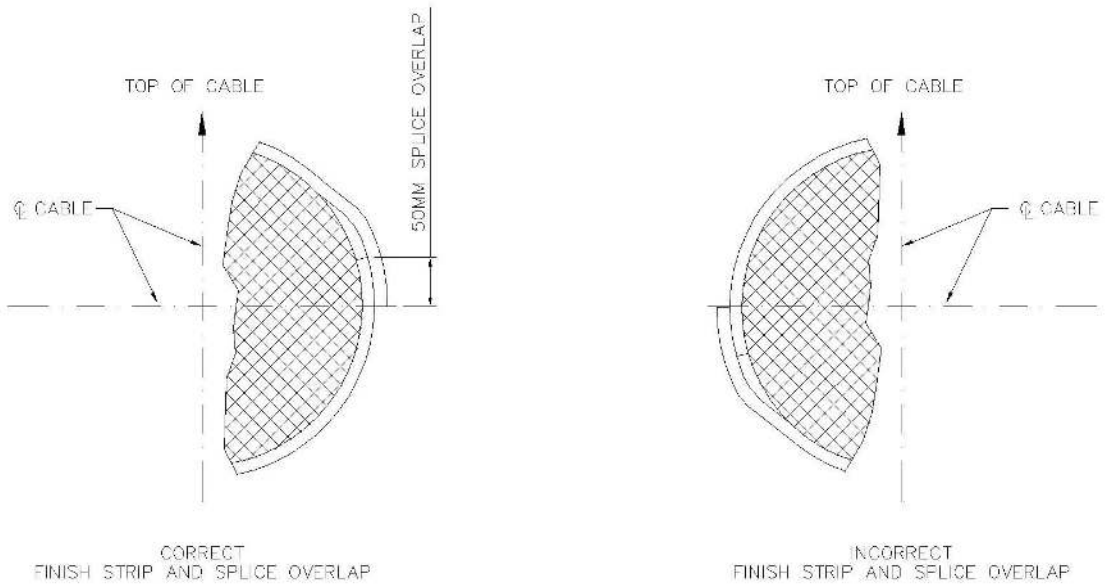

FIGURE 19: FINISH STRIP INSTALLATION AND SPLICE OVERLAP

5. After forming a snug loop around the cable with the finishing strip it is pulled back over itself and moved close to the wedge (Figure 21). The finish strip is then snapped over the wedge so that it covers the wedge (Figure 22), and a final 9.5 mm stainless strap is installed behind the indicating bump on the wedge (Figure 23).
6. Heat the finishing strip with a heating blanket.

FIGURE 20: HEATING FINISH STRIP

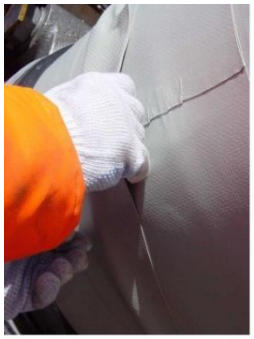

FIGURE 21: FINISH STRIP PULLED BACK

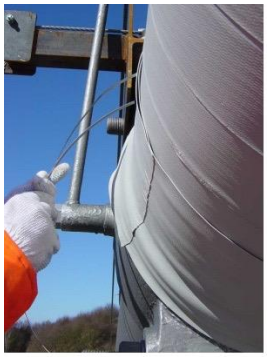

FIGURE 22: FINISHED STRIP SNAPPED OVER WEDGE

FIGURE 23: STRAP INSTALLED BEHIND INDICATOR BUMP

7. Cut a 10 mm wide by 15 mm long slot on the upper cable band finishing strip and align this slot with the wedge gap as shown in Figure 24.

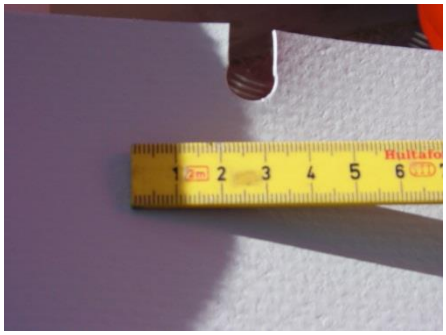

FIGURE 24: 10 mm WIDE BY 15 mm LONG SLOT

FIGURE 25: OPTIONAL 10 mm HOLE

8. **OPTIONAL** (see job specifications): A 10 mm diameter hole located 90 mm from the cable band and in the 6 o'clock position may be cut on the lower cable band finishing strip, as shown in Figure 25. This will allow any water that may have entered the cable to escape at the lowest point between the cable bands.

