SAUDI ARAMCO PETRO RABIGH
HPU2 SALES GAS CONVERSION PROJECT
SALES GAS COMPRESSOR PACKAGE (R280-K-1001)
SPEED INCREASING GEAR UNIT TECHNICAL SPECIFICATIONS Rev.0

(1)	Q'ty	:	One (1) set
(2)	Rated Power	:	1,900 kW
(3)	Input Speed	:	1,780 rpm (=100%)
(4)	Output Speed	:	11,701 rpm (=100% speed)
(5)	S.F.	:	1.4 as per API 613
(6)	Type	:	Increasing / Single Stage / Double Helical
(7)	Driver Type	:	Induction Motor (Fixed speed)
(8)	Driven Unit	:	Centrifugal Compressor
(9)	Instruments	:	RTD for Brg. Pad Temperature:

Journal Brg. — Two(2)/Each Brg, total 8
Thrust Brg. (Active side) — Two(2), total 2
(Inactive side) — Two(2), total 2

Vib. Measurement
(Probe, Probe Holder, Prox. and Extension cable):

Vibration Probe — Two(2)/Each Brg, total 8
Axial Position Probe — Two(2)/L.S.Shaft, total 2
~~Key Phasor Probe — One(1)/L.S.Shaft, total 1~~

Gear Casing Vibration
Accelerometer — Two(2)/Each CPLG end, total 2

(10)	Lubrication	:	ISO VG 46, Nor 54°C, 1.4 barg
(11)	Noise	:	85 dBA @ 1m (If not possible, vendor shall state the noise level in their proposal)
(12)	Inspection & Test	:	As per codes, standards & specifications.
(13)	Code, Standard	:	API 613 5th/2003, API 614 5th, API 670 4th/2000
(14)	Electrical Area	:	Zone 2, Class 1, Gas group IIB, Temperature class T3
(15)	Site condition	:	Outdoor (Harsh desert environment / Sand storm / Dust), Tropicalization Required, Unheated, Solar Radiation, 100%RH Ambient Temp (min/ avg/ max): TBA degF / TBA degF / TBA degF

(16) Special Requirements

16-1. The following items shall be included in gear vendor scope.
- Commissioning/start-up spares including O-rings and gaskets (2 Sets)
- Special tools, when required
- Undamped critical analysis report
- Damped rotor response analysis report
- Unbalanced rotor response verification test (as optional)

16-2. Gear shaft end shall be tapered hydrofit 1/24 as per KHI standard drawing, which will be provided at detail engineering stage.

16-3. Up-mesh configuration shall be applied.

16-4. Rotating direction shall be CW [HOLD] viewed from coupling end of the output shaft (compressor side)

16-5. Vendor to provide tilting pad bearings for thrust bearing. (as base)

16-6. Inertia data shall be provided with the quotation.

16-7. Oil load stage shall be 5 as per API requirement

16-8. Junction box will be provided by KHI.

16-9. Radial Bearings shall be Hydro Dynamic Tilt Pad shall be considered.

16-10. Please provide the option price for below items

16-10-1) Capital Spare : 1 set of Gear Box shaft with gears fitted. Shall be subject to Mechanical Run Test.

16-10-2) Capital Spare : 1 Set of Radial and Thrust bearings

16-10-3) Operational Spares : 1 set of Gear Operating spares, to include shaft seals, bearing RTDs, set of axial probes, set of vibration probes and set of accelerometers (including extension cable).

(17) **Attachment : Project Specifications**

Att-1. 1810-8420-DS-R280-0139 Rev 00B, Gear Data Sheet
Att-2. 175-130300, Gear Units : Special Purpose Inspection Form [Later]
Att-3. 175-340200, Instrumentation for Package Units
Att-4. 13-SAMSS-001, Special Purpose Gear Units (API613)
Att-5. 26-SAMSS-088, Turbine Oils
Att-6. 34-SAMSS-625, Machinery Protection System
Att-7. 34-SAMSS-831, Instrumentation for Packaged Units
Att-8. PR/ES/TSD/ES-001, Basic Engineering Design Data (LATER)
Att-9. SAES-H-001, Coating selection and Application requirements for Industrial Plants and Equipment
Att-10. SAES-H-101V, Approved Saudi ARAMCO data Sheet – Paints and Coatings
Att-11. SAEP-1151, Inspection Requirement for Contractor Procured Materials and Equipment
Att-12. 175-000003, Detailed instructions of Inspection and Testing requirement

ATTACHMENT-01

Saudi Aramco 2616-ENG (10/2002)

PETRO RABIGH

بترو رابغ
Petro Rabigh

HPU2 Sales Gas Conversion Project – Detailed Design
100% CAPACITY WITH FEED COMPRESSORS

WER#25-30-40000-018-001-01
WBS#20-24102

MECHANICAL DATASHEET FOR
SALES GAS COMPRESSOR R280-K-1001

ISSUED FOR ENQUIRY

JULY 2025

PREPARED BY:

NATIONAL ADVANCED CONSULTING ENGINEERING COMPANY

wood.

REV NO.	DATE	JO/EWO	DESCRIPTION	ENG'G	CERT	PMT	OPRNS
00A	11 Jul 25	WBS#20-24102	ISSUED FOR COMMENT	AD			
00B	25 Jul 25	WBS#20-24102	ISSUED FOR ENQUIRY	AD			

DISCIPLINE ENGINEER
AD
DATE 25-Jul-25

PROJECT ENGINEER
SP
DATE 25-Jul-25

CERTIFIED
DATE

CONSTRUCTION AGENCY
DATE

OPERATIONS
DATE

EDSD VERIFICATION
CONTROL NUMBER
BY:
DATE:

REVISION CERTIFICATE
THIS INDICATES THAT REV NO 00B OF THIS DRAWING IS COVERED, FOR ALL APPROVAL/CERTIFICATION REQUIREMENTS, BY DRAWING COMPLETION CERTIFICATE (DCC) NO.

Wood Doc. No. 720237-MEC-DAT-0004 Rev E1

MECHANICAL DATASHEET	DWG.TYPE	PLANT NO.	INDEX	DRAWING NO.	SHT.NO.	REV.NO.
SALES GAS COMPRESSOR R280-K-1001	DAT	R280	K	1810-8420-DS-R280-0139	1 OF 29	00B
HYDROGEN PRODUCTION UNIT						
RABIGH		WBS#20-24102				

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PETRO RABIGH

REVISION	G1	SIGNATURE	E1	SIGNATURE		SIGNATURE
DATE	11 Jul 25		25 Jul 25			
ORIG. BY	AWD	AWD	AWD	andrew.daley		
CHECK. BY	TR	TR	MB	Mark.Bashford		
APP. BY	TR	TR	AWD	andrew.daley		

Issued for comment 11/7/25 G1
Issued for enquiry 25/7/25 E1

REV NO.	DATE	JO/EWO	DESCRIPTION	ENG'G	CERT	PMT	OPRNS
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SALES GAS COMPRESSOR R280-K-1001	DAT	R280	K	1810-8420-DS-R280-0139	2 OF 29	00B
RABIGH						
#REF! SAUDI ARABIA		JO / EWO WBS#20-24102				

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JOB ORDER/EWO NO.: WBS#20-24102

PETRO RABIGH

DATA SHEET - GEAR UNIT (FOR INCREASERS & REDUCERS OF PARALLEL SHAFT DESIGN)

NOTE: O INDICATES INFORMATION TO BE COMPLETED BY PURCHASER: ☐ BY MANUFACTURER

EQUIPMENT DATA

APPLICABLE TO: ● PROPOSALS O PURCHASE O AS BUILT

■ MANUFACTURER VTA

■ SIZE & TYPE

☐ SERIAL NO.

● THIS DATA SHEET COVERS 1 GEAR(S)

● MARK NO(S): R280 - KG - 1001 - G

___ - KG - ___ - G

___ - KG - ___ - G

___ - KG - ___ - G

NOTE: FOR PUMP GEAR: GG / FOR COMPRESSOR GEAR: KG.

☐/ O GEARS OF IDENTICAL TYPE & SIZE IN OPERATION

___ - G- ___, P.O.:

___ - G- ___, P.O.:

GEAR APPLICATION: O REDUCER ● INCREASER

● BETWEEN **MOTOR** AND **COMPRESSOR**

● MARK NO. **R280-KM-1001** AND **R280-K-1001 A**

● DATA SHT. **Sheets 20 to 23** AND **Sheets 3 to 12**

NET MASS: GEAR ___ kg AUXILIARIES ___ kg

MAX. MAINTENANCE MASS (IDENTIFY): ___ kg

DESIGN OPERATING DATA

SERVICE

● CONTINUOUS O INTERMITTENT O STAND BY

O ATTENDED ● UNATTENDED

PERFORMANCE DATA

■ **BASIC GEAR DATA**

MECHANICAL RATING VTC kW @ VTC RPM

FULL LOAD POWER LOSS ___ kW

MECHANICAL EFFICIENCY ___ %

PITCH LINE VELOCITY ___ m/s

TOOTH PITTING INDEX, "K": ACTUAL ___ ALLOWABLE ___

TANGENTIAL LOAD, "W_t" ___ kg

BENDING STRESS NUMBER, "S_t"

	PINION	GEAR
ACTUAL		
ALLOWABLE		

MATERIAL INDEX NUMBER (API 613 / 677 TABLE 3)

ANTICIPATED SOUND PRESS. LEVEL ___ dbA @ ___ Ft

JOURNAL STATIC WEIGHT LOADS

PINION ___ kg; GEAR ___ kg

RESIDUAL UNBALANCE

PINION ___ oz in; GEAR ___ kg

WR^2 REFERRED TO LOW SPEED SHAFT ___ kg m2

BREAKAWAY TORQUE ___ kg mm @ LOW SPEED SHAFT

ALLOW. AXIAL DISPLACEMENT ___ mm

CRITICAL SPEED PINION GEAR ___ RPM

TORSIONAL STIFFNESS L.S. SHAFT ___ kg mm / RAD

H.S. SHAFT ___ kg mm / RAD

ALLOWABLE THRUST LOAD ___ kg;

CONTINUOUS ☐ YES ☐ NO

RATING REQUIREMENTS

Per section 2.2.1 of API 613 and 13-SAMSS-001

● DRIVEN EQUIPM. kW NORMAL ___ MAX. ___

● DRIVER kW RATED ___ MAX. ___

O GEAR RATED kW ___

O TORQUE @ MAX. CONT. SPEED ___ mm kg

O MAX. TORQUE ___ mm kg @ ___ RPM

O RATED INPUT SPEED ___ RPM O SPEC'D O NOM.

O RATED OUTPUT SPEED ___ RPM O SPEC'D O NOM.

O ALLOWABLE VARIATION IN GEAR RATIO (+) (-) ___ %

O MIN./MAX. CONTINUOUS SPEED ___ / ___ RPM

O TRIP SPEED ___ RPM

● MIN. GEAR SERVICE FACTOR **1.6 API SF**

O SHAFT ASSY. DESIGNATION (API 613 PARA. 2.1.16) (API 677 PARA 2.3) ___

O H.S. SHAFT ROTATION FACING CPL'G. O CW O CCW

O L.S. SHAFT ROTATION FACING CPL'G. O CW O CCW

● SHAFT ENDS: O CYLINDRICAL O TAPERED

● FLANGED O KEYED (1) OR (2)

		HIGH SPEED SHAFT		LOW SPEED SHAFT	
TYPE OF THRUST	FACING	COUPLING	END OPP. COUPLING	COUPLING	END OPP. COUPLING
CONTINUOUS					
TRANSIENT					
TOTAL					

CONSTRUCTION DATA

■ **GEAR TYPE** ■ (SINGLE) ~~(DOUBLE)~~ STAGE

■ ~~(SINGLE)~~ (DOUBLE) HELICAL

☐ EPICYCLIC ___

☐ **TEETH**

NO. OF TEETH PINION / GEAR /

GEAR RATIO CENTER DISTANCE ___

PITCH DIA. mm PINION / GEAR /

FINISH ___ µin RMS

AGMA GEOMETRY FACTOR, "J" ___

HELIX ANGLE ___ DEG.

NORMAL PRESS. ANGLE, ___ DEG.

NET FACE WIDTH, "F" ___ mm PINION L/d ___

NORMAL DIAMETRAL PITCH, "Pnd" ___ mm

BACKLASH ___ mm

TOOTH PLATING (RECOM.) (NOT RECOM.) ___

☐ **MANUFACTURING METHODS**

TEETH GENERATED BY THE ___ PROCESS

TEETH FINISHED BY THE ___ PROCESS

TEETH HARDENING METHOD ___

GEAR TO SHAFT ☐ INTEGRAL ☐ SHRUNK-ON

RIM ATTACHMENT ___

REVIEW FOR KEY DRAWINGS REQUIRED (SAUDI ARAMCO) ☐

OTHER | BY/DATE | OPERATIONS/DATE | CONST. AGENCY/DATE

DESIGN CERTIFICATION (DESIGN AGENCY)

CERTIFIED/DATE | ENGG./DATE

REVISION VALIDATION

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SALES GAS COMPRESSOR R280-K-1001	DAT	R280	K	1810-8420-DS-R280-0139	13 OF 29	00B
RABIGH						
SAUDI ARABIA						

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ISSUED FOR ENQUIRY	25 Jul 25	00B

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OTHER | BY/DATE

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DESIGN CERTIFICATION (DESIGN AGENCY) | CERTIFIED/DATE | ENGG./DATE

REVISION VALIDATION

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PETRO RABIGH

DATA SHEET - GEAR UNIT (FOR INCREASERS & REDUCERS OF PARALLEL SHAFT DESIGN)

NOTE: O INDICATES INFORMATION TO BE COMPLETED BY PURCHASER: ☐ BY MANUFACTURER

EQUIPMENT DATA

■ **RADIAL BEARINGS:**

	PINION	GEAR
TYPE	Hydro Dynamic Tilt Pad	Hydro Dynamic Tilt Pad
DIA. x LENGTH	___ x ___ mm	___ x ___ mm
JOUR. VELOCITY	___ m/s	___ m/s
LOADING	___ kg	___ kg
CLEARANCE	___ mm	___ mm
SPAN	___ mm	___ mm

☐ **THRUST BEARING(S):**

	PINION	GEAR
LOCATION		
MANUFACTURER/TYPE		
SIZE		
AREA	___ mm2	___ mm2
THRUST BRG. LOADING	___ kg	___ kg
THRUST BRG. RATING	___ kg	___ kg
INT. THRUST LOADS (+/-)	___ kg	(+/-) ___ kg
EXT. THRUST LOADS (+/-)	___ kg	(+/-) ___ kg

●/☐ **COUPLINGS AND GUARDS** Refer to Coupling DS (Sheets 16-19)

	H.S.	L.S.
☐ MANUFACTURER		
☐ MODEL		
● FURNISHED BY	COMPRESSOR VENDOR	
O MOUNT CPLG. HALVES		
● SPACER REQUIRED	YES	
☐ RATING, kW/100 RPM		
☐ KEYED (1) OR (2), OR HYD. FIT		
☐ SHAFT DIA. @ CPLG.	___ in	___ in
● GUARD FURNISHED BY	Compressor Vendor	
● GUARD DRAIN REQ'D.	Yes	

NOTE: The use of cast iron prohibited.

■ **MATERIALS**

GEAR CASING
OIL SEALS
BEARINGS
SHAFT H.S.
SHAFT L.S.
PINION(S) HARDNESS:
GEAR RIM(S) HARDNESS:

☐ **PIPING CONNECTIONS**

	NO.	SIZE	TYPE
LUBE OIL INLET			
LUBE OIL OUTLET			
CASING DRAINS			
VENTS			
CASING PURGE			

CONSTRUCTION DATA

LUBRICATION REQUIREMENTS

- ● OIL SYSTEM FURNISHED BY: COMPRESSOR VENDOR
- ● OIL SYSTEM IN ACCORDANCE WITH: 32-SAMSS-013 (Part 1 and 2)
- ● OIL VISC.: ISO VG 46 SSU @ 100°F ___ SSU @ 210°F
- ☐ MINIMUM STARTUP OIL TEMPERATURE ___ °F
- ☐ OIL FLOW REQ'D ___ GPM
- ☐ OIL PRESSURE REQ'D (NOMINAL) ___ /cm2G

SPECIAL REQUIREMENTS

INSTRUMENTS

TEMPERATURE INDICATORS

- EACH RADIAL BEARING ● YES O NO
- LUBE OIL INLET(S) ● YES O NO
- MAKE

MONITORING ● YES (*) O PROVISIONS ONLY O NO

- ● ELECTRICAL O PNEUMATIC
- ● RADIAL BEARINGS
  - ☐ MAKE
  - ☐ MODEL
- ● THRUST BEARINGS
  - ☐ MAKE
  - ☐ MODEL
- ● DETECTOR O SINGLE ● DOUBLE
- ☐ TEMP. SETTING "ALARM / SHUTDOWN" °F /

(*) min 2 elements per radial bearing and per face on thrust bearings

PRESSURE INDICATORS

- LUBE OIL INLET(S) ● YES O NO
- ☐ MAKE
- ☐ TYPE

PRESSURE TRANSMITTERS

- LOW LUBE OIL INLET PRESSURE O YES O NO
- ☐ ALARM SETTING: ___ /cm2G
- ☐ SHUTDOWN SETTING: ___ /cm2G
- ☐ MAKE
- ☐ TYPE

VIBRATION DETECTION ● YES O PROVISIONS ONLY O NO

MOUNTING ☐ ● ON GEAR CASE ☐ ● AT ALL BEARING(S)

- ☐ MAKE
- ☐ MODEL/TYPE
- ☐ SETTING

PEAK TO PEAK MILS	ALARM	SHUTDOWN

PROVIDE O VERT. / HOR. MOUNTING PLATE
O THREADED CONNECTION, SIZE ___ mm.
FOR FIELD INSTALLATION OF PURCHASER'S DETECTOR
O MAKE
O MAKE/TYPE

POWER FOR INSTRUMENTS AND CONTROL :

- ● ELECTRICAL
  - ● AC 230 VOLTS 1 PHASES 60 CYCLES
  - ● DC 24 VOLTS ___ AMPS
- ● AIR (**) ___ kg/cm 2G

(**) Refer to Basic Engineering and Design Data

MECHANICAL DATASHEET	DWG. TYPE	PLANT NO.	INDEX	DRAWING NO.	SHT. NO.	REV. NO.
SALES GAS COMPRESSOR R280-K-1001	DAT	R280	K	1810-8420-DS-R280-0139	14 OF 29	00B
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SAUDI ARABIA						

