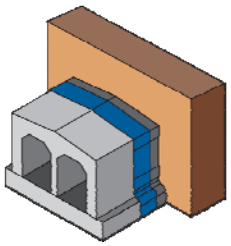

CARLISLE'S
TUNNEL WATERPROOFING SYSTEM

Sure-Seal®/Sure-Weld®/Sure-Flex™
"Cut And Cover" Method

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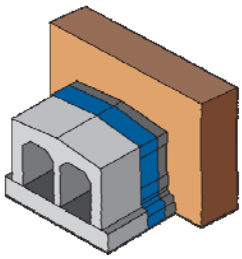


CARLISLE'S
TUNNEL
WATERPROOFING SYSTEM

Sure-Seal®/Sure-Weld®/Sure-Flex™
"Cut And Cover" Method

August 2013

This specification outlines requirements for Carlisle's Tunnel Waterproofing System and is intended for use by engineers and waterproofing contractors involved with design or installation of underground tunnels. While the specification contains specific installation details pertaining to various methods of membrane termination, contractors may reference other Carlisle technical publications for in-depth application procedures.

PART I GENERAL

1.01 DESCRIPTION

This Cut and Cover Tunnel Waterproofing System features three waterproofing options in conjunction with a protection or drainage course.

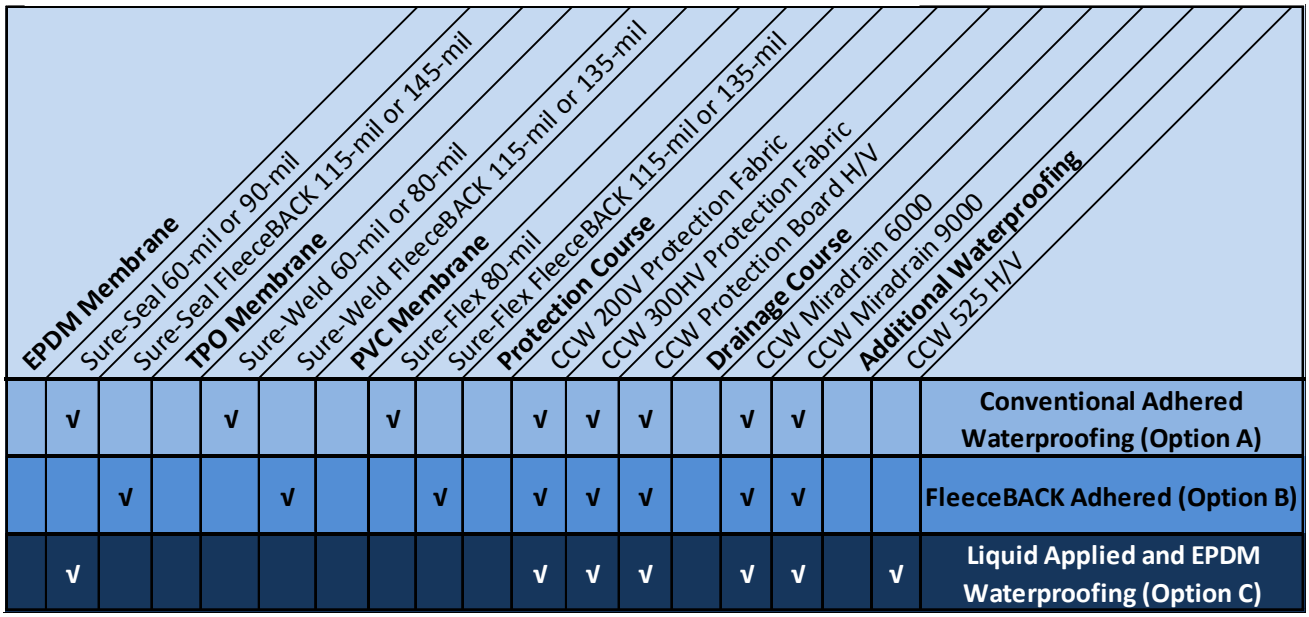
A. **Non-fleece adhered membrane option** incorporates a thermoset or thermoplastic membrane as outlined in the Table below. The membrane is directly adhered to the structural substrate with contact adhesive and adjacent membranes are spliced together by either hot air welding or through the use of Factory-Applied SecurTAPE™.

B. **FleeceBACK adhered membrane option** incorporates a thermoset or thermoplastic membrane as outlined in the Table below. The membrane is directly adhered to the structural substrate with low-rise Flexible FAST™ Adhesive and adjacent membranes are spliced together by either hot air welding or through the use of Factory-Applied SecurTAPE™.

C. **Liquid Applied and EPDM Waterproofing option** incorporates CCW 525-H/V Liquid Applied Waterproofing and a 60-mil EPDM Membrane as outlined in the Table below. The waterproofing is is directly adhered to the substrate and the membrane is directly adhered to the waterproofing with contact adhesive and adjacent membranes are spliced together using Factory-Applied SecurTAPE™.

For the three options listed above the protection course consists of either CCW 200 V/300H/V or CCW Protection Board H/V may be incorporated. In certain soil conditions, a drainage course consists of CCW MiraDRAIN 6000/9000 Series Drainage Board may be incorporated along with a drainage design plan. The protection or drainage course is adhered for vertical applications and loose-laid for horizontal applications.

Tunnel Waterproofing – Positive Side ("Cut and Cover") Application Options



EPDM Membrane	Sure-Seal 60-mil or 90-mil	Sure-Seal FleeceBACK 115-mil or 145-mil	TPO Membrane	Sure-Weld 60-mil or 80-mil	Sure-Weld FleeceBACK 115-mil or 135-mil	PVC Membrane	Sure-Flex 80-mil	Sure-Flex FleeceBACK 115-mil or 135-mil	Protection Course	CCW 200V Protection Fabric	CCW 300HV Protection Fabric	CCW Protection Board H/V	Drainage Course	CCW Miradrain 6000	CCW Miradrain 9000	Additional Waterproofing	CCW 525 H/V	
	√			√			√			√	√	√		√	√			Conventional Adhered Waterproofing (Option A)
		√			√			√		√	√	√		√	√			FleeceBACK Adhered (Option B)
	√									√	√	√		√	√		√	Liquid Applied and EPDM Waterproofing (Option C)

1.02 QUALITY ASSURANCE

A. This system must be installed by an Authorized Contractor in compliance with project specification and drawings. Any deviations made from this published specification must be approved by Carlisle.

B. Prior to installation, project shop drawings may be submitted to the manufacturer for review.

C. Comply with applicable regulatory requirements, applicable codes, ordinances and laws.

D. On-site technical assistance is available for a charge. Projects where technical assistance is required must have a manufacturer's approved drawing.

1.03 SUBMITTALS

A. To ensure compliance with the applicable design criteria, project drawings, specification and pertinent details may be submitted for Carlisle's review.

B. Requests for certification and/or formal drawing approval must be accompanied by a copy of the project specification and details.

C. Substitution of a non-Carlisle supplied product is permitted upon review and approval. Samples of the product along with technical literature may be forwarded to Carlisle for consideration.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

F. Deliver materials to the job site in the original, unopened containers labeled with the manufacturer's name, brand name and installation instructions.

G. Job site storage temperatures in excess of 32°C (90°F) may affect shelf life of curable materials (i.e., adhesive, sealants and cleaners).

H. When sealants or cleaners are exposed to lower temperatures, restore to a minimum of 16°C (60°F) before use.

I. Drums of Flexible FAST Adhesive must be a minimum of 21 degrees C (70 degrees F) at the time of use. Use drum band or blanket heaters when necessary.

1.05 JOB CONDITIONS

A. Comply with applicable codes and regulations pertaining to the operation and storage of heavy equipment.

B. Coordination between various trades is essential to prevent damage to the waterproofing membrane.

C. Do not allow waste products (i.e., petroleum, grease, oil, solvents) or direct steam venting to come in contact with the waterproofing membrane.

D. Do not expose membrane and accessories to constant temperatures in excess of 82°C (180°F).

E. Prior to the use of any product, consult the Material Safety Data Sheet and Technical Data Bulletin for cautions and warnings. Store adhesives, sealants and cleaners away from all sources of heat, flame or sparks.

F. Cold temperatures will not restrict the installation of these systems. Follow specified precautions for storage of materials.

G. Coordinate waterproofing work with other trades. The contractor shall have sole right of access to the specified areas for the time needed to complete the application.

H. Maintain work area in a neat and orderly condition, removing empty containers, rags and debris daily from the site.

1.06 WARRANTY

A 20 year Membrane Material Warranty is available for a charge. The Material Warranty will cover normal deterioration and is pro-rated.

PART II PRODUCTS AND RELATED EQUIPMENT

2.01 GENERAL

The components of these tunnel waterproofing systems are to be products of Carlisle or accepted by Carlisle as compatible. The installation, performance or integrity of products by others, **when selected by the specifier and accepted by Carlisle,** is **expressly disclaimed** by Carlisle.

2.02 MEMBRANES

A. **Thermoset Membranes**

1. Sure-Seal, non-reinforced, 1.5 mm (60-mil) or 2.2 mm (90-mil) EPDM Membrane is used for this system. Membrane is available in widths of 2.4 m (8') and lengths of 30 m (100'). Conforms with ASTM D6134-07 and meets the following physical properties, below.

SURE-SEAL NON-REINFORCED MEMBRANES				
Physical Property	**Test Method**	**ASTM SPEC. (Pass)**	**Typical**	
			1.5 mm (60-mil)	**2.2 mm (90-mil)**
			Sure-Seal FR	**Sure-Seal FR**
Tolerance on Nominal Thickness, %	ASTM D 412	±10	±10	±10
Weight, kg/m² (lb/ft²)			1.7 (0.35)	2.9 (0.59)**
Tensile Strength, min, MPa (psi)	ASTM D 412	9 (1305)	11 (1600)	11 (1600)
Elongation, Ultimate, min, %	ASTM D 412	300	465	540
Tear Resistance, min, kN/m (lbf/in)	ASTM D 624 (Die C)	26.3 (150)	35.0 (200)	35.0 (200)
Factory Seam Strength, min.	Modified ASTM D 816	Membrane Rupture	Membrane Rupture	Membrane Rupture
Resistance to Heat Aging* Properties after 4 weeks @ 240°F (116°C)	ASTM D 573			
Tensile Strength, min, MPa (psi)	ASTM D 412	8.3 (1205)	10.0 (1450)	10.0 (1450)
Elongation, Ultimate, min, %	ASTM D 412	200	280	280
Tear Resistance, min, kN/m (lbf/in)	ASTM D 624	21.9 (125)	37.6 (215)	37.6 (215)
Linear Dimensional Change, max, %	ASTM D 1204	±1.0	-0.5	-0.5
Ozone Resistance* Condition after exposure to 100 pphm Ozone in air for 168 hours @ 104°F (40°C) Specimen is at 50% strain	ASTM D 1149	No Cracks	No Cracks	No Cracks
Brittleness Temp., max, deg. F (deg. C)*	ASTM D 746	-45 (-49)	-45 (-49)	-45 (-49)
Resistance to Water Absorption* After 7 days immersion @ 70°C (158°F) Change in mass, max, %	ASTM D 471	+8.0, -2.0	+2.0	+2.0
Water Vapor Permeance* max, perm	ASTM E 96 (Proc. B or BW)	0.1	0.03	0.03
Resistance to Outdoor (Ultraviolet) Weathering* Xenon-Arc, total radiant exposure at .70 W/m² irradiance, 80º C (176°F) black panel temp.	ASTM D 4637 Conditions	No Cracks No Crazing @ 7560 kJ/m²	No Cracks No Crazing @ 41580 kJ/m²	No Cracks No Crazing @ 41580 kJ/m²(black) 25200 kJ/m²(white)

* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting.
** Sure-White 90-mil Membrane Weight in kg/m² (lb/ft²) is equal to 2.9 (0.60)

2. Sure-Seal FleeceBACK membrane incorporates 1.5 mm (60-mil) or 2.2 mm (90-mil) thick Sure-Seal (black) non-reinforced EPDM laminated to a 1.4 mm (55-mil) non-woven polyester fleece-backing resulting in a total finished sheet thickness of 2.9 mm (115-mil) or 3.6 mm (145-mil). A selvage edge with 7.6 cm (3") or 15.2 cm (6") wide Factory-Applied SecurTAPE is provided along the length of the membrane for splicing. The 2.9 mm (115-mil) or 3.6 mm (145-mil) membrane is available in 3 m (10') width and lengths of 30 m (100') depending on the product. Conforms to ASTM Standard D 4637M-13, Type III (Fabric-Backed membrane) with the following physical properties:

Physical Property	Test Method	SPEC. (Pass)	Sure-Seal Typical
Tolerance on Nominal Thickness, %	ASTM D 751	±10	±10
Thickness over Fleece, min, mm (in.) 2.92 mm (115 mil) 3.68 mm (145 mil)	ASTM D4637 Annex	 1.14 (.045) 2.03 (.080)	 1.52 (.060) 2.28 (.090)
Weight kg/m^2 (lb/ft^2) 2.92 mm (115 mil) 3.68 mm (145 mil)			 1.9 (0.38) 2.4 (0.59)
Breaking Strength, min, N (lbf) 2.92 mm (115 mil) 3.68 mm (145 mil)	ASTM D751 Grab Method	400 (90)	 890 (200) 934 (210)
Elongation, Ultimate, min, %	ASTM D 412	300 **	480 **
Tearing Strength, min, N (lbf) 2.92 mm (115 mil) 3.68 mm (145 mil)	ASTM D 751 B Tongue Tear	45 (10)	 200 (45) 266 (60)
Puncture Resistance, Joules 2.92 mm (115 mil) 3.68 mm (145 mil)	ASTM D5635		 20 25
Puncture Resistance, kN (lbf) 2.92 mm (115 mil) 3.68 mm (145 mil)	FTM 101C Method 2031		 1.5 (338) 1.6 (355)
Puncture Resistance, N (lbf) 2.92 mm (115 mil) 3.68 mm (145 mil)	ASTM D120		 97 (22) 124 (28)
Hail Resistance 2.92 mm (115 mil) 3.68 mm (145 mil)	UL 2218 Over Iso HP Rec. Bd. Gypsum Bd.	Class 4 Rating 2" steel Ball at 20'	 Pass Pass
Brittleness point, max, °C (°F)	ASTM D 2137	-45 (-49)	-55 (-67)
Resistance to Heat Aging * Properties after 4 weeks @ 116°C (240°F) for Sure-Seal Breaking Strength, min, N (lbf) Elongation, Ultimate, min, % Linear Dimensional Change, max, %	ASTM D 573 ASTM D 751 ASTM D 412 ASTM D 1204	 355 (80) 200 ** ±1.0	 890 (200) 225 ** -0.7
Ozone Resistance * Condition after exposure to 100 pphm Ozone in air for 168 hours @ 40°C (104°F) Specimen wrapped around 7.5 cm (3 inch) mandrel	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption * After 7 days immersion @ 70°C (158°F) Change in mass, max, %	ASTM D 471	+8, -2.0**	2.0 **
Resistance to Outdoor (Ultraviolet) Weathering * Xenon-Arc, total radiant exposure at 0.70 W/m^2 irradiance 80°C (176° F) black panel temperature	ASTM G 155	No Cracks No Crazing @ 7560 kJ/m^2	 No Cracks No Crazing @ 41580 kJ/m^2

* Not a Quality Control Test due to the time required for the test or the complexity of the test. However, all tests are run on a statistical basis to ensure overall long-term performance of the sheeting

** Specimens prepared from coating rubber compound.

B. **Thermoplastic Membranes**

1. Sure-Weld, reinforced, 1.5 mm (60-mil) OR 2.0 mm (80-mil) thick Thermoplastic Polyolefin (TPO) membrane is used for this system. Membrane is available in widths up to 3 m (10') and lengths of 30 m (100'). Available in white, gray or tan. Refer to membrane physical properties, below.

PHYSICAL PROPERTY	ASTM D6878 Requirement	1.5 mm (60-mil) Std & HS	2.0 mm (80-mil) EXTRA
Tolerance on nominal thickness, % ASTM D751 test method	+15, -10	± 10	± 10
Thickness over scrim, mm (in.) ASTM D6878 optical method, average of 3 areas	0.305 (0.012) min.	0.610 (0.024) typical	0.864 (0.034) typical
Breaking strength, kN (lbf) ASTM D751 grab method	976 N (220) min.	1.1 (250) min. 1.6 (360) typ.	1.6 (350) min. 1.9 (425) typ.
Elongation break of reinforcement, % ASTM D751 grab method	15 min.	15 min. 25 typ.	15 min. 25 typ.
Tearing strength, N (lbf) ASTM D751 proc. B 8 by 8 in.	245 (55) min.	245 (55) min. 578 (130) typ.	245 (55) min. 578 (130) typ.
Brittleness point, °C (°F) ASTM D2137	-40 (-40) max.	-40 (-40) max. -46 (-50) typ.	-40 (-40) max. -46 (-50) typ.
Linear dimensional change, % ASTM D1204, 6 hours at 70°C (158 °F)	± 1 max.	± 1 max. -0.2 typ.	± 1 max. -0.2 typ.
Ozone resistance, no cracks 7X ASTM D1149, 100 pphm, 168 hrs	Pass	Pass	Pass
Water absorption resistance, mass % ASTM D471-12a top surface only 166 hours at 70°C (158 °F) water	± 3.0 max.	3.0 max. 2.0 typ.	3.0 max. 2.0 typ.
Factory seam strength, kN/m (lbf /in.) ASTM D751 grab method	290 (66) min.	290 (66) min.	290 (66) min.
Field seam strength, kN/m (lbf /in.) ASTM D1876-08 tested in peel	No requirement	4.4 (25) min. 10.5 (60) typ.	7.0 (40) min. 12.3 (70) typ.
Water vapor permeance, Perms ASTM E96 proc. B	No requirement	0.10 max. 0.05 typ.	0.10 max. 0.05 typ.
Puncture resistance, kN (lbf) FTM 101C, method 2031 (see supplemental section)	No requirement	1.3 (300) min. 1.6 (350) typ.	1.8 (400) min. 2.0 (450) typ.
Properties after heat aging ASTM D573, 670 hrs at 240 °F (115°C) Breaking strength, % retained Elongation reinf., % retained Tearing strength, % retained Weight change, %	 90 min. 90 min. 60 min. ± 1.0 max.	 90 min. 90 min. 60 min. ± 1.0 max.	 90 min. 90 min. 60 min. ± 1.0 max.

2. Sure-Flex 2.0 mm (80-mil) thick Polyester Reinforced PVC (Polyvinyl Chloride) Membrane is used for this system. Membrane is available in widths of 2.05 m (81") or 3 m (10') and lengths of 30 m (100'). Available in white, gray or tan. Refer to membrane physical properties, below.

Sure-Flex Polyester Reinforced PVC Membrane			
Physical Property	**Test Method**	**Property of Unaged Sheet**	**Property After ASTM D3045 aging 56 days @ 80°C (176° F)**
Tolerance on Nominal Thickness, %	ASTM D 751	± 10	
Thickness over scrim, mm (in.) 80-mil	ASTM D 4434 Optical Method (avg. of 3 areas)	0.635 (0.025) min.	
Breaking Strength, kN/m (lbf/in.)	ASTM D 751 (Grab Method)	35 (200) min. 53 (300) typical	90% min. retention of original breaking strength
Elongation at Break of fabric, %	ASTM D 751	15 min. 25 typical	90% min. retention of original elongation
Tearing Strength, N (lbf) 20 cm x 20 cm (8 x 8 in.) specimen	ASTM D 751 (B-Tongue Tear)	200 (45) min. 445 (100) typical	
Low Temperature Bend, ° C (° F)	ASTM D 2136	-40 (-40) max. -46 (-50) typical	
Linear Dimensional Change (shrinkage), % After 6 hours at 80° C (176° F)	ASTM D 1204	+/- 0.5 max. -0.3 typical	
Ozone resistance, 100 pphm, 168 hours	ASTM D1149	No cracks	
Resistance to water absorption After 7 days immersion 70° C (158° F) Change in mass, %	ASTM D 570	3.0 max. 2.0 typical	
Field seam strength kN/m (lbf/in.) Seam tested in peel after welding	ASTM D1876	4.4 (25) min. 10.5 (60) typical	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, N (lbf) (see supplemental section for additional puncture data)	FTM 101C Method 2031	1110 (250) min. 1690 (380) typical	
Resistance to xenon-arc weathering Xenon-Arc, 12,600 kJ/m² total radiant exposure, visual condition at 10X (ASTM D 4434 light & spray cycle)	ASTM G155 0.35 W/m² 63 °C (145 °F) B.P.T. (10,000 hours)	No cracks No crazing	
B.P.T. is black panel temperature			

3. Sure-Weld FleeceBACK membrane incorporates 1.5 mm (60-mil) or 2.0 mm (80-mil) thick Thermoplastic Polyolefin (TPO) membrane laminated to a 1.4 mm (55-mil) non-woven fleece backing resulting in a total finished sheet thickness of 2.9 mm (115-mil) or 3.5mm (135-mil). Membrane sheets are available in rolls 3.6 m (12') wide by 30 m (100') long. Sure-Weld FleeceBACK Membrane is available in white, gray or tan in the 2.9 mm (115-mil) thickness and white only for the 3.5mm (135-mil) and conforms to the following:

Property	Test Method	Property of Unaged Sheet	Property After Aging (1) 28 days @ 115°C (240° F)
Thickness of reinforced sheet over fleece, mm (in.) tolerance is ±10	ASTM D 751	1.52 (0.060) – FB 115 2.03 (0.080) – FB 135	
Weight, kg/m^2 (lb/sq.ft.)		1.66 (0.34) FB 115 2.14 (0.44) FB 135	
Breaking Strength, min, kN (lbf)	ASTM D 751 Grab Method	1.8 (400) min. FB 115 1.9 (425) min. FB 135	1.8 (400) min. FB 115
Elongation at break of internal fabric,%	ASTM D 751	25 typical	25 typical
Tearing Strength, min, N (lbf) 20 cm x 20 cm (8 inch by 8 inch) specimen	ASTM D 751 B Tongue Tear	245 (55) min. 578 (130) typical	245 (55) min. 578 (130) typical
Brittleness Point, °C (°F)	ASTM D 2137	-40 (-40) min. -46 (-50) typical	
Linear Dimensional Change (shrinkage), %	ASTM D 1204	+/- 1.0 max. -0.2 typical	
Ozone Resistance, 100 pphm, 168 hours	ASTM D 1149	No Cracks	No Cracks
Resistance to Water Absorption After 7 days immersion @ 70°C (158°F) Change in mass, %	ASTM D 471 (fleece removed, edges sealed)	4.0 max. 2.0 typical	
Resistance to microbial surface growth, rating (1 is very poor, 10 is no growth)	ASTM D 3274 2 yr. S. Florida	9 – 10 typical	
Field seam strength, kN/m (lbf/in.) Seam tested in peel	ASTM D1876	10.5 (60) typical FB 115 12.3 (70) typical FB 135	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, N (lbf)	FTM 101C Method 2031	1.8 (400) min. FB 115 2.2 (500) typical FB 115 1.9 (425) min. FB 135 2.3 (525) typical FB 135	1.8 (400) min. FB 115 2.2 (500) typical FB 115 1.9 (425) min. FB 135 2.3 (525) typical FB 135
Puncture resistance, Joules	ASTM D5635	22.5 FB 115 30.0 FB 135	
Resistance to xenon-arc Weathering (2) Xenon-Arc, 20,160 kJ/m^2 FB 115; 27,720 kJ/m^2 FB 135; total radiant Exposure, visual condition at 10X	ASTM G 155 0.70 W/m^2 80°C (176 °F) B.P.T.	No Cracks No loss of breaking or tearing strength	

(1) Aging conditions are 28 days at 116° C (240° F) equivalent to 400 days at 80° C (176° F) for breaking strength, elongation, tearing strength, linear dimensional change, ozone and puncture resistance.
(2) Approximately equivalent to 14,000 hours exposure at 0.35 W/m^2 irradiance. B.P.T. is black panel temperature.

4. Sure-Flex KEE FRS FleeceBACK membrane incorporates 1.5 mm (60-mil) or 2.0 mm (80-mil) thick Fiberglass Reinforced Elvaloy PVC membrane laminated to a 1.5 mm (55-mil) non-woven fleece backing resulting in a total finished sheet thickness of 2.9 mm (115-mil) or 3.5 mm (135-mil). Membrane sheets are available in rolls 3 m (10') wide by 30 m (100') long. Sure-Flex FleeceBACK Membrane is available in white and conforms to the following:

Sure-Flex KEE FRS FleeceBACK Membrane			
Physical Property	**Test Method**	**Property of Unaged Sheet**	**Property After ASTM D3045 aging 56 days @ 176° F**
Tolerance on Nominal Thickness, %	ASTM D 638	± 10	
Thickness over Fleece, min 2.9mm (115-mil) 3.5 mm (135-mil)	ASTM D4637 Annex	 1.52 (0.060) 2.03 (0.080)	
Thickness over scrim, mm (in.) 2.9 mm (115-mil) 3.5 mm (135-mil)	ASTM D 4434	 0.558 (0.022) min. 0.889 (0.035) min.	
Weight, kg/m^2 (lb/sq.ft) 2.9 mm (115-mil) 3.5 mm (135-mil)		 2.39 (0.49) 2.83 (0.58)	
Breaking Strength, min, lbf (kN) 2.9 mm (115-mil) 3.5 mm (135-mil)	ASTM D751 Grab Method MD	 1.8 (400) 1.9 (425)	90% min. retention of original breaking strength
Elongation at Break, % Machine direction Cross-machine direction	ASTM D 638	250 min. (270 typical) 220 min. (250 typical)	90% min. retention of original elongation
Tear Resistance, N (lbf)	ASTM D 1004	45 (10) min. 53 (12) typical	90% min. retention of original tear
Static Puncture Resistance, kN (lbf)		.146 (33) Pass	
Low Temperature Bend at -40° C (-40° F)	ASTM D 2136	Pass	
Linear Dimensional Change (shrinkage), % After 6 hours at 80° C (176° F)	ASTM D 1204	+/- 0.1 max. 0.05 typical	
Ozone resistance, 100 pphm, 168 hours	ASTM D1149	No cracks	
Resistance to water absorption After 7 days immersion 70° C (158° F) Change in mass, %	ASTM D 570	3.0 max. 1.25 typical	
Seam strength, % of tensile strength	ASTM D638	75 min. 80 typical	
Water vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance 2.9 mm (115-mil) 3.5 mm (135-mil)	ASTM D5635	Pending	
Resistance to xenon-arc weathering Xenon-Arc, 17,640 kJ/m² total radiant exposure,	ASTM G155 0.35 W/m² 63 °C (145 °F) B.P.T.	No cracks No crazing	
B.P.T. is black panel temperature			

2.03 OTHER MATERIALS

A. **Sure-Seal Pressure-Sensitive Overlayment Strip:** A nominal 1 mm (40-mil) black, semi-cured EPDM membrane laminated to a nominal 0.7 mm (28-mil) cured, Factory-Applied TAPE. Available in 15 cm (6") and 22 cm (9") widths and 30 m (100') long and 30 cm (12") width and 15 m (50') long rolls used for seam overlayment of EPDM.

B. **Sure-Seal Pressure-Sensitive Elastoform Flashing:** A 15 cm (6") X 30 m (100') and 22 cm (9") or 30 cm (12") wide by 15 m (50') long, 1.5 (60-mil) thick Sure-Seal or Sure-White uncured EPDM Flashing laminated to a 0.7

mm (28-mil) Factory-Applied TAPE used in conjunction with EPDM Primer as an option to Sure-Seal Elastoform Flashing.

Carlisle's uncured flashings are to be used in conjunction with Sure-Seal (black) Membranes. Sure-Seal uncured Elastoform Flashing is used mainly to flash inside and outside corners, air shafts and pipes.

C. **Sure-Weld Flashing**: Sure-Weld non-reinforced flashing is available in rolls 30 cm (12") and 60 cm (24") wide by 15 m (50') long. Flashing is used for splice intersections and electrical conduit penetrations.

D. **Sure-Flex PVC non-reinforced Flashing**: 80-mil thick (white on gray) and available in rolls 30 cm (12") and 60 cm (24") wide by 15 m (50') long. Flashing is used for field fabricated flashings.

E. **Inside/Outside Corners:** A pre-molded corner flashing used for outside corners of air shafts.

F. **Water Cut-Off Mastic**: Used as a mastic to prevent moisture migration at membrane and flashing terminations with a coverage rate of approximately 3 m (10 feet) per tube or 30 m (100 feet) per 3.78 l (1gallon).

G. **Universal Single-Ply Sealant:** A 100% solids, solvent free, VOC free, one part polyether sealant that provides a weather tight seal to a variety of building materials. It is white in color and is used for general caulking such as above termination bars and metal counter flashings.

H. **Weathered Membrane Cleaner**: Used to prepare membrane that has been exposed to the elements for approximately 7 days prior to hot air welding at an approximate coverage rate of 300 m (1000 linear feet) per 3.78 l (1 gallon) on a 10 cm (4 inch) wide surface. For use with EPDM and TPO membranes.

I. **Sure-Seal (black) Lap Sealant:** A heavy-bodied material used at splice intersections beneath "T"-joint covers. For use with EPDM Membranes.

J. **PVC Membrane Cleaner:** Used to prepare membrane that has been exposed to the elements prior to heat welding or to remove general construction dirt at an approximate coverage rate of 37 square meters (400 square feet) per 3.78 liters (1 gallon)(one surface). For use with PVC Membranes.

K. **Sure-Seal or Sure-White SecurTAPE:** A 7.6 cm (3") or 15.2 cm (6") wide (used for Mechanically Fastened Roofing Systems and 20-year Warranty Systems) by 30 m (100') long splice tape used for splicing adjoining sections of EPDM membrane. Complies with the South Coast Air Quality Management District Rule 1168.

L. **Carlisle EPDM Primer:** A solvent-based primer used to prepare the surface of EPDM membrane for application of Splice Tape or Pressure-Sensitive products.

M. **Pressure Sensitive SecurTAPE:** A 7.6 cm (3") or 15.2 cm (6") wide by 30 m (100') long splice tape used for splicing adjoining sections of EPDM membrane.

N. **Water Swelling Waterbar (by others):** Used to provide efficient waterproofing of construction joints. When in contact with water, the waterbar will slowly increase in volume (20% to 200% depending on water salt concentration). The swelling action (limited to the side exposed to water) will cause the waterbar to profile itself into the joint filling all cavities and effectively stop water seepage. For added safety, wider joints can be filled using 2 waterbars. The Water Swelling Waterbar is used at the base of electrical conduits engaging through the shotcrete substructure and at any other joints or gaps.

O. **CCW 200V Protection Fabric:** A nonwoven polypropylene protection course designed to protect waterproofing membranes. CCW 200V is used in vertical applications.

P. **CCW 300HV Protection Fabric:** A nonwoven polypropylene protection course designed to protect waterproofing membranes. CCW 300HV is used in horizontal and vertical applications.

Q. **CCW Protection Board H:** Heavy-duty, asphalt impregnated organic mat with a fine mineral applied to the surface to prevent sticking in the roll. Used as a protection course on horizontal surfaces to protect the waterproofing membrane during installation of other work. Protection Board H is available in rolls of .91 m (3 feet) by 30 m (100 feet).

R. **CCW Protection Board V:** Lightweight, high-density, rigid, extruded polystyrene foam designed to provide protection for waterproofing membranes on vertical below-grade constructions. Protection Board V is available in

fan folded bundles of 1.2 m (4 feet) by 15 m (50 feet).

S. **CCW MiraDRAIN 6000 Drainage Composite**: A high strength drainage composite consisting of a three-dimensional, high-impact polystyrene core and a non-woven filter fabric on one side and a solid polymeric film on the other. Available in rolls of 1.2 m (4 feet) by 15 m (50 feet).

T. **CCW MiraDRAIN 9000 Drainage Composite**: A high strength drainage composite consisting of a three-dimensional, high-impact polystyrene core and a woven filter fabric on one side and a solid polymeric film on the other. The filter fabric is bonded to the individual dimples of the molded polystyrene core to minimize fabric intrusion into the flow channels caused by overburden pressure. Use MiraDRAIN 9000, in lieu of 6000, where higher soil pressures above Tunnel are present (i.e. roadways, runways, etc.). Available in rolls of 1.2 m (4 feet) by 15 m (50 feet).

U. **CCW 525 Liquid-Applied Waterproofing Membrane (H/V):** Liquid-applied, single component, moisture cured, elastomeric, coal-tar free, modified polyurethane that cures to form a flexible, monolithic, waterproof membrane on vertical and horizontal surfaces, above or below grade. Available in two viscosities (H&V) for application to horizontal and vertical surfaces. Available in 18.9 liters (5 gal) pails and 208 liters (55 gal) drums.

V. **CCW DrainGrip-R:** Roller grade, solvent based adhesive specially formulated to adhere protection courses and drainage composites to a variety of waterproofing membranes. Available in 3.8 liters (1 gallon) and 18.9 liters (5 gallon) containers.

W. **CCW Cav-Grip:** A low VOC contact adhesive used to prime surfaces for the application of 725TR. It features a quick dry time and ease of application from the self-contained pressurized cylinder. Cav-Grip is an alternate, high-strength, adhesive using a blend of VOC exempt and non-exempt solvent which complies with the State of California Clean Air Act of 1988 (updated in 1997). Coverage rate is 185-232 square meters (2,000-2,5000 sq ft) per cylinder.

