carboline®
Coatings - Linings - Fireproofing

Oil & Gas Upstream

System Guide

Coatings, Linings, and Fireproofing

Atmospheric Exposures

Clean to Bare Steel Substrates

PREP	1ST COAT	DESCRIPTION	2ND COAT	DESCRIPTION	THIRD COAT	DESCRIPTION
Structural Steel, Piping, and Equipment – Carbon Steel **Applications – Cranes, derricks, deck buildings, piping, equipment, pipe racks, decks, undersides, structural steel, ladders, handrails, commpressors, storage tank & process vessel exteriors operating to 250°F (121°C)**						
SP 6	**Carbozinc 11 Series -or- Carbozinc 858 or 859 Series -or- Carboguard 60**	Inorganic zinc primer for maximum corrosion protection -or- Organic zinc for quick topcoating and additional chemical resistance -or- Corrosion and chemical resistant epoxy	**Carboguard 635 Series -or- Carboguard 60**	Moisture tolerant, low temp cure epoxy -or- Epoxy polyamide for general purpose	**Carbothane 134 Series -or Carbothane 133 Series -or- Carboxane 2000 Series**	High gloss weatherable acrylic urethane -or- Satin finish; high build urethane hybrid -or- Ultra-weatherable siloxane
SP 3	**Carbomastic 15 Series -or- Carbomastic 615**	Aluminum surface tolerant epoxy -or- Inert-flake filled, moisture tolerant, low temp cure epoxy	**Carboguard 635 Series -or- Carboguard 60**	Moisture tolerant, low temp cure epoxy -or- Epoxy polyamide for general purpose	**Carbothane 134 Series -or Carbothane 133 Series -or- Carboxane 2000 Series**	High gloss weatherable acrylic urethane -or- Satin finish; high build urethane hybrid -or- Ultra-weatherable siloxane

Systems over Existing Coatings*

PREP	OVERCOAT SEALER	DESCRIPTION	SPOT PRIMER	DESCRIPTION	TOPCOAT	DESCRIPTION
Structural Steel, Piping, and Equipment – Carbon Steel **Applications – Cranes, derricks, deck buildings, piping, equipment, pipe racks, decks, undersides, structural steel, ladders, handrails, compressors, storage tank & process vessel exteriors operating to 250°F (121°C)**						
SP 1 and/or SP 7	**Rustbond Series**	Penetrating epoxy sealer	**Carbomastic 15 Series -or- Carboguard 60**	Aluminum surface tolerant epoxy -or- Epoxy polyamide for general purpose	**Carbothane 134 Series -or Carbothane 133 Series -or- Carboxane 2000 Series**	High gloss weatherable acrylic urethane -or- Satin finish; high build urethane hybrid -or- Ultra-weatherable siloxane

*Always determine suitability for overcoating prior to application (see Notes section).

High Heat Applications

Atmospheric Exposures

PREP	PRIMER	DESCRIPTION	TOPCOAT	DESCRIPTION
Uninsulated Piping and Equipment – Steel operating to 300°F (148°C) **Applications – Piping, heaters, furnaces, boilers, stacks, columns, drums, vessels, heat exchangers, mufflers, valves, pumps and equipment operating up to 300°F (148°C).**				
SP 3	**Carbomastic 15 Series**	Aluminum surface tolerant epoxy	**Carbomastic 15 Series**	Aluminum surface tolerant epoxy
SP 10	**Carboguard 858 or 859 -or- Carboguard 890 Series -or- Carboguard 690**	Organic zinc primer -or- High chemical resistant epoxy -or- Moisture tolerant, low temp cure epoxy	**Carboguard 890 Series -or- Carboguard 690**	High chemical resistant epoxy -or- Moisture tolerant, low temp cure epoxy

PREP	1ST COAT	DESCRIPTION	2ND COAT	DESCRIPTION	OPTIONAL THIRD COAT	DESCRIPTION
Uninsulated Piping and Equipment – Steel operating to 500°F (260°C) **Applications – Piping, heaters, furnaces, boilers, stacks, columns, drums, vessels, heat exchangers, mufflers, valves, pumps and equipment operating at 250-500°F (121-260°C).**						
SP10	**Carbozinc 11 Series**	Inorganic zinc primer for maximum corrosion protection	**Thermaline 4000 -or- Thermaline 4900**	Inorganic silicate; no heat cure requirement -or- Silicone acrylic	**Thermaline 4000 -or- Thermaline 4900**	Inorganic silicate; no heat cure requirement -or- Silicone acrylic
SP 3	**Thermaline 2977 Series**	Surface tolerant zinc-filled alkyd	**Thermaline 4900**	Silicone acrylic	**Thermaline 4900**	Silicone acrylic
Uninsulated Piping and Equipment – Steel operating up to 1000°F (538°C) **Applications – Piping, heaters, furnaces, boilers, stacks, columns, drums, vessels, heat exchangers, mufflers, valves, pumps and equipment operating at 450-1000°F (232-538°C).**						
SP 10	**Carbozinc 11 Series**	Inorganic zinc primer for maximum corrosion protection	**Thermaline 4000 -or- Thermaline 4700**	Inorganic silicate; no heat cure requirement -or- Silicone	**Thermaline 4000 -or- Thermaline 4700**	Inorganic silicate; no heat cure requirement -or- Silicone