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ISSUED FOR ENQUIRY	25 Jul 25	00B

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JOB ORDER/EWO NO. WBS#20-24102

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PETRO RABIGH

DATA SHEET - GEAR UNIT (FOR INCREASERS & REDUCERS OF PARALLEL SHAFT DESIGN)

NOTE: INDICATES INFORMATION TO BE COMPLETED BY PURCHASER: BY MANUFACTURER

SPECIAL REQUIREMENTS

TERMINAL BOXES

ALL WIRING SHALL COMPLY WITH NEC CODE 800

- O GENERAL PURPOSE WIRING
- O CLASS I, DIVISION I, GROUP D
- O CLASS I, DIVISION II, GROUP D
- O WEATHERPROOF DESIGN
- ● HAZARDOUS AREA CLASSIFICATION: **See Sheet 4 relevant to package**

LOCATION **see sheet 4 (site and location) relevant to package**

BASEPLATE (Refer to mech notes)

API 617 and 31-SAMSS-001

FURNISHED BY MANUFACTURER OF

● DRIVEN EQUIP O DRIVER O GEAR UNIT

FOR ● GEAR UNIT
● DRIVEN EQUIPMENT
● DRIVER

SHOP INSPECTION AND TESTS **per 13-SAMSS-001 & 175-IR130300**

	REQUIRED	WITNESSED
SHOP INSPECTION	●	●
MECHANICAL RUN TEST (low load, full speed)	●	●
OPTIONAL TESTS		
FULL LOAD, FULL SPEED	O	O
FULL TORQUE, SLOW ROLL	O	O
FULL TORQUE, STATIC	O	O
BACK TO BACK	O	O
SOUND LEVEL	●	●

DRAWINGS AND OTHER DATA

MANUFACTURER'S DRAWING OR DOCUMENTS NO.	REQUIRED YES	NO
DIMENSIONAL OUTLINE DRAWING	●	O
CROSS SECTIONAL DRAWINGS	●	O
LUBE SYSTEM DIAGRAM WITH IDENTIFICATION OF ALL COMPONENTS	●	O
OPER. & MAINT. INSTRUCTIONS	●	O
RECOMMENDED SPARE PARTS LIST	●	O
COLD ALIGNMENT CURVES	●	O
DATA L & T. VIBR. ANALYSIS	●	O
ROTOR RESPONSE ANALYSIS	●	O
COMPL'D GEAR DATA SHEET	●	O

SPARES

● SPARE SET OF GEAR ROTORS REQ'D. **Yes**

SPECIFICATIONS

● API 613 AND 13-SAMSS-001 O API 677 AND 13-SAMSS-003

O MFR'S STANDARD

REMARKS

R1. See notes sheet 11 for coating requirements.

R2. Contract Vibration & temperature probes shall be used for gear tests.

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PETRO RABIGH

EQUIPMENT NOISE DATA SHEET

GENERAL INFORMATION

Project Designation: **PETRO RABIGH** Inquiry/Purchase Order No.:

Location: **HYDROGEN PRODUCTION UNIT** Manufacturer:

Equipment Type: **SALES GAS COMPRESSOR R280-K-1001** Model No.:

Equipment Serial No.:

PURCHASER'S REQUIREMENTS

This form shall be completed for each piece of equipment (or integrated unit) that is likely to generate noise in excess of 85 dBA at a distance of one meter. If the noise level is greater than 90 dBA, the cost of special design and/or acoustic treatment should be supplied. Measurements are to be made in accordance with ANSI S1.13 and at full design load, unless otherwise indicated. For rotating electric machinery, use points defined in IEEE Standard 85.

Also measure at: 50% load _____ 120% load _____ Other load _____

SUPPLIER, MANUFACTURER OR VENDOR INFORMATION

Sound Pressure Level, dBA

Standard Design: _____ Special Design: _____ With Acoustic Treatment: _____

Octave Band Sound Pressure Levels, dBA (Ref. 0.02 mPA)
(Supplier's Guaranteed Maximum Sound Pressure Level at One Meter)

Octave Band (Hz)	Center Frequency (Hz)	Standard Design	Special Design	With Acoustic Treatment
20 - 75	63			
75 - 150	125			
150 - 300	250			
300 - 600	500			
600 - 1200	1000			
1200 - 2400	2000			
2400 - 4800	4000			
4800 - 9600	8000			

Description of Special Design: _____ Added Cost: _____

Description of Acoustic Treatment: _____ Added Cost: _____

Supplier, Manufacturer or Vendor: _____

Represented by: _____ Title: _____

Signature: _____ Date: _____

MECHANICAL DATASHEET	DWG. TYPE	PLANT NO.	INDEX	DRAWING NO.	SHT.NO.	REV.NO.
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ATTACHMENT-03

INSPECTION & TESTING REQUIREMENTS SAUDI ARAMCO FORM-175	REVISION: 01/19/2017 REPLACES: 10/31/2016	CODE NUMBER: IR340200	PAGE: 1 of 2

SCOPE: INSTRUMENTATION for PACKAGED UNITS.

TEST AND INSPECTION PER: 34-SAMSS-831and Specifications As Noted Below.

(1).VISUAL INSPECTION BY BUYER INSPECTION REPRESENTATIVE
(2) REVIEW AND VERIFICATION OF MATERIAL CERTIFICATES AND INSPECTION RECORDS
(3) SUBMISSION OF MANUFACTURING, INSPECTION AND QUALITY RECORDS

0010	*	*	*	**Pre-Fabrication/Production Requirements**	**Specification Details / Notes:**
0010	H			Pre Inspection Meeting	
0020		R		Factory Acceptance Test Procedure	FAT procedure shall be submitted for review and approval by Saudi Aramco.
0030		R	X	Raw Material Test Certificates and Reports	Random verification of sub-components (at least one per commodity) shall be performed on material and test certificates with original equipment manufacturer (OEM).
0020	*	*	*	**In process inspection & test requirement**	**Specification Details / Notes:**
0030	W			Electrical Components and Systems:	Per 34-SAMSS-831
0040		R		Control Valves	Per 34-SAMSS-711.
0050		R		Safety Relief Valves	Per 34-SAMSS-611 or 612 as applicable.
0060		R		Environmental Conditions	For outdoor cabinets only(34-SAMSS-821)
0070	W			Process connections, Instrument piping and tubing	Per 34-SAMSS-831.
0030	*	*	*	**Final inspection & test requirements**	**Specification Details / Notes:**
0010	H			Visual and Dimensional Inspection	Per 34-SAMSS-831.
0020	H			Functional test	Per 34-SAMSS-831.
0030	W			Nameplates,Marking,Tagging and shipment	Per 34-SAMSS-831.
0040		R	X	Product test certificates and records	As per applicable SAMSS and IR
0050		R	X	Certificate of Compliance	

Notes:

(1).VISUAL INSPECTION BY BUYER INSPECTION REPRESENTATIVE

(2) REVIEW AND VERIFICATION OF MATERIAL CERTIFICATES AND INSPECTION RECORDS

(3) SUBMISSION OF MANUFACTURING, INSPECTION AND QUALITY RECORDS

(1)Refer detailed instruction sheet SA175 form IR000003 of inspection requirement for ideal use of this form.

***End of* IR340200**

ATTACHMENT-04

Materials System Specification

03 August 2022

13-SAMSS-001
Special Purpose Gear Units

Document Responsibility: Compressors, Gears and Steam Turbines Standards Committee

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Summary of Changes

Paragraph Number		Change Type (Addition, Modification, Deletion, New)	Technical Change(s)
Previous Revision (27 November 2019)	**Current Revision** (04 August 2022)		
ALL	ALL	ALL	Adoption of IOGP S-713 as base specification

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I. Scope

This Specification, together with the gear unit Data Sheet, defines the mandatory requirements for special purpose gear units. Special purpose gear units shall be used when the rated power exceeds 2,250 kW (3,000 HP) or when the pitch line velocity is 61 m/s (12,000 ft/min) or higher.

Special purpose gear units shall be supplied by Vendors qualified by experience to manufacture the units proposed. To qualify, the Vendor must have manufactured at the proposed manufacturing location, at least two gear units of equal or greater power rating, pinion speed, pitch line velocity and journal velocity as the units proposed. These gears must have been in service for at least two years of trouble-free operation.

II. Conflicts & Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed to the EK&RD Manager.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302.

III. References

All referenced specifications, standards, codes, drawings, and similar material are considered part of this Material System Specification to the extent specified, applying the latest version, unless otherwise stated.

III.I Saudi Aramco References

Saudi Aramco Engineering Procedures

SAEP-302	Waiver of a Mandatory Saudi Aramco Engineering Requirement

Saudi Aramco Materials System Specifications

34-SAMSS-625	Machinery Protection Systems
34-SAMSS-831	Instrumentation for Packaged Units
26-SAMSS-088	Turbine Oils

Saudi Aramco Forms and Data Sheets

SA-8003	Gear Unit Data Sheet
SA-8020-415	Thermocouples
SA-8020-416	Resistance Temperature Detectors

III.II Industry Codes and Standards

International Oil & Gas Producers Association (IOGP)

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IOGP S-713 Supplementary Specification to ANSI/API Standard 613 Special Purpose Gear Units

American Petroleum Institute

API STD 613 Special Purpose Gear Units for Petroleum, Chemical, and Gas Industry Services

IV. Modifications

The following paragraph numbers refer to IOGP S-713, First Edition, July 2020, which is part of this Specification. The text in each paragraph below is an addition unless noted to be an exception, modification, or deletion to IOGP S-713. Paragraph numbers not appearing in IOGP S-713 nor API STD 613 are new paragraphs to be inserted in numerical order.

1 General

1.3 Alternative Design

All deviations from this Specification shall be separately listed by the Vendor in his quotation and shall refer to the relevant paragraph numbers.

1.7 (Exception) The vendor shall specify his compliance to the applicable International Standards (e.g., API, ISO, JIS, ASME, ASTM) depending on his point of manufacturing and sub-suppliers.

2 Basic Design

2.1 General

2.1.6 Saudi Aramco datasheet forms (SA-8003) shall be used. Equipment sound pressure level, when measured at a distance of one meter during Shop test at rated speed and maximum test power, shall not exceed the following:

a) 90 dB(A) for units with a pitch line velocity of 150 m/s (29,500 ft/min) or greater.

b) 87 dB(A) for units with pitch line velocity between 120 to 150 m/s (23,600 ft/min to 29,500 ft/min).

c) 85 dB(A) for units with pitch line velocity of 120 m/s (23,600 ft/min) or less.

Control of the sound pressure to meet these requirements shall be the sole responsibility of the Vendor. External acoustic insulation is not acceptable.

2.1.10 All electrical equipment, instrumentation and wiring shall be suitable for the electrical area classification specified on the Data Sheet.

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2.1.14 Unless otherwise specified in the datasheet, the equipment will be installed outdoors in a desert area, with relative humidity from zero to 100% (condensing) and ambient temperatures from 0°C to 50°C (32°F to 120°F). Metal temperature can reach 70°C (158°F) when exposed to direct solar radiation. The equipment shall be designed to withstand these conditions.

Additionally, equipment specified in the datasheet for offshore installation shall be protected against failure due to windborne seawater spray and the accumulation of wetted salt (NaCl).

If a spare gear-set is ordered, the rotors shall be shipped prepared and packaged, per Section 4.4, for long-term storage in steel container(s) purged with nitrogen at 5 psig.

2.1.20 (Delete)

2.2 Rating

2.2.1 Gear Rated Power

2.2.1.1 When the unit is driven by a synchronous motor, the Vendor with train responsibility shall confirm the torque fluctuations derived from the transient torsional analysis in addition to its rated power consumption and shall submit this data to the gear manufacturer and to the buyer. The minimum acceptable design life for synchronous motor driven gear units passing through torsional resonances during startup shall be 1,000 starts.

2.2.3 Gear Service Factor

2.2.3.1 Gears service factor shall be per Table 3 of API STD 613.

2.2.4 Tooth Pitting Index

2.2.4.4 The Vendor shall state the L/d ratio in his proposal.

2.2.4.5 (Correction) The units for deflection limits are mm not micrometers.

2.3 Casings

2.3.1 Design Parameters

2.3.1.3 (Modification) Spot facing need only to cover the nut contact area plus the 15 mm (1/2 in.) diametral allowance for alignment.

2.5 Gear Elements

2.5.2 Quality Assurance

2.5.2.2 (Modification) The tooth contact shall be checked only in the job casing at the vendor shop and shall conform to acceptable contact pattern. Unmodified leads shall have a minimum contact of 80% across the

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tooth length. The results of the contact check shall be preserved and included in the manual.

2.5.4 Shafts

2.5.4.4(a) (Exception) The total combined electrical and mechanical runout for areas to be observed by radial vibration sensors shall not exceed:

- 9 micrometers (0.35 mils) for rated shaft speeds up to 3600 RPM;
- 6 micrometers (0.25 mils) for rated shaft speeds exceeding 3600 RPM

2.6 Dynamics

2.6.2 Lateral Analysis

2.6.2.4.3 When damped unbalance response analysis is required, it shall also be submitted to the Company or Buyer representative for review.

2.6.5 Torsional Analysis

2.6.5.1 The vendor with train responsibility shall supply the torsional analysis torque values, including pulse torque, to the gear vendor.

2.6.6 Vibration and Balancing

2.6.6.2 Balancing machine calibration certificate submitted with the final residual unbalance records is an acceptable alternative to the residual unbalance check of Appendix “G” procedure.

2.6.6.8 (Exception) The permissible compensation for actual runout shall not exceed the values stated in 2.5.4.4.

2.7 Bearings and Bearing Housings

2.7.1 General

2.7.1.1 The bearing metal temperature shall not exceed 105°C in the loaded area based on a maximum oil inlet temperature of 60°C. During shop testing, the differential between the bearing loaded area metal temperature and the actual oil inlet temperature shall not exceed 45°C.

2.7.1.3 (Exception) Bearing metal temperature sensors shall be installed in accordance with 34-SAMSS-625.

2.7.3 Thrust Bearing

2.7.3.1 (Exception) Details of gears not having thrust bearings shall be submitted through the Company or Buyer Representative for review and approval.

2.7.4 Bearing Housings

2.7.4.4 Shaft oil seals shall be horizontally split and accessible for removal without removing shafts or coupling.

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2.7.4.6 (Exception) Installation of all instrumentation shall be in accordance with 34-SAMSS-625. There is no need for 1-event probe in the input side if the driver is already specified with such probe. Similarly, there is no need for 1-event probe in the output side if the driven equipment is already specified with such probe.

2.8 Lubrication

2.8.2 (Modification) The gear unit shall be designed to limit the maximum lube oil differential temperature to 30°C. The design oil inlet temperature shall be 60°C.

2.8.3 The lube oil system shall be supplied by the Vendor having unit responsibility for the equipment train.

2.8.4 Unless otherwise specified, the lube oil shall be ISO VG 46 Turbo-Compressor oil to the specifications of 4.3 in 26-SAMSS-088.

2.8.6 Unless otherwise specified, the common lube oil shall be ISO VG 46 Turbo-Compressor oil to the specifications of 4.3 in 26-SAMSS-088.

2.9 Materials

2.9.3 Heat Treatment

2.9.3.1 (Exception) After surface hardened gear materials have been completely heat treated, the surface hardness and case depth shall be checked on a representative coupon of suitable size that has accompanied the part during all heat treat processes.

2.10 Nameplates and Rotation Arrows

Information on the nameplate shall be engraved. It shall also include the year of manufacturing.

3 Accessories

3.2 Couplings and Guards

3.2.3 (Exception) Lubricated couplings are not permitted.

3.4 Controls and Instrumentation

3.4.1 General

3.4.1.1 (Modification) Instrumentation shall comply with 34-SAMSS-831. Terminals shall be mounted in junction boxes. Armored cables in cable trays are also acceptable.

3.4.1.5 Thermocouples shall be in accordance with Form SA-8020-415 and resistance temperature detectors shall be in accordance with Form SA-8020-416.

3.4.2 Vibration and Position Detectors

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3.4.2.1 (Modification) Installation and calibration shall be in accordance with 34-SAMSS-625.

3.4.2.8 Settings for vibration and temperature alarm and shutdown shall be recommended by the gear Vendor.

4 Inspection, Testing and Preparation for Shipment

4.1 General

4.1.1 Inspection and testing shall be in accordance with CAS level C of S-713Q quality requirements.

4.2 Inspection

4.2.1 General

4.2.1.2(b) Casing welds shall be examined using liquid penetrant, magnetic particle or tightness test.

4.2.3 Mechanical Inspection

4.2.3.2 All equipment, including piping and appurtenances, shall be inspected for cleanliness prior to final assembly of the piping.

4.2.3.3 All hardness values shall be verified by testing. Certificate for these tests shall be provided.

4.3 Testing

A pre-test is not required.

4.3.3 Optional Tests

4.3.3.1 Full-speed/Full- or Part-load Test

4.3.3.1.2 (Modification) When partial- or full-load tests are specified, vibration limits applicable to the gear unit during the test shall be 125 % of the limits specified in 2.6.6.5. Non-synchronous vibration limits for gear unit shall be 125 % of the limits specified in 4.3.2.2.8 during full load full speed test.

4.3.3.1.3 (Delete)

4.3.3.5 Sound-level test is required during mechanical run test.

4.4 Preparation for Shipment

4.4.3.3 (Modification) The gearbox and any spare rotors shall be preserved at site by immersion in oil (the gearbox and the spare rotors containers shall be filled with oil). The gearbox shall be supplied with a vent valve to remove trapped air while filling, and the drain shall be blinded with a gasket and stainless-steel blind with full flange bolting.

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5 Vendor's Data

Manuals in searchable and printable electronic format (CD's) shall be provided.

Document History

04 August 2022	IOGP Adoption
9 May 2019	Editorial revision to modify: - Reference title of 34-SAMSS-625 - The Conflicting Requirements paragraph 1.4. 27
27 December 2017	Revised the “Next Planned Update”. Reaffirmed the content of the document, and reissued with editorial changes.

