Engineering Standard

SAES-H-001 21 February 2018
Coating Selection and Application
Requirements for Industrial Plants and Equipment

Document Responsibility: Paints and Coatings Standards Committee

Contents

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1 Scope

1.1 This Standard covers the minimum mandatory requirements for the selection and application of protective coatings, internal and external, for new and existing onshore industrial facilities inside plants.

1.2 This Standard does not apply to building, infrastructures and community facilities, powder coatings, offshore facilities or decorative coatings unless specified in the scope of work or other mandatory Saudi Aramco document.

1.3 For projects reviews, all protective coating requirements, specifications and coatings map as per SAEP-303, shall be consolidated in index H.

1.4 This standard shall be attached to, and made part of, purchase orders when required.

2 Conflicts and Deviations

2.1 Any conflicts between this standard and other applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Consulting Services Department of Saudi Aramco, Dhahran.

2.2 Direct all requests to deviate from this standard in writing to the Company or Buyer Representative, who shall follow internal company procedure SAEP-302 and forward such requests to the Manager, Consulting Services Department of Saudi Aramco, Dhahran.

3 References

The selection of material and equipment, and the design, construction, maintenance, and repair of equipment and facilities covered by this standard shall comply with the latest edition of the references listed below, unless otherwise noted.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedures

SAEP-302	*Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement*
SAEP-316	*Performance Qualification of Coating Personnel*
SAEP-1200	*Process Flow Requirements for Qualification Procedures of Industrial Coating and Abrasive Blasting Products*

SAEP-303	*Engineering Reviews of Project Proposal and Detail Design Documentation*

Saudi Aramco Engineering Standards

SAES-B-067	*Safety Identification and Safety Colors*
SAES-H-002V	*Approved Saudi Aramco Data Sheets for the Pipeline and Piping Coatings.*
SAES-H-101V	*Approved Saudi Aramco Data Sheets - Paints and Coatings*
SAES-H-102	*Safety Requirements for Coating Applications*
SAES-L-133	*Corrosion Protection Requirements for Pipelines, Piping and Process Equipment*

Saudi Aramco Materials System Specifications

09-SAMSS-021	*Qualification Requirements for Alkyd Enamel Coating System (APCS-6)*
09-SAMSS-035	*Qualification Requirements for Aluminum-Pigmented Alkyd Coating System (APCS-4)"*
09-SAMSS-060	*Packaging Requirements for Coatings*
09-SAMSS-067	*Epoxy Coating for Immersion Service*
09-SAMSS-069	*Epoxy Coating for Atmospheric Service (with and without Polyurethane Topcoat)*
09-SAMSS-071	*Inorganic Zinc Primer (APCS - 17A and APCS - 17B)*
09-SAMSS-087	*Epoxy Coating for Application on Damp Steel Surfaces*
09-SAMSS-101	*Epoxy Mastic Coating (Self-Priming, with and without Polyurethane Topcoat)*
09-SAMSS-103	*Qualification Requirements for High Temperature External Coatings in Atmospheric Services (APCS-11A) and (APCS-11B)*
09-SAMSS-107	*Qualification Requirements and Application of Composite Fluoropolymer/Ceramic Coatings to Fasteners*
12-SAMSS-007	*Fabrication of Structural and Miscellaneous Steel*

Saudi Aramco Inspection Requirement

175-091900	*Coating: Shop Applied, for Tanks, Piping, Pipelines (and Associated Appurtenances & Fittings), Structures, Process Equipment, Internal & External; Onshore, Offshore and/or Subsea*

Saudi Aramco General Instruction

GI-0006.021	*Safety Requirements for Abrasive Blast Cleaning*

3.2 Industry Codes and Standards

American National Standards Institute

ANSI C57.12.30	*Requirements for Load-Tap-Changing Transformers 230 000 Volts and Below*

American Society for Testing and Materials

ASTM A123	*Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*
ASTM A385	*Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)*
ASTM D516	*Standard Test Method for Sulfate Ion in Water*
ASTM D6386 – 10	*Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting*
ASTM D 7127	*Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces Using a Portable Stylus Instrument*
ASTM E1575 – 12	*Standard Practice for Pressure Water Cleaning and Cutting*

National Association of Corrosion Engineers

NACE SP0198-2010	*Control of Corrosion under Thermal Insulation and Fireproofing Materials*
NACE SP0178-2007	*Design, Fabrication, and Surface Finish Practices or Tanks and Vessels to Be Lined for Immersion Service*

National Fire Protection Association

NFPA 70	*National Electric Code*

ISO Standards

ISO 12944	*Paints & Varnish-Corrosion Protection of Steel Structure by Protective Paint System*
ISO 8501	*Visual Assessment of Surface Cleanliness*
ISO 8502	*Tests for the assessment of surface cleanliness*
ISO 8503	*Surface Roughness Characteristics of Blast-Cleaned Steel Substrates*
ISO 8504	*Surface Preparation Methods*

SSPC- The Society for Protective Coatings

SSPC-Vis 1	*Guide to Vis 1 - 89 - Visual Standard for Abrasive Blast Cleaned Steel*
SSPC-PA 2	*Procedure for Determining Conformance to Dry Coating Thickness Requirements*
SSPC-SP1	*Solvent Cleaning*
SSPC-SP2	*Hand Tool Cleaning*
SSPC-SP3	*Power Tool Cleaning*
SSPC-SP5	*White Metal Blast Cleaning*
SSPC-SP6	*Commercial Blast Cleaning*
SSPC-SP7	*Brush-off Blast Cleaning*
SSPC-SP10	*Near White Blast Cleaning*
SSPC-SP12	*Water Jetting*
SSPC-SP16	*Brush-Off Blast Cleaning Of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals*
SSPC-PA 6	*Fiberglass-Reinforced Plastic (FRP) Linings Applied to Bottoms of Carbon Steel Aboveground Storage Tanks*
SSPC-WJ-1	*Waterjet Cleaning of Metals-Clean to Bare Substrate*
SSPC-WJ-2	*Waterjet Cleaning of Metals-Very Thorough Cleaning*
SSPC-AB 2	*Cleanliness of Recycled Ferrous Metallic Abrasive*

4 Definitions

Approved Product: A coating material that meets the requirements of the applicable APCS or SAMSS. Only approved products are allowed for use in Saudi Aramco. These requirements apply to all standards under the SAES-H-series.

Corrosive Industrial Atmosphere: high humid areas, downwind from sea shore or surrounded by Sea Islands, causeway, process area near water spray and fumes and polluted gases, equivalent to C5-I (80-200 microns metal loss/year) as per ISO 12944-2.

Maintenance Coating/Painting: Application of coating to preserve the useful state of an existing coating. Repairing is the most common method to maintain a coating. Complete replacement of an existing coating is not maintenance coating.

Mild Atmosphere: Areas not affected by either marine or industrial environments, but receive enough moisture in the air to cause corrosion if the carbon steel is not coated, equivalent to C3 (25-50 microns metal loss/year) as per ISO 12944-2.

New Construction Coating: Application of coating on a completely new and uncoated facility, equipment or machinery. New coating also applies to the coating application on completely bare substrate that was previously coated.

Thick Film Coating: Coatings with an average dry film thickness greater than 20 mils (500 microns).

Thin Film Coating: Coatings with an average dry film thickness of 20 mils (500 microns) or less.

Thixotropic Coating: A type of coating that thickens or gels in a relatively short time when at rest, but readily becomes more fluid when agitated or stirred.

Stripe Coat: A coat of paint applied only to edges or to welds on steel structures before or after a full coat is applied to the entire surface. The stripe coat is intended to give those areas sufficient film build to resist corrosion.

Sweep Blast Cleaning: A fast pass of fine nonmetallic abrasive blasting pattern at low pressure (< 275 kPa / 40 psi) over a surface to remove loose material and to roughen the surface sufficiently to successfully accept a coat of paint. This method of cleaning sometimes is specified as SSPC-SP 7, Brush-off Blast Cleaning.

Ultra-High Pressure Water Cleaning: Removal of surface contaminants (cleaning) by jetting with water at a pressure in excess of 25,000 psi (170 MPa).

Vessels: Where referred to in this standard, the term “vessels” includes, but is not necessarily limited to columns, traps, drums, heat exchangers, and boilers.

Wet-on-Wet Coating Application: Technique of coating application where additional coating passes are employed over a coating that is still wet, making the composite film dries as a whole. A wet coat applied over another wet coat is considered one coat of application.

5 Health, Safety and Environment

These are minimum safety requirements that are applicable to both shop and field coating (including surface preparation).

5.1 Fire and Explosion Prevention

5.1.1 Smoking and/or the use of open flames shall be permitted only in designated safe areas and never inside vessels. Welding and the use of heating coils are prohibited in areas where coating is in progress.

5.1.2 All electrical lighting, equipment, and connections shall conform to NFPA 70 National Electric Code, Class I, Division 1, Group D explosion proof requirements (NEC Article 500).

5.1.3 Solvents and coatings shall not be applied to surfaces warmer than 50°C if practical alternatives exist.

5.1.4 Work Permits for hot work, cold work, and confined space entry shall be obtained in accordance with GI-0002.100.

5.2 Ventilation

5.2.1 Mechanical (forced) ventilation shall be used in confined spaces whenever abrasive blasting, solvent cleaning, and/or coating application are in progress.

5.2.1.1 Forced ventilation shall continue until the coating is fully cured to immersion.

5.2.1.2 Natural ventilation (through opened manways, etc.) shall not be substituted for forced ventilation in confined spaces.

5.2.2 Ventilation shall ensure good air circulation with no dead air pockets in the confined space.

5.2.2.1 The fresh air inlet shall be located near the top of the confined space whenever practical.

5.2.2.2 The discharge opening shall be located near the bottom of the confined space.

5.2.2.3 Supplementary fans shall be used if necessary to ensure adequate air circulation in low spots or other dead spaces.

5.2.3 Ventilation requirements for various sizes of confined spaces are given in Table 5-1.

5.2.4 Respirable air-fed hoods shall be worn by all personnel inside confined spaces whenever:

5.2.4.1 Blast cleaning or spray coating is in progress.

5.2.4.2 Solvent cleaning or brush painting is in progress in a confined space having a volume of less than 16 m^3.

5.3 Health Hazards

5.3.1 If alkaline catalysts (such as used in many epoxy coatings) come in contact with the skin, they shall be immediately washed off with water to avoid chemical burns. Follow the coating manufacturer's materials safety data sheet and other safety documents for washing off action.

5.3.2 The appropriate personnel protection equipment listed in Table 5-2 shall be worn. In addition, safety belts and lines shall always be used by personnel working from unguarded platforms or in confined spaces where a manhole accessed by a ladder is the only exit.

5.3.3 Adequate washing facilities shall be readily available so that coatings and solvents splashed on the body or in the eyes can be immediately removed.

5.3.4 Safety shoes and coveralls shall always be worn, and safety hats shall be worn as required by proponent organizations.

5.3.5 Neither compressor air nor equipment cleaning solvents shall be used by personnel for personal cleaning or personal cooling.

5.3.6 Materials Safety Data Sheets for all coatings, solvents, and cleaners in use shall be readily available on-site in paint store and all work locations.

5.3.7 ASTM E1575 – 12 is the minimum safety requirement for pressure water jetting.

5.3.8 Any person required to operate or maintain pressure water-jetting equipment shall have been trained and have demonstrated the ability and knowledge to do so in accordance with the original equipment manufacturer’s instructions, specifications, and training programs.

5.4 Equipment Hazards

5.4.1 Power tools

5.4.1.1 Electrically driven power tools shall be properly grounded to prevent shock.

5.4.1.2 Power equipment shall be operated at the speeds recommended by the manufacturer and shall have proper safety guards.

5.4.1.3 Hearing protection shall always be worn whenever chipping guns or pneumatic hammers are in use.

5.4.1.4 Vessels such as air receivers that are used as a surge tank between the compressor and the blasting pot shall be manufactured and stamped in accordance with international Norms, Unfired Pressure Vessels. These shall be hydrotested at a pressure of at least 1.73 MPa (250 psig) at ambient temperature using clean water. These vessels shall be revalidated by hydrotesting at least annually and the test certificates shall be submitted to the Saudi Aramco Inspector for verification.

5.4.1.5 All pressure relief valves, gauges, and devices shall be tested annually and tagged with the expiration date. The test certificates shall be submitted to the Saudi Aramco Inspector for verification.

5.4.2 Abrasive Blasting (including automated equipment)

5.4.2.1 Blasting shall be equipped with a remote control shut-off of the "deadman" variety.

5.4.2.2 The blast nozzle shall be electrically connected to an external ground in order to prevent static electrical discharges or shocks to operating personnel. Grounding wire shall be AWG-4 or larger.

5.4.2.3 The blast cleaning hose shall be the static dissipating type with external couplings.

5.4.2.4 Respirable air-fed abrasive blasting hoods and OSHA-approved in-line respirable air filters shall be utilized at all times by abrasive blasting personnel.

5.4.2.5 Compressor hoses, air lines, and blast hoses shall be pinned at

each coupling.

5.4.2.6 Hearing protection shall be worn in confined spaces where abrasive blast cleaning is in progress.

5.4.3 Solvent Cleaning

Benzene, gasoline, carbon tetrachloride, and chlorinated hydrocarbons shall not be used.

5.4.4 Coating Preparation and Equipment Cleaning

5.4.4.1 Coatings shall be mixed in an open area or in an adequately ventilated area. Use eye protection (goggles), respirators, protective gloves and other safety equipment.

5.4.4.2 Electrically driven power mixers shall be grounded.

5.4.4.3 Avoid splash or spillage during mixing. Clean spilled paints immediately using proper cleaning solvent.

5.4.5 Airless Spray Coating Application

5.4.5.1 Airless spray guns shall never be pointed at anyone or at any part of the body.

5.4.5.2 The tip guard shall always be in place on the airless gun while spraying.

5.4.5.3 Leather gloves shall be worn by the operator whenever the airless spray gun is in use.

5.4.5.4 The trigger safety catch shall be engaged whenever the airless gun is left unattended.

5.4.5.5 Hoses, pumps, and accessories shall never be operated at pressures exceeding their rated pressure. In no case shall the working pressure in the coating line exceed 34.5 MPa (5000 psi). Safety pressure relief valves shall be used on discharge side of the pressure pump(s).

5.4.5.6 The pump shall be shut down and the fluid pressure in the system relieved before servicing or cleaning any components, including clogged spray tips.

5.4.5.7 Hoses shall be grounded and anti-static type.

5.4.5.8 Airless spray equipment shall not be operated unless all grounds (earths) are in place, connected, and in good condition. Grounding wire shall be AWG-4 or larger.

5.4.5.9 Airless spray equipment shall not be operated if any of the pressure system components is not in good condition.

5.4.5.10 Solvents shall not be flushed into containers that are hotter than 50°C.

Emergency medical care shall be obtained immediately if any high pressure fluid from the airless equipment penetrates the skin. (High pressure fluid injection injuries can be extremely serious, including the need for amputation).