High Heat Applications

Under Insulation

PREP	1ST COAT	DESCRIPTION	2ND COAT	DESCRIPTION	SYSTEM PROPERTIES
Insulated Piping and Equipment – Steel operating up to 300°F (148°C) **Applications – Insulated piping and equipment operating at elevated temperatures.**					
SP 3	**Carbozinc 15 Series**	Aluminum surface tolerant epoxy	**Carbomastic 15 Series**	Aluminum surface tolerant epoxy	
SP 10	**Carboguard 890 Series -or- Carboguard 690**	High chemical resistant epoxy -or- Moisture tolerant, low temp cure epoxy	**Carboguard 890 Series -or- Carboguard 690**	High chemical resistant epoxy -or- Moisture tolerant, low temp cure epoxy	
Insulated Piping and Equipment – Steel operating up to 450°F (148-232°C) **Applications – Insulated piping and equipment operating at elevated temperatures.**					
SP 10	**Thermaline 450 EP**	Epoxy phenolic; amine cured	**Thermaline 450 EP**	Epoxy phenolic; amine cured	Good to 400°F (204°C) continuous
SP 10	**Thermaline 450**	Glass-flake epoxy novolac			Single coat; good to 450°F (232°C) non-continuous
SP 10	**Thermaline 451**	Micaceous iron-oxide flake epoxy novolac			Single coat; good to 450°F (232°C) non-continuous
Insulated Piping and Equipment – Steel operating from -321°F (-200°C) up to 1200°F (649°C) **Applications – Insulated piping and equipment operating at cryogenic to high temperatures.**					
SP 10	**Thermaline Heat Shield**	Multi-polymeric matrix	**Thermaline Heat Shield**	Inert polymeric matrix	High heat barrier protection

Specialty Applications

PREP	1ST COAT	DESCRIPTION	2ND COAT	DESCRIPTION	OPTIONAL THIRD COAT	DESCRIPTION
Galvanized Steel **Applications – Over-coating galvanized steel or other surfaces to provide color and UV protection.** **May be used on stainless, bronze, brass, fiberglass, etc.**						
SP 1	**Galoseal WB**	Water-borne acrylic bonding primer	**Carbothane 134 Series -or- Carbothane 133 Series**	High gloss weatherable acrylic urethane -or- Satin finish; high build urethane hybrid		
SP 7	**Carboguard 60**	Epoxy polyamide				
Deck Plate (Normal Duty) – Steel **Applications - Deck plate in areas of low to moderate traffic.**						
SP 10	**Carbozinc 858 or 859 -or- Carboguard 60**	Organic zinc for quick topcoating and additional chemical resistance -or- Chemical resistant epoxy primer	**Carboguard 890 GF -or- Carboguard 869 Non-Skid**	Heavy-duty, glass-flake epoxy with optional #36 or #47 Filler -or- Medium-duty, non-skid epoxy	**Carbothane 134 Series -or- Carbothane 133 Series**	High gloss weatherable acrylic urethane -or- Satin finish; high build urethane hybrid
Deck Plate (Heavy Duty) – Steel **Applications - For applications where heavy-duty, non-slip walking surfaces are required such as helidecks and walkways.**						
SP 10	**Carbozinc 858 or 859 -or- Carboguard 60**	Organic zinc for quick topcoating and additional chemical resistance -or- Chemical resistant epoxy primer	**Carboguard 1209 -or- Carboguard 1207**	Heavy-duty, high-load, glass-flake epoxy using either Filler #36 or #47 non-skid aggregate -or- Aggregate-filled, high impact resistant epoxy cladding	**Carbothane 134 Series -or- Carbothane 133 Series**	High gloss weatherable acrylic urethane -or- Satin finish; high build urethane hybrid
Splash Zone – Steel **Applications – Platform legs, pilings, risers, conductors, structural steel, cross bracing, boat bumpers, boat landings and other steel components in the splash zone or tidal area (typically –10 to +15 ft. from mean sea level).**						
SP 10	**Carbozinc 858 or 859**	Organic zinc for resistance to corrosion undercutting	**Carboguard 890 GF -or- Carboguard 1209 -or- Carboguard 1207**	Heavy-duty, glass-flake epoxy -or- Heavy-duty, high-load, glass-flake epoxy -or- Aggregate-filled, high impact resistant epoxy cladding	**Carbothane 134 Series -or- Carbothane 133 Series**	High gloss weatherable acrylic urethane -or- Satin finish; high build urethane hybrid
Ballast Tanks and Seawater Immersion – Steel **Applications – Ballast tank linings and coating of structural steel, hulls, caissons, sumps, etc. located in water immersion service or below waterline.**						
SP 10	**Carbomastic 18 BT -or- Carboguard 635 Series**	Epoxy polyamide -or- Epoxy phenalkamine	**Carbomastic 18 BT -or- Carboguard 635 Series**	Epoxy polyamide -or- Epoxy phenalkamine		