PART III EXECUTION

3.01 GENERAL

Prior to commencement of the work, manufacturer's Material Safety Data Sheets, Technical Data Bulletins and product labels should be referenced for cautions and warnings and specific installation requirements.

a. Ensure proper curing of the substructure prior to the installation of the membrane, protection course and drainage course.

b. Check to ensure the substrate is clean, free of debris, other contaminants, and dry, before applying adhesives for Option A and B OR before applying liquid applied waterproofing for Option C . Adhesives cannot be applied to a wet or a damp surface.

c. **Ensure** that water does not flow beneath any completed sections of the membrane system by completing all flashings, terminations and daily seals by the end of each workday.

d. Adjoining sheets of EPDM membrane are spliced together using Splice Tape/Primer (SecurTAPE).

e. Do not apply FAST Adhesive when surface and/or ambient temperatures are below -4° C (25 F).

When using **FAST Adhesive in heated spray equipment**, the adhesive cannot be applied unless surface and/or ambient temperatures are -4° C (25 F) or warmer. When using **FAST Adhesive in non-heated spray equipment** surface and/or ambient temperatures must be 16° C (60 F) or warmer.

The addition of Sure-Seal FAST Adhesive Catalyst to FAST Adhesive (Part B) is recommended to speedup reaction time when temperatures are below 10° C (50 F). Refer to Spec Supplement G-02-11 "FAST Adhesive Equipment, Catalyzing Instructions and Equipment Set-Up" for additional information.

f. The coverage rate of FAST Adhesive **used to adhere the membrane** is approximately 929 square meters (10,000 square feet) per 189 liter (50 gallon) "Drum Set" and 278 square meters (3,000 square feet) per 56.7 liter (15 gallon) drum set.

g. **Sweep** all loose debris from the substrate.

h. **Verify** all sections are dry prior to proceeding with the application of FAST Adhesive/FleeceBACK membrane.

CAUTION: Due to solvent flash off, condensation may form on freshly applied Bonding Adhesive when the ambient temperature is near the dew point. If condensation develops, possible surface contamination may occur and the application of Bonding Adhesive must be discontinued. Allow the surface to dry and apply a thin freshener coat at the coverage rate, which is approximately half of the coverage rate stated above to the previously coated surface when conditions allow for continuing.

3.02 INSTALLATION

A. **CCW 525 H/V Liquid Applied Waterproofing Installation (OPTION C ONLY)**

1. Ensure surface temperature of substrate is 5 degrees C (40 degrees F) or above during installation.

2. **Horizontal Application:** Apply CCW 525 over cleaned concrete surface. Using a notched squeegee, apply CCW 525-H at a rate of 2 square meters (22 square feet) per 3.8 liters (1 gallon) or as required to obtain a 1.5 mm (60-mil) thickness to the entire area to receive waterproofing.

3. **Vertical Application:** Using a roller, Apply CCW 525-V in one coat at a rate of 2 square meters (22 square feet) per 3.8 liters (1 gallon) or as required to obtain a final dry film thickness of 1.5 mm (60-mil).

4. Allow 24 hours of dry time before applying additional membrane.

5. Refer to product literature for further installation and product handling information.

B. **Membrane Placement and Securement**

The installation of the single-ply membrane can be accomplished with a continuous sheet or multiple sheets. This can be determined by calculating the length of the tunnel arc.

1. **Non-Fleece Thermoset (EPDM) Membranes (OPTION A and C ONLY)**

   Prior to unrolling sheets ensure the tape side is properly located so that seams are properly shingled down slope. (Pre-applied SecurTAPE should always be facing downwards once the sheet is unrolled).

   a. Position EPDM membrane over the structural concrete or CCW 525 Liquid Applied Waterproofing, if Option C is selected.

   b. Allow the membrane to relax approximately 1/2 hour prior to bonding.

   c. Place adjoining membrane sheets in the same manner, overlapping edges appropriately to provide for the minimum splice width. It is recommended all splices be shingled.

   d. **Adhere** EPDM membrane to an acceptable substrate with Carlisle Bonding Adhesive. Comply with Labels, Material Safety Data Sheet (MSDS) and Product Data Sheets for installation procedures and use. Adhesive must be applied to both the membrane and the surface to which it is being bonded.

   e. **Fold** membrane sheet back so half of the underside of the sheet is exposed. Sheet fold should be smooth without wrinkles or buckles.

   f. **Stir** Bonding Adhesive thoroughly scraping the sides and the bottom of the can (minimum 5 minutes stirring is recommended). Bonding surfaces must be dry and clean.

   g. **Apply** Bonding Adhesive evenly, without globs or puddles with a plastic core medium nap paint roller. A 22.8 cm (9") roller will easily fit into the 18.9 liter (5-gallon) containers.

      Apply Adhesive to both the membrane sheet and the substrate to achieve continuous coating of both surfaces at a coverage rate of approximately 11 square meters (120 square feet) per 3.7 liters (1 gallon) per one surface (membrane or substrate) or approximately 5.5 square meters (60 square feet) per 3.7 liters (1 gallon) per finished surface (includes coverage on both membrane and substrate). **Depending on**

adhesive used and the substrate type adhesive coverage rate will vary. Refer to Technical Data Bulletin for the appropriate adhesive for the proper coverage rate.

A mechanical roller dispenser or a mechanical sprayer can be used to apply Bonding Adhesive when the continuous coating and coverage rate noted above are maintained. When used, **the adhesive must be rolled after applying** with a plastic core medium nap paint roller to provide continuous coverage.

h. **Allow** adhesive to dry until it is tacky but will not string or stick to a dry finger touch.

i. **Roll** the coated membrane into the coated substrate while avoiding wrinkles.

j. **Brush** down the bonded half of the membrane sheet, immediately after rolling the membrane sheet into the adhesive, **with a soft bristle push broom** to achieve maximum contact.

k. **Fold** back the unbonded half of the membrane sheet and repeat the bonding procedure.

2. **Non-Fleece Thermoplastic (TPO/PVC) Membranes (OPTION B ONLY)**

a. Maximum 3.6 m (12') wide Sure-Weld or maximum 3 m (10') wide Sure-Flex Membrane is fully adhered to an approved insulation or substrate.

b. **Position** Sure-Weld or Sure-Flex membrane over the acceptable substrate.

c. **Place** adjoining membrane sheets in the same manner, overlapping edges appropriately to provide for the minimum overlap width. It is recommended all overlaps be shingled.

d. **Adhere** Sure-Weld or Sure-Flex membrane to an acceptable substrate with Carlisle Bonding Adhesive. Comply with Labels, Material Safety Data Sheet (MSDS) and Product Data Sheets for installation procedures and use. Adhesive must be applied to both the membrane and the surface to which it is being bonded.

e. **Fold** membrane sheet back so half the underside is exposed. Sheet fold should be smooth without wrinkles or buckles.

f. **Stir** Bonding Adhesive thoroughly scraping the sides and the bottom of the can (minimum 5 minutes stirring is recommended). Bonding surfaces must be dry and clean.

g. **Apply** Bonding Adhesive to the exposed underside of the membrane and the corresponding substrate area. Do not apply Bonding Adhesive along the splice edge of the membrane to be heat welded over adjoining sheet.

When using **Sure-Weld Bonding Adhesive or Sure-Flex Low VOC Bonding Adhesive**, a coverage rate of approximately 11 square meters (120 square feet) per 3.7 liters (1 gallon) per one surface (membrane or substrate) or approximately 5.5 square meters (60 square feet) per 3.7 liters (1 gallon) per finished surface (includes coverage on both membrane and substrate) shall be achieved. **Apply** adhesive evenly, without globs or puddles with a plastic core, medium nap paint roller to achieve continuous coating of both surfaces. A 22.8 cm (9") roller will easily fit into the 18.9 liter (5-gallon) containers.

A mechanical roller dispenser can be used to apply Bonding Adhesive when the continuous coating and coverage rate noted above are maintained. Backrolling is required.

h. **Allow** adhesive to dry until tacky but will not string or stick to a dry finger touch.

CAUTION: Care must be exercised to ensure proper drying. Avoid thin areas of adhesive because over drying can occur and proper adhesion may not be achieved.

i. **Roll** the coated membrane into the coated substrate while avoiding wrinkles.

j. **Brush** down the bonded section of the membrane sheet immediately after rolling the membrane into the adhesive with a soft bristle push broom to achieve maximum contact.

k. **Fold** back the unbonded half of the sheet and repeat the bonding procedures. **Apply** Bonding Adhesive

to the remaining exposed underside of membrane and adjacent substrate and complete this section as described above.

l. **Install** adjoining membrane sheets in the same manner, overlapping edges a minimum of 5 cm (2 inches) to provide for a minimum 3.8 cm (1-1/2 inch) heat weld. It is recommended that all splices be shingled.

3. **FleeceBACK (EPDM, TPO and PVC) Membranes (OPTION B ONLY)**

a. **Position** first roll of FleeceBACK membrane at the designated starting point on the roof.

b. **Chalk** a line to ensure proper positioning of the FleeceBACK membrane.

c. **Unroll** 3 m (10') to 4.5 m (15') of membrane to ensure it is properly aligned and fold unrolled section back over roll.

d. **Spray** FAST Adhesive over the substrate area to be covered by the membrane that is folded back. Do not apply adhesive within approximately 45 cm (18") of the membrane edge adjacent to where the next roll will be installed (this unadhered edge will be folded back to prevent overspraying when installing the next adjoining sheet).

e. Once the FAST Adhesive is sprayed in place and has begun to foam up approximately 3.1 mm (1/8") in height and **develop strings when touched with an HP Splice Wipe**, fold the membrane back into the wet adhesive.

f. **Roll** the membrane using a weighted steel roller approximately 76.2 cm (30") wide, to set the membrane into the adhesive. Roller shall weigh 45 – 68 kg (100 - 150 pounds).

g. Proceed to the front of the roll and continue to apply FAST Adhesive and roll the FleeceBACK membrane into the adhesive. At the end of the roll, leave approximately 45 cm (18") unadhered (to be folded back to prevent overspraying when installing the adjoining sheet).

h. Once the first sheet is positioned, measure to allow for a minimum 5 cm (2”) overlap along the length of the sheet.

i. At EPDM end laps, membrane shall be butted together and overlaid with 15 cm (6") wide Pressure-Sensitive Cured Cover Strip and Primer

j. For TPO/PVC end laps are overlaid with a minimum 15 cm (6”) wide Sure-Weld/Sure-Flex Reinforced Membrane hot air welded on all edges. (Cut edges of Sure-Weld/Sure-Flex membrane shall be sealed with Cut Edge Sealant).

Note: If 135-mil or 145-mil FleeceBACK membranes are utilized, Continuous Overlayment of all seams is required.

k. Position the next roll and repeat the process as described above.

Note: With the placement of the second sheet and all subsequent sheets, overspray can be controlled by lifting the 45 cm (18") wide unadhered area of the previous sheet as the FAST Adhesive is applied. FAST Adhesive is sprayed under this area as the next roll is adhered and folded down after the membrane is unrolled.