Table 5-1 – Ventilation Requirements for Confined Spaces

Volume of Confined Area		Required Air Mover Capacity	
m^3	**BBL**	**L/s**	**cfm**
16	100	472	1000
80	500	1180	2500
160	1000	2360	5000
800	5000	4720	10000
1600	10000	7080	15000
4000	25000	9440	20000

Table 5-2 – Personal Protective Equipment to be Worn or Used during Surface Preparation & Coating Application

Key: O = Outdoors
C = Confined Spaces

Type of Work to be Performed	**OSHA-Approved Respirable Airfed Hood and Filter 1000129995(21-444-934) 1000129991(21-443-500)**		**Respirator; Chemical Cartridge 1000128213 (21-370-800)**		**Dust Respirator 1000128165 (21-370-500)**		**Face Shield (1) 10000129345 (21-426-121)**	
	O	C	O	C	O	C	O	C
Surface Preparation								
Wire Brushing, Chipping, Scrapping & Grinding					x	x	x	x
Blast Cleaning Operator Other workmen	x	x x			x		x	
Coating Removal				x			x	x
Solvent Cleaning				x			x	x

Coating Application	Brush		Spray		Brush		Spray		Brush		Spray		Brush		Spray	
	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C
Epoxy and Coal Tar Epoxy				x		x							x	x	X	
Alkyd						x	x									
Inorganic Zinc				x										X		
Chlorinated Rubber						x	x									
Bituminous						x	x									

Note: (1) Face shields shall always be used when working overhead.

Table 5-2 – Personal Protective Equipment to be Worn or Used during Surface Preparation & Coating Application (Cont'd)

Key: O = Outdoors
C = Confined Spaces

Type of Work to be Performed	Goggles Safety Impact 1000129810 (21-434-249)		Gloves; Leather 1000124493 (21-432-353)		Gloves; Rubber 1000129636 (21-432-630)		Hearing Protection 10000127803 (21-327-105) 10000127807 (21-327-272)	
	O	C	O	C	O	C	O	C
Surface Preparation								
Wire Brushing, Chipping, Scrapping & Grinding	X	x	x	x			x	X
Blast Cleaning Operator			x	x				x
Other workmen In Vicinity	x		x					x
Coating Removal				x	x			
Solvent Cleaning				x	x			

Coating Application	Brush		Spray		All
	O	C	O	C	
Epoxy and Coal Tar Epoxy					x
Alkyd			x	x	x
Inorganic Zinc			x	x	x
Chlorinated Rubber			x	x	x
Bituminous			x	x	x
Polyurethane			x	x	x

6 General Requirements

6.1 General

6.1.1 Blasting and coating shall not be performed if one or more of the following conditions exist unless the coating is specifically formulated for the averted condition (except in case novel technology applied):

a) The substrate temperature is less than 10°C or more than the temperature limit given in the applicable Saudi Aramco Data Sheet.

b) The substrate contains oil, grease, dirt, loose coating, loose rust, or other surface contaminants.

c) The substrate temperature is less than 3°C (5°F) above the dew point (see Table 1).

d) Adverse weather conditions exist such as, but not restricted to, the following:

1) Wind is strong enough to blow sand, salt spray, or other foreign matter onto the surface being coated.

2) Wind is strong enough to cause dry spray or to otherwise seriously disturb the spray pattern when application is by spray gun.

6.1.2 When required, solvent cleaning shall be carried out in accordance with SSPC-SP1. Do not use kerosene, diesel, or other degreasers that leave an oily film unless the surface is subsequently cleaned with a non-greasy solvent or cleaner such SAP m/n 1000186759 (s/n 26-854-642), m/n 1000022130 (s/n 45-605-875) and m/n 45-605-875/880 (s/n 1000022131).

6.1.3 For color coding and identification, refer to Loss Prevention Department standard SAES-B-067. All coatings' color requirements shall be referred to this LPD standard.

6.1.4 Any approved coating that is subjected to modifications and/or reformulations, or replacement including change of names or re-branding shall be requalified.

6.1.5 Coating selection shall be based on exposure, service, operating conditions involved with the object to be coated. End-users shall determine and provide all relevant information regarding these conditions whenever coatings or coating applications are required.

6.1.6 Operating conditions shall refer to type of service, maximum operating temperature, and maximum operating pressure as minimum. Other relevant information such as involvement of steam cleaning (steam out) shall also be provided. Operating parameters shall be preferred over design parameters during coating selection.

6.1.7 For service / operating / exposure /application conditions not covered by the SAES-H standards but are involved with the item/s to be coated, the approved coating manufacturer of the selected coating or coating system shall be requested to confirm in writing the suitability of their product/s to the concerned conditions. A formal letter shall be submitted to the

end-user regarding the suitability confirmation including a 5-year minimum coating performance warranty based on the involved conditions prior to the purchase and application of the coating or coating system. Relevant 3rd party laboratory tests report shall be provided together with the letter as proof of the confirmed suitability.

6.1.8 Tanks, vessels, equipment manufacturer's standard coating or finish shall only be acceptable if this meets the following two conditions:

a. The coating is suitable for the intended service, exposure, operating conditions of the equipment. Manufacturer shall provide test report/s to support suitability.

b. The coating can be maintenance coated with standard Saudi Aramco approved coatings. Manufacturer shall provide confirmation letter on this regard.

6.1.9 Airless spray shall be the acceptable method of application for all coatings under the APCS listed in this standard. Brush application shall only be used for touch-up repair. Other method of application shall only be acceptable if specified in SAES-H-101V. The use of rollers shall not be allowed.

6.2 Handling and Storage of Coating Materials

Coatings and thinners shall be stored in well-ventilated buildings at storage temperatures as recommended in the Manufacturer's data sheet

6.2.1 Coating materials used at construction sites must be covered with appropriate canvas, tarpaulins, or equivalent for a temporary storage period not to exceed 14 days.

6.2.2 Temperature sensitive and self polymerization coating materials must be stored in air conditioned storage area to maintain the temperature as recommended in the Manufacturer's data sheet.

6.2.3 Each coating container shall be clearly marked in accordance with 09-SAMSS-060.

6.2.4 Coatings shall not be used from a container showing a sign of leakage.

6.2.5 Coatings which have exceeded the shelf life given in the Saudi Aramco Data Sheet (SAES-H-101V) shall be set aside and must not be used unless written authorization to the contrary is given by the Consulting Services Department.

6.3 Abrasive Materials

6.3.1 The reference standards for surface preparation are ISO 8501, ISO 8502, ISO 8503, ISO 8504 and SSPC-SP surface preparation standards.

6.3.2 The type of abrasive to be used shall be determined by the degree of cleanliness and surface profile requirements as specified in the particular APCS. Silica Sand as abrasive material is prohibited in Saudi Aramco as per GI-0006.021 requirements.

6.3.3 Abrasive materials specification and qualification requirements shall be in accordance with ISO 11126 and ISO 11127 series.

6.3.4 Recycling systems of abrasives shall be permitted only in shops provided that the recycled abrasives shall have same quality and performance required by this standard.

6.3.5 For spot removal of existing coating for inspection purposes, use other non-silica sand abrasive such as garnet, grit and slag. The affected areas shall be re-blasted with suitable abrasive prior to re-coating.

6.4 Pre-blast Check

6.4.1 The coating inspector shall decide if the substrate requires solvent or detergent cleaning before abrasive blasting.

6.4.2 Welds, cut edges, and other areas with surface imperfections shall be prepared according to ISO 8501-3 prior to blasting. Rough welds and cut-offs shall be ground to a minimum radius of 3 mm to ensure proper coating application.

6.4.3 Abrasive blasting shall be carried out only when the steel surface is at least 3°C (5°F) above the Dew Point as determined from Table 1.

6.5 Equipment

6.5.1 Compressed air supply shall be free of oil, moisture and contamination. As a minimum, the inspector shall check and approve the air quality at the start and mid-point of each 8-hour period. This shall be determined as follows:

Attach a piece of blotter or absorbent paper to a clip board, then hold it approximately 45 – 60 cm in front of the blast nozzle during air flow only, with a nozzle pressure of 388 kPa (50 psig) for approximately one minute. Satisfactory results shall be no water or oil contamination on the blotter.

Commentary Note:

The blast system shall be operated for at least 5 minutes under actual field conditions at the specified pressures prior to making the blotter test. A properly sized dehumidifier can be connected downstream of the compressor during periods of high relative humidity to improve moisture removal from the air stream.

6.5.2 The Operational remote control valve ("Deadman") shall be securely attached to the nozzle. Minimum nozzle pressure acceptable for blasting steel shall be 620 kPa (90 psig) measured at the nozzle side.

6.5.3 High intensity floodlights or spotlights shall be installed in vessels, tanks, and other poorly illuminated locations for visibility.

6.5.4 Sufficient dust suction Blowers shall be fitted adequately to remove dust and fine blasting debris during the blasting operation.

6.5.5 All personnel entering tanks or vessels after abrasive blasting shall wear rubber-soled shoes with clean disposable covers, sweatbands and lint-free gloves.

6.6 Cleaning

6.6.1 Spent abrasive shall be removed from cleaned external surfaces by dry brushing and blowing down with clean, dry compressed air. Internal surfaces shall be dry brushed and vacuum cleaned.

6.6.2 Abrasive-cleaned surfaces shall be primed or coated before the surface condition degrades below the specified cleanliness level.

6.6.3 Abrasive blasted surfaces shall call for inspection prior to priming or coating if the surfaces are hold for more than 4 hours after blasting.

6.6.4 The reference standard for profile measurement shall be the Replica Tape Method according to ISO 8503-5. This does not preclude the use of other techniques provided that these give similar measurable profile values in microns. Surface comparators are not acceptable.

6.6.5 Ultra high pressure water jetting (cleaning) is acceptable for the surface preparation of previously blasted equipment in accordance with SSPC-SP WJ-1/ NACE WJ-1 and SSPC-SP WJ-2/ NACE WJ-2. Waterjetting cleaning does not create profile, it only exposes the pre-existing profile.

7 Coating Materials Selection

7.1 Exterior Surfaces, Atmospheric Exposure

Description	Coating System		Remarks
	New	Maintenance	
A. Mild Atmospheric Exposure (e.g. tanks, vessels, equipment, non-galvanized)	APCS-1A APCS-1B APCS-1E APCS-4 APCS-5A APCS-6 APCS-22A APCS-22B APCS-26 APCS-26T	APCS-1A APCS-1B APCS-1E APCS-4 APCS-5A APCS-6 APCS-22A APCS-22B APCS-26 APCS-26T	1. Use APCS-4 on steel operating up to 80°C when an aluminum finish is required such as GOSP Traps and Water Tanks. 2. Use APCS-6 on steel operating up to 70°C when a finish color other than aluminum is required. 3. Use APCS-1B on steel operating between the upper service temperature limits of APCS-4 and APCS-6 up to 120°C °C dry heat. 4. Use APCS-22A or APCS-22B on steel operating up to 120°C °C dry heat that is located outdoors and that will be coated in the field when surfaces will be damp during application. 5. APCS-1B on top wind girders, the top shell course above these girders, skirts, and the center deck of floating roofs. 6. Use APCS-1B on the inside surface of the top shell course in external floating roof tanks. 7. Coating is not required on the roof underside of both internal/external floating roof tanks. 8. When necessary, APCS-5A can be used on facilities storing or transporting hydrocarbons and other fluids.
B. Corrosive Industrial Atmospheric Exposure (e.g. tanks, vessels, equipment, non-galvanized)	APCS-1A APCS-1B APCS-1D APCS-1E APCS-22A APCS-22B	APCS-1B APCS-1C APCS-1E APCS-1F APCS-22A APCS-22B APCS-26 APCS-26T	1. Use APCS-1A on steel in wetted and/or corrosive industrial environments operating at temperatures up to 120°C and located indoors or outdoors. 2. Use APCS-1B on steel in direct contact with splashed and/or spilled chemicals (e.g., tanks and vessels in chemical services): a. Operating at temperatures up to 120°C °C and located indoors or outdoors. b. To maintain systems APCS-1A

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
			and APCS-1B. 3. Use APCS-1C for maintenance painting steel in wetted and/or corrosive industrial environments: a. Operating at temperatures up to 120°C and located indoors or outdoors. b. To maintain systems APCS-1A and APCS-1B. 4. Use APCS-1D on steel in wetted and/or corrosive industrial environments operating up to 80°C and located outdoors. 5. Use APCS-1E on steel in direct contact with splashed and spilled chemicals (e.g., tanks and vessels in chemical services): a. Operating up to 80°C and located outdoors. b. To maintain systems APCS-1D and APCS-1E. 6. Use APCS-1F for maintenance painting steel in wetted and/or corrosive industrial environments: a. Operating at temperatures up to 80°C and located indoors or outdoors. b. To maintain systems APCS-1D and APCS-1E. 7. Use APCS-22A or APCS-22B on steel operating up to 120°C that is located outdoors and that will be coated in the field when surfaces will be damp during application. 8. APCS-26 can be used on steel operating up to 120°C to maintain systems APCS-1A, APCS-1B and APCS-1C when abrasive blasting is not required. 9. APCS-26T can be used on steel operating up to 80°C to maintain systems APCS-1D, APCS-1E, and APCS-1F when abrasive blasting is not required. It can also be used as a New coating system onshore (but not

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
			offshore). 10. Use APCS-1B on the inside surface of the top shell course in floating roof tanks if corrosion protection is needed. 11. Coating is not required on the roof underside of both internal/external floating roof tanks.
C. Insulated Surface **(**e.g. tanks, vessels, heat exchanger, equipment, valves and piping)	APCS-2A APCS-2C APCS-11C APCS-17A APCS-17B TSA	APCS-2A APCS-2C APCS-11C APCS-17A APCS-17B	1 Corrosion under Insulation (CUI) requirements are as per SAES-L-133. The recommended coating selection is as follow: a. Use APCS-2A for temperatures below 90°C. b. Use APCS-2C for temperatures up to 175°C. c. Use APCS-17A/B for temperature range of 175°C to 400°C. d. APCS-17A/B shall never be used where operating temperature can drop below 175°C e. Use APCS-11C for temperature range of 400°C to 650°C or where APCS17A/B cannot be used. f. Thermal Spray Aluminum (TSA) coating can be used for temperatures up to 600°C. the application requirement is as per SAES-H-005. 2 Coating is mandatory under Insulated Stainless steel as per paragraph 7.2.5 SAES-L-133. The recommended coating systems are: a. Use APCS-2A for temperatures between 50°C and 90°C. b. Use APCS-2C for temperatures between 90°C and 175°C. c. Use APCS-11C for temperature range of 175°C to 650°C. Do not exceed the maximum service temperature limitation of the selected approved coating under APCS-11C 3 Handling precautions and impact/abrasion protection shall be