DEHUMIDIFIED CABLE BAND PREPARATION

Cable Band Without Wedge Seal (Sealant Only):

1. Before beginning any work at the cable band first clean the cable band recess with a wire brush or other utensil approved by the engineer.
2. Once it has been ensured that no dirt, debris, or moisture are present in the cable band recess, wrap a strip of un-reinforced 30 mil Cableguard™ around the cable. Cut the un-reinforced material to a single wrap length, leaving an extra 50 mm to 75 mm of overlapping material. The 50 mm to 75 mm overlap should be made so that the exposed end faces down.
3. Heat the unreinforced wrap to itself using a heat gun and roller then slide the unreinforced wrap into the band recess as deep into the groove as possible. Work the heat gun around the cable band recess which will tighten the unreinforced wrap on the cable inside the recess.
4. Once the unreinforced wrap has been installed, begin wrapping at the cable band with reinforced 45 mil Cableguard™ wrap as laid out in the "Standard Cable Band Preparation" section above. Using an end seal blanket at the lower cable band prior to continuing work up the cable will enable finishing work to be performed at the cable band locations while the balance of the panel is being heated.
5. Once the wrap abutting the lower cable band has cooled, clean the Cableguard™ where sealant will be applied with xylene. Once the xylene has dried, seal the joint as shown in the contract drawings.

6. Sealant must fully cure to achieve a tight seal (24 to 48 hours for 6 mm diameter bead). Contact D.S. Brown for expected cure times if more than a 6 mm diameter bead of sealant is being applied inside the cable band recess.

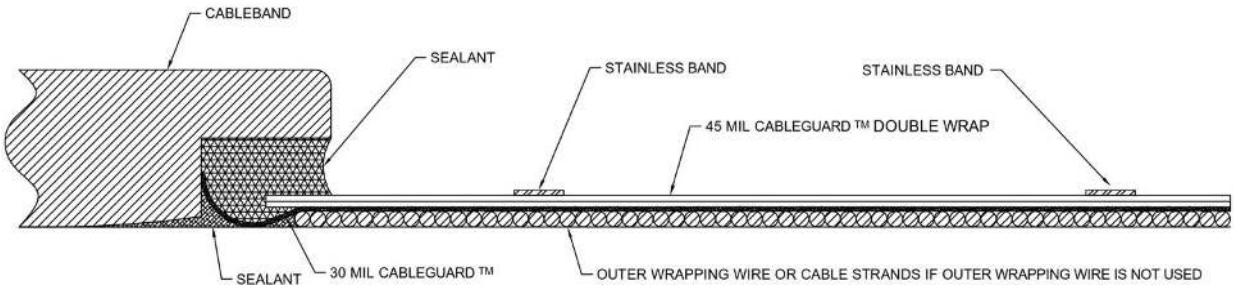

FIGURE 26: CABLE BAND FINISH WITHOUT CABLEGUARD™ WEDGE SEAL – SEALANT ONLY OPTION

Cable Band with Wedge Seal:

1. Before beginning any work at the cable band first clean the cable band recess with a wire brush or other utensil approved by the engineer.
2. Once it is insured that no dirt. debris, or moisture are present in the cable band recess, begin wrapping the cable with reinforced 45 mil Cableguard™ wrap. After one full wrap around the cable, slide the reinforced wrap as deep into the cable band as possible and apply tension to the wrap to tighten it on the cable.
3. Continue wrapping up the cable by hand. Using an end seal blanket at the lower cable band prior to continuing work up the cable will enable finishing work to be performed at the lower cable band locations while the balance of the panel is being heated.
4. After heating the Cableguard™ abutting the lower cable band, verify the wrap end just outside the cable band is bonded. If not, use a heat gun to bond the loose end of the wrap.
5. Install the wedge over the wrap with no gap between the wedge. The wedge splice for both upper and lower cable band locations should be placed at 90° as shown in Figure 9. Move the wedge to approximately 50 mm from the cable band.
6. Install the stainless-steel band in the wedge seal groove but do not tighten the band.
7. Clean the area between the wedge seal and the cable band with xylene. When the xylene has dried, seal the cable band recess as shown in the contract drawings.
8. Slide the wedge seal into place as shown in Figure 15. The wedge seal should compress into the cable band face as shown in Figure 18.
9. Sealant must be allowed to fully cure to achieve a tight seal (24 to 48 hours for 6 mm diameter bead) prior to applying pressure from the dehumidification system.
10. Finishing strip can be applied following steps 4 to 6 beginning on page 17.