C. **Thermoset (EPDM) Splicing**

a. **1.5 mm** (**60-mil) EPDM Membrane:** Tape splices must be a minimum of 6 cm (2-1/2”) wide using 7 cm (3”) **Factory-Applied Tape (FAT)** OR a minimum of 14 cm (5-1/2”) wide using 15 cm (6”) **field applied** SecurTAPE.

Note: A single layer of 15 cm x 15 cm (6”x6”) uncured pressure sensitive Elastoform flashing must be used at all splice intersections. The use of continuous Overlayment strip is optional and can be used in lieu of ‘T’-Joint Overlayment.

b. **2.2 mm (90-mil) EPDM Membrane:** Tape splices may be a minimum of 6 cm (2-1/2”) wide using 7 cm (3”) wide **Factory-Applied Tape (FAT)**. In addition the entire field splice must be overlaid with a continuous 15 cm (6”) wide Pressure Sensitive Overlayment Strip.

D. **Thermoplastic (TPO/PVC) Splicing**

a. Weld adjoining membranes with a Hot Air Wedge Welder to achieve a double hot air weld 30 mm (1-1/4 inch) wide each OR an Automatic/Hand Hot Air Welder to achieve a single hot air weld 38 mm (1-1/2 inch) wide.

Note: Follow manufacturer’s operating procedures and published instructions to achieve proper temperature output and welding speed. It is advisable to perform various test welds prior to seaming consecutive membrane sheets.

b. Membrane that has been exposed to the elements for approximately 7 days must be prepared with Weathered Membrane Cleaner as follows.

1) Using a Scotch Brite Pad and Weathered Membrane Cleaner, scrub the area to be welded. (The cleaner will become white with membrane residue during this step of the procedure.

2) Clean all residue from the area to be welded with a HP Splice Wipe or clean natural fiber (cotton) rag.

3) Weld the cleaned material together with an appropriate hot air welder.

c. Using a compatible test kit and compressed air, examine every seam for defects in the double weld. Defective areas should be repaired using a patch of reinforced membrane large enough to extend 5 cm (2 inches) beyond the defective area. Intersections between the reinforced patch and the hot air welded seam in the membrane should be overlaid with Sure-Weld/Sure-Flex Flashing.

E. **Membrane Flashing**

1. Ensure tight fitting between electrical conduits, tunnel air shafts and any other gaps by installing Water Swelling Bar in accordance with manufacturer’s instructions.

2. Flash electrical conduit using uncured non-reinforced Sure-Seal/Sure-Weld/Sure-Flex membrane.

3. All intersections shall be overlaid with Sure-Seal/Sure-Weld/Sure-Flex non-reinforced flashing.

4. Around air shafts additional fasteners and plates shall be incorporated to mechanically secure the membrane approximately 30 cm (12 inches) on center. Sure-Seal/Sure-Weld/Sure-Flex Reinforced Membrane shall be used to flash the sidewall of the air shaft extending approximately 5 cm (2 inches) past the plates. Against the sidewall of the air shaft the Sure-Weld/Sure-Flex membrane is terminated using a 6 mm x 50 mm (1/4 inch x 2 inch) Termination Bar and pneumatic fasteners. Seal the end of the air shaft flashing with Universal Single-Ply Sealant.

5. Where FleeceBACK membranes are flashed using a termination bar and water cut-off mastic, remove fleece backing at the area to receive water cut-off mastic so that the mastic is in direct contact with the structural concrete.

3.03 Protection Course Installation

A. **CCW 200V Protection Fabric Installation (Vertical Installation)**

1. Temporarily secure in place with SecurTAPE, CAV-GRIP or other compatible construction adhesive.

2. Adjacent rolls of protection fabric should be placed with a minimum 5 cm (2”) side and end overlap.

3. Upon completion of installation of fabric, proceed with placement of backfill or designated cover material.

B. **CCW 300HV Protection Fabric Installation (Horizontal Installation)**

1. Unroll CCW 300HV Protection Fabric directly over waterproofing membrane with a minimum of 5 cm (2”) side and end overlap.

2. Secure Protection Fabric with overburden or use SecurTAPE, CAV-GRIP or other compatible adhesive.

3. Upon completion of installation of fabric, proceed with placement of backfill or designated cover material.

C. **CCW Protection Board H Installation (Horizontal Installation)**

1. Place boards on waterproofing membrane

2. Butt boards tightly with no gaps greater than 3 mm (1/8”).

3. Proceed with placement of backfill or designated cover material.

D. **CCW Protection Board V Installation (Vertical Installation)**

1. Temporarily secure in place with SecurTAPE.

2. Proceed with placement of backfill.

3.04 Drainage Course Installation

A. **CCW MiraDRAIN 6000/9000 Drainage Composite Installation**

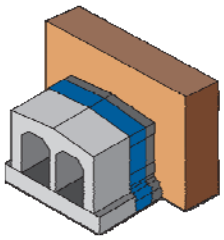
1. Unroll and place CCW MiraDRAIN 6000/9000 with the geotextile filter fabric side against the waterproofing membrane. The drainage composite can be installed horizontally or vertically.

2. At end rolls, peel back filter fabric and overlap two rows of dimples approximately 40 mm (1-1/2 inches) and press to interlock the panels.

3. Along the length of the drainage composite, position drainage panels so the side of the panel with a flange overlaps the side of the panel without a flange.

4. Attach the drainage board with CCW Contact Adhesive or SecurTAPE. Apply CCW Contact Adhesive over entire surface of waterproofing membrane and back side of MiraDRAIN and mate the two surfaces together.

Carlisle SynTec Incorporated
P. O. Box 7000, Carlisle, PA 17013
800-479-6832
http://www.carlisle-syntec.com



CARLISLE'S
TUNNEL
WATERPROOFING SYSTEM

Sure-Seal®/Sure-Weld®/Sure-Flex™
Positive Side ("Cut And Cover") Application System

"Attachment I"

Heat Welding Equipment

August 2013

1.01 HEAT WELDING EQUIPMENT

A. **Generator/Electrical Requirements**

Power supplies do not typically provide the proper amount of power necessary for consistent hot air welding. The use of a portable generator conforming to the following guidelines is strongly advised.

1. A **minimum 6500 watt generator** with a minimum output of 210 volts is required **for one Automatic Hot Air Welding Machine**. Reduced power availability will result if additional equipment is connected to the generator and may result in faulty hot air welded seams. GFI (Ground Fault Interrupter) protection is recommended. Additional generators will be required for operating other power tools and hand held hot air welders.

2. **Electrical cords** (3 conductor) of the maximum length indicated must be used with the corresponding wire as listed below:

Maximum Length	Wire Size
15 m (50 foot)	#12
30 m (100 foot)	#10
90 m (300 foot)	#8

3. **A minimum 3,000 watt generator** may be used to power a maximum of **two hand held welders** as long as no other equipment is connected. This generator should service a minimum of 110 volts and be GFI (Ground Fault Interrupter) protected.

   Electrical cords (3 conductors) of the maximum length indicated must be used with the corresponding wire as listed below:

Maximum Length	Wire Size
15 m (50 foot)	#14
30 m (100 foot)	#12

   For extension cords longer than 30 m (100 feet), consult an electrician or electrical contractor to ensure proper size of generator and wire.

B. **Automatic Wedge Welding Machine:** A lightweight, approximately 7 kg (15.75 pounds) welding machine with a maximum temperature output of 420° C (788° F) capable of delivering a double hot air weld 30 mm (1-1/4 inch) wide each. The Automatic Wedge Welding Machine is manufactured by Leister and could be furnished by Carlisle. A welding seam test kit should be made available on site to ensure the integrity of the double welded seam. Consult a Leister Manufacturer Representative for appropriate test kit and recommended air pressure.

C. **Automatic Heat Welder:** An electrically powered, self-propelled device that utilizes an electrical resistance

heating element or heater and fan-forced, super-heated air to weld membrane seams.

D. **Hot Air Hand Welder:** An electrically powered, hand-held device that utilizes an electrical resistance heating element or heater and fan-forced, super-heated air to hot air weld Sure-Weld membrane and flashing. A hand-held **silicone** rubber roller is used in conjunction with the welder to apply the pressure that fuses the heated membrane surfaces to each other. The hand-held welder is typically used for seam overlays at "T" joints and flashing of electrical conduits and around tunnel airshafts.

E. **Seam Prober:** Probing of hot air welded seams overlays is essential to ensure the continuous watertight seal at "T" joints and intersections between hot air welded seams and other penetrations (i.e., electrical conduit, air shafts, etc.). The use of a cotter pin puller is the recommended tool.

F. **Silicone Rubber Roller**: A 40 mm (1-1/2 inch) wide rubber roller used for rolling hot air welded overlays at "T" joints, patches and flashing at airshafts and electrical conduits.

1.02 Hot Air Welding Set Up

Due to a variety of heat welding equipment available, manufacturer's operating instructions and safety procedures should be referenced. Listed below are additional recommendations intended to extend the life expectancy of welders and ensure safe operation.

1. Before the machine is connected to the power source, make sure it is switched off to prevent a power surge that could damage the unit. Turn the unit on and allow the blower/heater unit to warm up for approximately 5 to 10 minutes to reach operating temperature.

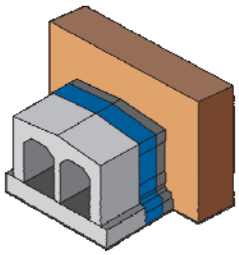
2. Clean the heat nozzle with a wire brush to remove any build-up of membrane residue, as needed.

3. To extend the life of the heating element of the Hot Air Welding Equipment, always turn the temperature adjustment down, so the welder can cool prior to switching the machine off.

4. Follow all care and maintenance instructions recommended by the respective manufacturer.

5. It is recommended that two Hot Air Welding Machines and two generators be available at the project site in the event of mechanical failure.