Description	Coating System		Remarks
	New	Maintenance	
			taken during transportation and construction of coated equipment or piping. It is recommended to apply this coating type in the field site. 4 The cured coating of stainless steel surface shall not contain low melting metals or zinc and any leachable chlorides and halides. 5 Use APCS-2A on carbon steel or stainless steel operating at cold/cryogenic temperature below -10°C.
D. Elevated Temperature (Uninsulated) **(**e.g. Tanks, vessels, equipment, boilers, stacks, heaters, heat exchangers, reactors and stack)	APCS-11A APCS-11B APCS-11C APCS-5B	APCS-11A APCS-11B APCS-11C APCS-5B	1. Use APCS-11A on steel operating between 150°C and 400°C: a. Use the solvent based primer when the relative humidity will be above 50% during coating application. b. Use the water based primer when the relative humidity will be below 50% during coating application. 2. Use APCS-11B on steel operating between 400°C and 540°C. 3. APCS-11C can be used up to 650°C which require less cleaning and surface preparation than APCS-11A. 4. Temperature indicating paint could be used as topcoat over conventional APCS coatings on hydrogen reactors, refractory lined heaters, and stacks. 4. Temperature Indicating Paint (TIP) could be used as topcoat over conventional APCS coatings on hydrogen reactors, refractory lined heaters, and stacks. There are no available APCS or coating's SAMSS for TIPs. Therefore, manufacturer should submit a confirmation letter for the suitability of their product to proponent. 5. Use APCS-5B as a top coat only for personal protection up to 120°C.
E. Coating under	APCS-1B	APCS-1B	1. Use APCS-1B primer only prior to

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
Fireproofing			the installation of intumescent fireproofing material on bare Carbone steel. 2. Use the complete system of APCS-1B before the installation of cementitious fireproofing on bare carbon steel. 3. The intermediate and top coats of APCS-1B system are used over both fireproofing systems. 4. Selection of fireproofing materials shall be as per Loss Prevention Department's approval. 5. Sweep blast galvanized steel to abrade the surface prior to the application of APCS-1B primer.
F. Auxiliary Equipment i. Engineered Equipment (i.e., Cranes, Launchers, Receivers, skid mounted items, etc.) ii. "Off-the-Shelf" Equipment (i.e., Valves, Pumps, Actuators iii. Electrical Motors	See Remarks	See Remarks	1. "Engineered Equipment" are items specifically designed and fabricated for Saudi Aramco and shall be coated with Saudi Aramco approved systems or products meeting the requirements of ISO 12944. 2. Manufacturer's standard coating system can be accepted. It is the responsibility of the main contractor and designated coating inspector to review the selected coating system and ensure it is in compliance with para. 6.1.8. 3. No additional coating is required when the manufacturer's standard finish meets the following two conditions: a. The coating is suitable for the intended service/exposure operating conditions. b. The coating can be maintenance coated with standard Saudi Aramco approved coatings.
iii. Transformer Radiators			1. To be coated as per the guidelines of NACE RP-0297-2004.
G. Fasteners; Carbon Steel and Low Alloy	See Remarks	See Remarks	1. Bolting material installed in aggressive external environment such as underground piping shall be protected using Ceramic-fluoropolymer coating per 09-SAMSS-

Description	Coating System		Remarks
	New	Maintenance	
			107. 2. Galvanizing is acceptable for onshore equipment and areas that will not be subjected to water.
H. Galvanized Steel	APCS-1B APCS-1E APCS-12 APCS-22A APCS-22B APCS-26 APCS-26T	APCS-1B APCS-1C APCS-1E APCS-12 APCS-22A APCS-22B APCS-26 APCS-26T	1. Materials to be galvanized are specified in 12-SAMSS-007. 2. Coating of galvanized steel is not required for mild environment. 3. Coating is recommended at corrosive and humid areas to increase chemical and corrosion resistance. 4. Prior to the application of coating on galvanized surface, remove any hydrocarbon contamination with solvent as per SSPC-SP1. In addition, the surface shall be roughened with sweep blasting. Painting should begin as soon as possible after cleaning and profiling. 5. Use APCS-26 on galvanized steel operating up to 120°C and located indoors or outdoors. 6. Use APCS-26T on galvanized steel operating up to 80°C; located outdoors. 7. Use APCS-22A or APCS-22B on galvanized steel operating up to 120°C that is located outdoors and that will be coated in the field when surfaces will be damp during application. 6. Use APCS-1C primer only to touch-up and repair galvanizing that will not be coated with another system. 7. Refer to paragraph 7.1.E for galvanized steel requiring fireproofing materials. 8. Use APCS-12 only for galvanized steel floors and decks that require non-slip properties. APCS-12 is not acceptable, however, for galvanized steel grating-type floors or decks.
I. Stainless Steel	APCS-1B APCS-11C	APCS-1B APCS-11C	1. Normally, coating is not required. If coating is needed in industrial areas with high humidity and aggressive

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
			atmospheres conditions, the following coating systems are recommended: a. For temperatures up to 120°C, APCS-1B shall be used. b. For temperatures above 120°C, APCS-11C shall be used.
J. Aluminum	APCS-26 APCS-26T APCS-22A APCS-22B	APCS-26 APCS-26T APCS-22A APCS-22B	1. Not normally coated for dry environment, but it requires coating for reasons of appearance or increasing chemical and corrosion resistance at humid areas. 2. Lightly abrade the aluminum surface using sweep blasting prior to coating application. 3. Use APCS-26 on aluminum operating up to 120°C and located indoors or outdoors. 4. Use APCS-26T on aluminum operating up to 80°C; located outdoors. 5. Use APCS-22A or APCS-22B on aluminum located outdoors and operating up to 120°C and that will be coated in the field when surfaces will be damp during application.
K. Steel Structures and Accessories	See Remarks	See Remarks	1. Hot dip galvanizing is required as per 12-SAMSS-007. 2. If coating is needed, selection should be in accordance with paragraphs 7.1.A or 7.1.B as appropriate. 2. See paragraph 7.1.H when coating galvanized items.
L. Steel Floors (except Grating)	APCS-12	APCS-12	1. Applied over carbon steel and galvanized steel floors and decks except grating.
M. Steel Grating	See Remarks	See Remarks	1. Shall be hot dip galvanized in accordance with ASTM A123 and ASTM A385. Liquid applied coatings shall not be used in lieu of

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
			galvanizing. 2. See paragraph 7.1.H for galvanizing repair.
N. Electrical Conduit	See Remarks	See Remarks	1. Coating as specified in SAES-P-104.

7.2 Exterior Surfaces, Buried

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
A. Structural Steel	APCS-3 APCS-113A	APCS-3 APCS-113A	1. Use APCS-113A for structural steel with extension above ground portion instead of APCS-3.
B. Driven Piling and Sheet	APCS-104A APCS-113A	APCS-3 APCS-113A	1. Coat below-ground portion of driven piles to a depth at least 1 m below grade. Uncoated pile section shall be back-excavated and coated after driving. 2. Use either dual FBE powder coatings (FBE corrosion resistance + FBE abrasion resistance) or use APCS-104A and top-coat with liquid coating of APCS-113A.
C. Tank bottoms (soil side/external)	APCS-3 APCS-113A	See Remarks	1. For welding purposes, leave a minimum 2.5 cm wide strip of uncoated steel along the underside of the replacement floor plates centered on, and directly below, the weld seam. 2. Use APCS-3 for temperatures up to 70°C and APCS-113A for temperatures up to 120°C.

7.3 Interior Coatings for Plant Equipment

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
A. Interior of Hydrocarbon Storage Tanks & Dark Products such as crude oil and heavy refined products	APCS-2A APCS-2E APCS-2H APCS-3	APCS-2A APCS-2E APCS-2H APCS-3 APCS-20A APCS-20B	1. Select the appropriate coating depending on type of service, and maximum operating temperature and pressure. 2. APCS-20A or APCS-20B are used for renovation of badly corroded tanks. 3. Coat all areas in contact with standing water, including all internals except anodes and heating coils. Normally, these are: a. Cylindrical tanks- bottom and first 0.6 m up wall (1 m for APCS-20A/B). b. Spheroids- up to the lower deck of manway. 4. Use APCS-1B on the inside surface of the top shell course in external floating roof tanks. 5. The vapor space areas of internal floating roof tanks shall be coated with full system of either APCS-2A, APCS-2E or APCS-2H. 6. Internal floating roof made of aluminum or stainless steel shall not be coated.
B. Interior of Hydrocarbon Storage Tanks; Light Products except jet fuel	APCS-2A APCS-2E APCS-2H	APCS-2A APCS-2E APCS-2H APCS-20A APCS-20B	1. Select the appropriate coating depending on type of service, and maximum operating temperature and pressure. 2. APCS-20A or APCS-20B are used for renovation of badly corroded tanks. 3. Coat all areas in contact with standing water, including all internals except anodes and heating coils. Normally, these are: a. Cylindrical tanks- bottom and first 0.6 m up wall (1 m for APCS-20). b. Spheroids- up to the lower deck of manway. 4. The vapor space areas of internal floating roof tanks shall be coated

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
			with full system of either APCS-2A, APCS-2E or APCS-2H. The sides of the pontoon of the internal floating roof will be coated.
C. Interior of Water Tanks: Raw Water for Industrial Use	APCS-2A APCS-2E APCS-2G APCS-2H	APCS-2A APCS-20A APCS-20B APCS-2E APCS-2G	1. Select the appropriate coating depending on service and temperature. 2. APCS-20A or APCS-20B are used for renovation of badly corroded tanks. 3. Coat entire interior including all internals except anodes.
D. Interior of Water Tanks: Potable and Domestic Water	APCS-2B	APCS-2B	1. Use APCS-2B on tanks operating up to 90 °C. 2. Coat entire interior including all internals except anodes.
E. Interior of Aviation Fuel and Kerosene Storage Tanks	APCS-2D	APCS-2D	1. For bulk plant and/or air-port terminals, the whole tank must be 100% coated with APCS-2D. 2. Refinery Tanks is not mandatory to coat the whole tank. Only the internal bottom and 0.6 m of shell.
F. Chemical Tanks			1. Minimum and maximum operating temperature and pressure involved with the tank shall be determined by end-user or proponent including the name of the chemical, % composition, pH, and concentration. The approved coating manufacturers shall be requested to provide their recommended APCS for this tank in writing including a formal letter confirming the suitability of their APCS plus 5-year coating performance warranty to the service conditions involved with the concerned tank. Suitability confirmation shall be supported with lab. tests report from their R&D or from reputable 3rd party lab.
G. Interior of Hot Water Tanks; Demineralized	APCS-2C APCS-2H	APCS-2C APCS-2H	1. Select the appropriate coating depending on type of service, and maximum operating temperature and

Description	Coating System		Remarks
	New	Maintenance	
Water, Boiler Skim Water Tanks, Boiler Blow Down, etc.			pressure involved. 2. Coat entire interior including all internals except anodes.
H. Interior of Gas/Oil/Water Separators, Desalters, and Dehydrators, Gas Slug Catchers	APCS-2A APCS-2C APCS-2E APCS-2H	APCS-2A APCS-2C APCS-2E APCS-2H	1. For GOSP traps, degassers, and WOSEP's in wet sour service, coat entire interior surface including all internals except anodes and heating coils. 2. For wet sweet service, coat 0.3 m above maximum expected water level. 3. For desalters and dehydrators, coat the bottom 60% including all internals except anodes up to this level. Coat the last 25-50 mm of the tips of the grid, if needed. 4. APCS-2H and APCS-2E are solvent free, fast cure coating and can be applied in a single coat. 5. 5. APCS-2E or APCS-2H are recommended for slug catchers.
I. Heat Exchanger **i. internal Tubes** **ii. Tube Covers** **iii. Tube Sheets**	 APCS-100 APCS-2H APCS-2E APCS-2G APCS-27 APCS-28 APCS-2H APCS-2G APCS-27	 APCS-2E APCS-2H APCS-2G APCS-27 APCS-28	1- Use products under APCS-100 that are suitable for the intended service. 2- Use thick film coating, APCS-2E, APCS-2H, APCS-2G or APCS-27 on tube sheet.
J. Interior of Launchers and Receivers, in crude and water service	APCS-2E APCS-28	APCS-2E APCS-28	1. Coat the entire interior of launchers and receivers up to the main block valve.
K. Amine service in Gas Treating Plants	APCS-2H APCS-27	APCS-2H APCS-27	1. Recommended on the contactor bottom, absorber bottom, heat exchanger tube sheet and cover,

Description	Coating System		Remarks
	New	Maintenance	
			reflux drum, piping and valves.
L. Air Conditioning Unit (condenser fins and tubing)	1. Heat cured dipping with epoxy-phenolic 2. Electo-Deposition Coating		1. The coating thickness should be thin enough so that it will have minimal effect on heat transfer efficiency.

7.4 Coating Compatibility

7.4.1 Purpose

The Overcoating Chart shows which combinations of existing coat/top coat coating systems may and may not be used for maintenance painting on Saudi Aramco facilities. Combinations marked "N" shall not be used. For combinations marked "Y(3)" see Note 3.

7.4.2 Overcoating Chart

		Epoxy	Coal Tar Epoxy	Epoxy Mastic	Epoxy Enamel	Zinc Silicate	Alkyd
E	Epoxy (2)	Y	Y	Y	Y	N	Y(3)
X	Coal Tar Epoxy (2)	Y	Y	Y(3)	Y	N	Y(3)
I	Epoxy Mastic (2)	Y(3)	Y	Y	Y	N	Y(3)
S	Epoxy Enamel (2)	Y(3)	Y(3)	Y	Y	N	Y(3)
T	Zinc Silicate	Y	Y	Y	Y	Y(3)	N
I	Alkyd	N	N	Y	N	N	Y
N	Silicone Alkyd	N	N	N	N	N	N
G	Polyurethane Enamel	Y(3)	Y(3)	N	N	N	Y(1)
	Bituminous	N	N	N	N	N	Y(3)
C	Chlorinated Rubber	N	N	N	N	N	Y
O	Latex Emulsion	Y(3)	Y(3)	N	N	N	Y
A	Lacquer	N	N	N	N	N	Y(3)
T	Vinyl Ester						
I	Polyester						
N	Phenolic Epoxy						
G	**Y = Yes**		**N = No**		**Y(3) = See Note 3**		

EXISTING COATING		Silicone Alkyd	Poly-Urethane Enamel	Bitumi-nous	Chlori-nated Rubber
	Epoxy (2)	N	Y	Y(3)	Y(1)
	Coal Tar Epoxy (2)	N	Y(3)	Y(3)	Y(1)
	Epoxy Mastic (2)	N	Y	Y(3)	N
	Epoxy Enamel (2)	N	Y	N	N
	Zinc Silicate	Y	Y	N	Y
	Alkyd	N	N	Y	N
	Silicone Alkyd	Y	N	N	N
	Polyurethane Enamel	N	Y	N	N
	Bituminous	N	N	Y	N
	Chlorinated Rubber	N	N	N	Y
	Y = Yes	**N = No**			

Notes:

(1) Gloss must be removed from existing coat by sanding or similar prior to applying topcoat.

(2) Intercoat intervals must be observed.

(3) Technically acceptable, but not normal practice. Special surface preparation requirements may apply. Selected coating manufacturer shall confirm in writing to the end-user or proponent the suitability of the concerned combination and provide 5-year coating performance warranty based on the concerned combination.

(4) Coating manufacturer must be contacted for compatibility confirmation whenever their coating will be applied over an existing coating from another manufacturer."

8 Surface Preparation

8.1 General

8.1.1 The type of abrasive to be used shall be determined by the degree of cleanliness and surface profile requirements.

8.1.2 The reference standards for surface preparation are ISO 8501, ISO 8502, ISO 8503, ISO 8504 and SSPC-SP “Surface Preparation standards”.