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ATTACHMENT-05

Materials System Specification

07 November 2022

26-SAMSS-088

Oils, Greases and Specialty Chemicals for Rotating Equipment Lubrication and Protection

Document Responsibility: Vibration and Lubrication Standards Committee

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Summary of Changes

Paragraph Number		Change Type (Addition, Modification, Deletion, New)	Technical Change(s)
Previous Revision 30 July 2019	**Current Revision** 07 November 2022		
-	-	Addition	Merge of 26-SAMSS-046/048/50/51/56/59/69/76/87/89/90/91 into 26-SAMSS-088
Title	Title	Addition	Changed title of the document from "Turbine Oils" to "Oils, Greases and Specialty Chemicals for Rotating Equipment Lubrication and Protection"
3	3	Addition	Added multiple references to test procedures and standards, such as ISO 4406, MIL-L-2105B & MIL-PRF-2105E.
4	5	Modification	Modified the cleanliness requirement with ISO 4406 code.
4.3.2	5.3	Modification	Modified the Viscosity Index to 110.
-	8.1	Addition/Modification	- Added dielectric strength requirement as per ASTM D877 for Refrigeration Oil WF 68. - Added cleanliness requirement as per ISO 4406 for refrigeration oil WF 68.
-	12.1	Addition/Modification	Modified the requirement with MIL-PRF-2105E for Automotive Gear Oil 85W140
-	12.1 & 12.2	Addition/Modification	Modified cleanliness requirement with ISO Code, and added maximum acceptable moisture content
-	12.2	Addition/Modification	Removed Daimler Benz Specification Sheet 235.1 from scope of Automotive Gear Oil 90.

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1 Scope

This specification describes the requirements for different types of oils, greases, and specialty chemicals to be used in different rotating equipment for lubrication and protection.

2 Conflicts and Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed to the EK&RD Manager.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302.

3 References

All referenced specifications, standards, codes, drawings, and similar material are considered part of this Materials System Specification to the extent specified, applying the latest version, unless otherwise stated.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedures

SAEP-301	Instructions for Establishing and Maintaining Mandatory Saudi Aramco Engineering Requirements
SAEP-302	Waiver of a Mandatory Saudi Aramco Engineering Requirement

3.2 Other References

American Society for Testing and Materials

ASTM D92	Standard Test Method for Flash and Fire Points by Cleveland Open Cup
ASTM D93	Standard Test Method for Flash Point by Pensky- Martens Closed Cup Tester
ASTM D97	Standard Test Method for Acid and Base Number by Color-Indicator Titration
ASTM D130	Standard Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test
ASTM D217	Standard Test Methods for Cone Penetration of Lubricating Grease
ASTM D566	Standard Test Method for Dropping Point of Lubricating Grease
ASTM D445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids
ASTM D482	Standard Test Method for Ash from Petroleum Products
ASTM D665	Standard Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water
ASTM D874	Standard Test Method for Sulfated Ash from Lubricating Oils and Additives
ASTM D877	Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D892	Standard Test Method for Foaming Characteristics of Lubricating Oils
ASTM D943	Standard Test Method for Oxidation Characteristics of Inhibited Mineral Oils
ASTM D974	Standard Test Method for Acid and Base Number by Color-Indicator Titration
ASTM D1401	Standard Test Method for Water Separability of Petroleum Oils and Synthetic Fluids

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ASTM D2270	Standard Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100°C
ASTM D2272	Standard Test Method for Oxidation Stability of Steam Turbine Oils by Rotating Pressure Vessel
ASTM D2509	Standard Test Method for Measurement of Load - Carrying Capacity of Lubricating Grease
ASTM D2596	Standard Test Method for Measurement of Extreme-Pressure Properties of Lubricating Grease
ASTM D2896	Standard Test Method for Base Number of Petroleum Products by Potentiometric Perchloric Acid Titration
ASTM D3233	Standard Test Methods for Measurement of Extreme Pressure Properties of Fluid Lubricants
ASTM D3336	Standard Test Method for Life of Lubricating Greases in Ball Bearings at Elevated Temperatures
ASTM D3427	Standard Test Method for Air Release Properties of Petroleum Oils
ASTM D3487	Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D6973	Standard Test Method for Indicating the Wear Characteristics of Petroleum and Non-Petroleum Hydraulic Fluids in a Vane Pump
ASTM D877	Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

International Electrotechnical Commission

IEC 60296	Specification for New Insulating Oils for Transformers and Switchgear

German Institute for Standardization

DIN 51354-2	Testing of lubricants; FZG gear test rig; method A/8,3/90 for lubricating oils
DIN 51503-1	Lubricants - Refrigeration oils - Part 1: Minimum requirements.
DIN 51524 Part II	Specifications for Anti Wear Type Hydraulic Oil

Institute of Petroleum

IP 280	Standard Test Method for Oxidation Stability of Inhibited Mineral Turbine Oils

International Standards Organization

ISO 11158	Type HM Specifications for Anti Wear Type Hydraulic Oil
ISO 4406	Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles
ISO 6743-13	Family G (Lubricants for Slideways)

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US Military Standard

MIL-PRF-23699 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base

MIL-PRF-2105E Lubricating Oil, Gear, Multipurpose

DEXRON-III (H) Specification – Technical Specifications of Automatic Transmission Fluid

4 Terminology

4.1 Acronyms

ISO	International Organization Standardization
API	American Petroleum Institute
VG	Viscosity Grade
RPVOT	Rotating Pressure Vessel Oxidation Test
TOST	Turbine Oil Stability Test
FZG	**F**orschungsstelle für **Z**ahnräder und **G**etriebebau; the Technical Institute for the Study of Gears and Drive Mechanisms of the Technical University in Munich
EP	Extreme Pressure

4.2 Definitions

Synthetic	Synthetic oil is a lubricant made up of artificially made chemical compounds
Foaming	Foaming is a collection of small bubbles of air that accumulate on or near the surface of the oil
Oxidation	Oxidation is a chemical reaction that occurs with a combination of the lubricating oil and oxygen. It is the primary mechanism of lubricant degradation.
Timken OK Load	Timken OK Load is a standardized measurement that indicates the possible performance of extreme pressure (EP) additives in a lubricating grease or oil
Micropitting	Micropitting is a surface-initiated fatigue phenomenon occurring during the gear meshing process between interacting surfaces in which a cluster of micropits presents a grey-colored appearance
Micropitting Test	Micropitting Test (FZG FVA 54) is used to determine oil's ability to protect against micropitting

5 Turbine Oils

5.1 Requirements for Turbine Oils 32, 46, 68, and 100

The following requirements of turbine oils are for use in steam turbines, compressors, pumps, hydraulic, and circulating oil systems. Also, ISO VG 68 for centrifugal refrigeration compressors, where refrigeration oils are not required.

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The oils shall be of premium quality blended from highly refined distillate virgin base an shall be free from suspended solids, water and other impurities and formulated to meet the following:

Parameter	Requirement
ISO Viscosity Grades	32, 46, 68, and 100
Appearance	Clear and Bright
Corrosion, copper strip, 3 hrs. at 100ºC, (ASTM D130)	1b Maximum
Demulsification (ASTM D1401)	15 minute, Maximum
Foaming, ASTM D892 Seq. I, II, & III	10/0 max
Oxidation Stability (ASTM D943	2,000 hours minimum
Oxidation Stability (RPVOT), (ASTM D2272)	500 minutes minimum
Oxidation characteristics (IP 280)	
Total oxidation products (TOP), mass %	1.0 Maximum
Rust Inhibition (ASTM D665A)	Pass
Total Acid No. (ASTM D974), mgKOH/g	0.10 Maximum
Viscosity Index (ASTM D 2270)	95 Minimum
Kinematic Viscosity cSt at 40°C (ASTM D 445):	
VG 32	28.8 - 35.2 cSt
ISO VG 46	41.4 - 50.6 cSt
ISO VG 68	61.2 - 74.8 cSt
ISO VG 100	90.0 - 110 cSt
Ash Oxide (ASTM D482)	Nil
Metals content, any one metal	5 ppm, Maximum
Cleanliness Level during delivery	ISO 19/17/14 (ISO 4406), Maximum
Water Content	100 ppm, Maximum

5.2 Requirements for Gas Turbine Oil 32

The following requirements of oil are for sever service conditions in all Saudi Aramco industrial combustion gas turbines and specifically for GE Frame 7 and above.

The oil shall be made from hydrotreated base oil and formulated with ashless additives designed to resist oxidation, rust and corrosion, foaming and system wear. It shall be free from water, sediment and inorganic acids. It shall meet the requirements of GEK-32568J and approved by General Electric Company by brand name.

Parameter	Requirement
Viscosity Grade	ISO VG 32
Viscosity Index (ASTM D 2270)	110 Minimum
Flash Point, °C, (ASTM D92)	220 Minimum
Foaming, ASTM D892 Seq. I, II, & III	10/0 Maximum
Air Release Value (ASTM D 3427)	3 Minutes, Maximum
TOST Life (ASTM D 943)	10,000 Hours, Minimum
RPVOT (ASTM D 2272)	950 Minutes, Minimum
FZG Failure Load Stage (DIN 51354-2)	9 Minimum
Cleanliness Level during delivery	ISO 19/17/14 (ISO 4406), Maximum
Water Content	100 ppm, Maximum

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5.3 Requirements for Turbo Compressor Oil 46

The following requirements of special turbine oils are for axial and centrifugal gas compressors, where a common lubricant is used in the driver, gearbox, compressor, and combined lube and seal oil system. Also, for rotary air compressors and industrial gas turbines, where turbine oils are specified. In addition, these are suitable for use in steam turbines, pumps, hydraulic systems, and circulating systems, where improved oxidation stability is required to prevent or minimize varnish deposits on shafts, bearings, seals, and gears.

Note:

This Turbo Compressor oil is not intended to replace Saudi Aramco Turbine Oil 46 for general use when varnish deposits are not an issue and longer oil life is not an essential requirement.

The oils shall be of premium quality blended from highly refined hydro-processed virgin base oil meeting API Group II/III specifications and shall be free from suspended solids, water and other impurities, and formulated to meet the following:

Parameter	Requirement
ISO Viscosity Grades	46
Appearance	Clear and Bright
Flash Point °C (ASTM D92)	230 Minimum
Corrosion, copper strip, 3 hrs. at 100°C (ASTM D130)	1b Maximum
Demulsification (ASTM D1401)	15 minutes, Maximum
Foaming, ASTM D892 Seq. I, II, & III	ml 10/0 Maximum
Oxidation stability (ASTM D943)	10,000 hours Minimum
Oxidation stability (RPVOT), (ASTM D2272)	1,000 minutes Minimum
Oxidation characteristics (IP 280)	
Total oxidation products (TOP), mass %	1.0 Maximum
Sludge content of TOP, mass %	40.0 Maximum
Rust Inhibition (ASTM D665A)	Pass
Acid No. (ASTM D974/equivalent) mgKOH/g	0.10 Maximum
Viscosity Index (ASTM D2270)	110 Minimum
Kinematic Viscosity cSt at 40°C (ASTM D445)	41.4 - 50.6 cSt
Ash Oxide (ASTM D482)	Nil
Metals content, any one metal	5 ppm Maximum
Air Release Value at 50°C, (ASTM D3427)	4 minutes maximum
FZG Failure Load Stage (DIN 51354-2)	9 Minimum
Cleanliness Level during delivery, Max	ISO 19/17/14 (ISO 4406)
Water Content, Max	100 ppm

Note:

The oil shall not contain additives to improve viscosity index.

6 Machinery Oils 150, 220, 320, and 460

The following requirements are for machinery oils for use where high viscosity rust and oxidation inhibited oils are required and extreme pressure additives are not necessary.

The oils shall be blended from refined virgin HVI base oils and formulated to meet the following:

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Parameter	Requirement
ISO Viscosity Grades	150, 220, 320 and 460
Viscosity Index	95 Minimum
Appearance	Clear and Bright
Corrosion, copper strips, 3 hrs. at 100°C (ASTM D130)	2 Maximum
Rust inhibition (ASTM D665)	Pass
Total Acid Number (ASTM D974), mgKOH/g	0.2 Maximum
Demulsification (ASTM D1401)	To be reported
Oxidation stability (ASTM D943), time to neut. No. 2	1000 hours min
Cleanliness Level during delivery, Max	ISO 21/19/16 or NAS 10
Water Content, Max	200 ppm

7 Hydraulic Oils AW 32, 46 and 68

The oil shall be a premium quality anti-wear type hydraulic oil meeting the minimum requirement of DIN 51524 Part II / ISO 11158 Type HM which is formulated with paraffinic base oil. It shall also meet the following requirements:

Parameter	Requirement
Appearance	Clear and Bright
Viscosity	ISO VG 32, 46, and 68
Viscosity Index	95 Minimum
Corrosion, Copper strip, 3 hours at 100°C, (ASTM D130)	1B Maximum
FZG A/8.3/90; Failure Load Stage	10 Minimum
Rust test, (ASTM D665)	Pass
Vane Pump test (ASTM D6973), (Vane + Ring) weight loss, mg	90 Maximum
Oxidation Stability (ASTM D943), time to Neut - No. 2	2000 hours, Minimum
Foaming, ASTM D892 Seq. I, II, & III	ml 20/0 max
Cleanliness Level during delivery, Max	ISO 19/17/14 (ISO 4406) or NAS 8
Water Content, Max	200 ppm

8 Refrigeration Oils

8.1 Requirements for Refrigeration Oil WF 68

The following requirements are for lubricating oil used in refrigeration and air-conditioning systems using reciprocating compressors. It also meets the requirements of certain rotary type refrigeration compressors.

This product shall be made from high viscosity mineral oil cut back with solvents and a fatty oil type additive to promote penetration. It shall have approximately the following characteristics:

Parameter	Requirement
ISO Viscosity Grade	68
Flash Point, °C (ASTM D92)	200 Minimum
Pour Point °C (ASTM D97)	-40 Maximum
Dielectric Strength, kV (ASTM D877)	30, Minimum
Water content	25 ppm Maximum
Cleanliness level during delivery (ISO 4406)	19/17/14, Maximum

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8.2 Requirements for Oil HFC-134a Synthetic

The following requirements are for lubricating oil for use in refrigeration and air conditioning systems where the refrigerant in use is HFC-134a. This oil is HFC-134a compatible and is the only lubricant suitable for use with this refrigerant.

The oil shall be made from polyol ester base oil that has been specifically synthesized to provide excellent miscibility with refrigerant HFC-134a over a wide temperature range. The oil must be specifically formulated for use in air conditioning chiller systems and shall meet the following:

Parameter	Requirement
Viscosity Grade	ISO VG 68
Pour Point °C (ASTM D97)	-40 Maximum
Water content	25 ppm Maximum
Falex Failure Load kg (ASTM D3233)	490 Minimum
Total Acid Number mgKOH/g (ASTM D974)	0.15 Maximum
Viscosity Index	95 Minimum

9 Synthetic Gas Turbine Oil 5

The following requirements are for a synthetic lubricant designed for aircraft type gas turbine engines used in stationary industrial applications.

The oil shall be formulated to meet the following:

Parameter	Requirement
Viscosity, cSt at 100°C	5.0 ± 0.5
Standard	MIL-PRF-23699 STD

10 Industrial Gear Lubes EP 68, EP 100, EP 150, EP 220, EP320, EP 460 and EP 1000

The following requirements are for extreme pressure type gear oils for use in industrial gear boxes and other specialized applications.

The oils shall be blended from refined virgin high VI base oils and formulated with synergistic additive packages to impart high oxidative/ thermal stability, anti-corrosion (ferrous and non-ferrous metal), anti-foam, extreme pressure, and anti-wear properties to meet the following requirements:

Parameter	Requirement
ISO Viscosity Grade	68, 100, 150, 220, 320, 460, 680, and 1000
Viscosity Index (ASTM D2270)	95 Minimum
Timken OK Load (ASTM D2782), lbs	65 Minimum
4 Ball Weld Load, Kg	300 Minimum
Rust Test (ASTM D 665 A/B)	Pass
Copper Corrosion (ASTM D130)	1b
Cincinnati Thermal Stability, (CCMC Thermal B)	Pass
Foaming Test (ASTM D892)	50/0 Max
Demulsiblity (ASTM D1401)	30 Minutes, Max
Micropitting Test [FVA 54(I-IV)]; fail load stage	>10
FZG Scuffing Test (A/8.3/90), (ISO 14635-1)	>12 load stage
FZG Scuffing Test (A/16.6/90), (ISO 14635-1)	>12 load stage
FE-8 Bearing (DIN 51819-3)	

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Roller wt loss, mg	<30
Cage wt loss, mg	Report

Note:

Viscosity Modifier (VM) is not acceptable in the formulation.

11 Automatic Transmission Fluid III

The following requirements are for oils for use in automotive automatic transmissions, mobile hydraulic systems and hydraulic torque converter systems. It is not suitable for use in high speed gearboxes.

The oil shall meet DEXRON-III (H) specifications.

Parameter	Requirement
Water Content, Max	200 ppm
Cleanliness Level during delivery, Max	ISO 19/17/14 (ISO 4406) or NAS 8

12 Automotive Gear Oils

12.1 Requirements for Automotive Gear Oil 85W-140

The following requirements are for a hypoid-type gear lubricant for general use in all types of automotive rear axles except where specifically stated otherwise.

The oil shall be of premium quality and approved for use as a MIL-L-2105E product and suitable for API Service GL-5.

Parameter	Requirement
Viscosity Grade	SAE 85W-140
Cleanliness Level during delivery, Max	ISO 19/17/14 (ISO 4406)
Water Content, Max	100 ppm

12.2 Requirements for Automotive Gear Lube 90

The following requirements are for automotive gear lubricant for use in manual transmission and differentials specifying SAE 90 gear oil.

The oil shall be premium quality and approved for use as a MIL-L-2105B product and suitable for API Service GL-4.

Parameter	Requirement
Viscosity Grade	SAE 90
Cleanliness Level during delivery, Max	ISO 19/17/14 (ISO 4406)
Water Content, Max	100 ppm

13 Diesel Engine Oils

13.1 Requirements for Diesel Engine Oil API CH-4 SAE 15W-40

The following requirements are for engine oil to be used in Caterpillar direct injection diesel engines (except 3600 series) and other makes of diesel engines requiring API CH-4 and below performance level crankcase oils.

An engine oil meeting the requirements of this sections is also suitable for use in the following types of equipment: Allison transmissions requiring C3/C4 Fluid, Caterpillar hydraulic systems and other mobile or marine hydraulic systems where a crankcase oil of SAE 15W-40 is suitable, diesel engines requiring API CF-4 and CG-4 performance level crankcase oils and gasoline engines requiring API SF, SG, SH, and SJ performance level crankcase oils where SAE 15W-40 is suitable.

