Engineering Standard

SAES-H-001 28 September 2005

Coating Selection & Application
Requirements for Industrial Plants & Equipment

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Saudi Aramco DeskTop Standards

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1 Scope

1.1 This Standard covers the minimum mandatory coating requirements for the internal and external protection of industrial facilities inside plants.

This Standard does not apply to infrastructure facilities, powder coatings, or decorative coatings unless specified in the scope of work or other mandatory Saudi Aramco document.

1.2 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*

Saudi Aramco Engineering Standards

SAES-B-006	*Fireproofing for Plants*
SAES-H-101V	*Approved Saudi Aramco Data Sheets - Paints and Coatings*

Saudi Aramco Materials System Specifications

09-SAMSS-021	*Alkyd Enamel Coating System (APCS - 6)*
09-SAMSS-030	*Conversion Coating / Alkyd Coating System (APCS - 7)*
09-SAMSS-035	*Aluminum Pigmented Alkyd Coating System (APCS - 4)*
09-SAMSS-060	*Packaging Requirements for Coatings*
09-SAMSS-067	*Epoxy Coating for Immersion Service*
09-SAMSS-068	*Qualification Requirements for Coal Tar Epoxy in Buried or Immersion Services (APCS-3)*
09-SAMSS-069	*Epoxy Coating for Atmospheric Service (with and without Polyurethane Topcoat)*
09-SAMSS-070	*Epoxy Splash Zone Compound (APCS - 19A and APCS - 19B)*
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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)*

Saudi Aramco Inspection Requirement

Form 175-09 Series	*Coating: Shop-Applied*

Saudi Aramco General Instruction

GI-0006.021	*Safety Requirements for Abrasive Blast Cleaning*

3.2 Industry Codes and Standards

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 D512	*Standard Test Methods for Chloride Ion in Water*
ASTM D516	*Standard Test Method for Sulfate Ion in Water*

Swedish Standards Institution

SIS 05-59-00	*Pictorial Surface Preparation Standard for Painting Steel Surfaces*

The Society of Protective Coatings

SSP-Vis 1	*Guide to Vis 1 - 89 - Visual Standard for Abrasive Blast Cleaned Steel*
SSPC-Vis 2	*Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces*
SSPC-PA 2	*SSPC Method of Measurement of Dry Paint Thickness with Magnetic Gages*
SSPC-SP1	*Solvent cleaning*
SSPC-SP2	*Hand tool cleaning*
SSPC-SP3	*Power tool cleaning*
SSPC-SP7	*Brush-off blast cleaning*
SSPC-SP6	*Commercial blast cleaning*
SSPC-SP10	*Near white blast cleaning*
SSPC-SP5	*White metal blast cleaning*
SSPC-SP12	*Water Jetting*

4 Definitions

Approved Product: A coating material that has been approved by the RSA as meeting the requirements of the applicable APCS or SAMSS. If no applicable APCS or SAMSS exists, the product must be certified in writing by the RSA that it is suitable for the intended service. Only approved products are allowed for use on Saudi Aramco jobs. These requirements apply to all coatings referred to in all the SAES-H-series standards.

Corrosive Industrial Atmosphere: Areas exposed to gases, fumes, mists or dusts from chemical or industrial facilities. This term does not include direct contact with splashed or spilled chemicals.

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. Replacing completely 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.

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.

Responsible Standardization Agency (RSA) Representative: The Coatings Engineer who is designated by the Manager, Consulting Services Department in accordance with Material Supply Organization's instruction MI-350.020.

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.

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 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 80°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's 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.

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 ASME SEC VIII D1, Unfired Pressure Vessels. They 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

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 outside confined areas or in an adequately ventilated area.

5.4.4.2 Electrically driven power mixers shall be grounded.

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 Other workmen In Vicinity	x		x x	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	
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:

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 I).

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.

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 (see definition in SAES-H-101) 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 abrasive blasting shall be SIS 05-59-00 and SSPC Vis 1.

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 shall be kept dry and clean. Regardless of the type of abrasive, the sulfate content shall be less than 100 PPM, the chloride shall be less than 100 PPM, and calcium carbonate shall be 2.0% maximum by weight.

6.3.4 The use of reclaimed slag abrasives is prohibited. The use of reclaimed garnet is permitted provided if it meets the requirements of CSD-approved recycling system (refer to the RSA).

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 Prior to blasting, rough welds and cut-offs shall be ground to a minimum radius to ensure proper coating application. Weld spatter shall be removed.

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 I.

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 flood 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 Clemtex Anchor Pattern Standards. This does not preclude the use of other techniques providing they agree with the reference standard.