8.1.3 Compressed air supply equipment, hoses and fittings shall be free of oil, moisture and contamination. The inspector shall check and approve the air quality at the start and mid-point of each 8-hour period. This shall be conducted and determined as follows:

Attach a piece of blotter paper to a clip board, then hold it approximately 45 – 60 cm in front of the blast nozzle during air flow only, with a nozzle pressure of 388 kPa (50 psig) for approximately one minute.
The satisfactory results shall be no water or oil contamination on the

blotter paper, and therefore operation is allowed to start or continue. In case of unsatisfactory results, i.e., contaminants are evident the equipment deficiencies shall be corrected and air stream shall be tested.

The blast system shall be operated for at least 5 minutes under actual field conditions at the specified pressures prior to making the blotter test. A properly sized dehumidifier can be connected downstream of the compressor during periods of high relative humidity to improve moisture removal from the air stream.

8.1.4 The operational remote control valve (Dead-man) shall be securely attached to the nozzle. Minimum nozzle pressure acceptable for blasting steel shall be 620 kPa (90 psig) measured at the nozzle side.

8.1.5 High intensity floodlight or spotlights shall be installed in tanks and vessels for inspection purposes.

8.1.6 Sufficient dust suction blowers (exhaust fans) shall be fitted adequately to remove dust and fine blasting debris during the blasting operation.

8.1.7 Temperature Indicating Paint (TIP) can be used as a topcoat over reactor, refractory lined heaters and stack.

8.2 Abrasive Materials

8.2.1 Abrasive shall be kept dry and clean. Regardless of the type of abrasive, the sulfate content shall be less than 50 PPM, the chloride content shall be less than 50 PPM, and calcium carbonate shall be 1.0% by weight.

8.2.2 The use of reclaimed slag abrasives is prohibited. The use of reclaimed garnet is permitted for pre-blasting work provided it meets the requirements of ISO 11126-7 and ASTM D7393 for oil contamination.

8.2.3 For spot removal of existing coating for inspection purposes, use other non-silica abrasive such as garnet, grit and slag. The affected areas shall be re-blasted with suitable abrasive prior to re-coating.

8.2.4 Abrasive blasting of stainless steel can be accomplished by using clean, fine, hard non-metallic abrasive particles. The abrasive medium must be iron-free to avoid contamination, which can result in rust staining on the surface prior to coating and the compressed air carrying the abrasive medium must be free of compressor oil. Stainless steel surfaces should be prepared to give a surface roughness specified in the product data sheet.

8.3 Requirements before abrasive blasting

8.3.1 The substrate shall not contain oil, grease or lubricant

8.3.2 Prior to blasting, rough welds and sharp edges shall be ground to a minimum radius not less than 3 mm to ensure proper coating application in accordance with ISO 8501-3 and NACE SP0178.

8.3.3 After blasting, test the substrate for the chloride content. Residual chloride shall not exceed 40 mg/m² for external coatings and 20 mg/m² for internal coatings. Wash down the surface with sweet water to remove chloride contamination. Chloride test shall follow the water wash down until the correct value is achieved in accordance with ISO 8502-6.

8.3.4 Cover all coated areas near to the defective area before commence repair or patching up. Use heavy duty textile or fabric adhesive tape.

8.4 Clean the substrate after abrasive blasting

8.4.1 Spent abrasive shall be removed from the cleaned surfaces by dry brushing and/or blowing down or vacuum cleaning with clean, dry compressed air. Internal surfaces shall be dry brushed and vacuum cleaned. After cleaned surface, residual dust level shall be checked and dust rating shall be level 2 or better in accordance with ISO 8502-3.

8.4.2 Cleaned surfaces shall be primed or coated before the surface condition degrades below the specified cleanliness level requirement.

8.4.3 Abrasive blast cleaned surfaces shall be re-inspected prior to priming or coating if the surfaces are held for more than 4 hours after blasting. Correction shall be done and retested before coating application.

9 Coating Application

9.1 Coating System Selection

9.1.1 Coating system selection shall be based on service/exposure operating conditions involved with the item/s to be coated.

9.1.2 The type of service, and maximum operating temperature and pressure involved shall be determined before selecting internal coating systems. If chemicals are involved, the name of the chemical/s and % composition/concentration shall also be determined prior to selection.

9.1.3 For external coatings, the type of service environment and maximum exposure temperature shall be determined prior to coating system selection.

9.1.4 For projects, the service/exposure operating conditions involved in each equipment and facility that requires coating shall be established/defined during the design stage for proper coating system selection.

9.2 Coating Preparation

9.2.1 Coatings, which have gelled, shall not be used.

9.2.2 Coating skins shall be cut and removed before application on recently opened and partially used containers. If any skinning is found on previously unopened coating, the cans should be set aside and not used.

Prior to application, all coating shall be thoroughly mixed until it is homogeneous. For quantities over 5L, a power stirrer shall be used.

Exception:

For thick catalyzed coatings with filler, splash zone compounds and all thixotropic coatings, a power mixer shall be used regardless of the quantity.

If sludge has formed in the bottom of the coating container, stirring to mix shall be continued until the coating is fully homogeneous mix. If sludge cannot be dispersed, the coating shall not be used.

9.2.3 If thinning is required, the thinner type and quantity to be added shall be as given in the Saudi Aramco Data Sheet (SAES-H-101V). Two-pack coatings and all coatings in quantities over 5L shall be mixed with a power stirrer/mixer during adding the thinner. Thinner shall be added only when the coating is homogeneously mixed.

9.2.4 All coating materials for each coating system shall be supplied by the same Manufacturer unless otherwise approved by Consulting Services Department. The Manufacturer shall also either supply the thinner or approve the thinner being used with his products.

9.2.5 Partial mixing in two-component and multi-component coatings is prohibited.

9.2.6 Paints that contain metallic zinc should not be used on stainless steel as embrittlement of the stainless steel substrate can occur in the event of severe fire damage.

9.3 Coating Application

9.3.1 In multi-coat applications, primer, intermediate coat, and topcoats shall be of contrasting colors and from the same coating manufacturer.

9.3.2 All weld lines, edges, bolts, nuts and rivets shall be given a brush applied stripe coat prior to all coating applications. Special attention shall be given to structures and equipment in offshore and immersion services. When inorganic zinc is used stripe coating should be applied after the first coating.

9.3.3 When using inorganic zinc primer, the contractor shall check for surface zinc oxide formation immediately prior to applying an epoxy topcoat. This shall be determined by examining the surface for the presence of visible insoluble white deposits, overall white appearance and/or white staining. Any oxide formation shall be removed by high pressure cleaning using sweet water (with maximum chloride contents of 50 PPM and maximum TDS of 500 PPM), or by sweet water hosing followed by scrubbing with stiff brushes to remove zinc salts. The surface shall be allowed to dry thoroughly prior to applying the topcoat. To avoid pinholes and bubbles occurring in the intermediate coat of epoxy, a mist-coat thinned 10 to 20% should first be applied to the inorganic zinc primer.

9.3.4 Recoating intervals shall be as given in the Saudi Aramco Data Sheet. (See SAES-H-101V). In stringent application conditions, the latest Materials Technical Data Sheet of the manufacturer shall be used as a supporting document to the Saudi Aramco Data Sheet given in SAES-H-101V.

9.3.5 The finished coating film shall have the following characteristics:

a) The dry film thickness shall be within the minimum and maximum limits allowed in the applicable APCS. Dry film thickness shall be checked in accordance with SSPC-PA 2.

b) Generally free of application related defects such as runs, sags, drips, dry spray or foreign matter

c) Uniform in appearance.

Commentary Note:

Heavy dry spray during application of inorganic zinc primer is prohibited.

d) Adhesion strength of all coating systems shall not be less than that required in the appropriate Saudi Aramco Materials System Specification for new product approval.

e) Areas with blisters, cracks, porous or below minimum dry film thickness shall be repaired in accordance with paragraph 9.6.

Commentary Note:

Inorganic zinc applied below minimum dry film thickness shall be brought up to the minimum thickness using zinc rich epoxy.

9.3.6 In case of brush application, the maximum brush size used shall be 125 mm.

9.3.7 Coatings to be sprayed shall be filtered through a 30 to 60-mesh screen prior to use and shall be continuously agitated with a low-speed stirrer during application.

9.4 Thin film Coatings (up to 500 microns nominal DFT) for Immersion Service (Coatings for Tanks and Vessels including Vapor Zones)

9.4.1 Coatings for immersion service (including vapor zones) shall be applied by airless spray equipment.

Exception:

See paragraph 9.3.3 for stripe coats.

9.4.2 Vessels or tanks with large area to blast and coat in one day shall be completed with minimum coating overlaps.

9.4.3 During coating application of the interior of tanks or vessels, forced ventilation shall operate continuously. The tank or vessel shall not be closed, nor forced ventilation stopped, until the cure times to immersion specified in the Approved Saudi Aramco Data Sheet (refer to SAES-H-101V) have been reached.

9.4.4 A 360° spray gun nozzle with proper tip size shall be used to coat the interior of nozzles and traps inside tanks and vessels.

9.4.5 All coated tanks, vessels, and other structures in immersion services shall be holiday checked using a wet sponge at 67.5 volts if coating thickness does not exceed 500 micron. A small amount of a wetting agent shall be added to the water to aid in finding holidays. Dry spark tester shall be used for holiday detection if the coating dry film thickness exceeds

500 microns. Holidays shall be repaired in accordance with paragraph 9.6.

9.4.6 Coating thickness within 2 m of anode connections shall be at least 30% greater than the specified minimum dry film thickness.

Exception:

Not applicable for APCS-19 and APCS-20 series.

9.5 Thick film Coatings (greater than 500 microns DFT) for Immersion Services

9.5.1 Mixing the catalyst with coating shall be carried out according to Saudi Aramco approved data sheets (SAES-H-101V) using power operated slow stirrer to prevent air ingress to the mixed coating material. Partial mixing catalyst with coating is prohibited. For small areas, coating manufacturers shall supply smaller quantity containers with their measured catalyst for one time mixing.

9.5.2 All edges, cavities, internal piping, bolts and nuts, nozzles, and any inaccessible areas shall be stripe coated before the spray coating application.

9.5.3 Coating shall be applied in a single coat "Wet-On-Wet" method to achieve the required film thickness. Only airless spraying equipment with high pump ratios (45:1 or higher) shall be used.

9.5.4 Allow forced ventilation during the curing time of these coatings.

9.5.5 High voltage dry spark holiday detector shall be used to locate pinholes and coating film discontinuities after the full coating system is fully cured.

9.6 Repair Procedure

Repair procedure of coatings shall be issued in accordance with the surface preparation and application requirements stated in the applicable APCS, SAES-H-101V, and SAES-H-002V.

9.6.1 Cover areas adjacent to defects with heavy duty textile or fabric adhesive tape before commencing repair or patch up.

9.6.2 Clean defective area by solvent or detergent wash.

9.6.3 For areas less than 0.1 m^2, grind to a rough metal surface using at least an 80 grit disc sander. Alternatively spot blast or power tool cleaning to bare steel. Feather edge of coating at least 25 mm beyond bare metal.

9.6.4 For areas greater than 0.1 m², blast clean to obtain the metal surface pre-treatment originally specified. Feather edge the coating at least 50 mm beyond bare metal.

9.6.5 Remove dust and debris by brush or vacuum.

9.6.6 Apply coating by brush for areas less than 0.1 m² and by spray for areas greater than 0.1 m² to the original specification except that the first coat of a multi-coat system shall be thinned.

9.6.7 The full coat of the repair internal/immersed coatings shall be holiday tested when cured.

10 Inspection and Testing

Requirements in this section refer only to coating in the following categories:

a) New construction

b) Major renovation

c) Internal coatings for immersion service

The requirements of SAEP-316 apply to these categories when the coating is performed in Saudi Arabia.

10.1 Quality Control Equipment

The coating contractor shall have the quality control equipment listed in (Attachment A) on site for the inspection of surface preparation and coatings application. The Quality Control Daily Checklist included in Attachment A shall be used.

10.2 Quality Control Records

10.2.1 Quality Control Equipment Check Sheet (Attachment B)

This form shall be completed prior to job start-up. It shall be completed and signed by the coating contractor supervisor and then signed by the Saudi Aramco Inspector. No work is allowed until this form is completed.

10.2.2 Daily Job Log

The coating contractor supervisor shall fill out a log, on a daily basis, recording all problem areas, delays, non-compliances, and corrective actions taken for Saudi Armco inspector witnessing and surveillance.

10.2.3 In-process Inspection Sheet (Attachment C)

This form shall be completed and signed every work-day by the contractor supervisor. The Saudi Aramco inspector shall initial each item marked with an asterisk before work is allowed to begin on subsequent items.

10.2.4 Coatings and Equipment Log (Attachment D)

This form shall be completed and signed by the coating contractor supervisor and verified and signed by the Saudi Aramco inspector.

10.2.5 Final Acceptance Report

The final acceptance report shall include the 4 quality control documents described above.

10.2.6 Non Conformance Report

The non-conformance report shall be issued whenever any defect is resulted by coating materials deficiencies or/ and application malfunctioning. Remedial action and method of repair shall be defined and agreed. The Saudi Aramco inspector shall ensure that report copies have been routinely circulated and remedial actions have been implemented correctly.

10.3 Additional Inspection Requirements Applicable to Purchase Orders

Saudi Aramco Form 175-091900 applies whenever this Standard is referenced in a Purchase Order

11 Approved Protective Coating Systems

11.1 Index

APCS - 1A *Epoxy Coating System for Atmospheric Service (with Inorganic Zinc Primer)*

APCS - 1B *Epoxy Coating System for Atmospheric Service (with Epoxy Primer)*

APCS - 1C *Epoxy Coating System for Atmospheric Service (with Zinc-Rich Epoxy Primer)*

APCS - 1D *Epoxy/Polyurethane Coating System for Atmospheric Service (with Inorganic Zinc Primer)*

APCS - 1E *Epoxy/Polyurethane Coating System for Atmospheric Service (with Epoxy Primer)*

APCS - 1F	*Epoxy/Polyurethane Coating System for Atmospheric Service (with Zinc-Rich Epoxy Primer)*
APCS - 2A	*Epoxy Coating System for General Immersion Service (Self-Priming)*
APCS - 2B	*Epoxy Coating System for Potable Water Immersion Service (Self-Priming)*
APCS - 2C	*Epoxy Coating System for Immersion Service, at Temperatures up to 120°C*
APCS - 2D	*Epoxy Coating System for Interior of Steel Aviation Fuel Storage Tanks and Piping*
APCS - 2E	*Solvent Free Epoxy Coating for Immersion Service at Temperature up to 93°C*
APCS - 2G	*Glass Flake Reinforced Vinyl Ester Coating for Immersion Service at Temperature up to 90°C*
APCS - 2H	*100% Solid, Glass Flake Epoxy Coating for Immersion Service up to 105°C*
APCS - 3	*Coal Tar Epoxy Coating System for Immersion & Buried for Steel and Concrete*
APCS - 4	*Aluminum-Pigmented Alkyd Coating System*
APCS - 5A	*Heat Radiant Insulating Coating*
APCS - 5B	*Hot Insulating Coating*
APCS - 6	*Alkyd Enamel Coating System*
APCS - 9	*Chlorinated Rubber Coating System*
APCS - 10	*Bituminous Paint for Moderate Temperature, Buried or Immersion Service (Self-Priming)*
APCS - 11A	*High Temperature Coating System for Atmospheric Service between 150°C - 400°C*
APCS - 11B	*Very High Temperature Coating System for Atmospheric Service between 400°C - 540°C*
APCS - 11C	*Air-Drying, Single Component, High Heat External Coating for Bare and Insulated Carbon Steel & Austenitic Stainless at Service*
APCS - 12	*Non-Skid Epoxy Coating System for Floors and Decks*
APCS - 17A	*Inorganic Zinc Primer, Solvent Based*
APCS - 17B	*Inorganic Zinc Primer, Water Based*

APCS - 19C *Glass Flake Reinforced Polyester/ Epoxy Coating Systems for Offshore Structural Steel at Splash Zone*

APCS - 20A *Fiberglass Reinforced Coatings, Hand Lay-Up*

APCS - 20B *Chopped Fiberglass Reinforced Epoxy Coatings, Spray Applied*

APCS - 22A *(Epoxy Coating for Application onto Damp Steel Surfaces; Two-Coat System)*

APCS - 22B *(Epoxy Coating for Application onto Damp Steel Surfaces; One-Coat System)*

APCS - 26 *Epoxy Mastic Coating (Self-Priming)*

APCS - 26T *Epoxy Mastic/Polyurethane Coating System*

APCS - 27 *Solvent Free Two-component Ultra Hybrid Epoxy Coating System for Immersion Service at Temperature up to 150°C*

APCS - 28 *Specialty Coating Systems for Pumps, Valves, Piping Fitting and Exchanger Boxes*

11.2 Service condition limitations for the APCS's assume continuous service.

11.3 The APCS coating systems shall not be used under conditions that violate service limitations or other requirements in the applicable APCS data sheets. Only approved products shall be used. (See definitions in SAES-H-001).