DURA-GRIP™ WALK SURFACE APPLICATION

Dura-Grip™ Walk Surface is an anti-slip coating that provides traction for workers walking the cables after Cableguard™ has been installed. If the optional Dura-Grip™ Walk Surface is specified, it MUST BE APPLIED WITHIN 7 DAYS of heating the Cableguard™ wrap. Apply Dura-Grip™ Walk Surface as follows:

1) Verify proper conditions for the installation:
   a) The ambient air temperature is between 5°C (40°F) and 43°C (110°F).
   b) The ambient relative humidity is between 0% and 90%.
   c) Cableguard™ surface temperature is between 5°C (40°F) and 43°C (110°F).
   d) Cableguard™ surface temperature is at least 3°C (5°F) above dew point (Figure 25).
      i) There is no visible moisture on the area to be coated.
   e) The base coat material is between 16°C (60°F) and 43°C (110°F).
      i) If stored at temperatures below 5°C (40°F), base coat and top coat must be warmed to room temperature 22°C (72°F) for at least 48 hours prior to application.
   f) Thoroughly wipe down the Cableguard™ with xylene where the Dura-Grip™ Walk Surface will be applied.
   g) Mask off the area where the Dura-Grip™ Walk Surface is to be applied to ensure a uniform width on top of the cable as required in the job specifications (Figure 28).
2) Install Dura-Grip™ Walk Surface base coat and grit:
   a) Thoroughly mix the base coat (part number 45-1S).
   b) Apply a heavy coat with a brush or roller the full width of the Dura-Grip™ Walk Surface in a continuous process between cable bands to maintain a wet edge (Figure 28).
   c) While applying the base coat, immediately sprinkle Dura-Grip™ Walk Surface grit (part number 45-2S) into the wet base coat at a rate of 732 grams per square meter (GSM) to 976 GSM (0.15 lb/ft^2 to 0.20 lb/ft^2) (Figure 28). Minimizing grit application on the longitudinal edges of the walking surface provides the best top coat edge bond.

FIGURE 27: CHECKING DEW POINT

FIGURE 28: BASE COAT AND GRIT APPLICATION

3) Install Dura-Grip™ Walk Surface top coat:
   a) Dura-Grip™ Walk Surface top coat should be applied the same day as the base coat and grit. Top coat may be applied once the base coat no longer lifts or strings when touched (Figure 29).
      i) A cure accelerator (part number 45-224S) should be used when installing the top coat between 5°C (40°F) and 10°C (50°F). Cure accelerator must be used when installing the top coat below 5°C (40°F). The minimum top coat installation temperature is -7°C (20°F). See table 3 for cure time when using cure accelerator.
      ii) If same day top coat application is not possible, the top coat can be applied up to 5 days after the base coat and grit if the following conditions are met:
         (1) Document the cable section on which the Dura-Grip™ Walk Surface top coat was not installed the same day as the base coat and grit. Record the date of base coat and grit application, cable identification number, and verification that shrink wrap was applied. When the top coat is applied, record the date, ambient temperature, and relative humidity or dew point.
         (2) The base coat and grit must be tightly wrapped with shrink wrap to keep the surface clean from dirt, debris, and moisture. Shrink wrap must be applied the same day as the base coat and grit, but only after the base coat is no longer tacky.
         (3) Shrink wrap must be applied from cable low point to cable high point with a 150 mm minimum overlap to prevent dust build up and avoid water intrusion.
         (4) Shrink wrap must be sealed by taping or other means at the high and low points to keep water out and to prevent the shrink wrap from coming lose. There should be no visible holes in the shrink wrap.
         (5) After removing the shrink wrap and prior to applying the top coat, verify the surface is dry and free from dust or dirt. Verify proper conditions for top coat installation as outlined in section 1 of the Dura-Grip™ Walk Surface installation instructions. Clean edges of the Dura-Grip™ Walk Surface thoroughly with xylene without removing the base coat.
   b) Pre-mix top coat resin with a power mixer at moderate speeds to homogenize the contents.
   c) Add top coat cure to resin and mix with a power mixer for 1 to 2 minutes until completely dispersed.
   d) Apply the mixed top coat to the base coat and grit with a brush or roller. Apply longitudinally followed by transversely to fill voids.
      i) Total top coat thickness must be between 125 μm to 175 μm (5 mils to 7 mils).
      ii) Pot life of the mixed top coat is 2.5 hours at 20°C (68°F) and 50% relative humidity.
   e) Remove masking tape immediately after application of the top coat (Figure 31).
   f) If needed, an additional top coat may be applied within the overcoat interval times shown in tables 2 and 3.

