

# 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
<b>Structural Steel, Piping, and Equipment – Carbon Steel</b> 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 6	<b>Carbozinc 11 Series</b> -or- <b>Carbozinc 858 or 859 Series</b> -or- <b>Carboguard 60</b>	Inorganic zinc primer for maximum corrosion protection -or- Organic zinc for quick topcoating and additional chemical resistance -or- Corrosion and chemical resistant epoxy	<b>Carboguard 635 Series</b> -or- <b>Carboguard 60</b>	Moisture tolerant, low temp cure epoxy -or- Epoxy polyamide for general purpose	<b>Carbothane 134 Series</b> -or- <b>Carbothane 133 Series</b> -or- <b>Carboxane 2000 Series</b>	High gloss weatherable acrylic urethane -or- Satin finish; high build urethane hybrid -or- Ultra-weatherable siloxane
SP 3	<b>Carbomastic 15 Series</b> -or- <b>Carbomastic 615</b>	Aluminum surface tolerant epoxy -or- Inert-flake filled, moisture tolerant, low temp cure epoxy	<b>Carboguard 635 Series</b> -or- <b>Carboguard 60</b>	Moisture tolerant, low temp cure epoxy -or- Epoxy polyamide for general purpose	<b>Carbothane 134 Series</b> -or- <b>Carbothane 133 Series</b> -or- <b>Carboxane 2000 Series</b>	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
<b>Structural Steel, Piping, and Equipment – Carbon Steel</b> 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	<b>Rustbond Series</b>	Penetrating epoxy sealer	<b>Carbomastic 15 Series</b> -or- <b>Carboguard 60</b>	Aluminum surface tolerant epoxy -or- Epoxy polyamide for general purpose	<b>Carbothane 134 Series</b> -or- <b>Carbothane 133 Series</b> -or- <b>Carboxane 2000 Series</b>	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
<b>Uninsulated Piping and Equipment – Steel operating to 300°F (148°C)</b> 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	<b>Carbomastic 15 Series</b>	Aluminum surface tolerant epoxy	<b>Carbomastic 15 Series</b>	Aluminum surface tolerant epoxy
SP 10	<b>Carboguard 858 or 859</b> -or- <b>Carboguard 890 Series</b> -or- <b>Carboguard 690</b>	Organic zinc primer -or- High chemical resistant epoxy -or- Moisture tolerant, low temp cure epoxy	<b>Carboguard 890 Series</b> -or- <b>Carboguard 690</b>	High chemical resistant epoxy -or- Moisture tolerant, low temp cure epoxy

PREP	1ST COAT	DESCRIPTION	2ND COAT	DESCRIPTION	OPTIONAL THIRD COAT	DESCRIPTION
<b>Uninsulated Piping and Equipment – Steel operating to 500°F (260°C)</b> 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	<b>Carbozinc 11 Series</b>	Inorganic zinc primer for maximum corrosion protection	<b>Thermaline 4000</b> -or- <b>Thermaline 4900</b>	Inorganic silicate; no heat cure requirement -or- Silicone acrylic	<b>Thermaline 4000</b> -or- <b>Thermaline 4900</b>	Inorganic silicate; no heat cure requirement -or- Silicone acrylic
SP 3	<b>Thermaline 2977 Series</b>	Surface tolerant zinc-filled alkyd	<b>Thermaline 4900</b>	Silicone acrylic	<b>Thermaline 4900</b>	Silicone acrylic
<b>Uninsulated Piping and Equipment – Steel operating up to 1000°F (538°C)</b> 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	<b>Carbozinc 11 Series</b>	Inorganic zinc primer for maximum corrosion protection	<b>Thermaline 4000</b> -or- <b>Thermaline 4700</b>	Inorganic silicate; no heat cure requirement -or- Silicone	<b>Thermaline 4000</b> -or- <b>Thermaline 4700</b>	Inorganic silicate; no heat cure requirement -or- Silicone

# High Heat Applications

## Under Insulation

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

# Specialty Applications

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

# Subsea Equipment

PREP	1ST COAT	DESCRIPTION	2ND COAT	DESCRIPTION	NOTES
<b>Subsea Equipment – Steel</b> <b>Applications – External coating of subsea trees, valves, piping, manifolds, etc.</b>					
SP 10	<b>Carboguard 890</b>	Cycloaliphatic amine epoxy	<b>Carboguard 890</b>	Cycloaliphatic amine epoxy	Meets NORSOK System 7B Requirements. Suitable for temperature service up to 50°C (122°F)
SP 10	<b>Carboguard 890 GF</b>	Heavy-duty, glass-flake epoxy	<b>Carboguard 890 GF</b>	Heavy-duty, glass-flake epoxy	Meets NORSOK System 7B and 7C Requirements. Suitable for temperature service up to 90°C (194°F)
SP 10	<b>Carbomastic 615 AL</b>	Aluminum-filled phenalkamine epoxy	<b>Carboguard 690</b>	Phenalkamine epoxy	Meets NORSOK System 7B and 7C Requirements. Suitable for temperature service up to 120°C (248°F)
SP 10	<b>Phenoline 353 LT</b>	Modified novolac epoxy	<b>Phenoline 353 LT</b>	Modified novolac epoxy	Meets NORSOK System 7C Requirements. Suitable for temperature service up to 180°C (356°F)