END OF SECTION



CARLISLE'S
TUNNEL WATERPROOFING SYSTEM

Sure-Seal®/Sure-Weld®/Sure-Flex™
"Cut And Cover" Method

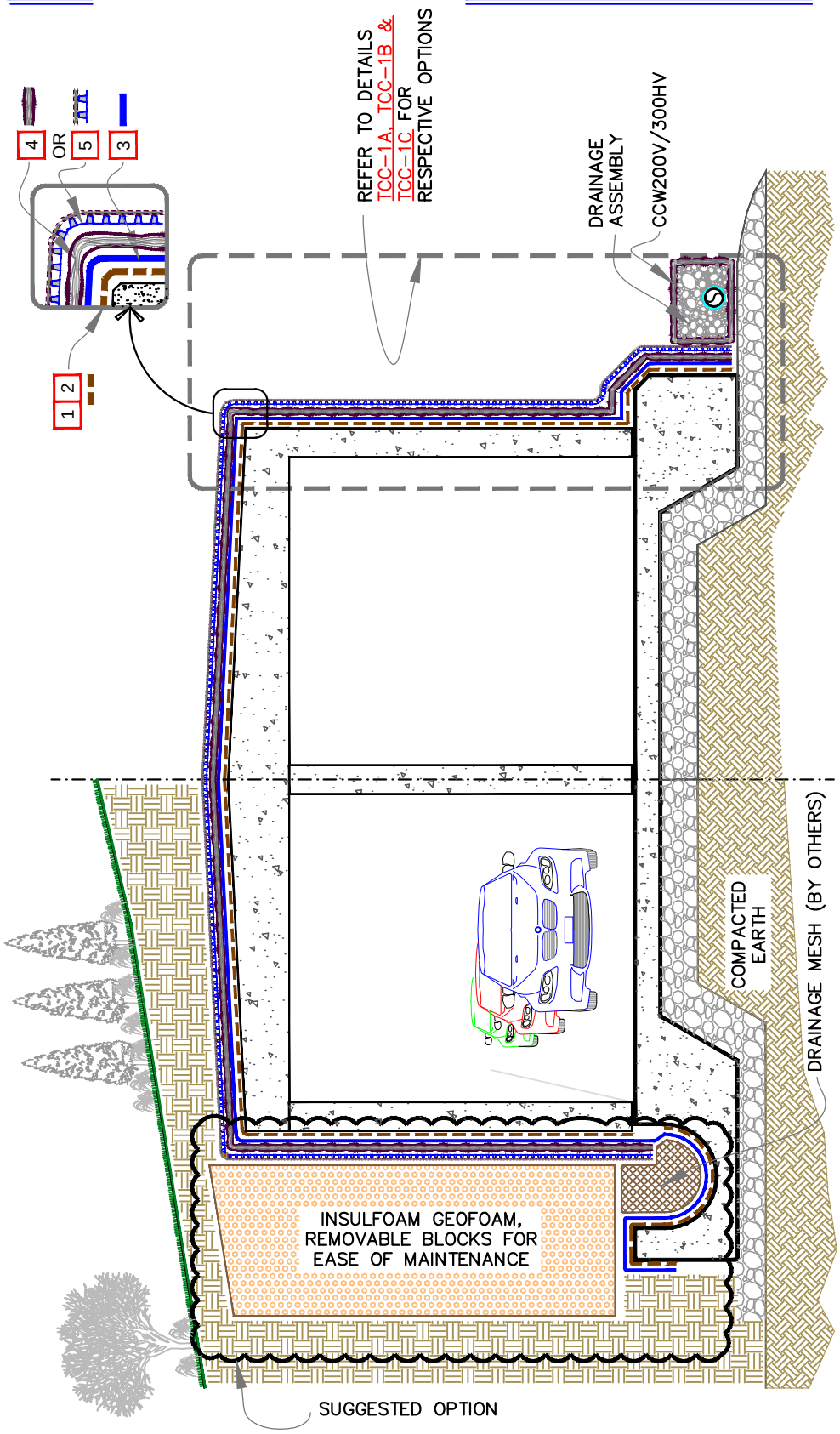
Installation Details

Table of Contents
August 2013

Details

General

Splices



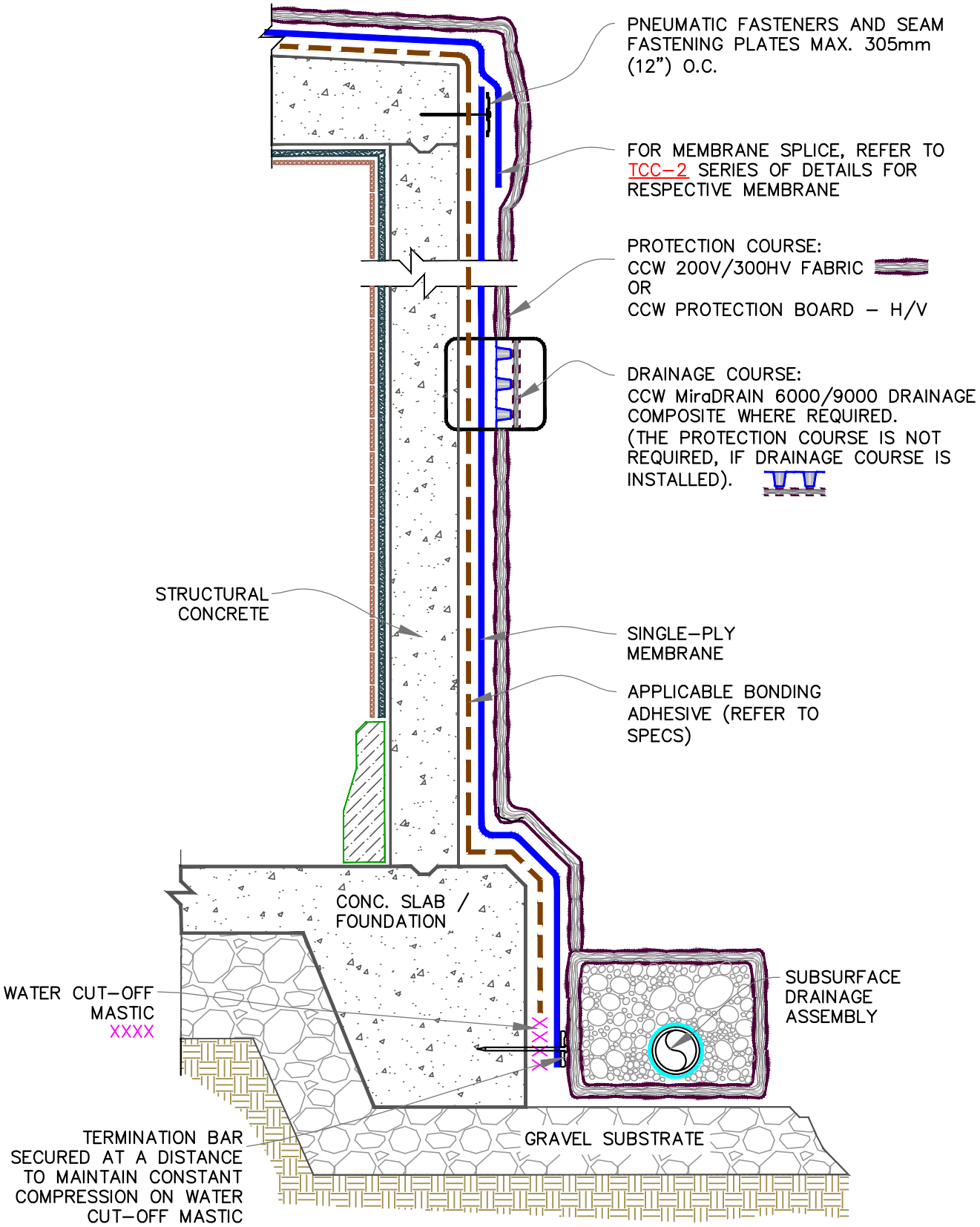
WATERPROOFING OPTIONS	1 ADDITIONAL LAYER	2 ADHESIVE	3 MEMBRANE (REFER TO SPECS)	4 PROTECTION COURSE	5 DRAINAGE COURSE	REFER TO DETAILS
CONVENTIONAL ADHERED WATERPROOFING (OPTION A)		APPLICABLE BONDING ADHESIVE (SEE SPECS)	EPDM, TPO & PVC MEMBRANES (NON-FLEECE)	CCW200V/300HV FABRIC OR CCW PROTECTION BOARD-HV	OR CCW MiraDRAIN 6000/9000	TCC-1A
FleeceBACK ADHERED (OPTION B)		FlexibleFAST ADHESIVE	EPDM, TPO & PVC MEMBRANES (NON-FLEECE)			TCC-1A
LIQUID APPLIED AND EPDM WATERPROOFING (OPTION C)	CCW 525-H/V	APPLICABLE BONDING ADHESIVE (SEE SPECS)	1.5 mm (60-MIL) EPDM (NON-FLEECE)			TCC-1C

SYSTEM OVERVIEW & OPTIONS

0 SEE NOTE(S) www.carlisle-syntec.com www.carlisle-ccw.com

SHEET NO.

TCC-1

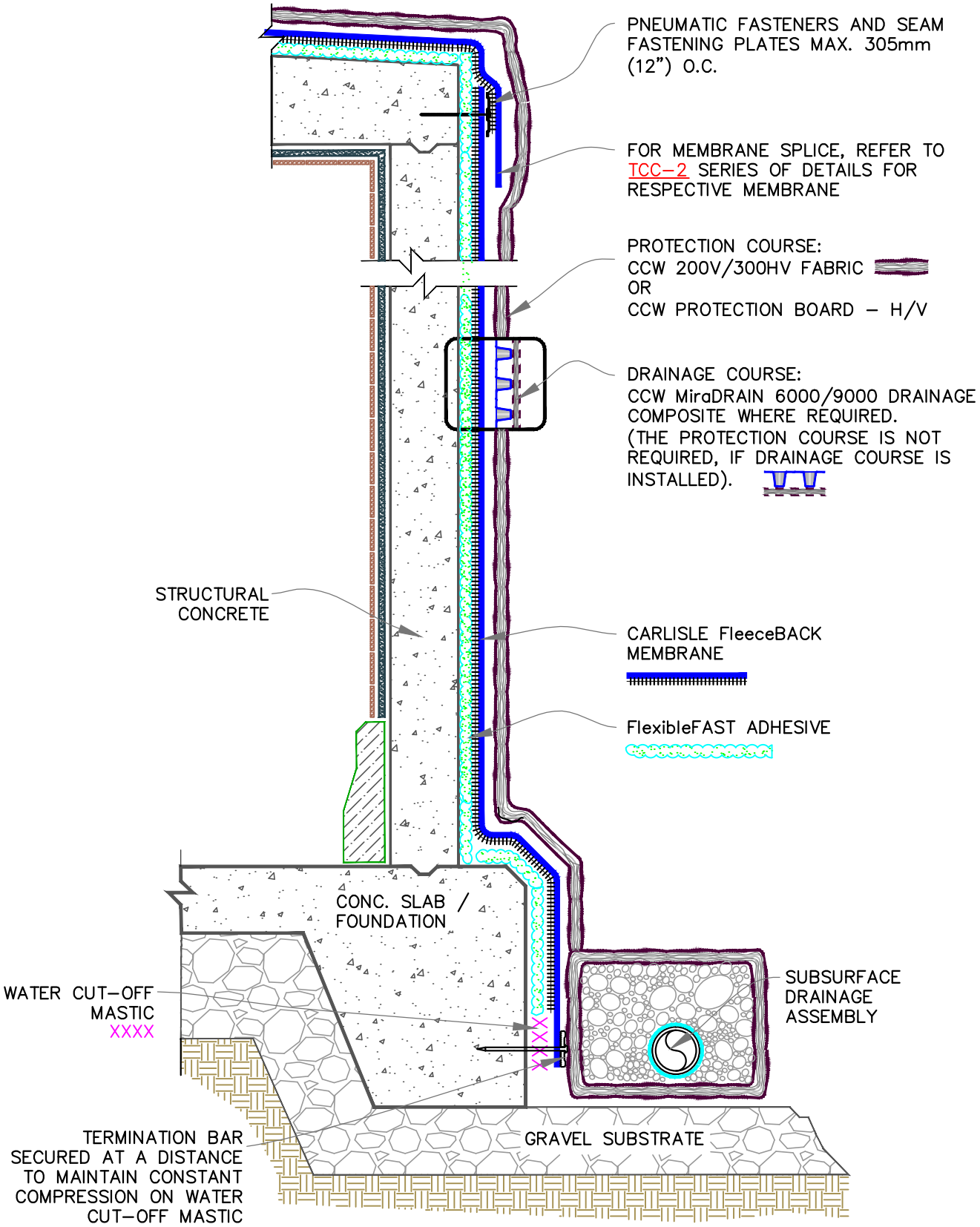


CONVENTIONAL ADHERED WATERPROOFING (OPTION A)
(NON-FLEECE EPDM/TPO/PVC) MEMBRANE

SHEET NO.