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An engine oil meeting the requirements of this section is not suitable for use in EMD engines and other engines requiring Zinc-free oil.

The oil shall be blended from high viscosity index virgin base oil free from suspended solids, water, and other impurities and formulated to meet the following:

Parameter	Requirement
Viscosity Grade	SAE 15W-40
API Service Category	CH-4/SJ
Sulfated Ash, (ASTM D874) mass %	1.6 Maximum
Base Number (ASTM D2896)	10 Minimum
Cleanliness Level during delivery, Max	ISO 21/19/16 or NAS 10
Water Content, Max	200 ppm

13.2 Requirements for Diesel Engine Oil API CI-4 SAE 15W-40

The following requirements are for engine oil to be used in diesel engines requiring API CI-4 or similar performance level crankcase oils.

An engine oil meeting the requirements of this sections is also suitable for use in the following types of equipment:

- Diesel engines requiring API CF-4/ CG-4/ CH-4 performance level crankcase oils.
- Diesel engines requiring Cat ECF-1a/ ECF-2 performance level crankcase oils.

An engine oil meeting the requirements of this section is not suitable for use in EMD engines and other engines requiring Zinc-free oil.

The oil shall be blended from high viscosity index virgin base oil free from suspended solids, water and other impurities and formulated to meet the following:

Parameter	Requirement
Viscosity Grade	SAE 15W-40
API Service Category	CI-4
Sulfated Ash, (ASTM D874) mass %	1.6 Maximum
Base Number (ASTM D2896)	10 Minimum
Cleanliness Level during delivery, Max	ISO 21/19/16 or NAS 10
Water Content, Max	200 ppm

13.3 Requirements for Diesel Engine Oil EMD

The following requirements are for engine oil for use in General Motors Corporation Electromotive Division (EMD) engines and other engines requiring high alkalinity and Zinc-free oil.

The oil shall be premium quality blended from virgin base oils free from suspended solids, water and other impurities and formulated with Zinc-free additives to meet the following specifications:

Parameter	Requirement
LMOA	Generation 4/5
Viscosity Grade	SAE 40
Caterpillar Micro Oxidation Test	120 minutes, Minimum
API	CF/ CF-2

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Base Number (ASTM D2896)	16 Minimum
Zinc Content	10 ppm, Maximum
Cleanliness Level during delivery, Max	ISO 21/19/16 or NAS 10
Water Content, Max	200 ppm

13.4 Requirements for Two-Stroke Diesel Engine Oil SAE 40

The following requirements are for engine oil to be used in Detroit two-stroke diesel engines requiring a mono-grade SAE 40 crankcase oil. It can also be used in certain off-highway 4-cycle engine applications where low sulphated ash is required.

The oil shall be blended from HVI virgin base oils free from suspended solids, water and other impurities and formulated to meet the following:

Parameter	Requirement
API Service	CF-2
Viscosity Grade	SAE 40
Viscosity Index (ASTM D2270)	90 Minimum
Sulphated Ash (ASTM D874), mass %	0.8 Maximum
Base Number (ASTM D2896), mg KOH/g	8.0 typical
Cleanliness Level during delivery, Max	ISO 21/19/16 or NAS 10
Water Content, Max	200 ppm

14 Insulating Oil

The following requirements are for insulating oil for use in transformers and oil-immersed switchgear including cathodic protection rectifiers.

The oil shall be virgin hydrocarbon mineral oil specifically manufactured for use as an electrical insulating oil. The oil shall contain no additives, shall be certified to be PCB (polychlorinated biphenyls) free and shall meet the following requirements:

IEC 60296 Type B or ASTM D3487 Type 1

Cleanliness Level during delivery, Max: ISO 19/17/14 (ISO 4406) or NAS 8

15 Way Lubricant

The following requirements are for a product formulated to lubricate slides and guideways of machine tools.

This product shall be formulated from mineral oil meeting ISO 6743-13 Family G specifications, and it shall provide the following characteristics:

Parameter	Requirement
Viscosity Grade	ISO VG 220
Copper Corrosion, 3 hours at 100oC	1B
Cleanliness Level during delivery, Max	ISO 21/19/16 or NAS 10
Water Content, Max	200 ppm

16 Machining, Finishing and Protection Oils

16.1 Requirements for Penetrating Oils

The following requirements are for a low viscosity product suitable for brush or spray application and is used to aid in loosening nuts, studs, bolts, etc. In addition to its penetrating ability, it is a good rust preventative and lubricant.

This product shall be made from high viscosity mineral oil cut back with solvents and a fatty oil type additive to promote penetration. It shall have approximately the following characteristics:

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ISO Viscosity Grade: 7

Flash Point, °C (ASTM D92): 65 Minimum

16.2 Requirements for Rust Preventive

The basic material of this product is approximately of NLGI-5 consistency and contains a thinner to facilitate application. This product, on application shall be resistant to flow in ambient temperatures up to 60°C and shall have approximately the following characteristics:

Parameter	Requirement
Penetration (ASTM D217), Unworked at 25°C	250
Diluent, mass %	20
NLGI-consistency before solvent evaporation	2
NLGI-consistency after solvent evaporation	5

16.3 Requirements for General-Purpose Cutting Oil

The following requirements are for general purpose non-corrosive, transparent type cutting oil for the machining of metals and alloys, where an active sulphur type oil might cause staining or other undesirable effects. It can also be used for relatively mild cutting operations, where surface requirements are critical.

This product is a blend of mineral oil with a fatty type and other additives and shall meet the following requirements:

Parameter	Requirement
Viscosity Grade	ISO VG 32
Approximate Flash Point (ASTM D92), °C	180 Minimum
Corrosion, copper strip (ASTM D130), 3 hours at 100°C	4a Maximum

16.4 Requirements for Heavy-Duty Cutting Oil

The following requirements are for heavy duty cutting oil to cover a wide range of severe machining operations, particularly for high-alloy steels where active cutting oils are prescribed. It may stain non-ferrous metals and some steels.

This product is a highly sulfurized mineral oil product containing fatty type and other additives and shall meet the following requirements:

Viscosity Grade: ISO VG 32 approximate

Flash Point, COC, °C: 185 Minimum (ASTM D92)

16.5 Requirements for Soluble Oil

The following requirements are for soluble oil for use in metal working operations where a water emulsion type product is required. It is also suitable for use in automotive cooling systems to prevent rust and corrosion.

The soluble oil shall be of premium quality, blended from mineral oil containing emulsifiers and stabilizers, rust and oxidation inhibitors, wetting agents and other appropriate compounding and formulated to provide the following characteristics:

- Stable emulsion with water (hardness 1,000 ppm minimum as calcium carbonate)
- To be stable in storage
- Effective rust and corrosion protection
- Effective approved disinfectant

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16.6 Requirements for Honing Oil

The following requirements are for a low viscosity mineral oil product designed for cooling and lubricating honing equipment.

The oil shall be a proprietary type product of premium quality, blended from mineral oil base stocks formulated to the appropriate viscosity with additives to provide the following:

- Optimum lubricating of honing stones
- Good surface finish
- Minimized hone loading

16.7 Requirements for Synthetic Grinding Fluid

The following requirements are for an aqueous type synthetic base coolant specifically for use in high speed grinding operations where optimum cooling, wheel loading, and superior surface finish are required.

The concentrate shall be a proprietary type product to be diluted with water to produce a finished coolant having the following performance characteristics:

- Non-staining
- Rust and corrosion protection
- Minimize wheel loading
- Optimum surface finish of high alloy steels
- No separation and must not leave tacky or gummy residues on work pieces or machine parts
- Shall contain effective and approved biocides

16.8 Requirements for Turbine Oil Vapor Space Inhibitor

The following requirements are for a vapor space inhibitor concentrate. When added to turbine oils at the manufacturer's recommended concentration, corrosion protection of enclosed systems above and below the lube oil liquid level is provided. This product is intended for use in the mothballing of compressors, pumps, turbines, crank cases, and other rotating equipment.

The vapor space inhibitor concentrate is made with a highly refined base oil as the carrier which contains the rust and corrosion inhibitors. The product shall not precipitate out or contain any suspended solids after it is mixed with lube oils. It shall not affect the demulsibility characteristics of the system original oil and shall not have any detrimental effect on labyrinths, seal elastomers or bearing materials.

Viscosity, cSt at 40°C: 46 Minimum

Flash Point (Pensky-Martens) (ASTM D93): 60 Minimum

17 Greases

17.1 Requirements for All-Purpose EP Grease

The following requirements are for an all-purpose extreme pressure grease for use where a No. 0, 1, 2, or 3 consistency grade is recommended. Additionally, it is specified for wheel bearings, water pumps and trunnion bearings as per requirement.

The grease shall be of premium quality made from lithium 12-hydroxystearate soap and ISO VG 150 or higher viscosity base oil. This product shall contain an extreme pressure additive and rust and oxidation inhibitors. It shall meet the following:

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NLGI Grade 0

Penetration, worked at 25°C (ASTM D217)	355–385
Oil Viscosity	ISO VG 150
Dropping Point (ASTM D566), °C	165 Minimum
Timken OK Load (ASTM D2509), kg	18 Minimum

NLGI Grade 1

Penetration, worked at 25°C (ASTM D217),	310–340
Oil Viscosity	ISO VG 150
Dropping Point (ASTM D566), °C	165 Minimum
Timken OK Load (ASTM D2509), kg	18 Minimum

NLGI Grade 2

Penetration, worked at 25°C (ASTM D217),	265–295
Oil Viscosity	ISO VG 150
Dropping Point (ASTM D566), °C	180 Minimum
Timken OK Load (ASTM D2509), kg	18 Minimum

NLGI Grade 3

Penetration, worked at 25°C (ASTM D217),	220–250
Oil Viscosity	ISO VG 150
Dropping Point (ASTM D566), °C	180 Minimum
Timken OK Load (ASTM D2509), kg	18 Minimum

17.2 Requirements for Ball Bearing Grease 2

The following requirements are for an NLGI 2 grade premium ball and roller bearing grease for use in antifriction bearings of all types and particularly where speeds are high and operating temperatures may be in the order of 175°C or higher.

The grease shall be formulated with highly refined based oil, a polyurea **ash-less** organic thickener, and high-performance oxidation and rust inhibitors to protect against moisture and salt water contamination.
It shall meet the following:

NLGI Grade 2

Penetration, Worked at 25°C (ASTM D217),	265–295
Dropping Point (ASTM D566), °C	235 Minimum
Oil Viscosity	ISO VG 100
Viscosity Index (ASTM D2270)	95 Minimum
High Speed Bearing Test @ 350°F (ASTM D3336)	500 hours, Minimum

17.3 Requirements for Gear Coupling Grease 1

The following requirements are for a lubricant for gear type couplings on rotating machinery. It is a special application product and shall not be used as a general-purpose grease.

The grease shall be formulated with highly refined based oil and polyethylene thickener with density closer to that of the oil to withstand the centrifugal forces created by rotating couplings. It shall also be fortified with extreme pressure additives and rust and oxidation inhibitors. The grease shall conform to the following:

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Thickener	Polyethylene NLGI 1
Base Oil Viscosity at 40°C, cSt	600 Minimum
Viscosity Index	90 Minimum
Dropping Point (ASTM D566), °C	100 Minimum
Timken OK Load (ASTM D2509), kg	18 Minimum

17.4 Requirements for Rack and Pinion Grease

The following requirements are for high viscosity mineral oil grease containing solid lubricants to provide good adhesion, water resistance and high load bearing characteristics. For use on jack-up barge racks, rack pinions and jack leg guide shoes, particularly when grease is supplied using a centralized lubrication system. It is a special purpose product and shall not be used as general-purpose grease.

The grease shall provide good pumpability for use in centralized greasing systems. It shall contain a high viscosity mineral oil and shall incorporate graphite and molybdenum disulfide components.

NLGI Grade 2

Penetration, Worked at 25°C	270
Load-Wear Index, Kg (ASTM D2596)	50 Minimum
Oil Viscosity at 40°C, cSt	680 Minimum
Graphite, mass %	20 Minimum
Molybdenum Disulfide, mass %	3-5

17.5 Requirements for High Temperature Grease

The following requirements are for NLGI 1 or 2 grade high temperature non-melting grease for use in plain bearings in high temperature sulfur pumps and other applications where high temperatures, up to 300°C continuous operation, necessitate a non-melting type grease. It is not suitable for use in grease lubricated electric motor bearings or other equipment containing high speed anti-friction bearings.

The grease shall be made with highly refined low volatility oil, a non-melting high temperature thickener that provides high extreme pressure properties, and solid lubricant.

Exception: Clay solid lubricant is not acceptable.

The grease shall meet the following:

NLGI Grade 1-2

Penetration, Worked at 25°C (ASTM D217)	265–340
Dropping Point (ASTM D566), °C	None
Oil Viscosity	ISO VG 460 Minimum
Timken OK Load (ASTM D2509), kg	18 Minimum

17.6 Requirements for Open Gear and Wire Rope Lubricant

The following requirements are for a residual straight mineral oil compounded to provide improved water resistance, water displacement and rust prevention characteristics. It contains a non-flammable volatile solvent to facilitate application and is used for the lubrication and protection of open gears, chains, wire ropes, and cables.

This product has the following requirements before solvent addition:

Viscosity, cSt at 100°C: 950 typical

Timken OK Load, (ASTM D2509) kg: 18 Minimum

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18 Qualification

The following is the qualification process for new lubricants:

- Vendor shall provide technical data sheet and safety data sheet for intended lubricant
- Vendor shall provide reference list with equipment details and lube oil analysis report to confirm the performance
- Vendor shall provide complete sample analysis data from Saudi Aramco approved accredited 3rd party lab
- Vendor shall provide compatibility data against existing lubricant under intendent SA material number conducted by Saudi Aramco approved accredited 3rd party lab
- Vendor shall provide 5-liter sample of intended lubricant to Southern Area Laboratories Division for internal analysis
- Vendor shall conduct a field trial with SA operating facility to confirm the performance

19 Identification

- Each container shall be marked with the applicable Material Master Number as per Appendix I.

  Note: The Material Master Number varies based on product and container size.

- Fill date and location
- Batch number
- Blender's name or other identification
- Saudi Aramco purchase order number
- Certificate of Analysis (CoA) to be supplied with each PO (per batch)

  Note: Color Coded Label shall be attached to the container.

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Appendices

Appendix I: Material Master Numbers of Lubricants

Type of Lubricant	Material Master Number
Turbine Oils	
Turbine Oil 32	1000172836 / 1000172838
Turbine Oil 46	1000172864 / 1000172866
Turbine Oil 68	1000172920 / 1000172922
Turbine Oil 100	1000645108
Gas Turbine Oil 32	1000173547
Turbo Compressor Oil 46	1000172966 / 1000756096
Machinery Oils	
Machinery Oil 150	1000172925 / 1000172926
Machinery Oil 220	1000176139
Machinery Oil 320	1000172927 / 1000172928
Machinery Oil 460	1000172929
Hydraulic Oils	
Hydraulic Oil AW 32	1000621156
Hydraulic Oil AW 46	1000955848
Hydraulic Oil AW 68	1000173093 / 1000173152
Refrigeration Oils	
Refrigeration Oil WF 68	1000173717 / 1000173760
Refrigeration Oil HCF-134a Synthetic	1000173763 / 1000173767
Synthetic Gas Turbine Oil	
Synthetic Gas Turbine Oil 5	1000173581 / 1000173585
Industrial Gear Lubes	
Gear Lube EP 68	1000955849

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Gear Lube EP 100	1000176135
Gear Lube EP 150	1000176463
Gear Lube EP 220	1000173030 / 1000173063
Gear Lube EP 320	1000176467
Gear Lube EP 460	1000173065
Gear Lube EP 1000	1000173069
Automatic Transmission Fluid III	
Automatic Transmission Fluid III	1000173155 / 1000173207
Automotive Gear Oils	
Automotive Gear Lube 85W-140	1000173005/1000173007
Automotive Gear Lube 90	1000172969/1000173002

Diesel Engine Oils	
Diesel Engine Oil API CH-4 SAE 15W-40	1000173600
Diesel Engine Oil API CI-4 SAE 15W-40	1001022827
Diesel Engine Oil SAE 40	1000173525 / 1000173540
Diesel Engine Oil EMD	1000173543
Two-Stroke Diesel Engine Oil SAE 40	1000645830
Insulating Oil	
Insulating Oil	1000173668
Way Lubricant	
Way Lubricant	1000174083
Machining, Finishing, and Protection Oils	
Penetrating Oil	1000173839
Rust Preventive	1000173862/1000173865
General Purpose Cutting Oil	1000174002

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Heavy Duty Cutting Oil	1000174006
Soluble Oil	1000174040
Honing Oil	1000174047
Synthetic Grinding Fluid	1000174049
Turbine Oil Vapor Space Inhibitor	1000173887
Greases	
All Purpose Grease EP 1	1000173240
All Purpose Grease EP 3	1000173241 / 1000173245
Ball Bearing Grease 2	1000173248 / 1000173268
Gear Coupling Grease 1	1000173347
Rack and Pinion Grease	1000173371 / 1000173375
High Temperature Grease	1000173341
Open Gear and Wire Rope Lubricant	1000173881 / 1000173884

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Document History

07 November 2022	Major	Major revision to mainly merge twelve (12) SAMSS; 26-SAMSS-046, 26-SAMSS-048, 26-SAMSS-050, 26-SAMSS-051, 26-SAMSS-056, 26-SAMSS-059, 26-SAMSS-069, 26-SAMSS-076, 26-SAMSS-087, 26-SAMSS-089, 26-SAMSS-090, 26-SAMSS-091into existing 26-SAMSS-088 and rename from turbine oils to "Oils, Greases and Specialty Chemicals for Rotating Equipment Lubrication and Protection".
30 July 2019	Editorial	Editorial revision to: −Change the revision cycle from three years (22 November 2020) to five years (22 November 2022) −Reflect document's references in the proper section(s)/paragraph(s) to comply with SAEP-301
16 May 2019	Editorial	Editorial revision to modify the title of reference SAEP-302
22 November 2017	New	New Saudi Aramco Materials System Specification that describes the requirements for different types of Machinery Lubricants to be used in different rotating equipment for lubrication.