Subsea Equipment

PREP	1ST COAT	DESCRIPTION	2ND COAT	DESCRIPTION	NOTES
Subsea Equipment – Steel **Applications – External coating of subsea trees, valves, piping, manifolds, etc.**					
SP 10	**Carboguard 890 -or- Carbomastic 615**	Cycloaliphatic amine epoxy -or- Phenalkamine epoxy	**Carboguard 890 -or- Carboguard 690**	Cycloaliphatic amine epoxy -or- Phenalkamine epoxy	Thin film two-coat epoxy systems for optimal protection. Carbogmastic 615 has extreme tolerance to moisture during application and low temperature cure.
SP 10	**Carboguard 1209 -or- Carboguard 890 GF**	Heavy-duty, high-load, glass-flake, filled epoxy -or- Heavy-duty, glass-flake epoxy	**Carboguard 1209 -or- Carboguard 890 GF**	Heavy-duty, high-load, glass-flake, filled epoxy -or- Heavy-duty, glass-flake epoxy	Thicker film glass-flake filled epoxies for improved durability and barrier protection.
SP 10	**Carboguard 878 Alu**	Modified epoxy	**Carboguard 878**	Modified epoxy	Suitable for higher temperature service > 50°C

Passive Fireproofing

PREP	PRIMER	DESCRIPTION	FIREPROOFING	DESCRIPTION	TOPCOAT	DESCRIPTION
Structural Steel, Piping, and Equipment – Carbon Steel **Applications – For hydrocarbon and/or jet-fire protection to steel surfaces for the protection of crews quarters, bulkheads, underdecks, structural steel, pipe racks, saddles, and vessel skirts.**						
St 3 -or- Sa 2 ½	**Qualified Carbozinc Series -or- Carboguard Series -or- Carbomastic Series**	Primer system (used in conjunction with qualified tie-coat where applicable). Consult Carboline for appropriate primer.	**Pyroclad X1**	Epoxy intumescent fireproofing designed for hydrocarbon pool fire protection and jet fire protection	**Carbothane 134 Series**	High gloss polyurethane weatherable finish

Linings for Storage Tanks and Vessels

All tank lining recommendations must be reconfirmed through Carboline Technical Service Department.