11.4 When an APCS system is used to coat concrete surfaces, the surface preparation and coating application requirements shall be in accordance with SAES-H-003.

11.5 Coatings that have exceeded their shelf life shall not be used.

Revision Summary

3 April 2016 Major revision: This revision was conducted to introduce cost effective options, add more details to clarify some of the requirements, be in line with the international standards, and delete old technologies/coating systems that are not used in this document. The operating temperature of some of the coating systems were lowered to meet international requirements. Globally used technologies were added such as water jetting for surface preparation and Thermal Spray Coating for corrosion under insulation. It was requested in the scope of this standard to consulate all coating requirement and selection of the new projects in Index H.

21 February 2018 Editorial revision to modify paragraph (4), (6.1.7), (6.3.4), (7.1.F Remark 2), and (7.3.F Remark1).

APCS - 1A

1 Type of Coating

Epoxy Coating System for Atmospheric Service (with Inorganic Zinc Primer).

2 General Data

2.1 Typical Use

Severe atmospheric exposure, particularly for offshore construction.
Not generally specified for maintenance painting.

2.2 Service Condition Limitations

Maximum Service Temperature: 120°C

2.3 Purchase Specifications

2.3.1 Primer: 09-SAMSS-071

2.3.2 Topcoats: 09-SAMSS-069

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Primer: 1000194146 (09-611-958) / 1000194182 (09-611-969) solvent or water based.

Thinner: 1000198445 (09-738-220)

2.4.2 Topcoat: 1000194629 (09-612-364), 1000194797 (09-612-369) or 1000194960 (09-612-375) depending on color.

Thinner: 1000198452 (09-738-260)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP10)
St 3 (SSPC-SP3) for areas less than 0.1 m²
Use APCS - 1C zinc-rich epoxy for primer repair

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068 (08-220-865) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1 Primer: One Coat 65-100 micrometers, minimum-maximum

4.1.2 Topcoats: Two coats 105-150 micrometers, maximum-maximum per coat

4.2 Total System: Three coats 275-400 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 1B

1 Type of Coating

Epoxy Coating System for Atmospheric Service (with Epoxy Primer).

2 General Data

2.1 Typical Use

Severe atmospheric exposure including exposure to many acids and alkalis; primer can be used with APCS - 12.

2.2 Service Condition Limitations

Maximum Service Temperature: 120°C

2.3 Purchase Specifications

2.3.1 Primer: 09-SAMSS-069

2.3.2 Topcoats: 09-SAMSS-069

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Primer: 1000194626 (09-612-362)

Thinner: 1000198455 (09-738-280)

2.4.2 Topcoat: 1000194629 (09-612-364), 1000194797 (09-612-369) or 1000194960 (09-612-375) depending on color.

Thinner: 1000198452 (09-738-260)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP10)
St 3 (SSPC-SP3) for areas less than 0.1 m²

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068 (08-220-865), 1000161203 (08-220-895) or 1000160374 (08-202-900).

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1 Primer: One coat 55-100 micrometers, minimum-maximum

4.1.2 Topcoats: Two coats 110-150 micrometers, minimum-maximum per coat

4.2 Total System: Three coats 275-400 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 1C

1 Type of Coating

Epoxy Coating System for Atmospheric Service (with Zinc-Rich Epoxy Primer).

2 General Data

2.1 Typical Use: Maintenance painting for severe atmospheric exposures; primer can be used with APCS - 12.

2.2 Service Condition Limitations

Maximum Service Temperature: 120°C

2.3 Purchase Specifications: 09-SAMSS-069

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Primer: 1000195348 (09-612-580), 1000195361 (09-612-590) or 1000195361 (09-612-590) depending on can size

Thinner: 1000198449 (09-738-240)

2.4.2 Topcoat: 1000194629 (09-612-364), 1000194797 (09-612-369) or 1000194960 (09-612-375) depending on color.

Thinner: 1000198452 (09-738-260)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP10)
St 3 (SSPC-SP3) for areas less than 0.1 m²

3.2 Profile: 25-40 micrometers, minimum-maximum

Abrasive: 1000161068 (08-220-865), 1000161203 (08-220-895) or 1000160374 (08-202-900).

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1 Primer: One coat 40-75 micrometers, minimum-maximum

4.1.2 Topcoats: Two coats 105-150 micrometers, minimum-maximum per coat

4.2 Total System: Three coats 250-375 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 1D

1 Type of Coating

Epoxy/Polyurethane Coating System for Atmospheric Service (with Inorganic Zinc Primer).

2 General Data

2.1 Typical Use

Severe atmospheric exposure, when added gloss retention, color retention and abrasion resistance are required (usually outdoors). Not generally specified for maintenance painting.

2.2 Service Condition Limitations

Maximum Service Temperature: 80°C

2.3 Purchase Specifications

2.3.1	Primer:	09-SAMSS-071
2.3.2	Topcoats:	09-SAMSS-069

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1	Primer:	1000194146 (09-611-958) / 1000194182 (09-611-969) solvent or water based.
	Thinner:	1000198445 (09-738-220)
2.4.2	Intermediate coat:	1000194629 (09-612-364), 1000194797 (09-612-369) or 1000194960 (09-612-375) depending on color.
	Thinner:	1000198452 (09-738-260)
2.4.3	Topcoat:	1000194672 (09-612-365), 1000194675 (09-612-366), 1000194793 (09-612-367), 1000194795 (09-612-368) or 1000194851 (09-612-371) depending on color.
	Thinner:	1000198479 (09-738-345)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 2-1/2 (SSPC-SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SSPC-SP10) St 3 (SSPC-SP3) for areas less than 0.1 m^2 Use APCS - 1C zinc-rich epoxy for primer repair.

3.2	Profile:	40-65 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1	Primer:	One coat 65-100 micrometers, minimum-maximum
4.1.2	Intermediate Coat:	One coat 100-150 micrometers, minimum-maximum
4.1.3	Topcoat:	One coat 25-65 micrometers, minimum-maximum

4.2	Total System:	Three coats 190-315 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 1E

1 Type of Coating

Epoxy/Polyurethane Coating System for Atmospheric Service (with Epoxy Primer).

2 General Data

2.1 Typical Use

Severe atmospheric exposure including exposure to many acids and alkalis, when added gloss retention, color retention and abrasion resistance are required (usually outdoors).

2.2 Service Condition Limitations

Maximum Service Temperature: 80°C

2.3 Purchase Specifications: 09-SAMSS-069

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1	Primer:	1000194626 (09-612-362)
	Thinner:	1000198455 (09-738-280)
2.4.2	Intermediate coat:	1000194629 (09-612-364), 1000194797 (09-612-369) or 1000194960 (09-612-375) depending on color.
	Thinner:	1000198452 (09-738-260)
2.4.3	Topcoat:	1000194672 (09-612-365), 1000194675 (09-612-366), 1000194793 (09-612-367), 1000194795 (09-612-368) or 1000194851 (09-612-371) depending on color.
	Thinner:	1000198479 (09-738-345)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 2-1/2 (SSPC-SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SSPC-SP10) St 3 (SSPC-SP3) for areas less than 0.1 m^2

3.2	Profile:	40-65 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865), 1000161203 (08-220-895) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1	Primer:	One coat 50-100 micrometers, minimum-maximum
4.1.2	Intermediate Coat:	One coat 100-150 micrometers, minimum-maximum
4.1.3	Topcoat:	One coat 25-65 micrometers, minimum-maximum

4.2	Total System:	three coats 175-315 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 1F

1 Type of Coating

Epoxy/Polyurethane Coating System for Atmospheric Service (with Zinc-Rich Epoxy Primer).

2 General Data

2.1 Typical Use

Maintenance painting for severe atmospheric exposures when added gloss retention, color retention and abrasion resistances are required (usually outdoors).

2.2 Service Condition Limitations

Maximum Service Temperature: 80°C

2.3 Purchase Specifications: 09-SAMSS-069

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1	Primer:	1000195348 (09-612-580), 1000195361 (09-612-590) or 1000195361 (09-612-590) depending on can size.
	Thinner:	1000198449 (09-738-240)
2.4.2	Intermediate coat:	1000194629 (09-612-364), 1000194797 (09-612-369) or 1000194960 (09-612-375) depending on color.
	Thinner:	1000198452 (09-738-260)
2.4.3	Topcoat:	1000194672 (09-612-365), 1000194675 (09-612-366), 1000194793 (09-612-367), 1000194795 (09-612-368) or 1000194851 (09-612-371) depending on color.
	Thinner:	1000198479 (09-738-345)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 2-1/2 (SSPC-SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SSPC-SP10) St 3 (SSPC-SP3) for areas less than 0.1 m^2

3.2	Profile:	25-40 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865), 1000161203 (08-220-895) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1	Primer:	One coat 40-75 micrometers, minimum-maximum
4.1.2	Intermediate Coat:	One coat 125-175 micrometers, minimum-maximum
4.1.3	Topcoat:	One coat 25-65 micrometers, minimum-maximum

4.2	Total System:	Three coats 190-315 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 2A

1 Type of Coating

Phenolic Epoxy Coating System for Immersion Service (Self-Priming).

2 General Data

2.1 Typical Use

Immersion service particularly for raw or treated waters and for GOSP traps handling hot crude oil/brine solutions. Not suitable for potable water.

2.2 Service Condition Limitations

2.2.1	Maximum Service Temperature:	90°C
2.2.2	Maximum Service Pressure:	6890 kPa (ga) (1000 psig)
2.2.3	Maximum Partial Pressure H_2S, CO_2:	345 kPa (ga) (50 psig)
2.2.4	Requires 7 days curing time at 25°C	

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers (SAMS Stock Numbers)

Coating:	1000195232 (09-612-425) or 1000195235 (09-612-453) depending on color
Thinner:	1000198377 (09-738-140)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 3 (SSPC-SP5)
3.1.2	Touch-up:	Sa 3 (SSPC-SP5)

3.2	Profile:	40-65 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1	Each Coat:	90-125 micrometers, minimum-maximum
4.2	Total System:	Three coats 270-375 micrometers, minimum-maximum

4.3 Coating thickness within 2 m of anode connections shall be 30% greater than the specified-dry film thickness range.

4.4 Succeeding coats shall be of contrasting colors.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 2B

1 Type of Coating

Epoxy Coating System for Potable Water Immersion Service (Self-Priming).

2 General Data

2.1 Typical Use

Immersion service for potable water application.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 90°C

2.2.2 Maximum Service Pressure: 3445 kPa (ga) (500 psig)

2.2.3 Requires valid certificate to be used for potable water applications

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers (SAMS Stock Numbers)

Coating:	1000195317 (09-612-518) or 1000195341 (09-612-546) depending on color
Thinner:	1000198372 (09-738-100)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 3 (SSPC-SP5)
3.1.2	Touch-up:	Sa 3 (SSPC-SP5)

3.2	Profile:	40-65 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat: 90-125 micrometers, minimum-maximum

4.2 Total System: Three coats
275-375 micrometers, minimum-maximum.

4.3 Coating thickness within 2 m of anode connections shall be 30% greater than the specified dry film thickness range.

4.4 Succeeding coats shall be of contrasting colors.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 2C

1 Type of Coating

Epoxy Coating System for Immersion Service, at temperatures up to 120°C.

2 General Data

2.1 Typical Use

Immersion service for de-mineralized water and boiler skim tanks.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 120°C

2.2.2 Maximum Service Pressure: 3445 kPa (ga) (500 psi)

2.2.3 Requires 7 days curing time at 25°C

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1	Primer:	1000194295 (09-612-312)
2.4.2	Topcoat:	1000194298 (09-612-313) or 1000194352 (09-612-314) depending on color
	Thinner:	1000198483 (09-738-380)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 3 (SSPC-SP5)
3.1.2	Touch-up:	Sa 3 (SSPC-SP5)
3.2	Profile:	40-65 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1	Primer:	One coat, see Saudi Aramco data sheets (SAES-H-101V) for the primer dry film thickness.
4.1.2	Topcoats:	Two coats 125 micrometers, maximum per coat

4.2	Total System:	Three coats 275-375 micrometers, minimum-maximum

4.3 Coating thickness within 2 m of anode connections shall be 30% greater than the specified dry film thickness range.

4.4 Succeeding coats shall be of contrasting colors.

4.5 APCS - 2C can be used for potable water immersion service if it has certificate purposes from an authorized agency.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 2D

1 Type of Coating

Epoxy Coating System for Interior of Steel Aviation Fuel Storage Tanks and Piping.

2 General Data

2.1 Typical Use

Immersion service for aviation fuels, turbine fuels and kerosene

2.2 Service Condition Limitations

Maximum Service Temperature: 90°C

2.3 Purchase Specification(s): MIL-C-4556E, QPL-4556E

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Primer (Yellow): 1000194354 (09-612-316)

2.4.2 Topcoat (White): 1000194357 (09-612-317)

2.4.3 Thinner: 1000198458 (09-738-290)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP5)

3.1.2 Touch-up: Sa 3 (SSPC-SP5)

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068 (08-220-865) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat: 100-125 micrometers, minimum-maximum per coat

4.2 Total System: Two coats
200 - 250 micrometers, minimum-maximum

4.3 The total system thickness shall be applied in a minimum of two coats of contrasting colors.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 2E

1 Type of Coating

Solvent Free Phenolic Epoxy Coating for General Immersion Service (Self-Priming).