7 Coating Materials Selection

7.1 Exterior Surfaces, Atmospheric Exposure

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
A. Mild Atmospheric Exposure Tanks Vessels Non-galvanized Structural Steel Equipment such as heat exchangers, rotating equipment, etc.	APCS-4 APCS-6 APCS-1B APCS-1E APCS-22 APCS-26 APCS-26T	APCS-4 APCS-6 APCS-1B APCS-1E APCS-22 APCS-26 APCS-26T APCS-7	1. Use APCS-4 on steel operating up to 80°C when an aluminum finish is required. 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 limits for APCS-4 and APCS-6 and 150°C. 4. Use APCS-22 on steel operating up to 150°C 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. APCS-7 can be used to maintain APCS-4 or APCS-6 (only) when areas of bare, slightly rusted steel are present. 7. Use APCS-1B on the inside surface of the top shell course in floating roof (external) tanks if corrosion protection is needed.

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
B. Corrosive Industrial Atmospheric Exposure Tanks, Vessels, Non-galvanized Structural Steel, Equipment such as heat exchangers, rotating equipment, etc.	APCS-1A APCS-1B APCS-1D APCS-1E APCS-22 APCS-26T	APCS-1B APCS-1C APCS-1E APCS-1F APCS-22 APCS-26 APCS-26T	1. Use APCS-1A on steel in wetted and/or corrosive industrial environments operating at temperatures up to 150°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 150°C and located indoors or outdoors. b. To maintain systems APCS-1A and APCS-1B. 3. Use APCS-1C for maintenance painting steel in wetted and/or corrosive industrial environments: a. Operating at temperatures up to 150°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-22 on steel operating up to 150°C that is located outdoors and that will be coated in the field when surfaces will be damp during application.

Description	Coating System		Remarks
	New	Maintenance	
B. (Cont'd)			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 offshore). 10. Use APCS-1B on the inside surface of the top shell course in floating roof tanks if corrosion protection is needed.
C. Insulated Tanks and Vessels	APCS-2A APCS-2C APCS-17A APCS-17B	APCS-2A APCS-2C APCS-17A APCS-17B	1. Coating is not required if operation is continuously above 65°C and the facility is in service at least 90% of the time, unless it is subject to wash down or deluge. 2. Use APCS-2A on steel cycling below 65°C and up to 90°C. See Remark 1. 3. Use APCS-2C on steel cycling below 65°C and up to 20°C. See Remark 1. 4. Use APCS-17A on steel cycling below 65°C and up to temperatures between 120°C and 400°C that will be coated when the relative humidity will be above 50%. See Remark 1. 5. Use APCS-17B on steel cycling below 65°C and up to temperatures between 120°C and 400°C that will be coated when the relative humidity will be below 50%. See Remark 1. 6. Use APCS-2A on steel operating at cryogenic temperatures.
D. Elevated Temperature (Uninsulated) Tanks, Vessels, boilers, stacks, heaters, heat exchangers, etc.	APCS-11A APCS-11B	APCS-11A APCS-11B	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.

Description	Coating System		Remarks
	New	Maintenance	
E. Fireproofing	APCS-1B	APCS-1B	1. Use APCS-1B primer only prior to the installation of intumescent fireproofing material, and the complete system of APCS-1B before the installation of cementitious fireproofing. The intermediate and top coats of the APCS-1B system are used over both fireproofing systems. 2. For galvanized steel, sweep blast to abrade the surface prior to the application of APCS-1B primer.
F. Auxilliary Equipment i. Engineered Equipment (i.e., Cranes, Launchers, Receivers, skid mounted items, etc.)	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. 2. Coat engineered equipment using the coating systems and selection criteria given in paragraphs 7.11.A or 7.1.B as appropriate.
ii. "Off-the-Shelf" Equipment (i.e., Valves, Motors, Electrical Equipment, etc.)	See Remarks APCS-26 APCS-26T APCS-6	See Remarks APCS-26 APCS-26T	1. A detailed description of the manufacturer's standard coating system shall be submitted to the RSA for review prior to use. No additional coating is required when the manufacturer's standard finish meets the following conditions: a. The coating is suitable for the intended use of the item. b. The coating can be maintenance coated with standard Saudi Aramco approved coatings. 2. Use APCS-26 over the equipment manufacturer's standard finish when that finish is not suitable for the intended use of the equipment and it operates up to 120°C, located indoors or outdoors. 3. Use APCS-26T over the equipment manufacturer's standard finish when that finish is not suitable for the intended use of the equipment and it operates up to 80°C, located outdoors.
G. Fasteners, Carbon Steel and Low Alloy	See Remarks	See Remarks	1. Galvanized and fluoropolymer (09-SAMSS-107) coated fasteners can be used without subsequent coating.