FIGURE 29: BASE COAT LIFTING AND NOT READY FOR TOP COAT APPLICATION

FIGURE 30: TOP COAT APPLICATION

FIGURE 31: MASKING TAPE BEING REMOVED IMMEDIATELY AFTER TOP COAT APPLICATION

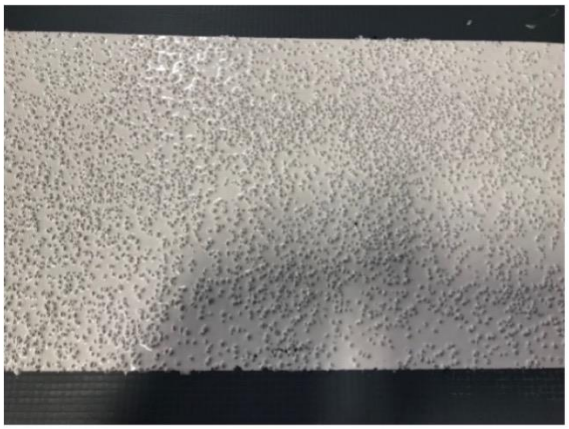

FIGURE 32: COMPLETED DURA-GRIP™ WALK SURFACE INSTALLATION

TABLE 2: TOP COAT CURING SCHEDULE AT 125 μm (5 MILS)

Surface Temp	Dry to Touch*	Overcoat Min/Max Interval*	Dry to Handle*
5°C (40°F)	8 hours	3 days to 7 days	3 days
10°C (50°F)	4 hours	48 hours to 7 days	48 hours
21°C (70°F)	2.5 hours	8 hours to 4 days	10 hours
32°C (90°F)	1 hour	4 hours to 12 hours	5 hours

*Assumes 50% relative humidity. Higher humidity levels extend dry times.

TABLE 3: TOP COAT CURING SCHEDULE WITH ACCELERATOR ADDITIVE AT 125 μm (5 MILS)

Surface Temp	Dry to Touch*	Overcoat Min/Max Interval*	Dry to Handle*
-7°C (20°F)	8 hours	16 hours to 4 days	16 hours
0°C (32°F)	4 hours	8 hours to 48 hours	10 hours
10°C (50°F)	75 minutes	4 hours to 24 hours	6 hours

*Assumes 1.6 ounces of accelerator additive per top coat gallon kit (part number 45-224S) at 50% relative humidity. Higher humidity levels will extend dry times.

TABLE 4: DURA-GRIP™ WALK SURFACE COVERAGE & APPLICATION RATES – METRIC UNITS

Dura-Grip™ Walk Surface Width	Linear Meters per Gallon Kit	Grams of Grit per Linear Meter*
150 mm	61.9 m	134 g
200 mm	46.3 m	179 g
250 mm	37.2 m	223 g
300 mm	31.1 m	268 g
350 mm	26.5 m	313 g
400 mm	23.2 m	357 g
500 mm	18.6 m	447 g
600 mm	15.5 m	521 g

*Grams of grit applied at 878 GSM

TABLE 5: DURA-GRIP™ WALK SURFACE COVERAGE & APPLICATION RATES – IMPERIAL UNITS

Dura-Grip™ Walk Surface Width	Linear Feet per Gallon Kit	Pounds of Grit per Linear Foot*
5.91”	203’	0.09 lbs
7.87”	152’	0.12 lbs
9.84”	122’	0.15 lbs
11.81”	102’	0.18 lbs
13.78”	87’	0.21 lbs
15.75”	76’	0.24 lbs
19.69”	61’	0.30 lbs
23.62”	51’	0.35 lbs

*Pounds of grit applied at 0.18 pounds per square foot

Installation on Cable-Stayed Bridges

Because there is no cable band on cable-stayed bridges, installation is straightforward.