# Passive Fireproofing

PREP	PRIMER	DESCRIPTION	FIREPROOFING	DESCRIPTION	TOPCOAT	DESCRIPTION
<b>Structural Steel, Piping, and Equipment – Carbon Steel</b> <b>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.</b>						
St 3 -or- Sa 2 ½	<b>Qualified Carbozinc Series</b> -or- <b>Carboguard Series</b> -or- <b>Carbomastic Series</b>	Primer system (used in conjunction with qualified tie-coat where applicable). Consult Carboline for appropriate primer.	<b>Pyroclad X1</b>	Epoxy intumescent fireproofing designed for hydrocarbon pool fire protection and jet fire protection	<b>Carbothane 134 Series</b>	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	<b>Bitumastic 300 M</b>	1-2	16-24 (400-600)
		Cycloaliphatic epoxy	<b>Phenoline 385</b>	2	10-14 (250-350)
		Solvent-free epoxy	<b>Phenoline Tank Shield</b>	1	25-30 (625-750)
Acid, Oxidizer, Alkali Storage		Flake pigment vinyl ester	<b>Plasite 4300</b>	2	35-45 (875-1125)
		Solvent-free novolac epoxy	<b>Plasite 4550 Series</b>	1	40-50 (1000-1250)
Amine Storage		Flake pigment vinyl ester	<b>Plasite 4300</b>	2	35-45 (875-1125)
		Solvent-free novolac epoxy	<b>Plasite 4550 Series</b>	1	25-30 (625-750)
Glycol Storage	EG @150°F DEG/TEG @100°F	Epoxy	<b>Phenoline 353 LT</b>	2	12-15 (300-375)
	EG @150°F DEG/TEG @120°F	Flake pigment vinyl ester	<b>Plasite 4300</b>	2	35-45 (875-1125)
	EG @200°F DEG/TEG @150°F	Baking phenolic	<b>Plasite 3073</b>	3	5-7 (125-175)
Brine Storage		Solvent-free epoxy	<b>Phenoline Tank Shield</b>	1	25-30 (625-750)
		Epoxy Phenolic	<b>Plasite 7159</b>	2	10-12 (250-300)
		Glass-flake novolac	<b>Phenoline 1205</b>	2	10-12 (250-300)
Process Water Storage	210°F	Epoxy phenolic	<b>Plasite 7159</b>	2	12-15 (300-375)
	200°F	Proprietary epoxy	<b>Plasite 4550 HT</b>	1	20-30 (500-750)
	150°F	Cycloaliphatic Epoxy	<b>Phenoline 385</b>	2	10-12 (250-300)
	130°F	Solvent-free epoxy	<b>Phenoline Tank Shield</b>	1	40-50 (1000-1250)
Pressure Vessels, Separators, Treaters (Oil, Gas, Water)		Epoxy	<b>Plasite 7159</b>	2	12-15 (300-375)
		Solvent-free novolac epoxy	<b>Plasite 4550 Series</b>	1	40-50 (1000-1250)
Drilling and Workover Fluids		Glass-flake epoxy novolac	<b>Phenoline 1205</b>	2	16-20 (400-500)
	20% HCl @120°F 25% NaOH @120°F	Solvent-free novolac epoxy	<b>Plasite 4550 Series</b>	1	20-40 (500-1000)
	20% HCl @120°F 10% HCl @150°F	Vinyl ester	<b>Plasite 4300</b>	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	Cycloaliphatic amine epoxy	<b>Phenoline 385</b>	2	12-14 (300-350)
	Epoxy fast cure	<b>Plasite 4500 FS</b>	1	25-30 (625-750)
	Epoxy	<b>Phenoline Tank Shield</b>	1	25-30 (625-750)
Ethanol	Epoxy amine	<b>Plasite 7159</b>	2	10-12 (250-300)
	Epoxy amine	<b>Phenoline 4500</b>	1	20-25 (500-625)
	Epoxy novolac	<b>Plasite 4550 HT</b>	1	20-25 (500-625)
Waste and Potable Water Storage	Epoxy	<b>Carboguard 891 VOC</b>	2	8-12 (200-300)

## NOTES:

1. This system guide often refers to a "series" of products (e.g. Carbozinc 11 Series) where you may select the specific product for your application within this equivalent family. This "series" typically includes product versions that meet regional VOC regulations (e.g. Carbozinc 11 VOC) as well as product versions that offer faster cure (e.g. Carbozinc 11 FC). You can be assured that all the products within a "series" offer the same performance characteristics. Please consult your Carboline Sales Representative for specific recommendations.
2. Please consult your Carboline Sales Representative for specific recommendations to meet regional environmental regulations. Carboline offers many products with reduced VOC and HAPs.



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