Description	Coating System		Remarks
	New	Maintenance	
H. Galvanized Steel	APCS-26 APCS-26T APCS-1B	APCS-26 APCS-26T APCS-22 APCS-1C APCS-1B	1. Not normally coated, but may require coating for reasons of appearance or increased chemical resistance. 2. Clean per SSPC-SP1 and lightly abrade the galvanized surface using hand or power tools. 3. Use APCS-26 on galvanized steel operating up to 120°C and located indoors or outdoors. 4. Use APCS-26T on galvanized steel operating up to 80°C; located outdoors. 5. Use APCS-22 on galvanized steel operating up to 150°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.
I. Aluminum	APCS-26 APCS-26T APCS-22	APCS-26 APCS-26T APCS-22	1. Not normally coated, but may require coating for reasons of appearance or increased chemical resistance. 2. Lightly abrade the aluminum surface using hand or power tools 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-22 on aluminum located outdoors and operating up to 150°C and that will be coated in the field when surfaces will be damp during application.
J. Stainless Steel and Copper Alloys	See Remarks	See Remarks	Normally not coated. Use chloride-free products when coating stainless steels. Contact the RSA prior to coating these materials.

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
K. Steel Accessories Hand Rails, Stairways, Ladders, Brackets, etc.	See Remarks	See Remarks	1. Hot dip galvanized or coated using the coating systems and selection criteria given in 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	
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 galvanizing. 2. See paragraph 7.1.H for galvanizing repair.
N. Electrical Conduit	See Remarks	See Remarks	See Saudi Aramco Engineering Standard SAES-P-104.

7.2 Exterior Surfaces, Buried

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
A. Structural Steel:	APCS-2A APCS-3 APCS-113A	APCS-2A APCS-3 APCS-113A	
B. Driven Piling and Sheet	APCS-3 APCS-104 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 APCS-3 or APCS-113A for field applications and APCS-104 for shop application.
C. Tank bottoms (soil side)	APCS-3 APCS-113A	See Remarks	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.

7.3 Interior Coatings on Tanks and Vessels

Description	Coating System		Remarks
	New	Maintenance	
A. Interior of Hydrocarbon Storage Tanks & Dark Products such as crude oil and heavy refined products	APCS-2A APCS-2E APCS-3	APCS-2A APCS-2E APCS-3 APCS-20A APCS-20B	1. APCS-3 usage is limited to operating temperature up to 70°C. 2. Use APCS-2A on tanks operating up to 90°C. 3. Use APCS-20A or APCS-20B for renovation of badly corroded tanks. 4. 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. 5. Coat the vapor space areas including the roof underside of external floating roof tanks with APCS-2A or APCS-3. For internal floating roof tanks, coat the space areas between the two roofs including the internal roof topside and the fixed roof underside. Utilize the same coating used for external floating roofs. Coating is not required on the roof underside of internal floating roof tanks. 6. Internal floating roof made of aluminum or stainless steel shall not be coated.

Description	Coating System		Remarks
	New	Maintenance	
B. Interior of Hydrocarbon Storage Tanks; Light Products except jet fuel	APCS-2A APCS-2E APCS-2F APCS-2G	APCS-2A APCS-20A APCS-20B APCS-2E APCS-2F APCS-2G	1. Use APCS-2A and APCS-2E on tanks operating up to 90°C. 2. Use APCS-2F and APCS-2G on tanks with operating temperatures exceeding 90°C. 2. Use APCS-20A or APCS-20B 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. Coat the vapor space areas of external floating roof tanks with APCS-2A, APCS-2E, APCS-2F or APCS-2G. Also, coat the sides of the pontoon of the internal floating roof.
C. Interior of Water Tanks: Raw Water for Industrial Use	APCS-2A APCS-2E APCS-2F APCS-2G	APCS-2A APCS-20A APCS-20B APCS-2E APCS-2F APCS-2G	1. Use APCS-2A and APCS-2E on tanks operating up to 90°C. 2. Use APCS-2F and APCS-2G on tanks operating at temperatures exceeding 90°C. 3. Use APCS-20A or APCS-20B for renovation of badly corroded tanks. 4. 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. 3. Hot dip galvanized steel is acceptable in lieu of coating for small drinking water tanks.
E. Interior of Aviation Fuel and Kerosene Storage Tanks	APCS-2D	APCS-2D	
F. Chemicals	See Remarks	See Remarks	Coating requirements vary with service. Contact the RSA.