1. Begin wrapping as outlined in the section “Installing the Wrap” under the heading “Installation on Suspension Bridges”.
2. Heat the wrap as outlined in the section “Heating the Wrap” under the heading “Installation on Suspension Bridges”.
3. Allow time for the wrap to cool.
4. After a complete section of cable is wrapped, heated, and has cooled, fold the top end up on itself and apply a 6mm bead of sealant around the cable where the wrap starts and finishes. Then roll the wrap over the sealant and apply a stainless-steel band to seal the area as in step 5 of the section “Upper Cable Band Preparation” under the heading “Installation on Suspension Bridges”. Apply a second stainless steel band to the bottom of the cable, but do not use sealant.

D.S. Brown can also supply transition boots to maintain an impervious seal in areas where cable diameters change dramatically (Figure 33).

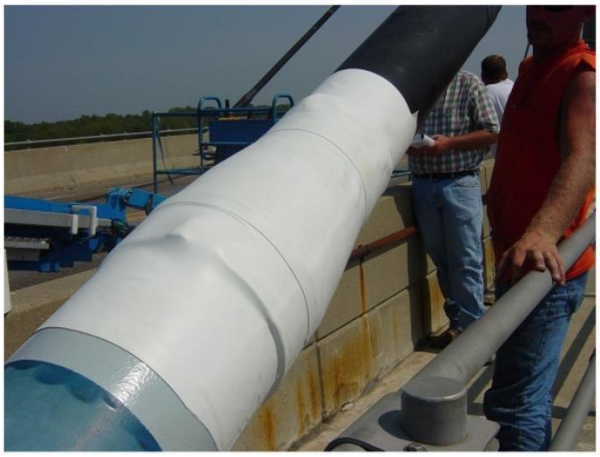

FIGURE 33: TRANSITION BOOT

FIGURE 34: CABLESTAY INSTALLATION WITH CLAMSHELL STYLE HEATER

Appendix A-1: Maximum Amperage for Length of Flexible Cord

Use these tables to determine a cable size that will keep voltage drop of the blanket supply cable below 3%. AWG is American Wire Gauge. Tables are based on copper conductors.

TABLE 6: MAXIMUM AMPERAGE FOR GIVEN LENGTH OF COPPER SOW CABLE CONDUCTOR AND AWG WIRE SIZE AT 240 VOLTS AC

3 PHASE AMPS / 1 PHASE AMPS

Length	#12 AWG	#10 AWG	#8 AWG	#6 AWG	#4 AWG
30 m (100')	20 / 25 amps	25 / 30 amps	35 / 40 amps	45 / 55 amps	60 / 70 amps
60 m (200')	13 / 11 amps	20 / 18 amps	33 / 29 amps	45 / 46 amps	60 / 70 amps
91 m (300')	9 / 7 amps	14 / 12 amps	22 / 19 amps	35 / 30 amps	55 / 48 amps
121 m (400')		10 / 9 amps	16 / 14 amps	26 / 33 amps	41 / 36 amps
152 m (500')			13 / 11 amps	21 / 18 amps	33 / 29 amps

TABLE 7: MAXIMUM AMPERAGE FOR GIVEN LENGTH OF COPPER SOW CABLE CONDUCTOR AND AWG WIRE SIZE AT 480 VOLTS AC

3 PHASE AMPS / 1 PHASE AMPS

Length	#12 AWG	#10 AWG	#8 AWG	#6 AWG	#4 AWG
30 m (100')	20 / 25 amps	25 / 30 amps	35 / 40 amps	45 / 55 amps	60 / 70 amps
60 m (200')	20 / 22 amps	25 / 30 amps	35 / 40 amps	45 / 55 amps	60 / 70 amps
91 m (300')	17 / 15 amps	25 / 24 amps	35 / 38 amps	45 / 55 amps	60 / 70 amps
121 m (400')	13 / 11 amps	21 / 18 amps	33 / 28 amps	45 / 45 amps	60 / 70 amps
152 m (500')		16 / 14 amps	26 / 23 amps	42 / 36 amps	60 / 58 amps

Appendix A-2: Generator Sizing

TABLE 8: THREE PHASE GENERATOR SIZING

Three Phase Generator Sizing			
	Generator Output Voltage		
	480	380	240
Generator KW	Maximum Amperes		
10	11	14	22
15	16	21	33
20	22	28	44
25	27	35	55
30	33	41	66
35	38	48	77
40	44	55	87
45	49	62	98
50	55	69	109

Notes:

1. Chart is calculated with unity power factor for blanket loads and a 10% allowance for variances.
2. Standard blanket voltage supply is 480-volt 3 phase (3 phases plus ground).
3. Any blanket voltage is available. Contact D.S. Brown for more information.
4. Contact D.S. Brown for single phase equipment.