TCC-1A

0 SEE NOTE(S) | www.carlisle-syntec.com | www.carlisle-ccw.com

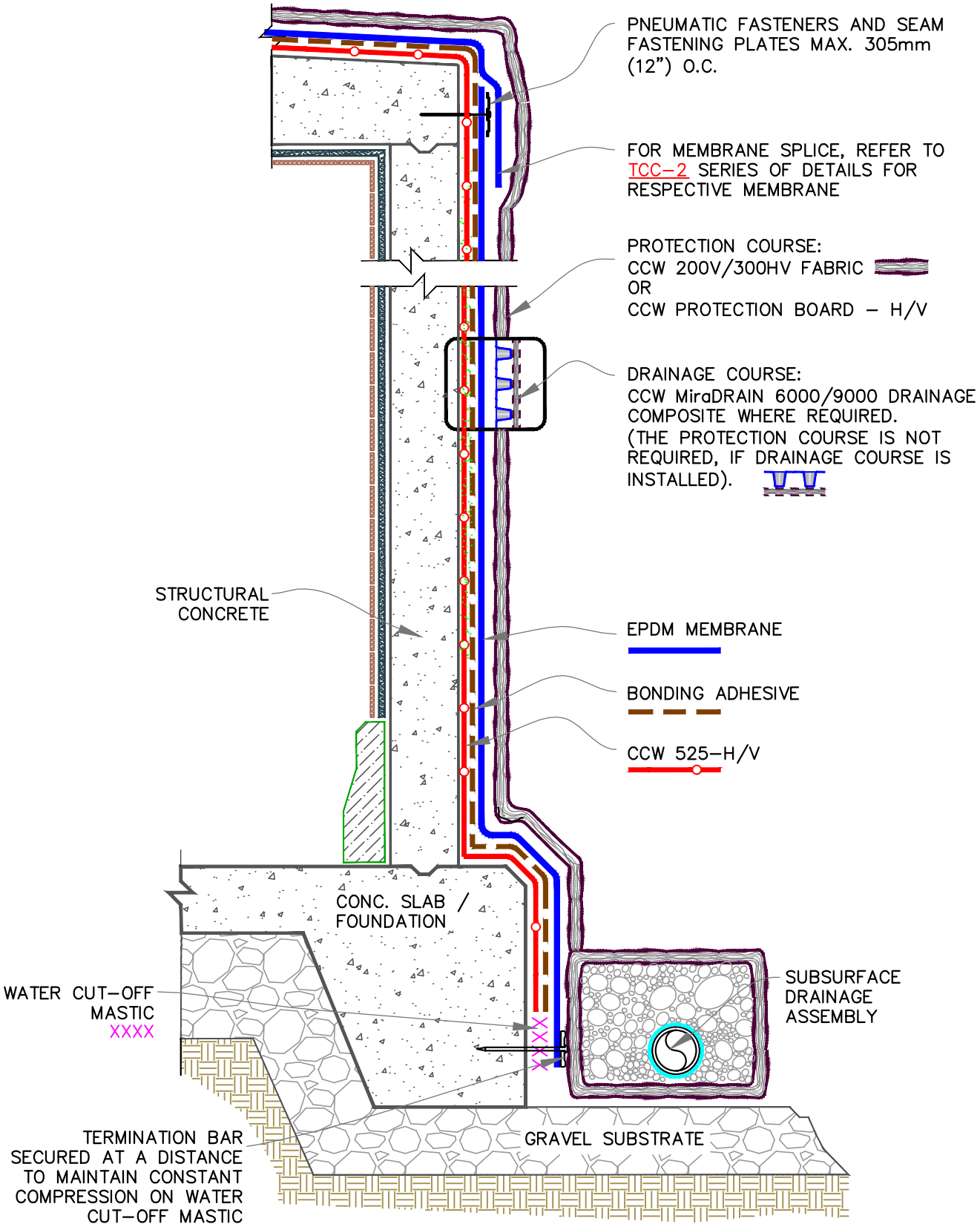


FleeceBACK ADHERED (OPTION B)
(FleeceBACK EPDM/TPO/PVC) MEMBRANE

SHEET NO.

TCC-1B

0 SEE NOTE(S) | www.carlisle-syntec.com | www.carlisle-ccw.com

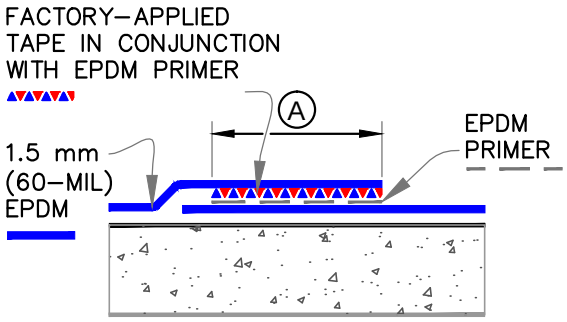


LIQUID APPLIED AND EPDM WATERPROOFING
(OPTION C)
CCW 525-H/V & EPDM NON-FLEECE MEMBRANE

SHEET NO.
TCC-1C

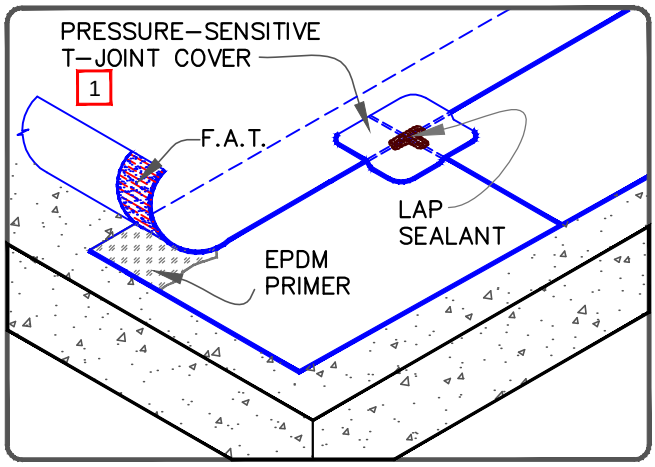
0 SEE NOTE(S) | www.carlisle-syntec.com | www.carlisle-ccw.com

1.5 mm (60-MIL) MEMBRANE



DIMENSION

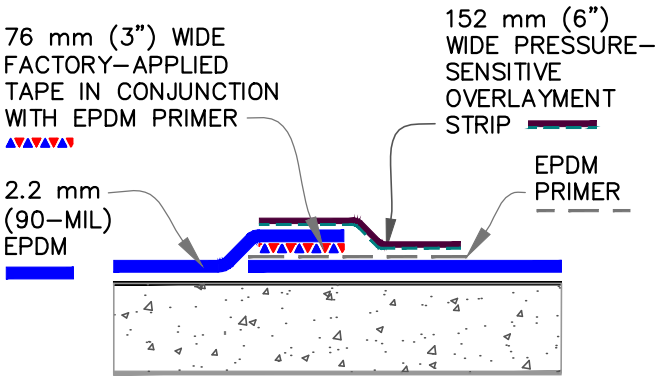
	mm	INCH	
A	76	3”	OR
	152	6”	

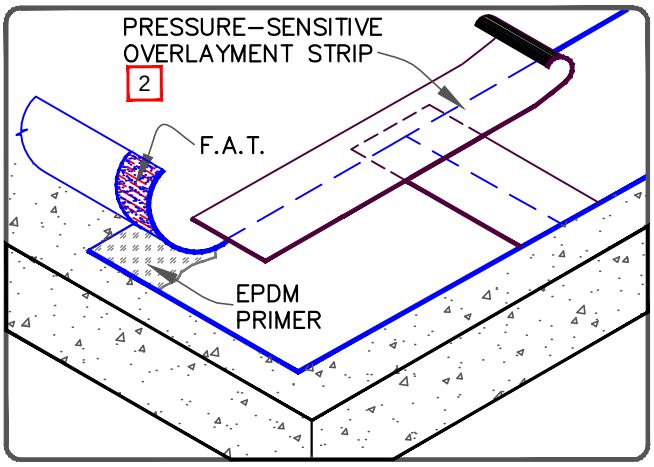


NOTE:

1. 152 mm (6”) WIDE PRESSURE–SENSITIVE ELASTOFORM FLASHING, IN CONJUNCTION WITH EPDM PRIMER, MAY ALSO BE CENTERED OVER THE INTERSECTING POINT OF THE LEADING EDGES OF THE FIELD SPLICE INTERSECTION.

2.2 mm (90-MIL) MEMBRANE 1

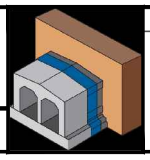




NOTES:

1. THIS DETAIL MAY ALSO BE USED FOR LESSER THICKNESS.
2. ON PROJECTS WITH 2.2 mm (90–MIL) EPDM MEMBRANE, THE TAPE SPLICES MAY BE A MINIMUM 76 mm (3”) WIDE FACTORY APPLIED TAPE (FAT). IN ADDITION, OVERLAY THE ENTIRE FIELD SPLICE WITH A CONTINUOUS 152 mm (6”) WIDE PRESSURE–SENSITIVE OVERLAYMENT STRIP.

EPDM MEMBRANE SPLICES



SHEET NO.

TCC-2A.1

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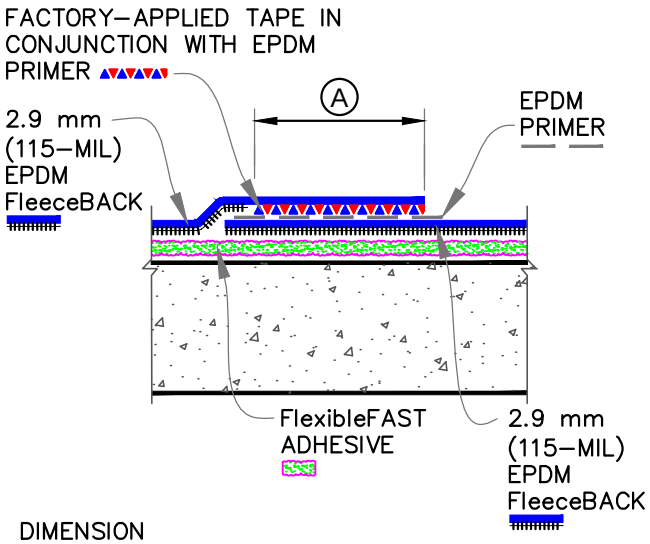
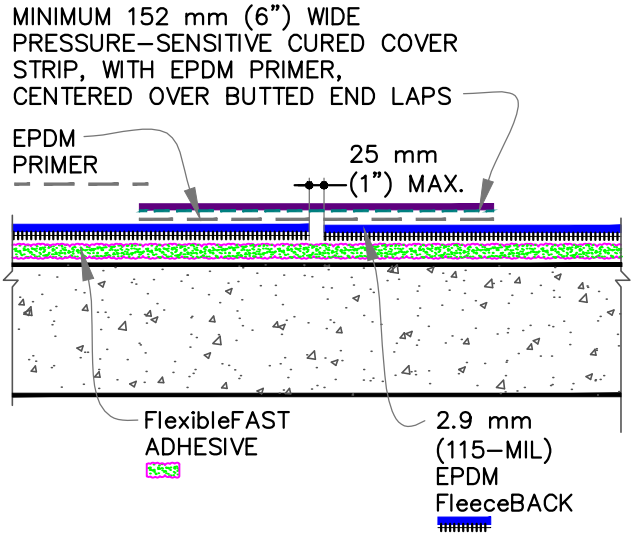
SIDE LAP SPLICE