Description	Coating System: New	Coating System: Maintenance	Remarks
G. Interior of Hot Water Tanks; Demineralized Water, Boiler Skim Water Tanks, etc.	APCS-2A APCS-2C APCS-2E APCS-2F APCS-2G	APCS-2A APCS-2C APCS-20A APCS-20B APCS-2E APCS-2F APCS-2G	1. Use APCS-2A and APCS-2E on tanks operating up to 90°C. 2. Use APCS-2C on tanks operating up to 120°C. 3 Use APCS-2F and APCS-2G on tanks operating up to 105°C. 4. Use APCS-20A or APCS-20B for renovation of badly corroded tanks. 5. Coat entire interior including all internals except anodes.
H. Interior of Gas/Oil/Water Separators, Desalters, and Dehydrators	APCS-2A APCS-2C APCS-2E APCS-2F APCS-2G	APCS-2A APCS-2C APCS-2E APCS-2F APCS-2G	1. Use APCS-2A and APCS-2E on vessels operating up to 90°C. 2. Use APCS-2C on tanks operating up to 120°C. 3. Use APCS-2F and APCS-2G on tanks operating up to 105°C. 4. For GOSP traps, degassers, and WOSEP's in wet sour service, coat entire interior surface including all internals except anodes and heating coils. For wet sweet service, coat 0.3 m above maximum expected water level. 5. For desalters and dehydrators, coat the bottom 60% including all internals except anodes up to this level. Also coat the last 25-50 mm of the tips of the grid.
I. Heat Exchanger **i. Tubes** **ii. Tube Covers** **iii. Tube Sheets**	APCS-100 APCS-100 APCS-2A APCS-2F APCS-2G	APCS-100 APCS-100 APCS-2A APCS-2F APCS-2G	
J. Interior of Launchers and Receivers			1. Coat entire interior up to the main block valve.

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

Coating Being Applied.

EXISTING COATING	Epoxy	Coal Tar Epoxy	Epoxy Mastic	Epoxy Enamel	Zinc Silicate	Alkyd
Epoxy [2]	Y	Y	Y	Y	N	Y[3]
Coal Tar Epoxy [2]	Y	Y	Y[3]	Y	N	Y[3]
Epoxy Mastic [2]	Y[3]	Y	Y	Y	N	Y[3]
Epoxy Enamel [2]	Y[3]	Y[3]	Y	Y	N	Y[3]
Zinc Silicate	Y	Y	Y	Y	Y[3]	N
Alkyd	N	N	Y	N	N	Y
Silicone Alkyd	N	N	N	N	N	N
Polyurethane Enamel	Y[3]	Y[3]	N	N	N	Y[1]
Bituminous	N	N	N	N	N	Y[3]
Chlorinated Rubber	N	N	N	N	N	Y
Latex Emulsion	Y[3]	Y[3]	N	N	N	Y
Lacquer	N	N	N	N	N	Y[3]
Vinyl Ester						
Polyester						
Phenolic Epoxy						
(FFB will add new coatings)						
Y = Yes	**N = No**		**Y[3] = See Note 3**			

EXISTING COATING	Silicone Alkyd	Poly-urethane Enamel	Bituminous	Chlorinated Rubber	Latex Emulsion	Lacquer
Epoxy [2]	N	Y	Y[3]	Y[1]	Y[1]	Y[3]
Coal Tar Epoxy [2]	N	Y[3]	Y[3]	Y[1]	Y[1]	N
Epoxy Mastic [2]	N	Y	Y[3]	N	Y[1]	N
Epoxy Enamel [2]	N	Y	N	N	Y[1]	N
Zinc Silicate	Y	Y	N	Y	N	N
Alkyd	N	N	Y	N	Y	N
Silicone Alkyd	Y	N	N	N	N	N
Polyurethane Enamel	N	Y	N	N	N	N
Bituminous	N	N	Y	N	Y	N
Chlorinated Rubber	N	N	N	Y	Y	N
Latex Emulsion	N	N	N	Y[3]	Y	Y[3]
Lacquer	N	N	N	N	Y	Y
Y = Yes (FFB will add new coatings)	**N = No**		**Y[3] = See Note 3**			

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. Consult the RSA before choosing or applying this combination.

8 Coating Application

8.1 Coating Preparation

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

8.1.2 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 unless authorization to the contrary is given by the RSA.

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.

8.1.3 If thinning is required, the thinner type and quantity to be added shall be as given in the Saudi Aramco Data Sheet (see definition in SAES-H-101). 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.

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

8.1.5 Partial mixing and use of two-component and multi-component coatings is prohibited.

8.2 Coating Application

8.2.1 Coating shall not be applied if one or more of the following conditions exist unless the coating is specifically formulated for the averted condition:

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 I).

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.