2 General Data

2.1 Typical Use

Immersion service such as hydrocarbon, aqueous and corrosive chemical environments.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 93°C

2.2.2 Maximum Service Pressure: 20,700 kPa (3,000 psig)

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers (SAMS Stock Numbers)

Coating:	1000608683 (09-000-445), 1000608684 (09-000-446) or 1000608685 (09-000-447) depending on can size
Thinner:	1000653652(09-000-469)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 3 (SSPC-SP5)
3.1.2	Touch-up:	Sa 3 (SSPC-SP5)

3.2	Profile:	60 - 100 micrometers, minimum-maximum
	Abrasive:	1000161168 (08-220-878) or 1000160377 (08-202-910)

4 Dry Film Thickness Requirements

4.1 Total System: Minimum one coat
500 – 600 micrometers, minimum-maximum.

4.2 Coating thickness within 2 m of anode connections shall be 30% greater than the specified dry film thickness range.

4.3 Succeeding coats shall be of contrasting colors.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 2G

1 Type of Coating

Glass Flake Vinyl Ester Coating System

2 General Data

2.1 Typical Use

Immersion service such as hydrocarbon, seawater, raw water, aqueous and corrosive chemical environments. Suitable for immersion service at GOSPs pressure vessels and headers. Not recommended when steam out cleaning will be utilized.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 90°C

2.2.2 Maximum Service Pressure: 20,700 kPa (ga) (3,000 psig)

2.2.3 Not suitable for demineralized water and polar solvents

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAMS Stock Numbers (SAP Material Numbers)

Coating:	09-000-502 (1000709300)
Inhibitor (Retarder):	09-000-505 (1000709303)
Cleaner:	09-000-503 (1000709301)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 3 (SSPC-SP5)
3.1.2	Touch-up:	Sa 2-1/2 (SSPC-SP10) St 3 (SSPC-SP3) for areas less than 0.1 m^2

3.2	Profile:	65-100 micrometers, minimum-maximum
	Abrasive:	1000161168 (08-220-878) or 1000160377 (08-202-910)

4 Dry Film Thickness Requirements

4.1	Total System:	One Coat 600-1000 micrometers, minimum-maximum

4.2 Coating thickness within 2 m of anode connections shall be 30% greater than the specified dry film thickness range.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 2H

1 Type of Coating

Solvent Free Glass Flake Filled Epoxy Novolac Coating for Immersion Service up to 105°C.

2 General Data

2.1 Typical Use

Immersion service such as hydrocarbon, aqueous and corrosive chemical environments.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 105°C

2.2.2 Maximum Service Pressure: 20,700 kPa (3,000 psig)

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers (SAMS Stock Numbers)

Coatings:	SAP Numbers (1000813296)
Thinners:	Manufacturer thinners

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 3 (SSPC-SP5)
3.1.2	Touch-up:	Sa 3 (SSPC-SP5)

3.2	Profile:	75 - 100 microns, minimum-maximum
	Abrasive:	1000161168 (08-220-878) or 1000160377 (08-202-910)

4 Dry Film Thickness Requirements

4.1 Total System: One Coat
600-1000 micrometers, minimum-maximum

4.2 Coating thickness within 2 m of anode connections shall be 30% greater than the specified dry film thickness range.

4.3 When used for gas service, the total dry film thickness shall be 15 to 20 mils.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 3

1 Type of Coating

Coal Tar Epoxy Coating System for Immersion Service and buried for steel and concrete

2 General Data

2.1 Typical Use

Immersion service in tanks containing hydrocarbons, seawater, fresh water and most alkalis; intermittent contact with acids and solvents. It is also for buried concrete foundations and oily water concrete sumps.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature (Immersion): 70°C

2.2.2 Not for use in pressure vessels.

2.2.3 Not suitable for use in direct sunlight.

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers (SAMS Stock Numbers)

Coating:	1000194372 (09-612-318); red, 1000194375 (09-612-320); black
Thinner:	1000198441 (09-738-180)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial for steel:	Sa 2-1/2 (SSPC-SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SSPC-SP10)
3.1.3	Initial for concrete:	Follow surface preparation per SAES-H-003

3.2	Profile for steel:	65-100 micrometers, minimum-maximum
3.3	Profile for concrete:	As per ICRI 03730
	Abrasive:	1000161168 (08-220-878) or 1000160377 (08-202-910)

4 Dry Film Thickness Requirements

4.1	Each Coat for steel:	Two coats 300 micrometers, maximum per coat
4.2	Total coating for steel:	Minimum two coats 400-600 micrometers, minimum-maximum

4.3 Succeeding coats shall be of contrasting colors. If a holding primer is used, it shall constitute an additional coat.

4.4 If coating concrete, thickness shall be not less than 720 microns (28 mils)

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 4

1 Type of Coating

Aluminum - Pigmented Alkyd Coating System.

2 General Data

2.1 Typical Use

Structural steelwork, tanks, vessels, pipes and equipment subject to moderate industrial atmospheres including H_2S fumes and high humidity. Not generally recommended for shop applications or when handling is required after coating.

2.2 Service Condition Limitations

Maximum Service Temperature: 80°C

2.3 Purchase Specifications: 09-SAMSS-035

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1	Primer:	1000197976 (09-708-133) or 1000198011(09-708-137) depending on can size
2.4.2	Topcoat:	1000196402 (09-686-354)
	Thinner:	1000198474 (09-738-340)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 2 (SSPC-SP6)
3.1.2	Touch-up:	Sa 2 (SSPC-SP6) St 3 (SSPC-SP3) for areas less than 1.0 m²

3.2	Profile:	40-65 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865), 1000161203 (08-220-895) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1	Primer:	Two coats 50 micrometers, maximum per coat 75 micrometers, minimum primer total
4.1.2	Topcoats:	One coats 40 micrometers, maximum per coat

4.2 Total System: Three coats
115-180 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 5A

1 Type of Coating

Radiant Heat Insulating Coating System.

2 General Data

2.1 Typical Use

External top-coating system for petroleum tanks, vessels and drums to reduce impact of solar heat and minimize evaporation losses.

2.2 Service Condition Limitations

Maximum Service Temperature: 120°C

Used over an approved primer of APCS-1A, APCS-1B or APCS-1C. A clear top coat of acrylic or polyurethane based coating may be applied over ~~the~~ insulating coating.

Approved aliphatic polyurethane can be used for color coding.

2.3 Purchase Specifications

Solar Reflectance shall not be less than 80% as per ASTM E903.

Emittance Value shall not be less than 90% as per ASTM E408.

The coating shall pass 1500 hour of Salt fog test ASTM B117 without any rust creep, blistering and cracking.

2.4 SAP Materials (SAMS Stock Numbers)

Radiant Heat Coat:	1000769612 (09-000-523)
Clear Coat:	1000769613 (09-000-524)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 2-1/2 (SSPC-SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SSPC-SP10) St 3 (SSPC-SP3) for areas less than 0.1 m^2 Use APCS - 1C (zinc-rich epoxy) as primer for repair.

3.2 Profile: 40-65 micrometers, minimum - maximum

Abrasive: 1000161068 (08-220-865),
1000161203 (08-220-895) or
1000160374 (08-202-900)

4 Total Dry Film Thickness Requirements

300 – 500 microns, minimum- maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 5B

1 Type of Coating

Hot Insulating Coating System for personal protection.

2 General Data

2.1 Typical Use

Alternative to conventional bulk insulations for personal protection on hot piping.

2.2 Service Condition Limitations

Maximum Service Temperature: 120 °C.

Used with an approved primer of APCS-1A, APCS-1B or APCS-1C. A clear top coat of acrylic may be applied over the insulating coating. Additionally, water-borne aliphatic polyurethane can be used for color coding.

2.3 Purchase Specifications

Solar Reflectance shall not be less than 80% as per ASTM E903.

Emittance Value shall not be less than 90% as per ASTM E408.

The coating shall pass 1500 hour of Salt fog test ASTM B117 without any rust creep, blistering and cracking.

Its thermal resistance (R) when applied at 500 microns (20 mills) DFT shall be equivalent to R-20 of conventional insulation as tested per ASTM C177 - 85.

2.4 SAP Material Numbers (SAMS Stock Numbers):

Hot Insulating Coating: 1000769611 (09-000-522)

3 Surface Preparation Requirements for Carbon Steel

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP10)

St 3 (SSPC-SP3) for areas less than 0.1 m^2

3.2 Profile: 40-65 micrometers, minimum-maximum for carbon steel

Abrasive for carbon steel: 1000161068 (08-220-865),
1000161203 (08-220-895) or
1000160374 (08-202-900)

4 Surface Preparation Requirements for stainless steel

- Use non-chlorinated solvent to remove oil, grease and soil
- Use non-metallic grit such as an approved garnet or aluminum oxide to perform the sweep blasting

5 Dry Film Thickness Requirements

5.1 Hot Insulating Coating 18 (450 microns) to 22 mils (550 microns)

DFT can be increased for additional temperature reduction.

APCS - 6

1 Type of Coating

Alkyd Enamel Coating System

2 General Data

2.1 Typical Use

Structural steels, machinery and equipment in marine and industrial environments including intermittent exposure to H_2S fumes and high humidity. Not recommended for shop application or when handling is required after coating. (See APCS - 26/26T).

2.2 Service Condition Limitations

Maximum Service Temperature: 70°C

2.3 Purchase Specifications: 09-SAMSS-021

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Primer: 1000197976 (09-708-133) or
1000198011 (09-708-137) depending on can size.

2.4.2 Topcoat: 1000195487 (09-630-753),
1000195490 (09-630-758),
1000195495 (09-630-763),
1000195532 (09-630-768),
1000195571 (09-630-769),
1000195577 (09-630-770),
1000195631 (09-630-771),
1000195637 (09-630-773),
1000195650 (09-630-785),
1000195683 (09-630-794),
1000195685 (09-630-796),
1000195687 (09-630-798),
1000195689 (09-631-301),
1000195742 (09-631-322),
1000195745 (09-631-450),
1000195747 (09-631-455),
1000195749 (09-631-462),
1000195801 (09-631-465),

1000195803 (09-631-590) or
1000195831 (09-631-645) depending on color.

2.4.3 Thinner: 1000198474 (09-738-340)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2 (SSPC-SP6)

3.1.2 Touch-up: Sa 2 (SSPC-SP6)
St 3 (SSPC-SP3) for areas less than 1.0 m^2

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068 (08-220-865),
1000161203 (08-220-895) or
1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1 Primer: Two coats
50 micrometers, maximum per coat
75 micrometers, minimum primer total

4.1.2 Topcoats: One coats
50 micrometers, maximum per coat

4.2 Total System: Three coats
125-200 micrometers, minimum - maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 9

1 Type of Coating

Chlorinated Rubber Coating System

2 General Data

2.1 Typical Use

Metallic and concrete surfaces exposed to salts, high humidity, and spillage of acids and alkalis.

2.2 Service Condition Limitations

Maximum Service Temperature: 60°C

2.3 Purchase Specifications

2.3.1 Primer: None

2.3.2 Topcoat: None

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Primer: 1000196351 (09-685-442)

2.4.2 Topcoat: 1000196312 (09-685-436),
1000196317 (09-685-438),
1000196355 (09-685-448),
1000196359 (09-685-450) depending on color.

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

Initial: Metallic Surfaces: Sa 2-1/2 (SSPC-SP10)

Nonmetallic Surfaces: Surface shall be dry and free of all contaminants such as grease, oil, dirt and loose paint.

Touch-up: Metallic Surfaces: Sa 2-1/2 (SSPC-SP10)
St 3 (SSPC-SP3) for area less than 0.1 m^2

	Nonmetallic Surfaces:	Surface shall be dry and free of all contaminants such as grease, oil, dirt, and loose paint.
3.2	Profile:	40-65 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865), 1000161203 (08-220-895) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1	Primer:	One coats 50-75 micrometers, minimum-maximum
4.1.2	Topcoat:	One coats 50-100 micrometers, minimum-maximum

4.2 Total System: Two coats
100-175 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 10

1 Type of Coating

Bituminous Paint for Moderate Temperature, Buried or Immersion Service (Self-Priming)

2 General Data

2.1 Typical Use

Buried and immersed steel. Resistant to water and acidic fumes. Not generally recommended for shop applications or when handling is required after coating.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 60°C

2.2.2 Not suitable for exposure to direct sunlight or hydrocarbon solvents.

2.3 Purchase Specification: None

2.4 SAP Material Numbers (SAMS Stock Numbers):

Coating: 1000194025 (09-611-715),
1000194029 (09-611-720) or
1000194032 (09-611-725) depending on can size.

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level, Initial and Touch-up

3.1.1	Pipelines in hydrocarbon service and all pipelines in road and camel crossings:	Sa 2 (SSPC-SP6) St 3 (SSPC-SP3) if less than 3 m long
3.1.2	General Steelwork:	St 3 (SSPC-SP3)

3.2 Profile: Not Critical

4 Dry Film Thickness Requirements

4.1 Each Coat

See Saudi Aramco data sheets (SAES-H-101V) for dry film thickness per coat and number of coats.

4.2 Total System

4.2.1 Buried: 750 micrometers, minimum

4.2.2 Immersed: 1150 micrometers, minimum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 11A

1 Type of Coating

High Temperature Coating System for Atmospheric Service between 150°C-400°C (with Inorganic Zinc Primer).

2 General Data

2.1 Typical Use: Steel in atmospheric service at elevated temperature.

2.2 Service Condition Limitations

Service Temperature:	150°C-400°C

2.3 Purchase Specifications

2.3.1	Primer:	09-SAMSS-071
2.3.2	Topcoat:	09-SAMSS-103

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1	Primer:	1000194146 (09-611-958) / 1000194182 (09-611-969) solvent or water based.
2.4.2	Thinner:	1000198445 (09-738-220)
2.4.3	Topcoat:	1000196488 (09-687-325)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 2-1/2 (SSPC-SP10)
3.1.2	Touch-Up:	Sa 2-1/2 (SSPC-SP10) St 3 (SSPC-SP3) for areas less than 0.1 m^2

3.2	Profile:	40-65 micrometers, minimum - maximum
	Abrasive:	1000161068 (08-220-865) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1 Primer: One coat
25-65 micrometers, minimum-maximum

4.1.2 Topcoat(s): One coat
15-40 micrometers, minimum-maximum

4.2 Total System: Two coats
40-105 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 11B

1 Type of Coating

Very High Temperature Coating System for Atmospheric Service between 400°C and 540°C

2 General Data

2.1 Typical Use

Steel in atmospheric service at elevated temperatures.