SERVICE CONDITIONS		GENERIC TYPE	PRODUCT	# OF COATS	mils (µm) TOTAL
Crude Oil, Gas Condensate, Produced Water, or Seawater Storage		Epoxy coal-tar	**Bitumastic 300 M**	1-2	16-24 (400-600)
		Cycloaliphatic epoxy	**Phenoline 385**	2	10-14 (250-350)
		Solvent-free epoxy	**Phenoline Tank Shield**	1	25-30 (625-750)
Acid, Oxidizer, Alkali Storage		Flake pigment vinyl ester	**Plasite 4300**	2	35-45 (875-1125)
		Solvent-free novolac epoxy	**Plasite 4550 Series**	1	40-50 (1000-1250)
Amine Storage		Flake pigment vinyl ester	**Plasite 4300**	2	35-45 (875-1125)
		Solvent-free novolac epoxy	**Plasite 4550 Series**	1	25-30 (625-750)
Glycol Storage	EG @150°F DEG/TEG @100°F	Epoxy	**Phenoline 353 LT**	2	12-15 (300-375)
	EG @150°F DEG/TEG @120°F	Flake pigment vinyl ester	**Plasite 4300**	2	35-45 (875-1125)
	EG @200°F DEG/TEG @150°F	Baking phenolic	**Plasite 3073**	3	5-7 (125-175)
Brine Storage		Solvent-free epoxy	**Phenoline Tank Shield**	1	25-30 (625-750)
		Epoxy Phenolic	**Plasite 7159**	2	10-12 (250-300)
		Glass-flake novolac	**Phenoline 1205**	2	10-12 (250-300)
Process Water Storage	210°F	Epoxy phenolic	**Plasite 7159**	2	12-15 (300-375)
	150°F	Cycloaliphatic Epoxy	**Phenoline 385**	2	10-12 (250-300)
	130°F	Solvent-free epoxy	**Phenoline Tank Shield**	1	40-50 (1000-1250)
Pressure Vessels, Separators, Treaters (Oil, Gas, Water)		Epoxy	**Plasite 7159**	2	12-15 (300-375)
		Solvent-free novolac epoxy	**Plasite 4550 Series**	1	40-50 (1000-1250)
Drilling and Workover Fluids		Glass-flake epoxy novolac	**Phenoline 1205**	2	16-20 (400-500)
	20% HCl @120°F 25% NaOH @120°F	Solvent-free novolac epoxy	**Plasite 4550 Series**	1	20-40 (500-1000)
	20% HCl @120°F 10% HCl @150°F	Vinyl ester	**Plasite 4300**	2	35-45 (875-1125)

Linings for Storage Tanks and Vessels

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SERVICE CONDITIONS	GENERIC TYPE	PRODUCT	# OF COATS	mils (µm) TOTAL
Fuel, Oil, Diesel Gasoline, or Gasoline + Ethanol Storage	Cycloaliphatic amine epoxy	**Phenoline 385**	2	12-14 (300-350)
	Epoxy fast cure	**Plasite 4500 FS**	1	25-30 (625-750)
	Epoxy	**Phenoline Tank Shield**	1	25-30 (625-750)
Waste and Potable Water Storage (NSF Approved)	Epoxy	**Carboguard 891 HS**	2	8-12 (200-300)
	Epoxy	**Carboguard 981 VOC**	2	8-12 (200-300)
	Epoxy phenalkamine	**Phenoline 341**	1	15-20 (375-500)

NOTES

1. Carbozinc 11 Series consists of four inorganic zinc products designed to meet every need:
   Carbozinc 11: Standard high performance inorganic zinc silicate.
   Carbozinc 11 FC: Fast cure to topcoat inorganic zinc primer.
   Carbozinc 11 VOC: High performance inorganic zinc silicate designed to meet local VOC limits of 3.2 lbs./gal. (389 g/l)
   Carbozinc 11 HS: High performance inorganic zinc silicate designed to meet local VOC limits of 2.4 lbs./gal. (288 g/l)
   Carbozinc 11 WB: A water-based inorganic zinc with a VOC of zero.
2. Carbothane 134 Series includes several choices of high gloss acrylic urethanes to meet your needs:
   Carbothane 134 HG, 134 HS, 134 HP, 134 GS: Superior performance polyurethane exceeding the requirements of SSPC Paint 36 Level 3.
   Carbothane 134 VOC: Same performance as 134 HG but with a VOC limit of <200 g/l.
   Carbothane 134 MC: Same performance as 134 HG but with a VOC limit of <100 g/l.
   Carbothane 134 WB: A water-borne urethane exceeding the requirements of SSPC Paint 36; Level 3 and VOC <100 g/l.
3. Carbothane 133 Series may be used in lieu of 134 Series when a satin finish and higher film build characteristics are desired. Carbothane 133 Series includes 133 HB, 133 VOC, 133 MC, and 133 LH used where VOC regulations dictate.
4. Thermaline 4900 VOC and Thermaline 4700 VOC may be substituted for Thermaline 4900 and Thermaline 4700, respectively, as local VOC regulations dictate.
5. In maintenance painting, some coats may be eliminated depending on the condition of the existing paint system. Please consult your Carboline Sales Representative.
6. Heavily pitted steel can make coating application more complicated. Please consult your Carboline Sales Representative for specific advice.
7. The application technique of stripe coating edges and weld lines will improve coating system performance.
8. Surface Cleaner 3 is a water based cleaner that is effective in cleaning and degreasing surfaces prior to painting.
9. Where surface preparation designations of SSPC SP 10, SP 6, SP 7, SP 3, and SP 2 are used the ISO designations of Sa 2 ½, Sa 2, Sa 1, St 3, and St 2 (respectively) are also applicable.
10. Phenoline 311 or Plasite 4503 may be used as a holding primer for many lining applications. Consult Technical Service for specific applications.

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