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ATTACHMENT-06

Materials System Specification

20 October 2022

34-SAMSS-625

Machinery Protection Systems

Document Responsibility: Instrumentation Standards Committee

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Summary of Changes

Paragraph Number		Change Type (Addition, Modification, Deletion, New)	Technical Change(s)
Previous Revision 16 January 2020	**Current Revision** 20 October 2022		
III	III	Addition and Deletion	Updating references, SAEP-746, IEC 62734, SAES-G-117. Delete ISA 100.11a
IV	IV	Modification	Add 'Terminology' section
4.1.2	4.1.2	Modification	Exclude operating temperature range requirement for computers, servers and external network devices
4.6 & 4.6.3	4.6 & 4.6.3	Delete	Delete the requirement as an alignment with API 670
4.7.1.1	4.7.1.1	Addition	Add the machinery vendor shall communicate with the MPS vendor to ensure correct measurements and selection of the probes, transducers and sensors.
4.8.2	4.8.2	Modification	Delete ISA 100.11a and replace with IEC 62734. ISA 100.11a is currently under IEC 62734
4.9.5.d	4.9.5.d	Modification	Allow ATEX certification provided it is 3rd party certification.
4.12.12	4.12.12	Modification	Modify that only active relay contacts with 10% spare shall be hardwired to terminal block
4.12.16	4.12.16	Modification	Modify that only active relay contacts with 10% spare shall be hardwired to terminal strip
4.17, 4.17.1	4.17, 4.17.1	Addition	Add new para that MPS life cycle as per SAEP-746
4.22	4.22	Modification	Alignment with SAES-G-117
7.4.1.6	7.4.1.6	Clarification	Add 'serial digital communication' for trip multiplier per API 670

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Paragraph Number		Change Type (Addition, Modification, Deletion, New)	Technical Change(s)
Previous Revision 16 January 2020	**Current Revision** 20 October 2022		
7.4.4.4	7.4.4.4	Clarification	Add 'serial digital communication' for trip multiplier per API 670
7.7	7.7	Modification	Units of measurement per SAEP-301.
All	All	Modification	Editorial Changes
III	III	Addition and Deletion	Updating references, SAEP-746, IEC 62734, SAES-G-117. Delete ISA 100.11a

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I. Scope

This specification, together with the appropriate Buyer's Instrument Specification Sheets (ISS), Quotation Request or Purchase Order, cover the minimum requirements for a machinery protection system (MPS) measuring radial shaft vibration, casing vibration, shaft axial position, shaft rotational speed, piston rod drop, frame vibration, phase reference, overspeed, and critical machinery temperatures (such as bearing metal). It covers requirements for hardware (transducer and monitor systems), installation, documentation, and testing. It also defines the minimum mandatory requirements governing the design and installation of protective equipment system, as well as minimum requirements of condition monitoring equipment for rotating machinery.

Exceptions:

i.This specification does not apply to electrical motor and generator stator temperature monitoring equipment.

ii.Motor winding temperature monitoring shall not be implemented in the machinery protection system. Motor winding temperature shall be monitored by 'multipurpose motor protection' systems which are defined in the electrical standards.

iii.Surge Detection System is not covered in this specification.

iv.Emergency Shutdown System (ESD) is not covered in this specification. It shall be per 34-SAMSS-621, and 34-SAMSS-623.

v.Lubrication, shaft-sealing and control oil instrumentation are not a part of MPS and shall comply with 31-SAMSS-012 and 32-SAMSS-013.

Notes:

i.The motor winding temperature monitoring requirements are defined in Section 9.2 of SAES-P-113, Motors and Generators.

ii.Machinery to be protected

The protective instrumentation required for each type of rotating machinery shall be per the applicable Saudi Aramco Materials System Specifications (SAMSSs) or Saudi Aramco Engineering Standards (SAESs) under Consulting Services Department (CSD).

II. Conflicts and Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed to the EK&RD Manager.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302.

III. References

All referenced specifications, standards, codes, drawings, and similar material are considered part of this Materials System Specification to the extent specified, applying the latest version, unless otherwise stated.

i. Saudi Aramco References

Saudi Aramco Engineering Procedures

SAEP-250	Safety Integrity Level Assignment and Verification
SAEP-301	Instructions for Establishing and Maintaining Mandatory Saudi Aramco Engineering Requirements
SAEP-746	Lifecycle Management Procedures for Process Automation Systems

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Saudi Aramco Materials System Specification

31-SAMSS-012	Shaft Sealing Systems for Centrifugal and Rotary Pumps
32-SAMSS-013	Lubrication, Shaft Sealing, and Control Oil Systems and Auxiliaries
34-SAMSS-621	ESD Solid-State (non-programmable) Logic Solver
34-SAMSS-623	Emergency Shutdown (ESD) Systems
34-SAMSS-820	Instrument Control Cabinets

Saudi Aramco Engineering Standards

SAES-J-601	Emergency Shutdown and Isolation Systems
SAES-G-117	Requirements for Rotating Machinery Online Condition Monitoring Systems
SAES-P-113	Motors and Generators

Saudi Aramco Inspection Requirements

175-345100	Monitor System: Machinery Protection Systems

Saudi Aramco Forms and Data Sheets

NMR-7922	Non-Material Requirements (NMR) for Vibration, Axial Position, and Bearing Temperature Monitoring System
SA-8020-625	Vibration, Axial Position, and Bearing Temperature Monitoring System

ii. Other References

American Petroleum Institute

API STD 670	Machinery Protection Systems

International Electrotechnical Commission

IEC 60529	Degrees of Protection Provided by Enclosures
IEC 62591	Industrial Communications Networks- Wireless Communication Network and Communication Profiles- Wireless HARTTM

International Society of Automation (ISA)

IEC 62734	Industrial Networks - Wireless Communication Network and Communication Profiles - ISA 100.11a

National Fire Protection Association

NFPA 70	National Electrical Code

National Electrical Manufacturers Association

NEMA 250	Enclosures for Electrical Equipment
NEMA ICS 6	Industrial Control and Systems Enclosures

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IV. Terminology

i. Acronyms

DCS	Distributed Controlled System
MMI	Man-Machine Interface
VMS	Vibration Monitoring System

V. Modifications

The following paragraph numbers refer to API STD 670, 5th Edition, which is part of this specification. The text in each paragraph is an addition, exception, modification, or deletion to API STD 670 as noted. Paragraph numbers not appearing in API STD 670 are new paragraphs to be inserted in numerical order.

1 General

1.1 Scope

(Modification to 'Note') A bullet at the beginning of a paragraph indicates that either a decision is required or further information is to be provided by the purchaser. This information shall be indicated on the Saudi Aramco Instrument Specification Sheets (ISS) SA-8020-625; otherwise, it will be stated in the quotation request or in the purchase order.

Commentary Note:

The Saudi Aramco ISS sheets (SA-8020-625) replaces the API STD 670 data sheets located in Annex 'A'.

3 Terms, Definitions, Acronyms, and Abbreviations

3.1 Terms and Definitions

3.1.230 (Addition) Module: An assembly of interconnected components which constitutes an identifiable device or piece of equipment. A module can be disconnected, removed as a unit, and replaced with a spare. It has definable performance characteristics which permit it to be tested as a unit.

3.1.231 (Addition) Process critical equipment: Rotating equipment including turbines, electric driven pumps, compressors (Rotating / Reciprocating) or generators handling combustible, flammable or toxic materials and use drivers equal to or greater than 1,000 HP.

3.1.232 (Addition) True Peak amplitude values are detected from the vibration time wave of the signal. It is not a processed data calculated from Root Mean Square (RMS) detection scheme. It measures the maximum amplitude (positive or negative) of the peak compared to the neutral.

3.1.233 (Addition) Severe Corrosive Environments: For the purposes of this specification, severe corrosive environments include:

a.Outdoor offshore locations

b.Outdoor onshore locations within one kilometer from the shoreline of the Arabian Gulf

c.Outdoor onshore locations within three kilometers from the shoreline of the Red Sea.

d.All of the Ras Tanura Refinery and Terminal.

Locations where chlorine or other corrosive chemicals are being handled (e.g., sulfur plants, waste water treatment, water treatment, R.O. facilities).

If any part of a specific plant falls within these limits, that part of the plant area shall be treated as severe corrosive environment.

3.1.233 (Addition) Vibration, Axial Position and Bearing Temperature Monitoring System: The monitoring system consists of proximity probes, velocity sensors, accelerometers, and

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temperature sensors; signal conditioning devices (if required); interconnecting cables; racks; power supplies; monitors; and communication devices.

Commentary Note:

For simplicity, the remainder of the document will define the "Vibration, Axial Position and Bearing Temperature Monitoring System" as the "Vibration Monitoring System (VMS)".

3.1.234 (Addition) Shutdown Logic Solver: The logic system that receives the shutdown inputs from the MPS, processes the machinery protection logic and automatically sends shutdown commands to the rotating equipment train. The Shutdown logic solver shall be one of the following; Distributed Control System (DCS), Simplex Programmable Logic controller (PLC), or PLC based ESD system.

3.2 Acronyms and Abbreviations

(Addition) An addition of the following acronyms and abbreviations:

DCS: Distributed Controlled System

MMI: Man-Machine Interface

VMS: Vibration Monitoring System

4 General Design Specifications

4.1 Component Temperature Ranges

4.1.2 (Addition) For all MPS components not listed in Table-1 the operating temperature range shall be from 0°C to 65°C (32°F to 149°F).

Exception:

Computers, servers and external network devices are excluded

4.4 Chemical Resistance

4.4.3 (Modification) The MPS vendor shall ensure that all field mounted components are physically protected from the ambient air quality as defined below.

4.4.3.1 (Addition) Dust Concentration: Usual airborne dust concentration is

1 mg/m^3. During sandstorms, dust concentrations may reach 500 mg/m^3. Particle sizes are as follows:

95% of all particles are less than 20 micrometers

5% of all particles are less than 1.5 micrometers

4.4.3.2 (Addition) Elements present in dust include compounds of calcium, silicon, magnesium, aluminum, potassium, chlorides and sodium.

When wetted (high humidity conditions) these compounds function as electrolytes and can result in severe corrosion.

4.4.3.3 (Addition) If applicable, other pollutants present in the atmosphere under the most extreme conditions are:

H2S	20 ppm (vol/vol)
Hydrocarbon	150 ppm (vol/vol)
SO2	10 ppm (vol/vol)
CO	100 ppm (vol/vol)
NOx	5 ppm (vol/vol)
O3	1 ppm (vol/vol)

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4.7 Scope of Supply and Responsibility

4.7.1 (Modification) For each project, the owner shall specify the agency or agencies responsible for each function of the design, scope of supply, installation and performance of the monitoring system. A typical responsibility matrix worksheet is provided in Annex-B. The purchaser is responsible for the development, routing, and completion of the responsibility matrix worksheet.

4.7.1.1 (Addition) The machinery vendor shall supply and install the probes, transducers, and sensors as specified. All probes, transducers, and sensors shall be completely installed and connected to a skid mounted junction box. The junction box(s) shall be provided by the machinery vendor. The machinery vendor shall communicate with the MPS vendor to ensure correct measurements and selection of the probes, transducers and sensors.

Exception:

For MPS upgrades on existing equipment, the MPS vendor shall supply and install the probes, transducers, and sensors as specified.

4.7.1.2 (Addition) When requested by Owner, the MPS vendor shall act on the behalf of the purchaser to verify machinery vendor's compliance to this specification. The machinery vendor shall supply all information and documentation as requested by the MPS vendor, e.g., transducer types, quantities, locations, mounting arrangements, etc. The MPS vendor's review results shall be included in the data requirements specified in Section 12.

Commentary:

The MPS vendor's review of the machinery vendor's documentation and supplied materials will help to achieve consistency across different machine trains supplied by the machinery vendor and/or by multiple machinery vendors.

4.8 Segregation

4.8.2 (Modification) Wireless technologies shall not be used for protective functions (see Table 2). Wireless technologies may be used for monitoring applications, with the approval of the proponent. All wireless devices and gateways shall be fully compliant to IEC 62734 or IEC 62591 WirelessHARTTM. In either case, the same protocol shall be used for one machine train.

4.9 System Enclosures and Environmental Requirements

4.9.1 (Modification) Field –installed MPS installations shall be suitable for the area classification as specified in this specification Section 4.9.5. Intrinsically safe installations require prior written approval from the General Supervisor, Process Instrumentation Division, Process & Control Systems Department.

4.9.1.a (Addition) Enclosures (this includes junction boxes) not required to be explosion proof, shall be NEMA Type 4 or IEC Type IP65 manufactured and tested in accordance with NEMA ICS 6 and NEMA 250, or IEC 60529 as applicable. The enclosures shall be made of 316L.

4.9.1.b (Addition) Enclosures in the most extreme conditions and severe corrosive environments shall be NEMA Type 4X or IEC 60529 Type IP 66.

4.9.5 (Addition) Equipment for Hazardous Areas

4.9.5.a (Addition) In hazardous (classified) areas, electrical equipment shall be labeled, listed or certified by any of the agencies in the Approved IECEx Certification Bodies (ExCBs) under the IECEx Certified Equipment Scheme.

4.9.5.b (Addition) All equipment for hazardous areas shall be either labeled listed or certified, that this equipment is designed, manufactured, and tested to the applicable standards or procedures.

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4.9.5.c (Addition) Conduit sealing fittings shall be labeled, listed, or certified by Underwriters Laboratories, Inc. (UL), Factory Mutual Research Corp. (FM), or Canadian Standards Association (CSA).

4.9.5.d (Addition) Installations in hazardous locations shall be per the National Electrical Code, with the following additions and exceptions:

1. IEC or Ex labeled equipment meeting requirement of IEC 60079 and certified by one of the agencies in the Approved IECEx Certification Bodies (ExCBs) under IECEx Certified Equipment Scheme is acceptable. Class and Zone markings are not required on Ex marked equipment but method of protection must be marked and must correspond with NEC Article 505 requirements for suitable protection method(s) for the hazardous area where the equipment is applied. ATEX is technically acceptable only with the approval and certificate by a third party per EN60079 (i.e. Self-certification is not acceptable).
2. Equipment suitable for Class 1, Zone 0 locations may be used in
3. Class 1, Division 1 locations.
4. Equipment suitable for Class 1, Zone 1 or 2 locations may be used in Class 1, Division 2 locations.

5.Flameproof enclosures EEx d II are permitted in Class I, Division 1 locations as meeting the NEC requirements for approved enclosures, provided:

i) NEC requirements for cable entry are met;

ii) the overall enclosure is flameproof EEx d II (explosion-proof) as a whole (not only its components);

iii) the enclosure is constructed of a conductive metal or has an integral metal bonding device that ensures a positive low-resistance bond between conduits or/and cable armors entering or terminating at the enclosure; and

iv) if used outdoors, the enclosure is rated a minimum of

NEMA Type 4 or IEC Type IP65. Enclosure in the most extreme conditions and severe corrosive environments shall be NEMA Type 4X or IEC 60529 Type IP 66.

4.9.5.e (Addition) The equipment selection, approval, and identification

(i.e., certification, listing or labeling) requirements in the NEC for Division 2 installations also apply to Zone 2 installations.

4.9.5.f (Addition) For the purposes of this specification, “Certified” and “Certification” have the same meaning as “Listed” and “Listing” as defined and used in the National Electrical Code.

4.10 Power Supplies

4.10.10 (Modification) The monitor system shall be fitted with a redundant power supply. Each power supply shall:

a. accept the same input voltages or different input voltages as the other power supply (for input voltage options, see 4.10.1 and 4.10.2);
b. independently supply power for the entire machinery protection monitor system such that a failure in one supply and its associated power distribution busses shall not affect the other and not cause a trip or reduce MPS functions;

c.allow removal or insertion with power applied without affecting the operation or integrity of the protection system;

d.provide automatic switchover from one power supply to the other in case of fault of a power supply, without affecting the operation or the integrity of the protection system.

4.10.10.e (Addition) Power supply modules can be mechanically integrated into the monitor system rack or externally mounted.

4.11 Machinery Protection System Features/Functions

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4.11.1 (Modification) The requirements of SIS's shall apply to the MPS of process critical equipment upon determination of minimum safety integrity level one (SIL 1) during SIL assignment. The MPS supplier(s) shall provide the reliability/performance documentation to allow the SIS supplier to determine the safety integrity level (SIL) for the SIS. The design contractor shall be responsible for the following:

a. (Modification) Identify and ensure compliance of functional safety methods per SAES-J-601 requirement

b. (Modification) Perform SIL assignment per SAEP-250

c.(Delete)

d.(Delete)

e. (Delete)

4.11.3.b (Modification) The monitor system shall be provided with an internal time clock and shall have provisions for remotely setting the time and date through the digital communication port of 4.13.1. The internal clock time setting or synchronization shall be made with a maximum latency of

100 milliseconds between the master remote clock and the monitor system internal clock. The clock shall have battery backup.

Note:

Since the monitor system can implement alarm, shutdown and integrity logic, it shall also maintain a systems alarm record with an internal clock time stamp. This record shall be stored in non-volatile memory located in one of the monitor system modules and not on an external device or computer. The stored values shall be maintained in the event of a total loss of power or loss of communications to the monitor system. For purposes of troubleshooting shutdown events, the monitor systems alarm event file time stamp should match the plant's other control devices.

4.11.3.c (Modification) Any module excluding simplex relay module, shall be capable of being removed and replaced while the system is under power without affecting the operation of the protected machine or other modules.

4.11.4.f (Modification) If specified, a digital communications port shall be supplied for transmitting data between the MPS and a Condition Monitoring System (CMS) hardware (open code). The protocol used shall be mutually agreed upon between vendor and purchaser.

Note:

See Annex N of the API STD 670 for additional details on the purpose of this digital interface and the types of data typically transmitted.

4.11.5.h (Modification) A means to identify the first-out alarm (alert) and the first-out shutdown (danger) shall be provided for each machinery train.

4.12 System Output Relays

4.12.5 (Modification) The relay control circuit shall be field changeable to be either normally de-energized or normally energized. All active contacts with 10% spares shall be wired to the terminals blocks

4.12.12 (Addition) De-energize to alarm and de-energize to shutdown shall be standard, i.e., the alarm (alert) and shutdown (danger) relays shall be normally energized. The alarm and shutdown contacts shall be wired fail safe, i.e., the alarm and shutdown contacts shall be closed during normal operation and shall open when the alarm or shutdown condition is reached.