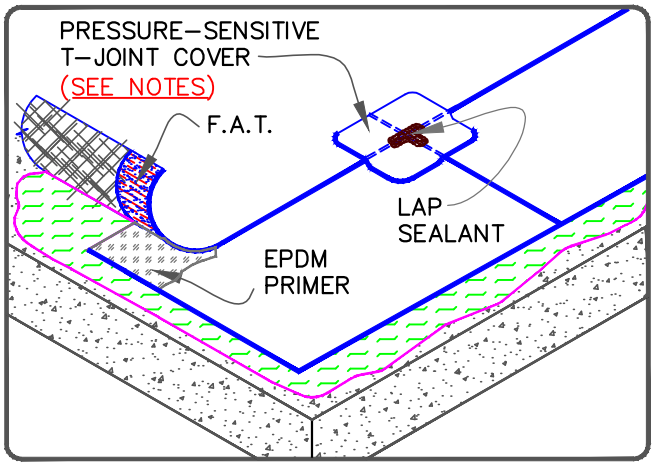


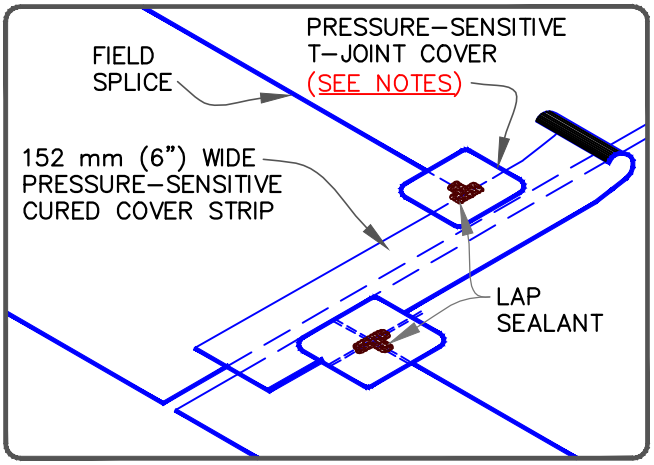
DIMENSION

	mm	INCH	
Ⓐ	76	3”	OR
	152	6”	

END LAP SPLICE





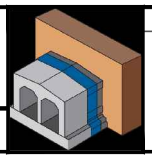


NOTES:

1. APPLY EPDM PRIMER TO MEMBRANE SURFACES PRIOR TO INSTALLING PRESSURE–SENSITIVE FLASHING AND/OR FACTORY APPLIED TAPE.

2. 152 mm (6”) WIDE PRESSURE–SENSITIVE ELASTOFORM FLASHING MAY ALSO BE CENTERED OVER THE FIELD SPLICE INTERSECTION.

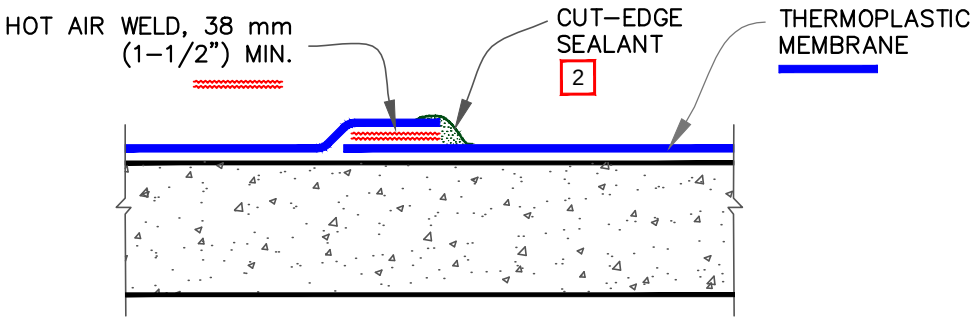
EPDM FleeceBACK MEMBRANE SPLICES

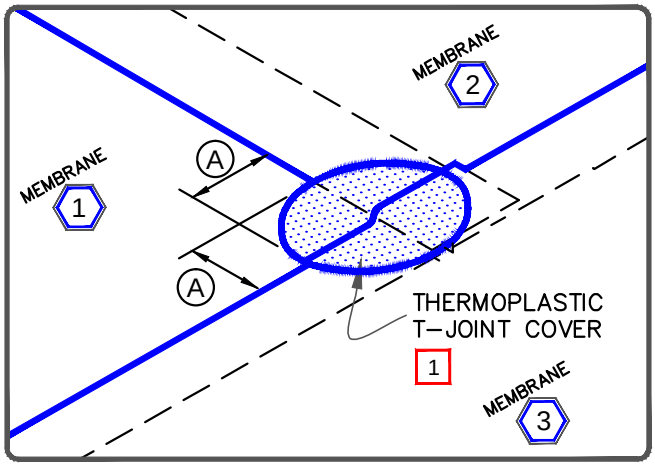


SHEET NO.

TCC-2A.2

0 SEE NOTE(S) | www.carlisle-syntec.com | www.carlisle-ccw.com



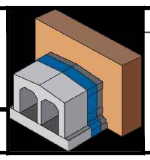


NOTE:

1. WHEN USING 1.5 mm OR 2 mm (60 OR 80–MIL) MEMBRANE, APPLY A 114 mm (4–1/2") DIAMETER "T–JOINT" COVER AT ALL FIELD SPLICE INTERSECTIONS.

2. APPROXIMATELY 3 mm (1/8") DIAMETER BEAD OF CUT–EDGE SEALANT IS REQUIRED ON CUT EDGES OF REINFORCED TPO MEMBRANE AND RECOMMENDED ON CUT EDGES OF SURE–FLEX PVC MEMBRANE.

TPO/PVC NON-FLEECE MEMBRANE SPLICES



SHEET NO.

TCC-2B.1

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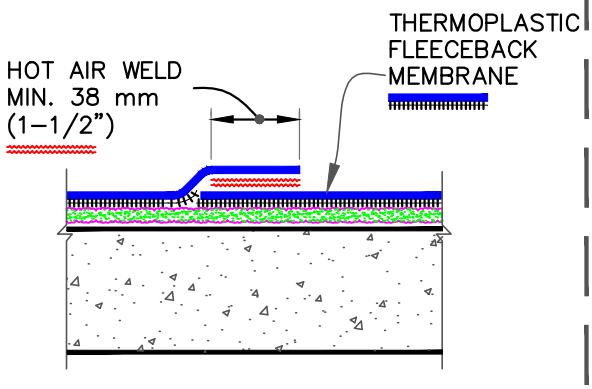
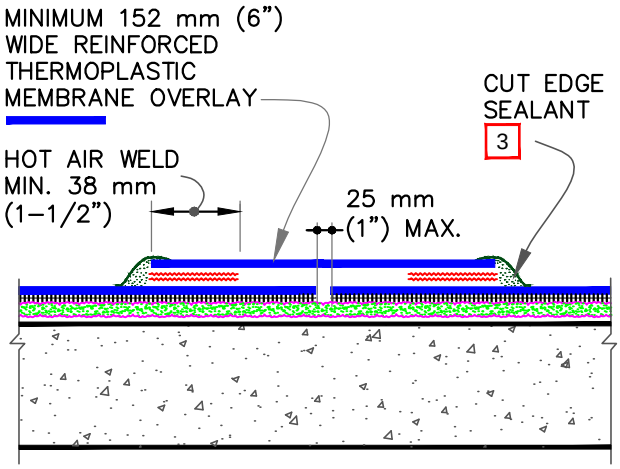
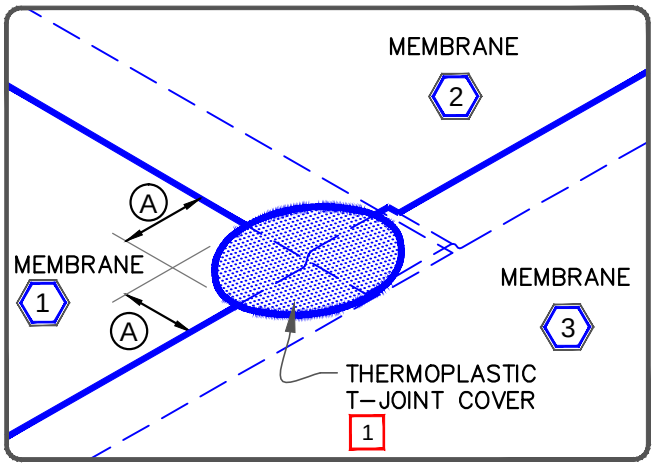
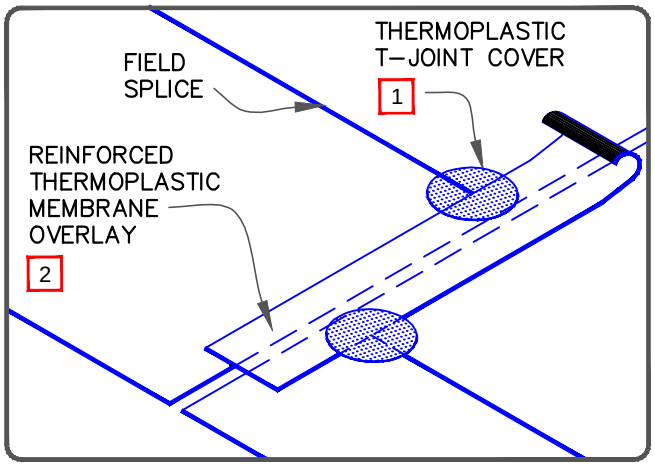
SIDE LAP SPLICE



END LAP SPLICE







DIMENSION

	mm	INCH	
(A)	57	2–1/4"	MIN.

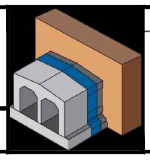
NOTES:

1. WHEN USING 2.9 mm (115–MIL) THERMOPLASTIC FLEECEBACK MEMBRANE, APPLY A 114 mm (4–1/2") DIAMETER THERMOPLASTIC "T–JOINT" COVER AT ALL FIELD SPLICE INTERSECTIONS.

2. WHEN USING 1.5 mm OR 2.1 mm (60 OR 80 MIL) THERMOPLASTIC REINFORCED MEMBRANE OVERLAY, INTERSECTIONS BETWEEN SPLICES MUST BE OVERLAID WITH A 114 mm (4–1/2") DIAMETER THERMOPLASTIC "T–JOINT" COVER.

3. APPROXIMATELY 3 mm (1/8") DIAMETER BEAD OF CUT–EDGE SEALANT IS REQUIRED ON CUT EDGES OF REINFORCED TPO MEMBRANE AND RECOMMENDED ON CUT EDGES OF SURE–FLEX PVC MEMBRANE.

TPO/PVC FLEECEBACK MEMBRANE SPLICES



SHEET NO.

TCC-2B.2

0 SEE NOTE(S) www.carlisle-syntec.com www.carlisle-ccw.com