8.2.2 In multi-coat applications, primer, intermediate coat, and topcoats shall be of contrasting colors.

8.2.3 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

8.2.4 When using inorganic zinc primer the contractor shall check for surface zinc oxide formation immediately prior to applying an epoxy topcoat. 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.

8.2.5 Recoating intervals shall be as given in the Saudi Aramco Data Sheet. (See definition in 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-101.

8.2.6 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 PA2.

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 8.3.

Commentary Note:

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

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

8.2.8 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.

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

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

Exception:

See paragraph 8.2.3 for stripe coats.

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

8.3.3 Holding primers, if permitted to be used, shall be first approved by the RSA.

8.3.4 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.

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

8.3.6 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 8.5.

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

Exceptions:

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

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

8.4.1 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.

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

8.4.3 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.

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

8.4.5 High voltage dry spark holiday detector shall be used to detect pinholes and coating film discontinuity after the full coating system is fully cured.

8.5 Repair Procedure for Immersion Coatings

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

8.5.2 Clean defective area by solvent or detergent wash.

8.5.3 For areas less than 0.1 m², grind to a rough metal surface using at least an 80 grit disc sander. Alternatively, spot blast to bare steel. Feather edge the coating at least 50 mm beyond bare metal.

8.5.4 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.

8.5.5 Remove dust and debris by brush or vacuum.

8.5.6 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.

8.5.7 The full coat of the repair coating shall be holiday tested when cured.

8.6 **Repair Procedure for Atmospheric Coatings** - Follow the surface preparation and application requirements in the applicable APCS and the manufacturer's technical data sheet.

9 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.

9.1 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.

9.2 Quality Control Records

9.2.1 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.

9.2.2 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.

9.2.3 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.

9.2.4 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.

9.2.5 Final Acceptance Report

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

9.2.6 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.

9.3 Additional Inspection Requirements Applicable to Purchase Orders

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

10 Approved Protective Coating Systems

10.1 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-2F	*Glass Flake Reinforced Polyester 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 105°C*
APCS - 3	*Coal Tar Epoxy Coating System for Immersion Service (Self-Priming)*
APCS - 4	*Aluminum-Pigmented Alkyd Coating System*
APCS- 5	*Thermal Reflective and Insulating External Coating*
APCS - 6	*Alkyd Enamel Coating System*
APCS - 7	*Rust Conversion Primer/Alkyd Topcoat System for Use on Slightly Rusted Steel*
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 - 12	*Nonskid Epoxy Coating System for Floors and Decks*
APCS - 17A	*Inorganic Zinc Primer, Solvent Based*
APCS - 17B	*Inorganic Zinc Primer, Water Based*
APCS - 19A	*Splash Zone Compound, Hand Applied*
APCS - 19B	*Splash Zone Compound, Spray Applied*
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 – 23	*High Temperature Mastic Paint for Buried or Immersion Service (Self-Priming)*
APCS – 26	*Epoxy Mastic Coating (Self-Priming)*
APCS - 26T	*Epoxy Mastic/Polyurethane Coating System*

10.2 Service condition limitations for the APCS's assume continuous service. For intermittent service, contact the RSA in the Consulting Services Department.

10.3 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).

10.4 In cases where a coating appears otherwise acceptable but has been applied at thicknesses greater than the specified maximum, consult the RSA, who will determine if the intent of the standard has been violated and what corrective action, if any, is needed.

10.5 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.

10.6 Coatings that have exceeded their shelf life shall not be used unless written approval is obtained from the RSA.

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: 150°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 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) St 3 (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	Topcoats:	Two or more coats 150 micrometers, maximum per coat
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 - 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: 150°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 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) St 3 (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	Topcoats:	Two or more coats 150 micrometers, maximum per coat
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 - 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: 150°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 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) St 3 (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 Topcoats: Two or more coats
150 micrometers, maximum per coat

4.2 Total System: Minimum 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 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) St 3 (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 or more coats 100-150 micrometers, minimum-maximum
4.1.3	Topcoat:	One coat 25-65 micrometers, minimum-maximum

4.2	Total System:	Minimum 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 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) St 3 (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 or more coats 100-150 micrometers, minimum-maximum
4.1.3	Topcoat:	One coat 25-65 micrometers, minimum-maximum

4.2	Total System:	Minimum 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 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:	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 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) St 3 (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 or more coats 125-175 micrometers, minimum-maximum
4.1.3	Topcoat:	One coat 25-65 micrometers, minimum-maximum

4.2	Total System:	Minimum 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 General 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 (SP5)
3.1.2	Touch-up:	Sa 3 (SP5) Refer to repair procedure in SAES-H-100 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

4.1	Each Coat:	Three or more coats 125 micrometers, maximum per coat
4.2	Total System:	Minimum 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 - 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 (SP5)
3.1.2	Touch-up:	Sa 3 (SP5) Refer to repair procedure in SAES-H-100 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:	Three or more coats 125 micrometers, maximum per coat
4.2	Total System:	Minimum 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 (SP5)
3.1.2	Touch-up:	Sa 3 (SP5) Refer to repair procedure in SAES-H-100 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

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 or more coats 125 micrometers, maximum per coat

4.2	Total System:	Three or more 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 is not normally recommended for potable water immersion service. In these cases, consult the RSA.