4.12.13 (Addition) For process critical equipment, as defined in Section 3.1.231, redundant relay modules shall be used for the shutdown (danger) contacts.

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4.12.14 (Addition) For machinery trains using redundant relay modules, the configuration of the redundant relay modules shall be identical such that the corresponding relay on each module will follow the same logic and will send the same signal to the logic solver (e.g., ESD).

Note:

Dual voting logic (two-out-of-two) is being mandated and shall be used in the logic solver to prevent the failure of one relay or the relay module from tripping the machinery train.

4.12.15 (Addition) Removal or fault of any one of the relay modules as described in paragraphs 4.12.13 and 4.12.14 shall result in fail safe behavior of the relay contact, e.g., the relay contact shall go to de-energize mode and the status alerts in the DCS.

4.12.16 (Addition) All active relay contacts with 10% spares shall be wired to an easily accessible and clearly marked intermediate terminal strip. The intermediate terminal strip shall be installed in the same cabinet as the associated relay module.

4.12.17 (Addition) Alarm (alert) and Shutdown (danger) Outputs

a. For fully or partially attended facilities both the alarm and shutdown outputs shall be annunciated on a visual alarm display, and with an audible alert signal. For unmanned facilities only the shutdown output shall be visually annunciated.

Note:

The audible and visual annunciation shall be in a discrete, multi-point alarm annunciator or to an alarm/annunciator display configured within a DCS system.

b.The shutdown outputs from the MPS danger relay shall be hardwired to the inputs of shutdown logic solver.

Note:

Default shutdown logic solver shall be either DCS or non-ESD PLC.

ESD shall be used as a shutdown logic solver only for process critical equipment when SIL assignment resulting minimum SIL 1.

4.13 Digital Communication Links

4.13.1 (Modification) A digital output proportional to the indicated variable,

not the measured variable, shall be provided at a digital communication ports located at the rear of the monitoring rack. A short circuit of this output shall not affect the MPS and the output shall follow the measured variable and remain at full scale as long as the measured variable is at or above full scale. The channel value for each variable shall be displayed on DCS man-machine interface (MMI). Unless otherwise specified, the protocol utilized for this standard digital output shall be Modbus.

Redundant communication modules supporting serial RS-485 link or an Ethernet link (Modbus over TCP/IP) shall be provided to exchange the data with a Modbus Master, i.e., a DCS.

Each communication port shall be on separate module, i.e., both communication ports shall not be located in one communication module and shall independently communicate with the monitors/modules to exchange the data. The serial interface between the Owner's distributed control system (DCS) and the monitoring system shall be bi-directional such that read/write functions can be performed from both devices. If the MPS vendor has a tightly integrated high speed communication link with the owner's DCS, then this communication link shall be used in lieu of links specified above.

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This output is intended for transmitting MPS status, proportional values, and other data to process control and automation systems as part of their operator display and trending environments. It is not designed or intended to replace the relays of 4.12 for machinery protection purposes. Relays are the only acceptable method of interconnecting the MPS to other devices used for carrying out a shutdown command (4.12.1). See also Annex N.

4.13.2 (Modification) The following information shall be also communicated and displayed via the DCS MMI.

a. (Modification) Channel Alarm Status
b. Alarm status shall be configured from the channel value (refer Section 4.13.1).
c.(Modification) Armed/disarmed (maintenance bypass) shutdown status for all channels.
d.Hardware and software diagnostics
e.Communication link status
f. (Addition) Common alarm per MPS rack

Note:

The Proponent organization shall determine which additional item listed in Section 4.13.2 of API STD 670, if any, will be communicated and displayed in the DCS MMI.

4.13.2.c (Modification to the item c) Alarm storage for storing the time, date and value for a minimum of 500 alarms. Time stamp shall be a 100 millisecond resolution.

4.14 System Wiring and Conduits

4.14.1 General

4.14.1.a (Modification) Wiring and conduits shall comply with the electrical practices specified in NFPA 70 (see Figure 5, Figure 6, Figure 7, Figure C.1, and Figure C.3). Flexible conduit shall be installed per Section 4.14.1.h.

4.14.1.h (Addition) Flexible liquid-tight conduit or equivalent, with fittings listed for grounding, shall be used at the terminal head end of the conduit to provide isolation from vibration and for ease of maintenance. Flexible liquid-tight conduit shall not be less than 18 inches in length and not more than 6 feet in length.

4.14.1.i (Addition) Monitor system modules, when specified, shall have the ability to allow multi-conductor cable plug-in arrangement at the module. The other end of the cable shall terminate on an intermediate terminal strip located in the same cabinet as the monitor module.

4.16 System Security, Safeguards, Self-tests, and Diagnostics

4.16.4.c (Addition) The event list shall maintain a minimum of 400 events with date and time stamp. The date and time stamp shall be 100 millisecond resolutions.

4.17 Reliability

4.17.1 (Modification) MPS vendor shall advise in the proposal any component design for a finite life. The MPS life cycle shall be per SAEP-746.

NOTE 1:

Finite life means that the components are designed to fail under normal operating conditions or date of planned obsolescence is known.

NOTE 2:

It is realized that there are some services where this objective is easily attainable and others where it is difficult.

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4.18 (Addition) Shutdown Signals

All shutdown signals for the rotating equipment train shall be wired directly to the shutdown logic solver. Shutdown signals may originate from three sources:

1. The vibration monitoring system (based on bearing temperature, radial vibration, and axial position sensors, and casing vibration),
2. Lubrication, shaft-sealing and control oil instrumentation (if applicable);
3. Process shutdown devices.

4.19 (Addition) Input Bypass Switches

a. Each MPS input shutdown signal shall be installed with a bypass switch to facilitate maintenance or testing.

b. Bypass switches in vibration monitoring equipment shall be either at the local MPS rack (hardwired), or software-configured using a restrictive access mechanism such as a key-lock, a password protection scheme, or both.

c. Activation of a bypass switch, to the bypass position, shall be annunciated on a visual alarm display, and with an audible alert signal.

d. Software configured bypass switches shall meet the following:

   i. Bypass individual channels

   ii. Shall be configured such that loss of communications between the MPS and DCS shall not deactivate any active bypasses.

   iii. Analog values for the bypassed channel shall not be disabled during bypass.

   iv. Provide bypass confirmation to the DCS console operator.

   v. The total cycle time from initiation of the channel bypass to operator confirmation shall be less than 5 seconds.

4.20 (Addition) Event/Logging Recording

a. First-out event logging, if required by the proponent organization, shall be implemented in the plant event logging and archiving system.

b. Vibration monitor systems which have the ability to perform on board event logging on a per rack basis are acceptable provided that, the system is designed to accept an external synchronization signal from the plant event logger and can provide the event time discrimination required by the Proponent organization.

4.21 (Addition) Setpoint Multiplier (Trip Multiply)

a. Setpoint Multiplication shall be used when both of the criteria below are encountered:

   i. The machine experiences vibration amplitudes in excess of its danger or alert setpoints as it passes through a machine resonance and this results in unwanted machine shutdown or alarms.

   ii. The duration of this setpoint violation exceeds the preset alarm delay times.

b. Bypassing or suppressing the machinery protection system alarms while it passes through a resonance in lieu of using properly established setpoint multiplication functions shall not be used.

Note:

Setpoint multiplication merely elevates the alarms, it does not suppress them. This ensures that machinery protection is provided at all rotational speeds of the machine.

4.22 (Addition) Condition Monitoring System (CMS)

a. General Description

b. The CMS is typically used for historical trending, machinery diagnostics, and predictive maintenance purposes, and not for machinery protection.

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c.The CMS shall meet SAES-G-117 requirements.

5 Sensors and Transducers

5.1 (Modification) Radial Shaft Vibration, Axial Position, Phase Reference, Speed Sensing, and Piston RodDrop Transducers

5.1.1 Proximity Probes

5.1.1.6 (Modification) The coaxial cable shall be 'tagged' per 34-SAMSS-820, Section 6.7.11.

5.1.3 Connectors

5.1.3.3 (Modification) Proximity probe extension cable connectors shall be insulated from ground. These connectors shall include an insulation material (boot) around them for electrical isolation and environmental protection.

5.1.3.4 (Addition) The connectors shall contain a mechanism to prevent the connectors from becoming loose during operation.

5.2 Seismic Transducers

5.2.2 Accelerometer Cables

5.2.2.3 (Modification) The accelerometer cable shall be 'tagged' per 34-SAMSS-820, Section 6.7.11.

5.2.2.5 (Addition) The MPS vendor shall furnish all multi-conductor cable assemblies that connect seismic sensors and transducers to terminal strips or signal conditioners installed within a common junction box on the machinery train skid.

5.2.2.6 (Addition) The construction agency shall provide the multi-conductor cable assemblies from the skid-mounted common junction box to the monitors.

5.2.4 Velocity Sensor Cables

5.2.4.3 (Modification) The velocity sensor cable shall be 'tagged' per 34-SAMSS-820, Section 6.7.11.

5.3 Temperature Sensors

5.3.1 Sensors

5.3.1.6 (Modification) The temperature sensor cable shall be 'tagged' per 34-SAMSS-820, Section 6.7.11.

6 Sensor and Transducer Arrangements

6.1 Location and Orientation

6.1.2 Radial Shaft Vibration Probes

6.1.2.2.d (Modification) shall be properly demagnetized or otherwise treated so that the combined total electrical and mechanical runout does not exceed 25% of the maximum allowed peak-to-peak vibration amplitude (0.5 mils is the maximum) or 6 µm (0.25 mil), whichever is greater.

6.1.5 Phase Reference Transducers

6.1.5.1 (Modification) A one-event-per-revolution mark and a corresponding phase reference transducer shall be provided on the driver for each machinery train (see Figure H.4 for an example), on the output shaft(s) of all gearboxes

(see Figure H.2), on the intermediate gear for double reduction/increaser gear set, and on reciprocating compressors when piston rod drop measurements are made (see Figure H.6).

6.1.5.8 (Addition) Phase reference transducers shall be supplied for all machine trains that will receive a CMS. The machinery vendor shall contact the Owner to verify which machine train(s) will receive a CMS.

6.3 Identification of Sensor Systems

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(Addition) All cables and conductors shall be identified with permanent tags per 34-SAMSS-820, Section 6.7.11.

7 Vibration Monitor Systems

7.1 General

7.1.3.c (Modification) Electrical or mechanical adjustments for zeroes, gains, and alarm (alert) and shutdown (danger) setpoints that are field changeable and protected through controlled access. The means for adjustment, including connection(s) for a portable configuration device, shall be accessible from the front of the monitor system. The monitor system alarm and shutdown functions shall be manually or automatically bypassed in accordance with 4.12.11 during adjustment. Controlled access for monitor system adjustments shall be in the form of a programming access key located at the front of the monitor system rack or via software, i.e., password protection. Configuration shall be stored in non-volatile memory so it is not lost in the event of a total power loss to the monitor system. A minimum of 60-days back-up is required for battery back-up of monitor RAM used to store configuration, values and event lists.

7.1.3.e (Modification) The monitor system shall be capable of interfacing to an external host computer for implementing a CMS for machine train(s) during steady state and transient operating conditions. This data link shall be independent from digital outputs of 4.13.1.

7.1.5.a (Modification) Fixed time delays for shutdown (danger) relay activation that are field changeable (via controlled access) to require from 1 to 3 seconds sustained violation. A delay of 3 seconds shall be standard.

7.1.11 (Addition) Where filters (low/high pass) are used, either at the interface or monitor, provisions shall be made to allow unfiltered vibration to be monitored from a buffered test point.

7.3 System-Output Relays

7.3.2 (Modification) For each machine train, shutdown signal(s) shall be commoned by a single output or redundant relay outputs from the VMS relay modules(s) to shutdown logic solver (redundant outputs from redundant relay modules for process critical equipment per 4.12.13 and 4.12.14). The voting of field sensors (i.e., radial shaft vibration, axial position, casing vibration, bearing temperature, and piston rod drop) shall be done in the MPS (i.e., VMS) rack.

A single (non process critical equipment) or one pair (process critical equipment) of shutdown (danger) configured relay(s), can be provided, only if the commoned shutdown signal(s) is/are not suitable for the given applications. In this case, the shutdown (danger) configured relays(s) shall be provided for each of the following monitored variables per machinery train:

a.Axial position
b.Radial shaft vibration
c.Casing vibration
d.Bearing temperature
e.Piston Rod Drop

7.4 Monitor Systems

7.4.1 Radial Shaft Vibration Monitoring

7.4.1.1 (Modification) The full-scale range for monitoring radial shaft vibration shall be from 0 to 5 mils (0 to 125 micrometers) true peak-to-peak displacement. When specified, the standard optional full-scale range shall be from 0 to 10 mils (0 to 250 micrometers) true peak-to-peak displacement. Peak-to-peak values factored from any other intermediate value or calculated measurement, other than the transducer or signal interface are not acceptable.

7.4.1.4 (Modification) The radial shaft vibration shutdown system shall be field changeable so that one (single logic) or both (dual voting logic) orthogonal ("X-Y") transducer signals shall persist at or above the set point to activate a shutdown (danger) relay. Dual voting (two-out-of-two) logic

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shall be standard. The MPS system shall have the capability to detect transducer circuit failure and include it as part of the trip logic.

The shutdown (danger) relay shall activate only when both channels jointly violate the shutdown (danger) set point. In the event of failure of a single radial shaft vibration channel transducer or circuit, only the circuit-fault alarm will activate [i.e., the shutdown (danger) relay will not activate].

7.4.1.6 (Modification) A controlled-access setpoint multiplier function shall be provided with the following capabilities

a. Actuation by an external contact closure and serial digital communication causes the alarm (alert) and shutdown (danger) setpoints to be increased by an integer multiple, either two (2) or three (3). Decimal values between one (1) and three (3) are acceptable. A multiplier of three (3) shall be standard.

Note:

It is highly recommended that the trip multiplier settings be verified with CSD and equipment manufacturer.

b. Positive indication (for example, lighted) shall be provided on the monitor system when the multiplier is invoked.

c. Elevation of the setpoint shall not attenuate the actual input signal nor alter the proportional digital or analog outputs representing the channel's amplitude.

7.4.1.8 (Addition) Vendor with proven (Saudi Aramco to verify) technology to reduce/eliminate runout should be investigated (Saudi Aramco to verify). A dedicated card specifically for Runout subtraction as an additional card could be approved.

7.4.2 Axial Position Monitoring

7.4.2.4 (Modification) The axial position shutdown system shall be dual voting logic (see 7.4.2.5) which both transducer signals reach or violate the shutdown (danger) setpoint to actuate the shutdown (danger) relay.

7.4.3 Piston Rod Drop Monitoring

7.4.3.3 (Modification) The piston rod drop monitor system shall be supplied with two channels per piston rod for X-Y measurements (see 6.1.3.7).

7.4.4 Casing Vibration Monitoring

7.4.4.1 (Addition) Add NOTE 3

NOTE 3:

Where the highest expected exciting frequency is higher than 1 kHz, each bearing shall be monitored by an accelerometer (recommended) or a velocity transducer.

7.4.4.2 (Modification) The monitored frequency range of each casing vibration channel shall be fixed with two field-changeable filters, high and low pass. Filters used to set the frequency range shall have the following characteristics.

a. Unity gain and no loss in the passband greater than 0.5 dB, referenced to the input signal level.

b. A minimum roll-off rate of 24 dB per octave at the high and low cutoff frequency (-3 dB).

c. Filtering shall be accomplished prior to integration.

d. Unless otherwise specified, casing velocity shall be monitored within a filter passband from the velocity transducer Low Cut to High Cut frequency.

7.4.4.4 (Modification) A controlled-access setpoint multiplier function shall be provided with the following capabilities

a. Actuation by an external contact closure or serial digital communication causes the alarm (alert) and shutdown (danger) setpoints to be increased by an integer multiple, either two

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(2) or three (3). Decimal values between one (1) and three (3) are acceptable. A multiplier of three (3) shall be standard.

Note:

It is highly recommended that the trip multiplier settings be verified with CSD and equipment manufacturer.

b.Positive indication (e.g., lighted) shall be provided on the monitor system when the multiplier is invoked.

c. Elevation of the setpoint shall not attenuate the actual input signal nor alter the proportional digital or analog outputs representing the channel's amplitude.

7.4.4.5.a.ii (Modification) Velocity shall be monitored in a frequency range between Low Cut to High Cut frequency; amplitude from 0 to 25 millimeters per second (0 to 1.0 inch per second) true RMS.

7.4.4.5.b.i (Modification) Pumps, fans, and motors with rolling element bearings (see notes following Section 7.4.4.1): Velocity shall be monitored in a filter passband from Low Cut to High Cut frequency: amplitude from 0 to 25 millimeters per second true RMS (0 to 1 IPS true RMS).

7.4.4.6 (Modification) As minimum, a casing vibration monitor system shall include the follow options:

a.monitor and display of single channel acceleration or velocity,

b.monitor true RMS.

7.4.4.7 (Addition) Monitor modules shall have programmable filters with options from 10 Hz to 20 kHz. Low Pass cut-off frequency filter should have minimum increment steps of 1000 Hz and High Pass cut-off frequency filter should have minimum increment steps of 1 Hz.

Note:

The programmable filter options from 10 Hz to 10 KHz is acceptable for non-high speed rotating machinery.

7.4.5 Temperature Monitoring

7.4.5.2 (Modification) A fault in the temperature monitor or its associated transducers shall initiate the circuit-fault status alarm. The direction of the readout or output signal upon temperature sensor burnout shall be selectable (either upscale or downscale). Downscale failure (that is, a failure in the zero direction) shall be standard unless otherwise specified by Owner.

7.4.5.6 (Addition) Monitor system shall be capable of performing differential temperature readings between various transducers terminated to the module. The monitor system shall have the capability to be programmed in the field for the type of input (resistance temperature detector or thermocouple). The monitor system shall support galvanically isolated transducers. All transducers terminated to the same module shall be monitored concurrently.

7.5 Location of Monitor Systems

7.5.1 (Modification) The monitors shall be located in electrically unclassified air-conditioned buildings, and housed in an Instrument Control Cabinet per the requirements of 34-SAMSS-820.

7.5.2 (Modification) Outdoor installations shall not be allowed.