2.2 Service Condition Limitations

Service Temperature: 400°C-540°C

2.3 Purchase Specification: 09-SAMSS-103

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Primer:

2.4.2 Topcoat:

2.4.3 Self Priming: 1000196502 (09-687-330)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP5)

3.1.2 Touch-up: Sa 3 (SSPC-SP5)

3.2 Profile: 25 micrometers, maximum

Abrasive: 1000161068 (08-220-865) or
1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1	Primer:	One coat 15-40 micrometers, minimum-maximum
4.2	Topcoat:	One coat 15-40 micrometers, minimum-maximum
4.3	Total System:	Two coats 30-80 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 11C

1 Type of Coating

Extremely High Temperature Coating for Bare/Insulated Carbon and Austenitic Stainless Steels

2 General Data

2.1 Uses: Steel in atmospheric/insulated service at elevated temperatures.

2.2 Service Condition Limitations

Maximum Service Temperature: 1200°F

2.3 Purchase Specifications

- Immersion Resistance to Boiling Water: (NACE TM0174 or ASTM C868)
- Resistance to hot salt spray (ISO 7253 or ASTM B117)
- No free soluble chlorides, halides, sulfides, nitrates after curing
- No zinc, lead, copper or low melting metal
- Resistance to high temperature service: (ASTM D2485 "Evaluating Coatings for High Temp. Service")
- Resistance to thermal shock under cycling condition : use hot oil chamber coated at 15-18 mils DFT,dry heating up to 400°F for 4 hours, and then quenched in cold water, then half immersed in wet, 3% sodium chloride solution for 4 hour and then cold quenching and so on for 200 cycles.

SAP Numbers:

3 Surface Preparation Requirements

Carbon Steel

Use solvent cleaning as per SSPC-SP1 and abrasive blasting as per commercial blast cleanliness level per SSPC-SP6

Stainless Steel

Remove all grease, oil, dirt, drawing and other foreign matter using the SSPC-SP1 "Solvent Cleaning" method with non-chlorinated solvents. Abrasive blast the surface as per SSPC-SP6.

4 Dry Film Thickness Requirements

System 1: Ambient Steel Application

First Coat: 5-6 mils (125-150 microns)

Second Coat: 5-6 mils (125-150 microns)

Total Dry Film Thickness: 10-12 mils (250-300 microns)

System 2: Hot Steel Application (300-500°F)

First Coat: 5-6 mils (125-150 microns)

Second Coat: 5-6 mils (125-150 microns)

Third Coat: 5-6 mils (125-150 microns)

Total Dry Film Thickness: 15-18 mils (375-450 microns)

APCS - 12

1 Type of Coating

Non-Skid Epoxy Coating System for Floors and Decks

2 General Data

2.1 Typical Use

Nonskid surface on interior and exterior floors and walkways.

2.2 Service Condition Limitations

Maximum Service Temperature: 120°C

2.3 Purchase Specifications

2.3.1	Primer:	09-SAMSS-069
2.3.2	Topcoats:	09-SAMSS-069
2.3.3	Aggregate:	Non-skid aggregate shall be provided by the coating material manufacturer subject to approval by Saudi Aramco.

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1	Primer:	1000194626 (09-612-362), 1000195348 (09-612-580) or 1000195361 (09-612-590) depending on generic type and can size.
	Thinner:	1000198455 (09-738-280) for epoxy primer, and 1000198449 (09-738-240) for zinc rich primer.
2.4.2	Topcoat:	1000194629 (09-612-364), 1000194797 (09-612-369) or 1000194960 (09-612-375) depending on color.
	Thinner:	09-738-260

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 2-1/2 (SSPC-SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SSPC-SP10) St 3 (SSPC-SP3) for areas less than 0.1 m^2.

3.2 Profile:

40-65 micrometers, minimum-maximum

Abrasive:

1000161068 (08-220-865),
1000161203 (08-220-895) or
1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1	Primer:	One coats 50-100 micrometers, minimum-maximum
4.1.2	Topcoats:	Two coats 150 micrometers, maximum per coat Nonskid aggregate shall be broadcast into the next to last topcoat while it is still wet. A final topcoat shall be applied over the aggregate sealing it in.

4.2 Total System:

Minimum three coats
275-400 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 17A

1 Type of Coating

Inorganic Zinc Primer, Solvent-Based

2 General Data

2.1 Typical Uses

Under thermal insulations in cyclic cryogenic condition up 77°C.

2.2 Coating Application Limitations

Relative humidity must exceed 50% during coating application and curing.

2.3 Service Condition Limitations

Maximum Service Temperature: 400°C

2.4 Purchase Specification: 09-SAMSS-071

2.5 SAP Material Numbers (SAMS Stock Numbers)

2.5.1 Coating: 1000194146 (09-611-958)

2.5.2 Thinner: 1000198445 (09-738-220)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP10)
St 3 (SSPC-SP3) for areas less than 0.1 m^2

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068 (08-220-865) or
1000160374 (08-202-900).

4 Dry Film Thickness Requirements

Total System:	One coat 65-100 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 17B

1 Type of Coating

Inorganic Zinc Primer, Water-Based.

2 General Data

2.1 Typical Uses

Under thermal insulation in cyclic cryogenic up to 77°C

2.2 Coating Application Limitations

Relative humidity must be less than 50% during coating application and curing.

2.3 Service Condition Limitations

Maximum Service Temperature: 400°C

2.4 Purchase Specification: 09-SAMSS-071

2.5 SAP Material Number (SAMS Stock Number): 1000194182 (09-611-969)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 2-1/2 (SSPC-SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SSPC-SP10) St 3 (SSPC-SP3) for areas less than 0.1 m²
3.2	Profile:	40-65 micrometers, minimum - maximum
	Abrasive:	1000161068 (08-220-865) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

Total System:	One coat 65-100 micrometers, minimum - maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 19C

1 Type of Coating

Glass Flake Reinforced Polyester/ Epoxy Coating Systems for Offshore Structural Steel at Splash Zone

2 General Data

2.1 Typical Use

Corrosion protection for all offshore and marine structural steel members at splash zone and atmospheric exposure. Suitable for jetties, pilings, and pipe at above/below ground transition areas.

2.2 Service Conditions and Limitations

2.2.1 Maximum Service Temperature: 93°C

2.2.2 Not suitable for Hot Risers in Splash Zone.

2.2.3 Suitable for new construction and rehabilitation of existing Structural Steel members.

2.3 Purchase Specification: 09-SAMSS-070

2.4 SAMS Stock Number

1000788243/1000788244 (Epoxy); 1000788245/1000788246 (Polyester)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial (New Construction): SSPC-SP5 (Sa 3)

3.1.2 Touch-up and Recoat: SSPC-SP6 (Sa 2)
St 3 (SSPC-SP3) for areas less than 0.1 m²

3.2 Profile: 60-100 microns, average 75 micrometers (3 mils)

Abrasive: M/N 1000161068, 1000161203 and 1000160374 (S/N 08-220-865, 08-220-895, or 08-202-900)

4 Dry Film Thickness Requirements

Total System:

4.1 New Construction: Two coats @ 750 microns per coat and total of 1500 microns

4.2 Maintenance Coating for Existing Structures: One Coat @ 750 – 1000 microns

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 20A

1 Type of Coating

Fiberglass Reinforced Coatings, Hand Lay-Up

2 General Data

2.1 Typical Use

Repair of badly corroded steel tank interiors. Applied at increased thicknesses if strengthening is required.

2.2 Service Condition Limitations

Maximum Service Temperature: Varies with resin used.

2.3 Purchase Specifications

2.3.1 Primer: None

2.3.2 Resin: None

2.3.3 Fiberglass Mat: None

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Primer: None

2.4.2 Resin: None

2.4.3 Fiberglass Mat: None

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP10)

All sharp dimensional changes, such as fillets shall be filled with the coating manufacturers' recommended patching compound to obtain a smooth contour. The minimum throat dimension of shell-to-bottom fillets in storage tanks shall be 25 mm.

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP10)
St 3 (SSPC-SP3) for areas less than 0.1 m^2

3.2 Profile: As recommended by the Coating Manufacturer.

4 Other Requirements

4.1 Coating should be applied in accordance with SSPC-PA 6/NACE No. 10.

4.2 Entrapped air, entrapped sand or other foreign matter, wrinkles, sags and dry spots in the coating shall be removed and the affected area repaired.

4.3 Use 2 layers of glass cloth with a 3:1 ratio of resin: reinforcement by weight.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 20B

1 Type of Coating

Glass Flake/Chopped Fiberglass Reinforced Coatings (Spray Applied) for Storage Tanks Interior Application

2 General Data

2.1 Typical Use

Repair of badly corroded steel tank interiors where spray application is preferred.

2.2 Service Condition Limitations

Maximum Service Temperature: Varies with product used

2.3 Purchase Specifications

2.3.1 Primer: None

2.3.2 Epoxy Resin: None

2.3.3 Chopped Fiberglass: None

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Primer: None

2.4.2 Epoxy Resin: None

2.4.3 Chopped Fiberglass: None

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP10).

All sharp dimensional changes such as fillets shall be filled with the coating manufacturer's recommended patching compound to obtain a smooth contour. The minimum throat dimensions of shell to bottom fillets in storage tanks shall be 25 mm.

3.1.2	Touch-up:	Sa 2-1/2 (SSPC-SP10) St 3 (SSPC-SP3) for areas less than 0.1 m^2
3.2	Profile:	As recommended by the Coating Manufacturer.

4 Other Requirements

Entrapped air, entrapped sand, or other foreign matter, wrinkles, sags, and dry spots in the coating shall be removed and the affected areas repaired.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS – 22A

1 Type of Coating

Epoxy Coating for Application onto Damp Steel Surfaces; Two-Coat System

2 General Data

2.1 Typical Use

Offshore Steel Structures in above-water areas. Can be applied in conditions of high humidity to a slightly damp substrate.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 120°C

2.2.2 Not normally suitable for immersion service.

2.3 Purchase Specifications: 09-SAMSS-087

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1	Primer:	1000194560 (09-612-352) or 1000195239 (09-612-459) depending on can size
2.4.2	Topcoat:	1000194565 (09-612-357), 1000194568 (09-612-358), 1000194590 (09-612-359), 1000195273 (09-612-462), 1000195277 (09-612-465) or 1000195314 (09-612-467) depending on color and can size.
2.4.3	Thinner:	1000198471 (09-738-300)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 2-1/2 (SSPC-SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SSPC-SP10) St 3 (SSPC-SP3) for areas less than 0.1 m^2

3.2	Profile:	40-65 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865), 1000161203 (08-220-895) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1	Each Coat:	Two or more coats 200 micrometers, maximum per coat
4.2	Total System:	Minimum two coats 300-400 micrometers, minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 22B

1 Type of Coating

Epoxy Coating for Application onto Damp Steel Surfaces; One-Coat System

2 General Data

2.1 Typical Use

Offshore Steel Structures in above-water areas. Can be applied in conditions of high humidity to a slightly damp substrate.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 120°C

2.2.2 Not normally suitable for immersion service.

2.3 Purchase Specifications: 09-SAMSS-087 (modified)

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Coating: 1000647350 (09-000-461),
1000647351 (09-000-462),
1000647352 (09-000-463),
1000647353 (09-000-464),
1000669337 (09-000-489),
1000669338 (09-000-490),
1000669339 (09-000-491) or
1000669590 (09-000-492) depending on color.

2.4.2 Thinner: 1000647354 (09-000-465)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP10)
St 3 (SSPC-SP3) for areas less than 0.1 m^2

3.2	Profile:	40-65 micrometers, minimum - maximum
	Abrasive:	1000161068 (08-220-865), 1000161203 (08-220-895) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1	Total System:	One coat
		350-500 micrometers for atmospheric service
		400-575 micrometers for splash zone service

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 26

1 Type of Coating

Epoxy Mastic Coating (Self-Priming)

2 General Data

2.1 Typical Use

a) One coat for coating maintenance works, fast dry alternative to APCS - 4 and APCS - 6.

b) A coating for galvanized steel and aluminum for appearance or increased chemical resistance.

c) A maintenance coating over existing sound coatings.

d) For new steel structures in mild atmospheric condition.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 120°C

2.2.2 Not suitable for buried service.

2.3 Purchase Specification: 09-SAMSS-101

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Coating: 1000194381 (09-612-330),
1000194386 (09-612-331),
1000194401 (09-612-332),
1000194407 (09-612-333),
1000194420 (09-612-334),
1000194427 (09-612-335),
1000194471 (09-612-336) or
1000194476 (09-612-337) depending on color.

2.4.2 Thinner: 1000198487 (09-738-420)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 New Construction: Sa 2-1/2 (SSPC-SP10)

Touch-Up: Sa 2-1/2 (SSPC-SP10)
St 2 (SSPC-SP2) for areas less than 0.1 m²

3.1.2 Maintenance Coating Steel Surfaces

Exposed Steel: Sa 2 (SSPC-SP6) for areas greater than 0.1 m²
St 2 (SSPC-SP2) for areas less than 0.1 m²

Sound Coating: Pressure Wash

3.1.3 Galvanized Steel and Aluminum: Sweep blast to lightly roughen the surface. On new galvanizing, solvent clean prior to sweep blasting.

3.2 Profile: New Coating 40-65 micrometers, min. – max.
Maintenance Coating N/A

Abrasive: 1000161068 (08-220-865),
1000161203 (08-220-895) or
1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 For Maintenance over Existing Sound Coating

4.1.1 Each Coat: One coats
125-200 micrometers, minimum-maximum

4.1.2 Total System: Minimum one coat
125-200 micrometers minimum-maximum
(above the thickness of any existing coating).

4.2 For New Construction

4.2.1 Each Coat Two coats
150 – 200 microns, minimum - maximum

4.2.2. Total System: 300 – 400 microns

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 26T

1 Type of Coating

Epoxy Mastic/Polyurethane Coating System for use outdoors when added gloss retention, color retention, and abrasion resistance are required.

2 General Data

2.1 Typical Use

a) A fast dry alternative to APCS - 4 and APCS - 6.

b) A coating for galvanized steel and aluminum for appearance or increased chemical resistance.

c) A maintenance coating over existing sound coatings.

d) For new steel structures for dry onshore areas.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 80°C

2.2.2 Not suitable for buried service.

2.3 Purchase Specifications: 09-SAMSS-101

2.4 SAP Material Numbers (SAMS Stock Numbers):

2.4.1	Primer:	1000194381 (09-612-330), 1000194386 (09-612-331), 1000194401 (09-612-332), 1000194407 (09-612-333), 1000194420 (09-612-334), 1000194427 (09-612-335) or 1000194471 (09-612-336) depending on color.
	Thinner:	1000198487 (09-738-420)
2.4.2	Topcoat:	1000194672 (09-612-365), 1000194675 (09-612-366), 1000194793 (09-612-367), 1000194795 (09-612-368) or 1000194851 (09-612-371) depending on color.
	Thinner:	1000198479 (09-738-345)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 New Bare Steel: Sa 2-1/2 (SSPC-SP10)

Touch-Up: Sa 2 (SSPC-SP6)
St 2 (SSPC-SP2) for areas less than 0.1 m²

3.1.2 Maintenance Coating:

Exposed Steel: Sa 2-1/2 (SSPC-SP5) for areas greater than 0.1 m²
St 2 (SSPC-SP2) for areas less than 0.1 m²

Sound Coating: Pressure Wash

3.1.3 Galvanized Steel and Aluminum: Sweep blast to lightly roughen the surface. On new galvanizing, solvent clean prior to sweep blasting.

3.2 Profile:

New Coating 40-65 micrometers, min. – max.