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 (SP5)

3.1.2 Touch-up: Sa 3 (SP5) Refer to repair procedure in SAES-H-100 for areas less than0.1 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:	Two or more coats 125 micrometers, maximum per coat
4.2	Total System:	Minimum 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 (ga) (3,000 psig)

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers (SAMS Stock Numbers)

Coating:	1000658840 (09-000-472) or 1000683474 (09-000-496) depending on color
Thinner:	1000647354 (09-000-465)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 3 (SP5)
3.1.2	Touch-up:	Sa 3 (SP5) Refer to repair procedure in SAES-H-100 for areas less than 0.1 m².

3.2	Profile:	40 - 100 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865) or 1000160374 (08-202-900).

4 Dry Film Thickness Requirements

4.1	Each Coat:	Two coats 300 micrometers, maximum per coat
4.2	Total System:	Minimum two coats 500 – 600 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-2F

1 Type of Coating

Glass Flake Polyester Coating System for General Immersion Service (one coat system).

2 General Data

2.1 Typical Use

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

2.2 Service Limitation

2.2.1 Maximum Service Temperature: 100°C

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

2.2.3 Not suitable for demineralised water and polar solvents.

2.3 Purchase Specification: 09-SAMSS-067

In addition to the following specifications: tensile strength > 3700psi, elongation at break 1.3% in immersion condition, abrasion resistance < 430 gm loss per 1000 cycles per 1000 gm load, and Hardness > 40 Barcol after full cure.

2.4 SAMS Stock Numbers: contact RSA

3 Surface Preparation

3.1 Minimum Cleanliness Level

3.1.1	Initial :	Sa 3 (SP5)
3.1.2	Touch-up:	Sa 3 (SP5) Refer to repair procedure in SAES-H-100 for areas less than0.1 m²
3.2	Profile:	65 - 100 micrometers, minimum-maximum
	Abrasive:	S/N 08-220-865, 08-220-895, or 08-202-900

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 bracket should be stripe coated prior to spray apply coating
4.2 Total Film Thickness:	Maximum two coats 600 - 1000 micrometers, minimum-maximum

4.3 The total system thickness shall be applied in a single coat or two coats wet on wet. Use contrasting colors if the second coat is to be applied within the allowed re-coating intervals.

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 for Heavy-Duty Immersion Service (One Coat 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.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 105°C

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

2.2.3 Not suitable for demineralised water and polar solvents

2.3 Purchase Specification: 09-SAMSS-067

In addition to the following specifications: tensile strength > 38740psi, elongation at break 1.6% in immersion condition, abrasion resistance < 134 gm loss per 1000 cycles per 1000 gm load, and Hardness > 45 Barcol after full cure.

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

3.2	Profile:	65-100 micrometers, minimum-maximum
	Abrasive:	1000161068 (08-220-865) or 1000160374 (08-202-900)

4 Dry Film Thickness Requirements

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

4.2 Film thickness higher than 600 microns shall be applied in two coats with minimum overcoating intervals preferably.

4.3 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 - 3

1 Type of Coating

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

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.

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-068

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:	Sa 2-1/2 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) Refer to repair procedure in SAES-H-100 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	Each Coat:	Two or more coats 300 micrometers, maximum per coat
4.2	Total System:	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.

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. (See APCS - 26/26T).

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 (SP6)
3.1.2	Touch-up:	Sa 2 (SP6) St 3 (SP3) for areas less than 1.0 m²
3.2	Profile:	Min.: Not critical Max.: 40 micrometers
	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 or more coats 50 micrometers, maximum per coat 75 micrometers, minimum primer total
4.1.2	Topcoats:	One or more coats 40 micrometers, maximum per coat

4.2 Total System: Minimum 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 – 5

1 Type of Coating

Thermal Reflective and Insulating External Coating.

2 General Data

2.1 Typical Use

External coating for petroleum tanks, vessels and drums to reduce the solar heat gain and to minimize the evaporation losses. Suitable as alternative safety protection for hot piping.