Appendix B: Cableguard™ Repair Instructions

There are three basic types of damage:

Type 1: Cut

Type 2: Tear or puncture

Type 3: Burn from overheating the wrap

TYPE 1: CUT

Cut less than 75 mm long

Cuts less than 75 mm in length can be repaired with a patch (Figure 35). Cut the patch in a square shape 100 mm longer than the cut length (Figure 36). For example, if the cut is 50 mm long, make a patch that is 150 mm by 150 mm. Use scissors to round the corners of the patch.

1. Clean the area to be patched, as well as the patch itself, with xylene (Figure 37 and Figure 38).
2. Apply the patch using a heat gun and roller (Figure 39). Ensure that the entire patch is well bonded.

FIGURE 35: CUT LESS THAN 75 mm LONG

FIGURE 36: PATCH 100 mm LONGER THAN CUT

FIGURE 37: CLEAN PATCH WITH XYLENE

FIGURE 38: CLEAN AFFECTED AREA

FIGURE 39: APPLY THE PATCH USING A HEAT GUN AND ROLLER

Cut greater than 75 mm long

Cuts greater than 75 mm long must be repaired by wrapping over the damaged area with new Cableguard™ material.

1. Clean the existing wrap at least 50 mm beyond each end of the cut around the entire circumference of the cable using xylene (Figure 37 and Figure 38). If the Dura-Grip™ Walk Surface is installed, follow instructions under Type 4: Repairs Over Dura-Grip™ Walk Surface.
2. Wrap reinforced Cableguard™ material over the cut and completely around the cable, overlapping per job specifications. Continue wrapping until the patch wrap extends at least 50mm beyond the cut area on each side.
3. Use the heating blanket to bond the patch using the normal heating procedure.
4. Reinstall the Dura-Grip™ Walk Surface in the overwrapped area.

TYPE 2: TEAR OR PUNCTURE

This type of damage is usually caused by physical contact from equipment or falling debris. Tears or punctures less than 75 mm in length can be repaired with a simple patch the same way a cut less than 75 mm is repaired as described above. Tears or punctures greater than 75 mm in length should be repaired as follows:

1. Cut a filler patch to match the size and shape of tear or puncture (Figure 42).
2. Clean the area to be patched, as well as the patch itself, with xylene (Figure 37 and Figure 38).
3. Apply the patch using a heat gun and roller (Figure 41). Ensure that the entire patch is well bonded.
4. After filling torn areas, tears or punctures should be patched or overwrapped the same way a cut greater than 75 mm is repaired as noted above.

FIGURE 40: PUNCTURE REQUIRING CUT PROCEDURE

FIGURE 41: TEAR

FIGURE 42: CUT 2-PLY FILLER PATCH TO MATCH TEAR

FIGURE 43: APPLY FILLER PATCH WITH A HEAT GUN AND ROLLER

TYPE 3: BURN

There are three types of burns caused by overheating the wrap:

A) A burn that has overheated the wrap only on the surface. No repair is necessary.

B) A burn that has melted the wrap down to the reinforcement mesh not more than halfway through.

C) A burn that has melted the wrap past the reinforcement mesh.

FIGURE 44: TYPE B BURN

FIGURE 45: TYPE C BURN

Type 3B: Burn Repair (Figure 44)

Burns that have melted the wrap down to the reinforcement mesh but not more than halfway through the material thickness may be repaired using a simple patch as described in “Cut less than 75 mm long”. Burn patches must be 100 mm wider than the burnt area. For example, a burn 112 mm wide would require a patch at least 212 mm wide. Use scissors to round the corners of the patch.

Type 3C: Burn Repair (Figure 45)

Burn less than 75 mm long

Burns that have melted the wrap past the reinforcement mesh and are less than 75 mm in length can be repaired with a patch as described in “Cut less than 75 mm long”. Cut the patch in a square shape 100 mm longer than the burn length (Figure 36). For example, if the burn is 50 mm long, make a patch that is 150 mm by 150 mm. Use scissors to round the corners of the patch. It may be easier to use the heating blanket depending on the situation.

Burn greater than 75 mm long

Burns that have melted the wrap past the reinforcement mesh and are greater than 75 mm long must be repaired by wrapping over the damaged area with new Cableguard™ material as described in “Cut greater than 75 mm long”.