Maintenance Coating: N/A

Abrasive: 1000161068 (08-220-865),
1000161203 (08-220-895) or
1000160374 (08-202-900)

4 Dry Film Thickness Requirements

4.1 For Maintenance over Existing Sound Coating

Each Coat

4.1.1 Primer: One or more coats
125-200 micrometers, minimum-maximum

4.1.2 Topcoat: One coat
25-65 micrometers

Total system: Minimum two coats,
150-260 micrometers, minimum-maximum above the thickness of any existing coating.

4.2 For New Construction

4.2.1	Primer:	Two or more coats 300 – 400 microns, minimum-maximum
4.2.2	Topcoat	One coat 40 – 60 microns, minimum-maximum
4.2.3	Total System:	340 - 460microns minimum-maximum

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 27

1 Type of Coating

Solvent Free Two-component Novolac Epoxy Coating System for Immersion Service at High Temperature up to 150ºC.

2 General Data

2.1 Typical Use

Immersion service for GOSP vessels handling hydrocarbon solutions at temperature up to 150°C. Suitable for immersion in DGA (Di-Glycol Amine) columns, Sulphur recovery units, sour gas treating units

2.2. Service Limitation: Not suitable for potable water services.

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers (SAMS Stock Numbers):

2.4.1 Brushable Grade 1000767602 (09-000-520)

2.4.2 Sprayable Grade 1000767601 (09-000-519)

3 Surface Preparation

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP5)

3.1.2 Touch-up: Sa 3 (SSPC-SP5)

3.2 Profile: 65 - 100 microns, minimum - maximum

Abrasive: 1000161063 (08-220-850),
1000161200 (08-220-890) or
1000160377 (08-202-910)

4 Application and Dry Film Thickness Requirements

4.1	Application:	Single coat application by airless equipment (45:1) to build up the required thickness
	Stripe Coating:	Weld lines, appurtenances, welded brackets, nozzles, and corners should be stripe coated prior to spray apply the coating. Use Hand brushing grade to wet out surfaces.
4.2	Total Thickness:	For Amines and Other Chemicals: One or two coats; 600 - 1000 microns For Gas, Crude Oil and Water: One coat; 400 - 600 microns

4.3 The total dry film thickness shall be applied in a single coat or two coats (wet on wet) in contrasting colors.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS - 28

1 Type of Coating

Internal Liquid Coating Systems for Pumps, Valves and Exchanger Boxes

2 General Data

2.1 Typical Use

Suitable for new and existing pump casing valves in immersion seawater and hydrocarbon services where good corrosion, abrasion, and chemical resistance are required. Glass-reinforced systems should be top-coated to achieve a smooth and even finish.

2.2 Service Condition: As specified in 09-SAMSS-067.

2.3 Purchase Specifications: 09-SAMSS-067

2.4 SAP Material Numbers:

3 Surface Preparation Requirements

3.1 Soluble salts on the steel substrate shall be less than 20 mg/m² prior to coating application.

3.2 Minimum Cleanliness Level

3.2.1 New Bare Steel: Sa 3 (SSPC-SP5)

Touch-Up: Sa 2.5 (SSPC-SP10)
St 2 (SSPC-SP2) for areas less than 0.1 m²

3.2.2 Maintenance Coating:

Exposed Steel: Sa 2.5 (SSPC-SP10) for areas greater than 0.1 m²

3.3 Profile: As specified in the product approved data sheet.

Abrasive: 1000161063 (08-220-850),
1000161200 (08-220-890) or
1000160377 (08-202-910)

4 Dry Film Thickness Requirements: As specified in the product approved data sheet

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets (SAES-H-101V).

APCS 113A

I. TYPE OF COATING

High-Build Liquid Epoxy Coatings for Renovation of Pipelines buried in Subkha and dry soils

II. GENERAL DATA

Uses: Primarily used as a renovation coating for the external of buried piping, pipelines, and associated fittings and appurtenances.

a) This system can also be used as a shop coating for pipeline spools, fittings and appurtenances. Its solids content ranges from 85 to100% by volume.

b) SAMS S/N: 1000686070 (old SAMS S/N: 09-000-497-00).

c) Maximum Service Temperature Limitations:

1) 125°C in dry soil.

2) 90°C in Subkha soil.

d) Generic Information: This APCS covers a variety of high build epoxy liquid coatings with or without reinforcing fillers. For generic information, see the stock number descriptions in the SAMS catalog or in the Saudi Aramco Data Sheets, SAES-H-002V.

e) Purchase Specification: 09-SAMSS-113.

III. SURFACE PREPARATION AND COATING APPLICATION REQUIREMENTS

a) Cleanliness: Near white metal (SSPC-SP10)

Surface Profile: 50 to 100 microns (2 to 4 mils)

Use abrasives SAP M/N 1000161068 and 1000160374.

b) Test the steel substrate for chloride salts contamination. Substrates with residual chlorides exceeding 40 mg/m² shall be decontaminated by fresh water high-pressure wash.

c) Dry Film Thickness:

600 - 1000 microns (24-40 mils) applied in wet-on-wet single coat application.

d) Shop coating application on pipes shall be done, using an automated process. The pipe can be rotated while the spray gun moves at a constant speed with the aid of a motor.

e) Compatible Repair Coatings: APCS-113A.

f) The required voltages for holiday detection of the coating prior to burial are 2400 ± 50 volts DC.

Commentary Note:

Mandatory technical properties and storage, mixing, and application requirements shall be as given in the Saudi Aramco Data Sheets,SAES-H-002V.

Attachment A – Quality Control Equipment Kit

1. Quality Control Equipment Check Sheet (Attachment B)
2. In-Process Inspection Sheet (Attachment C)
3. Anchor Pattern Measurement Device(s)
4. Wet Film Thickness Gage
5. Dry Film Thickness Gage (with a range appropriate for the Coating)
6. High Intensity Battery Powered Light for Internal Coatings
7. Coveralls
8. Lint-Free Gloves
9. Rubber-Soled Shoes
10. Thermometer for Air Temperature
11. Humidity Gage or Sling Psychrometer
12. Contact Thermometer for Metal Temperature
13. Sharp Knife
14. Hypodermic Needle Pressure Gage
15. Disposable Dust Covers for Shoes
16. SSPC-PA 2, "Paint Thickness Measurement"

Attachment B – Quality Control Equipment Check Sheet

Organization: _____ Job Location _____

Compressor: _____ Date _____

	1	2	3	4	5
Size	_____	_____	_____	_____	_____
Manifold Outlet	_____	_____	_____	_____	_____
Size	_____	_____	_____	_____	_____
Gauges	_____	_____	_____	_____	_____
No. of Outlets	_____	_____	_____	_____	_____
Oil Leaks	_____	_____	_____	_____	_____
General Condition	_____	_____	_____	_____	_____

Remarks: _____

_____

Deadman Handles and Hoses: Fitted _____ Not Fitted _____

Hoses Antistatic: Yes____ No____ Couplings and Safety Pins: Yes____ No____

Remarks: _____

_____

Air Hoods, Air Lines, and Purifiers: Type _____ Size _____

Condition: _____

_____

Blast Nozzles: Size _____ Condition _____ Size _____

Remarks: _____

Attachment B – Quality Control Equipment Check Sheet (Cont'd)

Blast Pots

	1	2	3	4	5
Type	_____	_____	_____	_____	_____
Size	_____	_____	_____	_____	_____
Condition	_____	_____	_____	_____	_____
Mixing Valves	_____	_____	_____	_____	_____
Moisture Traps	_____	_____	_____	_____	_____

Remarks: _____
_____

Compressor to Blast Pot Air Hoses: Size _____ Condition _____
Remarks: _____
_____

Airless Spray: _____

	1	2	3
No. of Spare Filters	_____	_____	_____
Hand Set	_____	_____	_____
Liquid Line Size	_____	_____	_____
Hand Set Condition	_____	_____	_____
Gauges	_____	_____	_____
Tip Size	_____	_____	_____
Condition of Reversible	_____	_____	_____
No. of Machines on Site	_____	_____	_____
Spare Hand Set	_____	_____	_____
Spare Tip	_____	_____	_____
Tools	_____	_____	_____

Remarks: _____
_____

Paint Mixers: Type _____ Size _____
Remarks: _____
_____

Crew Supervisor: _____
Saudi Aramco Inspector's Name: _____ Signature _____

Attachment C – In Process (Inspection Sheet)

Date: _____
Time: _____ To _____

	Crew Supvr. (Init. Line)	Saudi Aramco Insp. (Init. Line)
I. Surface Preparation		
A. Chemical Cleaning		
1. Required? (Circle) Yes No	_____	_____
1.1 If Required, Check The Type Solvent Clean _____ Detergent Wash _____ Steam Clean _____		
1.2 If Required, Acceptable? (Circle) Yes No	_____	_____
1.3 Chloride Residue Cleaning (Circle) Yes No	_____	_____
B. Grinding		
1. Required? (Circle) Yes No	_____	_____
1.1 If Required, Acceptable? (Circle) Yes No	_____	_____

Remarks: _____
_____

C. Abrasive Blasting		
1. Dew Point - Start _____, Mid Point _____	_____	_____
2. Substrate Temp-Start ____, Mid Point _____	_____	_____
3. Nozzle Press. - Start ____, Mid Point _____		_____
4. Anchor Pattern-Start ____, Mid Point _____	_____	_____
5. Degree of Cleanliness:		
Start (Sa) _____	_____	_____
Mid Point (Sa) _____	_____	_____

Remarks: _____
_____

Attachment C (Cont'd)

						Crew Supvr. (Init. Line)	Saudi Aramco Insp. (Init. Line)
D.	Pre-Priming Cleanliness						
	1.	Dust and Abrasive Removed By Brushing? (Circle)	Yes	No		_____	_____
	2.	Substrate Vacuumed (Circle)	Yes	No		_____	_____
*	3.	Acceptable For Priming (Circle)	Yes	No		_____	_____
II.	Painting						
A.	Prime Coat						
*	1.	Ensure All Non-Explosion Proof Lighting Has Been Disconnected Prior to the Start and During Painting				_____	_____
	2.	Ventilation Acceptable? (Circle)	Yes	No		_____	_____
	3.	Mixing Acceptable? (Circle)	Yes	No		_____	_____
	4.1	Ratio of Thinning (If Req): _____				_____	_____
	5.	Dew Point:Start _____, Mid Point _____				_____	_____
	6.	Substrate Temp:Start ____, Mid Point____				_____	_____
	7.	Average Wet Film Thickness: _____				_____	_____
	8.	Average Dry Film Thickness: _____				_____	_____
*	9.	Prime Coat Acceptable (Circle)	Yes	No		_____	_____

Remarks: _____
_____

B.	Intermediate Coat						
*	1.	Ensure All Non-Explosion Proof Lighting has been Disconnected Prior to the Start and During Painting					
	2.	Ventilation Acceptable? (Circle)	Yes	No		_____	_____
	3.	Mixing Acceptable? (Circle)	Yes	No		_____	_____
	4.	Ratio of Thinning: (If Req) _____				_____	_____
	5.	Dew Point: Start _____, Mid Point _____				_____	_____
	6.	Substrate Temp: Start _____, Mid Point _____				_____	_____
	7.	Average Wet Film Thickness _____				_____	_____
	8.	Average Dry Film Thickness _____				_____	_____
*	9.	Intermediate Coat Acceptable (Circle)	Yes	No		_____	_____

Remarks: _____

Attachment C (Cont'd)

						Crew Supvr. (Init. Line)	Saudi Aramco Insp. (Init. Line)
C.	Top Coat						
*	1.	Ensure All Non-Explosion Proof Lighting has been Disconnected Propr to the Start and During Painting					
	2.	Ventilation Acceptable?	(Circle)	Yes	No		
	3.	Mixing Acceptable?	(Circle)	Yes	No		
	4.1	Ratio of Thinning - (If Req)					
	5.	Dew Point: Start _____, Mid Point					
	6.	Substrate Temp: Start _____, Mid Point					
	7.	Average Wet Film Thickness					
	8.	Average Dry Film Thickness					
	9.	Final Curing Time Time _____ At Steel Temp _____					
*	10.	Top Coat Acceptable	(Circle)	Yes	No		

Remarks: _____
_____

* Indicates Mandatory Saudi Aramco Inspection Points

Attachment D – Paints/Coatings and Equipment Log

PLANT NO. _____ PLANT NAME _____
Equipment No. _____ Type _____
Service Fluid _____ Working Pressure _____Temp. _____
Previous Coating _____ Shop/Field Applied _____

CONTRACTOR ORGANIZATION:
Name _____ Reg. No. _____ Phone No. _____
Work Started _____ Work Completed _____

ABRASIVE BLAST: Sa _____
Started _____ AM/PM Date _____ Finished _____ AM/PM Date _____
Compressor Size _____ (CFM/1000LPM, etc.) Nozzle Size _____
Moisture-Oil Separator Size _____
Grit SAMS Stock No. _____ Amount at Job Site _____
Air Hose Size _____ Length _____ Blast Hose Size _____ Length _____

COATING SPECIFICATION: APCS _____

Primer Prod. No. _____	Topcoat Prod. No. _____
Mfgr. Date _____	Mfgr. Date _____
Batch No. _____	Batch No. _____
Color _____	Color _____
SAMS Stock No. _____	SAMS Stock No. _____
Amount at Job Site _____	Amount at Job Site _____

STORAGE TEMPERATURE: _____ºC Max

COATING APPLIED BY (Brush-Airless-Conventional) _____

REMARKS: _____
_____
_____

CREW SUPERVISOR: Name _____ Signature _____

Saudi Aramco INSPECTOR: Name _____ Signature _____

Mailing Address _____ Phone No. _____

Table 1 – Dew Point Calculation Chart Ambient Air Temperature (Degrees Celsius)

% Relative Humidity	-7°C	-1°C	4°C	10°C	16°C	21°C	27°C	32°C	38°C	43°C	49°C
90	-8	-2	3	8	14	19	25	31	36	42	47
85	-8	-3	2	7	13	18	24	29	35	40	45
80	-9	-4	1	7	12	17	23	28	34	39	43
75	-9	-4	1	6	11	17	22	27	33	38	42
70	-11	-6	-1	4	10	16	20	26	31	36	41
65	-11	-7	-2	3	8	14	19	24	29	34	39
60	-12	-7	-3	2	7	13	18	23	28	33	38
55	-13	-8	-4	1	6	12	16	21	27	32	37
50	-14	-9	-5	-1	4	10	15	19	25	30	34
45	-16	-11	-6	-2	3	8	13	18	23	28	33
40	-17	-12	-8	-3	2	7	11	16	21	26	31
38	-19	-13	-9	-5	-1	4	9	14	18	23	28
30	-21	-16	-11	-7	-2	2	7	11	16	21	25

Example: If the air temperature is 21°C and the relative humidity is 70%, the dew point is 16°C.

Table 2 – Calculating DFT, WFT and Theoretical Coverage

Dry Film Thickness (DFT):

No solvent added: DFT = WFT x % Solids by volume

Solvent added: DFT = WFT x (% Solids by volume / 1 + % thinner by volume)

Theoretical Coverage:

$$\text{Coverage } (m^2) = \text{No. L coating} \times \text{\% Solids per L} \times \frac{1000}{\text{DFT(micrometers)}}$$

$$\text{Coverage } (ft^2) = \text{No. Gal coating} \times \text{\% Solids per Gal} \times \frac{1604}{\text{DFT(mils)}}$$