2.2 Service Condition Limitations

Maximum Service Temperature: 450°F (232°C)

Used with approved primer and top coat for color retention

2.3 Purchase Specifications

Solar Reflectance shall not be less than 80% as per ASTM-903

Emittance Value shall not be less than 90% as per ASTM-408

The coating shall pass 1500 hour of Salt fog test ASTM B-117 without any rust creapage, blistering and cracking

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1	Initial:	Sa 2-1/2 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) St 3 (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: S/N 08-220-865, 08-220-895, or 08-202-900

4 Dry Film Thickness Requirements

For tanks, vessels, and drums 300 – 500 microns, minimum- maximum

For hot piping (safety) 500 microns reduce substrate temp. 40°F

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

3.2	Profile:	Min.: Not Critical Max.: 40 micrometers
	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 or more coats 50 micrometers, maximum per coat 75 micrometers, minimum primer total
4.1.2	Topcoats:	One or more coats 50 micrometers, maximum per coat

4.2	Total System:	Minimum 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 - 7

1 Type of Coating

Rust Conversion Primer/Alkyd Topcoat System for Use on Slightly Rusted Steel.

2 General Data

2.1 Typical Use

Maintenance coating system for APCS - 4 and APCS - 6. Applied directly to bare, slightly rusted steel surfaces. Not intended as an intermediate or tie coat over sound coatings.

2.2 Service Condition Limitations

Maximum Service Temperature: 70°C

2.3 Purchase Specification: 09-SAMSS-030

2.4 SAP Material Numbers (SAMS Stock Numbers)

2.4.1 Conversion Coating: 1000195390 (09-612-730)

2.4.2 Topcoat: Rust conversion coatings are only approved for use with specific topcoats. Refer to 09-612-730 or to the RSA for acceptable conversion coating/topcoat combinations.

3 Surface Preparation Requirements

3.1 Required Cleanliness Level

Slightly Rusted Steel: St 2 (SP 2) or St 3 (SP 3)

Note: Roughen (feather) adjacent sound coating.

3.2 Profile: Not critical

4 Dry Film Thickness Requirements

4.1 Rust Converter: One or more coats to the minimum thickness shown on the Saudi Aramco data sheet in SAES-H-10lV

4.2	Topcoats:	One or more coats 40 micrometers (1.5 mils) maximum per coat for aluminum alkyds 50 micrometers (2.0 mils) maximum per coat for alkyd enamels.
4.3	Total System:	Minimum three coats.
	Alkyd enamels:	50-100 micrometers (2-4 mils) above the thickness of the rust converter.
	Aluminum alkyds:	37-75 micrometers (1-½ to 3 mils) above the thickness of the rust converter.

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 (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 (SP10) St 3 (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:25-50 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 or more coats 50-75 micrometers, minimum-maximum
4.1.2	Topcoat:	One or more coats 50-100 micrometers, minimum-maximum

4.2	Total System:	Minimum 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.

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 (SP6)
St 3 (SP3) if less than 3m long.

3.1.2 General Steelwork: St 3 (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 (SP10)
3.1.2	Touch-Up:	Sa 2-1/2 (SP10) St 3 (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 (SP5)

3.1.2 Touch-up: Sa 3 (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 - 12

1 Type of Coating

Nonskid 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: 150°C

2.3 Purchase Specifications

2.3.1	Primer:	09-SAMSS-069
2.3.2	Topcoats:	09-SAMSS-069
2.3.3	Aggregate:	Nonskid 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 (SP10)

3.1.2 Touch-up: Sa 2-1/2 (SP10)
St 3 (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 or more coats
50-100 micrometers, minimum-maximum

4.1.2 Topcoats: Two or more 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:

a) Under thermal insulation in certain cyclic cryogenic and high temperature services.

b) A one-coat atmospheric coating system, with written RSA approval.

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 (SP10)

3.1.2 Touch-up: Sa 2-1/2 (SP10)
St 3 (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

a) Under thermal insulation in certain cyclic cryogenic and high temperature services.

b) A one-coat atmospheric coating system, with written RSA approval.

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 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) St 3 (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 - 19A

1 Type of Coating

Splash Zone Compound, Hand Applied Grade

2 General Data

2.1 Typical Use

Temporary maintenance coating on boat landings and non-critical steel surfaces in splash zone or immersion service. Patch repairs to APCS - 19A and APCS - 19B.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 80°C

2.2.2 Not suitable for use in contact with potable water.

2.3 Purchase Specification: 09-SAMSS-070

2.4 SAP Material Number (SAMS Stock Number)

1000194524 (09-612-345)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

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

3.2	Profile:	75 micrometers, minimum
	Abrasive:	1000161063 (08-220-850), 1000161200 (08-220-890) or 1000160377 (08-202-910).