TYPE 4: REPAIRS OVER DURA-GRIP™ WALK SURFACE

Before a repair can be made over the walking surface, the Dura-Grip™ Walk Surface must be removed at least 150 mm on either side of the repair. Use a heat gun and painter’s tool to remove the Dura-Grip™ Walk Surface. Heat the surface until the Dura-Grip™ Walk Surface becomes soft and can be scraped off with a painter’s tool. All Dura-Grip™ Walk Surface components must be completely removed, including the base coat. The base coat can then be removed my hand with xylene or by using a power burnishing tool. Care must be taken to avoid causing additional damage to the wrap while removing the Dura-Grip™ Walk Surface and base coat. Prior to installation of a patch, aggressively clean the repair area and the patch with xylene and a Scotch-Brite pad.

Appendix C: Tool List

- Hammer
- Caulk Gun
- Band Tightening Tool
- Tin Snips
- Tape Measure
- Utility Knife
- Scissors
- Painters Tool
- Heat Gun
- Roller
- Standard Wrenches
- Xylene
- Small Air Compressor
- Pliers
- Dew Point Meter

Appendix D: Approximate Time Temperature Setting For Heating Blankets

TABLE 9: APPROXIMATE BLANKET HEATING TIME - METRIC UNITS

Approximate Blanket Heating Time											
	Ambient Air Temperature °C										
Wind Speed meters/second	5	7	10	13	15	18	21	24	27	29	32
	Time in Minutes										
0	5	5	5	5	5	5	5	5	5	5	5
3	5	5	5	5	5	5	5	5	5	5	5
5	6	5	5	5	5	5	5	5	5	5	5
7	7	7	6	6	5	5	5	5	5	5	5
9	8	7	7	6	5	5	5	5	5	5	5
11	10	9	8	7	6	6	5	5	5	5	5
13	12	11	10	9	8	7	6	5	5	5	5

TABLE 10: APPROXIMATE BLANKET HEATING TIME - IMPERIAL UNITS

Approximate Blanket Heating Time											
	Ambient Air Temperature °F										
Wind Speed miles per hour	40	45	50	55	60	65	70	75	80	85	90
	Time in Minutes										
0	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5	5	5	5	5	5	5
10	6	5	5	5	5	5	5	5	5	5	5
15	7	7	6	6	5	5	5	5	5	5	5
20	8	7	7	6	5	5	5	5	5	5	5
25	10	9	8	7	6	6	5	5	5	5	5
30	12	11	10	9	8	7	6	5	5	5	5

Note: Low temperatures combined with wind speeds greater than 7 m/s (15 mph) may require additional insulation or wind block to maintain blanket temperature.

Note: Tables assume blanket temperature of 126°C to 129°C (258°F to 264°F).

Appendix E: Weather Considerations

Cableguard™ should not be installed in foul weather (precipitation) as it can affect the material's ability to bond. Foul weather may prevent completion of wrapping, heating, and/or finishing works on a single panel or series of panels. The procedures outlined below should be followed in the event of foul weather. Effort should be made to complete works on unheated panels as soon as possible.

FOUL WEATHER PROCEDURES FOR WRAPPING

In the event of foul weather during wrapping works, wrapping should be stopped and the loose end of the Cableguard™ wrap should be properly secured. Cable bands should be sealed to prevent water from accumulating in the clamp recess and penetrating between the unbonded layers of Cableguard™ material. The upper cable band and all unheated wrap should then be covered in plastic shrink wrap to prevent moisture from penetrating between the unbonded layers of Cableguard™ wrap. The plastic shrink wrap should be applied from the bottom of the cable with at least a 30% overlap.

FOUL WEATHER PROCEDURES FOR HEATING

In the event of foul weather during heating works, heating should be stopped and the loose end of the Cableguard™ wrap located at the lower cable band should be heat sealed (tacked in place) using a heat gun and stitching roller. Upper and lower cable bands should be sealed to prevent water from accumulating in the clamp recess and penetrating between the unbonded layers of Cableguard™ material if finishing work has not yet been completed in those locations. The unfinished cable bands and unheated portion of the wrapped panel should be covered in plastic shrink wrap to prevent moisture from penetrating between the unbonded layers of Cableguard™ wrap. The shrink wrap should be applied from the bottom of the cable with at least a 30% overlap.