7.6 (Addition) Alarm (alert) and Shutdown (danger) Setpoints

7.6.1 (Addition) The radial shaft vibration, casing vibration, shaft axial position, shaft rotational speed, piston rod drop, overspeed and critical machinery temperature limits for alarm and shutdown setpoints shall be approved, in writing, by Owner.

7.6.2 (Addition) The machinery vendor shall submit their recommended alert and danger setpoints, for each machinery train, to the Owners representative for their review and approval.

7.7 (Addition) Engineering Units

(Addition) Units of measurement shall be according to SAEP-301

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Exception:

Upgrades or modifications to existing facilities may retain existing operating units unless otherwise specified in project documentation.

8 Electronic Overspeed Detection

8.4.1.3 (Modification) An overspeed or underspeed condition sensed by any one circuit or all circuits shall initiate an alarm.

8.4.3.2 (Modification) Each overspeed circuit shall have an onboard frequency generator to allow the verification of the trip speed settings.

11 Inspection, Testing, and Preparation for Shipment

11.1 General

11.1.7 (Addition) Items manufactured to this specification are subject to the minimum Inspection requirements as specified in Saudi Aramco Inspection Requirement Form 175-345100.

12 Vendor's Data

12.1 General

12.1.1 (Modification) The information required in this section shall be furnished by the machinery vendor with unit responsibility or by the responsible agency specified in the responsibility matrix worksheet, i.e., Annex B.

The machinery vendor shall complete and forward the NMRs, as specified in Saudi Aramco Form NMR-7922, to the address or addresses noted on the inquiry or order. This form shall detail the schedule for transmission of drawings, curves, and data as agreed to at the time of the order, as well as the number and type of copies required by the purchaser.

Note:

Form NMR-7922 replaces the "Vendor Drawing and Data Requirements" form in Appendix 'G'.

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Document History

20 October 2022	Major	Updating references, SAEP-746, IEC 62734, SAES-G-117. Delete ISA 100.11a and other modification and clarifications
16 January 2020	Editorial	to change the next planned update to year 2022, remove brand names and remove cancelled reverences
6 August 2017	Major	to aligned and rearranged all requirements and paragraphs for the whole document in accordance to the latest API STD 670.
16 June 2017	Major	to align with the fifth edition of API STD 670 requirements
23 February 2015	Editorial	to align with API STD 670 requirements.
7 July 2013	Major	Major revision.

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ATTACHMENT-07

Materials System Specification

16 May 2024

34-SAMSS-831

Instrumentation for Packaged Units

Document Responsibility: Instrumentation Standards Committee

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Summary of Changes

Paragraph Number		Change Type (Addition, Modification, Deletion, New)	Technical Change(s)
Previous Revision 25 March 2021	**Current Revision** 16 May 2024		
3	3	Addition and Deletion	Add references: SAEP-301, IOGP S-716. Delete AE-036175
N/A	4.1	Addition	Add acronyms section
6.1	6.1	Modification	Units as per SAEP-301
7.1	7.1	Modification	Allow ATEX certification only by third party
7.1.2	7.1.2	Modification	Add pressure loaded screw less
7.3.2	7.3.2	Modification	Modify the exception – Clarify on vibration transmitter.
7.4	7.4	Deletion and Modification	Delete prior approval of Supervisor, Instrumentation Unit
8.1.1	8.1.1	Addition	Add Exception for thermowell in non-process
8.1.2	8.1.2	Addition	Add the requirement for stainless-steel chain or wire
8.2.1	8.2.1	Deletion and Modification	Welding bosses as per ASME. Delete the cancelled drawing AE-036175
8.3	8.3	Addition and Deletion	Adopt IOGP S-716 for Instrumentation tubing and fittings. Delete ASME B1.20.1 as it is covered in the IOGP.
9.1	9.1	Addition	Add 316SS for junction boxes
9.2.2	9.2.2	Modification and deletion	Adopt IOGP S-716 for Instrumentation tubing and fittings. Delete all requirements covered in the IOGP
All	All	Modification, Addition and Deletion	Editorial by adding and deletion

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1 Scope

This specification defines the minimum requirements for instrumentation provided for pre-engineered, pre-assembled and pre-wired skid mounted packaged units. This specification does not apply to custom engineered packaged units, unless specified in other MSAER.

Commentary Notes:

A packaged unit manufacturer will usually guarantee all materials, workmanship and performance characteristics in accordance with his standard terms and conditions. Components supplied by the packaged unit vendor will include, but are not limited to field instruments, controls, valves, safety systems, pre-wired field interfaces, plant control system interfaces, and electrical systems.

Custom engineered packaged units are governed by all applicable Mandatory Saudi Aramco Engineering Standards.

Modifications, required for a standard packaged unit to meet this specification, do not make the packaged unit a complete custom engineered package.

2 Conflicts and Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed to the EK&RD Manager.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302.

3 References

All referenced specifications, standards, codes, drawings, and similar material are considered part of this Materials System Specification to the extent specified, applying the latest version, unless otherwise stated.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedures	
SAEP-301	Instructions for Establishing and Maintaining Mandatory Saudi Aramco Engineering Requirements
SAEP-302	Waiver of a Mandatory Saudi Aramco Engineering Requirement

Saudi Aramco Materials System Specification	
01- SAMSS-035	API Line Pipe
01-SAMSS-043	Carbon Steel Pipes for On Plot Piping
34-SAMSS-510	Online Analyzers
34-SAMSS-611	Safety Relief Valves, Supplementary requirements to IOGP S-730
34-SAMSS-711	Control Valves

Saudi Aramco Standard Drawings	
AB-036521	Bridge Weld & Typical Brace, Seal-welded and Socket-welded Valves or Process Lines
Saudi Aramco Library Drawing	
DB-950046	Liquid Level Gauge Glasses, Instrument Piping Details

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Saudi Aramco Inspection Requirement	
Form 175-340200	Instrumentation for Packaged Units

Saudi Aramco Forms and Data Sheets	
SA-8020-611	ISS - Pressure Relief Valves Conventional and Balanced Types
SA-8020-612	ISS - Safety Relief Valves Pilot Operated
SA-8020-831	ISS - Package Unit Instrumentation

3.2 Other References

Institute of Electrical and Electronics Engineers	
ANSI/IEEE C37.90.1	Surge Withstand Capability (SWC) Tests for Relays and Relay Systems

American Petroleum Institute	
API STD 520 PT I	Sizing, Selection and Installation of Pressure-Relieving Devices in Refineries (Part I)
API STD 520 PT II	Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries (Part II)
API STD 521	Pressure-relieving and Depressuring Systems
API STD 526	Flanged Steel Pressure Relief Valves
API STD 527	Seat Tightness of Pressure Relief Valves
API RP 551	Process Measurement

American Society of Mechanical Engineers	
ASME B1.20.1	Pipe Threads, General Purpose
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.11	Forged Fittings, Socket-welded, and Threaded
ASME B46.1	Surface Texture
ASME SEC I	Rules for Construction of Power Boilers Non-interfiled
ASME SEC IV	Rules for Construction of Heating Boilers Non-interfiled
ASME SEC VIII D1	Rules for Construction of Pressure Vessels Division 1
ASME SEC VIII D2	Rules for Construction of Pressure Vessels Division 2 Alternative Rules
ASME B16.36	Orifice Flanges

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American Society for Testing and Materials	
ASTM A105	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A182	Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A269	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

Instrument Society of America	
ISA 75.01.01	Flow Equations for Sizing Control Valves

International Electrotechnical Commission	
IEC 60502-1	Power Cables with Extruded Insulation and their Accessories for Rated Voltages from 1 kV up to 30 kV-Part 1: Cables for Rated Voltages of 1 kV and 3 kV
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)

International Organization for Standardization	
ISO 5167	Measurement of Fluid Flow by Means of Pressure Differential Devices Inserted in Circular Cross-Section Conduits Running Full

International Association of Oil and Gas Producers	
IOGP S-716	Small Bore Tubing and Fittings

National Association of Corrosion Engineers	
NACE AMPP MR0175/ISO 15156	Petroleum and Natural Gas Industries-Materials for use in H2S-Containing Environments in Oil and Gas Production

National Electrical Manufacturers Association	
NEMA FG 1	Fiberglass Cable Tray Systems
NEMA IA 2.2 (IEC 61131, Part 2)	Programmable Controllers-Equipment Requirements and Tests
NEMA IA 2.3 (IEC 61131, Part 3)	Programmable Controllers-Programming Languages

National Fire Protection Association	
NFPA 70	National Electrical Code (NEC

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Underwriters Laboratories, Inc.	
UL 508	Industrial Control Equipment - Part XVII, Programmable Controllers

4 Terminology

4.1 Acronyms

AARH	Arithmetic Average Roughness Height
AWG	America Wire Gauge
DCS	Distributed Control System
ESD	Emergency Shutdown System
GRP	Glass Reinforced Plastic
GWR	Guided Wave Radar
ITC	Instrumentation Tray Cable
LCD	Liquid Crystal Display
MC	Metal-clad cable
NPT	National Pipe Thread
PLC	Programmable Logic Controller
PLTC	Power-Limited Tray Cable
PSA	Pressure Swing Adsorption
PZV	Pressure Relief Valve
SPDT	Single-pole, double-throw
SIF	Safety Instrumented Function
SIS	Safety Instrumented System
UV	Ultraviolet

4.2 Definitions

The following definitions shall apply to this specification.

Pre-Engineered Packaged Unit	A pre-assembled, pre-wired skid mounted equipment, which is a standard field tested, mass produced product (e.g., pump systems, instrument air packaged plants, small utility boilers, air conditioning systems, etc.).
Custom Engineered Packaged Unit	A package, which is particularly made to Saudi Aramco's standards and specifications (e.g., custody metering skids, surge relief skids, process boilers, etc.).
Nearshore	Any outdoor, onshore location within one kilometer from the shoreline of the Arabian Gulf; (all of Ras Tanura Refinery and Terminal); and within three kilometers from the shoreline of the Red Sea.

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5 Environmental Conditions

5.1 Temperature

The equipment shall operate continuously under the following ambient air temperatures without any degradation of the manufacturer's guaranteed performance:

	Indoor Air Conditioned (2)	Outdoor Sheltered (1)(2)(3)	Outdoor Unsheltered (2)(3)
Maximum	35°C (95°F)	55°C (131°F)	65°C (149°F)
Minimum	10°C (50°F)	0°C (32°F)	0°C (32°F)

Notes:

1. "Sheltered" refers to permanent, ventilated enclosures or buildings, or permanently fixed sunshades with a top and three sides.
2. For instruments which dissipate internal heat and are installed in custom engineered enclosures (e.g., enclosures not included in the original manufacturer's temperature certification), an additional 15°C shall be added to the above maximum temperatures.

   An example, for "indoor air conditioned" installation, the equipment must perform at 35 + 15 = 50°C. Similarly, for the "outdoor unsheltered" case, the equipment shall be designed for a maximum operating temperature of 65 + 15 = 80°C.
3. For the outdoor installations only, the designer can take credit for forced or passive cooling to eliminate or reduce the 15°C heat rise. For example, if vortex coolers are used, the heat removal capacity of the coolers may be subtracted from the generated heat. No more than 15°C reduction in temperature will be given as credit. The designer shall substantiate his claim by providing the support data and calculations.

5.2 Humidity

Indoor humidity design basis shall be 20% to 80% relative humidity.

Outdoor design basis shall be 5% to 95% relative humidity (non-condensing).

5.3 Contaminants

5.3.1 Onshore Environment

Usual airborne dust concentration is 1 mg/m^3. During sandstorms, dust concentrations may reach 500 mg/m^3. Particle size distribution is as follows:

- 95% of all particles are less than 20 micrometers
- 50% of all particles are less than 1.5 micrometers

Elements present in dust include compounds of calcium, silicon, magnesium, aluminum, potassium, chlorides and sodium. When wetted (high humidity conditions) these compounds function as electrolytes and can result in severe corrosion.

Other pollutants present in the atmosphere under the most extreme conditions are:

H_2S	20 ppm (vol/vol)
Hydrocarbon	150 ppm (vol/vol)
SO_2	10 ppm (vol/vol)
CO	100 ppm (vol/vol)
NOx	5 ppm (vol/vol)
O_3	1 ppm (vol/vol)

5.3.2 Offshore and Nearshore Environment

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Equipment that is not enclosed or hermetically sealed, but is situated offshore or nearshore shall be protected against failure due to wind-borne seawater spray and the accumulation of wetted salt (NaC1).

6 General Requirements

6.1 Engineering Units

Units shall be according to SAEP-301.

Exception:

Upgrades or modifications to existing facilities may retain existing operating units unless otherwise specified in project documentation.

6.2 Power Supply

6.2.1 Electrical Supply

All electrical instruments shall operate from the electrical power supply specified on Form SA-8020-831.

~~6.2.2~~ Air Supply

~~All pneumatic instruments shall operate from the instrument air supply and distribution system specified on Form SA-8020-831.~~

7 Basic Engineering and Design

7.1 Electrical Requirements

Electrical equipment or devices intended for operation in locations classified under NFPA 70, National Electrical Code (NEC) Article 505, shall be labeled, listed or certified by any of the agencies in the Approved IECEx Certification Bodies (ExCBs) under the IECEx Certified Equipment Scheme.

IEC or Ex labeled equipment meeting requirement of IEC 60079 and certified by one of the agencies in the Approved IECEx Certification Bodies (ExCBs) under IECEx Certified Equipment Scheme is acceptable.

Class and Zone markings are not required on Ex marked equipment but method of protection must be marked and must correspond with NEC Article 505 requirements for suitable protection method(s) for the hazardous area where the equipment is applied. ATEX is technically acceptable only with the approval and certificate by a third party per EN60079 (i.e. Self-certification is not acceptable).

All enclosures shall be weatherproof and dust-tight in accordance with NEMA ICS 6 and Type 4X according to NEMA 250 or IEC 60529, Protection Degree IP 66, and suitable for the electrical area classification as specified by ISS.

Conduit sealing fittings shall be labeled or listed by UL, FM or CSA.

7.1.1 Wiring

General power wiring, for circuits up to 600 V to ground and a maximum current rating of 15 A, shall be stranded copper; flame retardant PVC, XLPE, or XLPO insulated; size 14 AWG; have an insulation minimum temperature rating of 90°C and shall comply with NFPA 70 or IEC 60502-1.

Instrumentation signal wiring shall be stranded copper; flame retardant PVC, XLPE, or XLPO insulated and shall have an insulation minimum temperature rating of 90°C. The minimum wire size shall be:

- 16 AWG single twisted pair/triad from instruments to the nearest skid mounted junction box. Cables carrying analog signals shall also be shielded.
- 18 AWG for multi-twisted pair/triad cables from junction boxes to other junction boxes or marshalling cabinets.
- 22 AWG for multi-conductor cable inter-cabinet wiring.

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Specialty cables (e.g., High Temperature, communication, network cables) shall be certified by any of the agencies covered by Section 7.1.

Pair/triads of multi-twisted pair/triad control cables shall be numbered.

Except for thermocouple wiring, black and white colors shall be used for pair conductors and black, white and red for triad conductors unless otherwise specified in the purchase order. Blue color insulation or jacket shall only be used for intrinsically safe installation.

Splices are not permitted in wiring. When wiring must be extended, connections shall be made via terminal blocks.

7.1.2 Terminals

Wiring connections shall be made to channel (rail) mounted terminal blocks. These terminal blocks shall have tubular box clamp connector and compression bar, yoke or pressure-loaded screw less for wire termination.

More than two connections per terminal point are not allowed. If open screw type terminals are used, terminal lugs shall be ring tongue, compression type, with insulated sleeves.

Fused terminals shall be used for power distribution, alarm, and shutdown systems.

7.1.3 Interconnections

All packaged unit wiring, intended for interface with plant wiring, shall be terminated in junction boxes.

7.1.4 Cable Routing

Cables between skid mounted instruments and junction boxes may be routed utilizing one of two methods:

7.1.4.1 Instrument cables may be routed in conduits. The conduit installation shall be in accordance with NFPA 70.

7.1.4.2 Armored cables may be routed on trays. If this option is utilized, the following guidelines shall be followed:

7.1.4.2.1 The armored cable shall be suitable for the area classification where the packaged unit is installed and shall be listed per NFPA 70 on the outer jacket as ITC, PLTC or MC.

7.1.4.2.2 Cables trays shall be aluminum (0.4% maximum copper free) or stainless channel trays. Fiberglass cable trays are preferred for severe corrosive environment. Galvanized steel trays are not acceptable.

Commentary Note:

Fiberglass cable tray shall be designed, manufactured, rated, and tested in accordance with NEMA FG 1. Minimum individual rung load capacity shall be 90 kg. Fiberglass cable trays shall be sunlight (ultraviolet radiation) resistant.

7.1.4.2.3 The cable armor shall be either steel wire armor or interlocked steel armor.

7.1.4.2.4 The trays shall be elevated and shall not be mounted to the skid base plate.

7.1.4.2.5 The glands at both ends of the armored cable shall be certified flameproof (Exd) gland. Where sealing is required by the NFPA 70, the gland shall be certified flameproof (Exd) with a compound barrier seal.

7.1.4.3 Instrument signal cables and power cables shall not be routed on the same tray.

7.1.5 Wire Tagging

Interconnecting wires between skid mounted components and between skid mounted instruments and the skid termination panel shall be tagged. Each tag shall identify the device to which the opposite end of the wire is connected. Heat shrink or ferrule type wire tags with permanently embossed identification markings shall be used.

7.1.6 Grounding

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Provision for grounding the skid structure shall be made at diagonally opposite corners. The skid structure shall be designed to accommodate two-hole compression connector, for (2/0 AWG) copper conductor, at each corner.

7.2 Local Control and Alarm Display Cabinets

7.2.1 Finish

The cabinet finish shall be per manufacturer's standard unless stated otherwise. The color of the coating shall be as specified in the purchase order.

7.2.2 Design

Vortex coolers, heat pumps, or air conditioners may be used to reduce internal cabinet temperature and shall be per manufacturer's standard unless stated otherwise.

7.2.3 Drawings

Vendor shall provide wiring diagrams or wiring list showing termination strips and all electronic interconnections, with names and equipment/terminal identification.

All spare terminals, terminal strips, and wires shall appear on the vendor wiring drawings or list.

7.2.4 Indication Lights, Pushbuttons, and Switches

Indication lights, pushbuttons and switches shall be of the oiltight, heavy duty type. Long-life type derated lamps or LED cluster lamps shall be used.