4 Dry Film Thickness Requirements

Total System:	One coat 2500 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 - 19B

1 Type of Coating

Splash Zone Compound, Spray Applied Grade

2 General Data

2.1 Typical Use

Certain steel surfaces in splash zone areas of marine structures such as offshore platforms, jetties, and steel pilings. Also as a pipe coating at above/below ground transitions and road crossings.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 80°C

2.2.2 Not suitable for use in contact with potable water.

2.3 Purchase Specification: 09-SAMSS-070

2.4 SAP Material Number (SAMS Stock Number)

1000194520 (09-612-339)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

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

3.2 Profile:75 micrometers (3 mils), minimum

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

4 Dry Film Thickness Requirements

Total System:	One coat 2500 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 - 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 (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 (SP10)
St 3 (SP3) for areas less than 0.1 m^2

3.2 Profile: As recommended by the Coating Manufacturer.

4 Other Requirements

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

4.2 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 (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 dimensions of shell to bottom fillets in storage tanks shall be 25 mm.

3.1.2 Touch-up: Sa 2-1/2 (SP10)
St 3 (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: 150°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 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) St 3 (SP3) for areas less than 0.1 m^2

3.2 Profile:

40-75 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: 150°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 (SP10)
3.1.2	Touch-up:	Sa 2-1/2 (SP10) St 3 (SP3) for areas less than 0.1 m^2

3.2 Profile:40-75 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 - 23

1 Type of Coating

High Temperature Mastic Paint for Buried or Immersion Service (Self-Priming).

2 General Data

2.1 Typical Use

Buried steel pipe, tanks and structures.

2.2 Service Condition Limitations.

2.2.1 Maximum Service Temperature: 95°C.

2.2.2 Not suitable for exposure to sunlight or hydrocarbons.

2.3 Purchase Specification: None

2.4 SAP Material Numbers (SAMS Stock Numbers): 1000194097 (09-611-754) or 1000194111 (09-611-757) depending on can size

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

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

3.2 Profile:65 micrometers, minimum

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: 500 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 - 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 use two coats as minimum to build nominal dry film thickness of 250 microns.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 120°C

2.2.2 Usually 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) or 1000194471 (09-612-336) 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 3 (SP5)
	Touch-Up:	Sa 3 (SP5) St 2.5 (SP10) for areas less than 0.1 m^2

3.1.2 Maintenance Coating Steel Surfaces:

Exposed Steel: Sa 2 (SP6) for areas greater than 0.1 m^2
St 2 (SP2) for areas less than 0.1 m^2

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 40-75 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

4.1.1 Each Coat: One or more 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 or more coats
200 – 300 microns, minimum-maximum

4.2.2. Total System: Two coats 200 – 300 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.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 80°C

2.2.2 Usually 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 (SP6)

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

3.1.2 Maintenance Coating:

Exposed Steel: Sa 2 (SP6) for areas greater than 0.1 m^2
St 2 (SP2) for areas less than 0.1 m^2

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

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 200 – 300 microns, minimum-maximum
4.2.2	Topcoat	One coat 40 – 60 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).

Attachment A – Quality Control Equipment Kit

1. SAES-H-100, The Applicable APCS Sheet(s) From SAES-H-101, and the Approved Saudi Aramco Data Sheet(s) From SAES-H-101V.
2. Quality Control Equipment Check Sheet (Attachment "B")
3. In-Process Inspection Sheet (Attachment "C")
4. Anchor Pattern Measurement Device(s)
5. Wet Film Thickness Gage

6 Dry Film Thickness Gage (with a range appropriate for the Coating)

7. High Intensity Battery Powered Light for Internal Coatings
8. Coveralls
9. Lint-Free Gloves
10. Rubber-Soled Shoes
11. Thermometer for Air Temperature
12. Humidity Gage or Sling Psychrometer
13. Contact Thermometer for Metal Temperature
14. Sharp Knife
15. Hypodermic Needle Pressure Gage
16. Disposable Dust Covers for Shoes
17. SSPC PA2, "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	_____	
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.	Coating					
A.	Prime Coat					
*	1.	Ensure All Non-Explosion Proof Lighting Has Been Disconnected Prior to the Start and During Coating			_____	
	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 Coating				
	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 Coating				_____	
	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 – 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 _____

COATING APPLIED BY (Brush-Airless-Conventional) _____

REMARKS: _____
_____
_____

CREW SUPERVISOR: Name _____ Signature _____

Saudi Aramco INSPECTOR: Name _____ Signature _____

Mailing Address _____ Phone No. _____

Table I – 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 9-2 – 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:

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

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

Revision Summary

28 September 2005 Major revision.