FOUL WEATHER PROCEDURES FOR FINISHING

In the event of foul weather during finishing works, finishing work should be stopped and the cable bands should be sealed to prevent water from accumulating in the clamp recess and penetrating between the Cableguard™ material and the cable. Unfinished cable bands and the first meter of wrap from the unfinished band should then be covered in plastic shrink wrap to prevent moisture from penetrating between the unbonded layers of Cableguard™ wrap.

PROCEDURE FOR LEAVING WRAPPED PANELS UNHEATED

Wrapped panels may be left unheated overnight and for periods longer than 24 hours by following the procedures outlined above for foul weather work. Effort should be made to complete works on unheated panels as soon as possible to ensure a proper bond between layers of Cableguard™ material.

INSTALLATION TEMPERATURES FOR CABLEGUARD™ AND ADHESIVES

Cable wrapping may be undertaken in ambient temperatures down to 5°C (41°F) with no additional considerations provided the material is dry. Heating works may also be undertaken in temperatures down to 5°C (41°F) so long as attention is given to adjusting blanket temperature and/or cycle time to attain acceptable bonding. Special consideration must be given when installing the following components at temperatures below 5°C (41°F):

- D.S. Brown part number 45-121S (wedge glue) can be applied in temperatures as low as -17°C (2°F) to adhere neoprene system components. Set or cure time for the adhesive is increased as the temperature falls. For example, while cure time at 10°C (50°F) and 50% relative humidity is 7 seconds, cure time at -17°C (2°F) and 50% relative humidity could be up to 60 seconds. A spray-on accelerator (part number 45-122S) may be used to speed up cure time.
- D.S. Brown part 45-195S (sealant) can be applied in temperatures between -17°C (0°F) and 60°C (140°F). The sealant has a shelf life of 12 months when stored between 5°C (41°F) and 25°C (77°F). Lower temperatures and lower relative humidity will increase cure time.

Appendix F: Weld Solution Procedure

Cableguard™ Weld Solution is used to weld aged Cableguard™ or Cableguard™ that has been exposed to UV or rain (“exposed”). It can also be used in areas that are difficult to seal with heat alone.

The following steps are required to properly prepare and successfully weld aged, UV exposed, or heated Cableguard™. It may be necessary to repeat one or more of these steps depending upon the age and time of UV exposure of the wrap. Cross linking (bonding of the material) begins upon completion of the manufacturing process. Cableguard™ is an un-cured material which begins cross-linking once it is exposed to UV, moisture (including humidity), and heat. This cross-linking is sometimes called surface cure, which must be removed for a proper bond to be achieved.

Bonding New Wrap to Old Wrap

1) Clean the old material using a scrub pad and the industrial cleaner like Simple Green to remove all dirt and debris from the surface to be welded. Wipe the area off with a clean rag. Use the cleaner at full strength and never use water to wipe off the cleaned surface.
2) Scrub the old material with xylene (also known as xylol) using a scrub pad. Scrub until the Cableguard™ surface has a tacky feel when touched. Wipe off the area with a clean rag using a slight bit of xylene on the rag. In extreme cases 60 grit sandpaper or a wire brush attachment on a drill can be used.
3) Wipe the new material with a rag and a small amount of xylene. The new material when wiped should leave a color residue on the rag.
4) Apply a liberal coat of welding solution to both mating surfaces with a 75 mm paint brush.
5) Using a heat gun with a nozzle, slide the nozzle in between both pieces of Cableguard™ membrane with the temperature of the gun turned to high. Begin welding, keeping the stitching roller 6 mm to 12 mm away from the heat gun nozzle. Allow a minimum of 30 minutes cooling time before checking the seam.
6) In extremely difficult cases, repeat step 4, only let the welding solution dry to the touch and reapply then weld.

Using Weld Solution for Areas Difficult to Seal with Heat Alone

1) Scrub both surfaces to be bonded with xylene using a scrub pad. Scrub until the Cableguard™ surface has a tacky feel when touched. Wipe off the area with a clean rag using a small amount of xylene on the rag.
2) Apply a liberal coat of welding solution to both mating surfaces with a 75 mm paint brush shortly before application of the heating blanket. Heat with the blanket using normal times and temperatures. Immediately after removing the blanket, roll out the seam using a stitching roller where the weld solution was applied.
3) If the weld solution section will not be heated within an hour using the blanket, use a heat gun with a nozzle as in step 5 of “Bonding New Wrap to Old Wrap”.