Indication lights and pushbuttons shall have the following color:

Red - abnormal, trip, shutdown, off, closed, emergency

Yellow - (pre-) alarm

Green - normal, on, open, permissive start

7.2.5 Controllers and Instrumentation

The vendor shall verify that all equipment, including digital controllers and displays are suitable for operation in the ambient conditions specified in Section 5. Controllers and displays shall be installed in locations where vibration is negligible. Digital displays shall be screened from direct sunlight. Controllers shall have an interface with the plant main process control system.

7.2.6 Acceptable communication signals are 4-20 mA and foundation fieldbus. Wireless instrumentation is also an acceptable option for only monitoring and condition monitoring applications which shall have no impact on safety.

7.3 Alarm and Shutdown Systems

7.3.1 Alarm and shutdown systems shall be of fail-safe design. Solenoid valves and relays shall be energized during normal operating conditions. All contacts of direct process-operated, manual shutdown and equipment status switches shall be closed during normal operating conditions.

7.3.2 Each shutdown signal shall have an alarm. Initiating devices for shutdown systems shall be independent, dedicated primary elements having their own individual process connections. Primary elements in control or indicating loops shall not be used to initiate shutdowns.

Exception:

Machinery protection field sensors such as vibration probes, overspeed sensors, and other sensors that are connected to the vibration monitoring system may be used to initiate alarm and shutdown functions. If vibration transmitter is used, the protection logic and maintenance bypass can be configured in the Distributed Control System (DCS), Simplex Programmable Logic controller (PLC) or PLC based ESD system.

7.3.3 Analog transmitters are preferred for ESD initiating devices. If this is not practically possible, switches may be used.

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7.3.4 Switch contacts shall be single-pole, double-throw (SPDT) as a minimum. Unless otherwise specified, the minimum contact rating for disconnecting inductive loads shall be:

- 0.4 A @ 125 V DC
- 5.0 A @ 120 V AC/60 Hz

7.3.5 Shutdown logic shall be designed to incorporate test facilities to permit initiating devices and output devices to be tested on line. Inlet and outlet bypass switches shall be provided as necessary. Password protected software bypass switches are acceptable. The implementation of an input or output bypass shall be alarmed.

7.3.6 Solenoid valves shall have Code HT high-temperature molded coils, suitable for 180°C, with silicone rubber insulated coils and connection wires. Viton elastomers shall be used, for seating and other resilient, unless otherwise specified.

7.3.7 SIL study and verification shall be conducted for all safety instrumented functions (SIF). Segregation between SIS and DCS loops are required.

7.4 Control Valves

Control valves shall be specified in accordance with 34-SAMSS-711, Control Valves - General Service, unless otherwise stated.

Control valve sizing shall conform to ISA 75.01.01.

All control Valves shall be flanged. Threaded control valves (for size 1½" and smaller) are acceptable.

The minimum flange rating shall be ANSI Class 150, RF for valve sizes up to and including 16-in.

Self-acting thermostatic control valves shall not be used.

7.5 Safety Relief Valves

The specification for safety relief valves shall comply with 34-SAMSS-611, Safety Relief Valves Conventional and Balanced Types or Safety Relief Valve Pilot Operated Type as applicable.

The application, sizing, design and installation of safety relief valves (PZV) shall meet the requirements of ASME SEC I, ASME SEC IV, ASME SEC VIII D1, and ASME SEC VIII D2; API STD 520 PT I, API STD 520 PT II; API STD 521; API STD 526, and/or API STD 527, as applicable.

It is the vendor's responsibility to determine the requirements, sizes and set pressures of PZV for the complete packaged unit.

The vendor shall complete a specification sheet SA-8020-611 or SA-8020-612 as applicable.

Flow modulating pilot valves, are acceptable for lubrication oil system over pressure protection per Manufacturer's standard.

The minimum inlet flange rating of PZV shall be ANSI Class 150, RF for sizes up to and including 16-in.

For PZVs relieving to a discharge header the buyer will supply the necessary backpressure information.

7.6 Analyzers

For analyzers systems, sample conditioning, and recovery systems, the selection and design shall be based on 34-SAMSS-510.

7.7 Programmable Logic Controller (PLC)

7.7.1 The Programmable Logic Controller shall be designed, constructed, and tested in accordance with this specification and the following standards:

a. NEMA IA 2.2 & 2.3 (IEC 61131, Parts-2&3)
b. UL 508, Part XVII
c. ANSI/IEEE C37.90.1

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7.7.2 Auxiliary Power Supplies

Auxiliary power supplies used to power I/O field points shall be sized for 110% of the ampacity requirements (at rated voltage and maximum design temperature). Power supply loads shall be calculated with all points energized (including spare points), and all outputs carrying their maximum connected load.

7.7.3 Redundancy

Adding one spare module of each different type shall be provided based on the criticality and impact on plant operation (example: PLCs for instrument air system and PSA are considered critical).

8 Installation

8.1 Instruments

8.1.1 Mounting

All instruments shall be mounted as close to the process connection as possible. Impulse lines shall be as short as possible. The location of instruments shall be so that direct drainage of condensate, water or process fluids from adjacent equipment has no adverse effect. Instruments shall be mounted in locations where vibration is negligible.

All local instrumentation and associated control equipment shall be readily accessible from grade, platform, fixed walkway, or fixed ladder. Local indicating instruments shall be visible from where related equipment is operated or primary instruments are tested or calibrated.

Pressure and D/P instruments in liquid or condensable vapor service shall be self-venting (i.e., mounted below the process connections) with all impulse lines sloping downward approximately 1:10 minimum toward the instrument. Where this is not physically possible due to the location of the process connections (such as lube oil systems), then it is acceptable to mount the pressure instrument above the process connection as long as a high point vent is provided.

Pressure and D/P instruments in gas service shall be self-draining (i.e., mounted above the process connections) with all lines sloping downward approximately 1:10 minimum toward the process connection.

Pressure transmitters in gas service may be mounted on panels below their process connections provided that the process connections are located on the top of the process lines, low point drains are provided, and the impulse lines slope toward the low point. For other applications refer to API RP 551.

Impulse tubing shall be made with metallurgy compatible to process and ambient conditions. Threaded fittings shall be used.

Diaphragm (Capillary) seals shall be used in lieu of impulse tubing for volatile, dirty fluids and applications that may cause impulse line blockage.

Temperature sensors shall be fitted with terminal heads and installed in thermowells. For details, refer to API RP 551.

Exception:

Thermowell is not applicable for temperature sensor used for non-process such as bearing temperature, etc.

8.1.1.1 Control Valves

Control valves shall be installed so that they are not subjected to forces resulting from thermal expansion of piping, or from the mass of an unsupported line.

Each control valve installation shall have block and bypass valves, unless otherwise specified.

8.1.1.2 Level Measurement and Level Gauge Glasses

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Refer to Library Drawing DB-950046 for typical liquid level gauge glasses installations.

Weld pad type level gauges are acceptable for lube oil tanks.

Single rod GWR (Guided Wave Radar) shall be used for level measurement unless otherwise not recommended by the package supplier.

8.1.1.3 Safety Relief Valve Systems

8.1.1.3.1 Safety Relief Valves

All PZV shall be accessible for inspection and maintenance. When the mass of PZV exceeds 25 kg (50 lbs), and the location is inaccessible for cranes, davits shall be installed.

PZV of 1 inch and larger shall have a 1-inch drain between inlet block valve and PZV, and a 1-inch vent between PZV and outlet block valve.

The system's discharge piping shall be self-draining toward the discharge end. Pocketing of discharge lines is prohibited. The use of traps or other devices with operating mechanisms shall be avoided.

The discharge line shall be heat-traced when PZV handle viscous materials, or materials that can solidify as they cool to ambient temperature.

8.1.1.3.2 PZV Inlet and Outlet Block Valves

Block valves for maintenance isolation shall be installed in both the inlet and outlet piping except for PZVs in ASME SEC I fired boiler service.

Block valves shall be accessible for inspection and maintenance.

Block valves and vents need not be installed when a spare packaged unit is provided or the packaged unit can be shutdown, isolated, and depressurized for the removal of the PZV for maintenance.

Full-opening ball valves are preferred for block valve applications. Gate valves used as block valves shall have rising stems, and shall be installed with the stem horizontal.

Port areas of inlet and outlet block valves shall not be less than the nominal areas of the respective openings of the PZV. The pressure drop of the block valves shall be included in the PZV piping calculation. The pressure drop due to inlet block valve and piping shall not exceed 3% of the PZV set pressure.

Block valves shall be capable of being car-sealed.

PZVs venting to the atmosphere or to atmospheric tanks do not require outlet block valves.

Block valves shall be provided with a position indicator.

Block valves shall be painted orange.

8.1.2 Tagging

Instruments shall have permanently attached engraved phenolic / laminate or plastic nameplates or 316SS, showing instrument tag numbers. Nameplates shall be installed with two stainless steel screws. Where it is impractical to attach the nameplate to the instrument with screws, the use of stainless-steel chain or wire is an acceptable solution.

8.2 Process Connections

8.2.1 Threaded

All threaded process connections shall be tapered per ASME B1.20.1.

All threaded process connections to vessels, standpipes and lines, except thermowells, shall have threaded welding bosses as per ASME B16.11, and threaded gate type block valves as close to the vessel, standpipe or line as possible. Fittings between the block valve and the welding boss, other than the pipe nipple, are not allowed. The two threaded connections

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between the welding boss, pipe nipple and block valve shall be seal or bridge-welded per Standard Drawing AB-036521.

The table in Appendix 1 shows the type of welding (e.g., seal or bridge) for each application, but does not apply to thermowells and flanged connections.

Commercially available forged steel branch outlets of Class 6000 rating are considered equivalent (Thredolets or Socklets of Bonney Forge or equal) . Couplings or half coupling thermowells shall not be used, unless provision is made for a full penetration weld.

8.2.2 Flanged

All flanged process connections to vessels, standpipes or lines shall conform to ASME B16.5.

The flange rating shall be equal to or exceed the equipment or line design pressure and temperature, but shall be at least ANSI Class 150, RF.

All flanged process connections, except those for internal displacer level instruments, extended diaphragm level instruments and thermowells, shall have a flanged gate type block valve, directly connected to the process connection. Fittings between block valve and process connection are not allowed, unless otherwise specified.

Flange gasket contact surface smoothness shall be between 3.2 µm to 6.4 µm AARH (see ASME B46.1) based on visual comparison.

8.3 Instrument Piping and Tubing

The instrument piping and tubing installation shall ensure the reliable and accurate operation of the instrument(s) involved, and allow sufficient access for maintenance, calibration and testing. It shall be possible to test all alarm and shutdown initiating devices, without interfering with the process operation of the packaged unit.

Instrument tubing shall be adequately supported to eliminate any vibration transmission to the instruments or excessive load to the piping connection, process line or vessel. The tubing and fitting design, material selection, installation, inspection, testing and marking shall follow IOGP S-716.

Tubing to and from non-indicating instruments shall have a plugged tee or equivalent test point for calibration and testing purposes.

All incoming and outgoing interconnection lines shall terminate in bulkhead fittings. The lines shall be marked with the tag numbers of the corresponding instruments. Bulkhead fittings shall be installed with adequate spacing to ensure that any connection can be removed without the need to remove other fittings.

8.4 Instrument Connections

8.4.1 Process service

Instrument connections for process service shall be in accordance with Appendix 1. Threaded connections shall be tapered per ASME B1.20.1.

Flanged connections shall conform to ASME B16.5. The rating shall be equal to or exceed the equipment or line design pressure and temperature, but be at least ANSI Class 150, RF, except for PZV and control valves.

Oval flanged connections on manifolds and D/P transmitters may be manufacturer's standard, but the oval instrument flanges shall be provided with a ½-in NPT female connection.

8.4.2 Auxiliary

Auxiliary instrument connections shall be NPT female threaded and conform to ASME B1.20.1.

Pneumatic signal and supply connection sizes shall be ¼ inch or larger, NPT female.

Electric signal connection sizes shall be at least ½ inch NPT female for transmitters, indicators, switches, and solenoid valves.

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9 Materials

All materials shall be suitable for the specified service, and the vendor shall obtain a written approval from the buyer for all selected materials in severe process services. All wetted parts in sour service shall conform to NACE AMPP MR0175/ISO 15156.

9.1 Instruments

All instruments shall be technically acceptable to the buyer. The vendor shall submit a list of all selected instrument manufacturers, instrument model numbers, and specification sheets for approval by the buyer.

All instruments and associated ancillary equipment shall be new.

The process wetted parts of instruments shall be minimum cast or forged steel, stainless steel or a suitable corrosion resistant alloy equal to or better than the ASTM specifications referred to in the following paragraphs, as appropriate for the required service. However, cast iron shall not be used for hydrocarbon service, or for any flange-mounted instrument.

The non-wetted parts of instrument housings / enclosures and junction boxes shall be stainless steel or low copper aluminum, (0.4% max), and shall be rated as NEMA Type 4 or IEC Type IP 65.

In sever corrosive environment, junction boxes shall be either 316SS or UV protected GRP with three side sunshades. Instrument housing and enclosures in sever corrosive environment shall be NEMA 4X or IEC 60529 type IP66.

9.2 Instrument Piping and Tubing

Process connections up to and including the first block valve (the root valve) shall comply with 01-SAMSS-035 and 01-SAMSS-043 as applicable.

Piping and tubing materials downstream of the first block valve shall comply with paragraphs 9.2.1 and 9.2.2.

All threaded fittings shall be forged carbon steel or stainless steel per ASME B16.11, and be Class 3000 for systems rated up to and including ANSI Class 900, and Class 6000 for systems rated ANSI Class 1500.

All threaded connections shall be tapered per ASME B1.20.1.

9.2.1 Piping and Fittings

Piping and fittings shall conform to with 01-SAMSS-035 and 01-SAMSS-043 as applicable.

9.2.2 Instrument Tubing and Fittings

Instrument tubing and fitting materials, sizes, thickness, hardness and tubing clamps shall be per IOGP S-716. The material shall be Type 316 as minimum. For severe corrosive environment, the material shall be 6Mo, 25Cr Duplex SS or Alloy 400 as minimum.

Flexible hoses shall be stainless steel armored, with integral connectors. The hose length shall not exceed 600 mm.

The hose lining shall be suitable for the process and operating conditions.

9.3 Valves and Manifolds

Forged carbon steel valves shall conform to ASTM A105, Grade 2.

Forged stainless steel valves shall comply with ASTM A182, Grade F316.

9.3.1 Needle Valves

Needle valves shall be bar stock steel, with ratings as required, but at least Class 3000. Needle valves shall have 316 stainless steel trim, integral seat, and welded bonnet.

Needle valves shall have internal screw rising stems.

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9.3.2 Manifolds

Manifolds for flow meter service shall have a rating Class 6000 at 95°C, or Class 4000 at 260°C. Manifolds shall have 316 stainless steel body, bonnet, stem and seat, and Teflon packing.

Connections shall be ½ inch NPT female at oval flange surface.

10 Quality Requirements

10.1 Quality Program

The vendor shall implement and maintain a quality program with clearly defined and documented procedures. The quality program documents shall be made available to the buyer.

10.2 Inspection

The items manufactured to this specification are subject to verification by the buyer's inspection representative per Saudi Aramco Inspection Requirement Form 175-340200, attached to the purchase order.

10.3 Acceptance Criteria

Vendor's records shall be available to verify that all items have been subjected to the following tests prior to the final acceptance test.

10.3.1 Functional Tests

Buyer will witness a complete functional test of the control system to verify satisfactory operation of the instrumentation during the performance test of the packaged unit.

All pneumatic instrumentation shall pass:

a. Leakage test of all piping and tubing
b. Functional test of all pneumatic instruments
c. Functional test of all pneumatic control loops

All electric/electronic instruments and systems shall undergo:

a. Functional test of all electronic instruments after testing for short circuits, cable continuity, ground insulation with a “megger,” and ground faults.
b. Functional test of all electronic control loops verifying a proper response to a simulated input signal.

10.3.2 Pneumatic Tests

Instrument process tubing shall be tested pneumatically to 1.1 times design pressure starting at the root valve and ending at the instrument.

11 Identification Tagging

An instrumentation identification tag or nameplate of 316 stainless steel shall be attached securely to the equipment with SS or Monel fasteners. The tag shall be marked with raised alpha-numeric or die stamped with the following information:

- Saudi Aramco Purchase Order number
- Manufacturer
- Part/Model Number
- Serial Number
- Date of Manufacture
- Mark/Tag Number

The tag or nameplate shall be located so that the information can be read after installation of the equipment or components.

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Appendix 1 – Instrument/Process Connections

	Instr. Conn.		Gate Block Valve		Process Connect		
Instrument Type	**Size (in)**	**Type**	**Size (in)**	**Welding Nt 2**	**Boss Nt. 1**	**Size(in)**	**Type**
Flow (3)							
Orif. Run (D/P Xmtr)	½	OV FLG	½	Seal	-	½	NPTF
Orif. Run (Loc. Blw.)	½	NTPF	½	Seal	-	½	NPTF
Venturi (D/P Blw/Xm)	½	OV FLG	½	Seal	-	½	NPTF
Integral Orif. Xmtr	½	NPTF	¾	Bridge	I	¾	NPTF
Pressure (4)							
Press. Gauge (Local)	½	NPTM	¾	Bridge	I	¾	NPTF
Pr. Gauge (Wall/Pnl)	½	NPTM	¾	Bridge	I	¾	NPTF
Pr. Switch (Local)	½	NPTF	¾	Bridge	I	¾	NPTF
Pr. Switch (Wall/Pnl)	½	NPTF	¾	Bridge	I	¾	NPTF
Press. Xmtr	½	NPTF	¾	Bridge	I	¾	NPTF
Level							
Stand Pipe (5)	2	FLGD	2	-	-	2	FLGD
Level Gauge (Glass)	¾	NPTF	¾	Bridge	II	¾	NPTF
Level Gauge (Magn.) (9)	2	FLGD				2	FLGD
Displacer Transm./ Switch (Internal) / GWR (internal and external) (9)	3	FLGD	3	-	-	3	FLGD
Displacer Transm./ Switch (External) (9)	1-½	NPTF	1-½	Bridge	II	1-½	NPTF
Float Xmtr./ Switch (Internal)	4	FLGD	-	-	-	4	FLGD
Float Transm./ Switch (Internal)	1-½	NPTF	1-½	Bridge	II	1-½	NPTF
Diff. Pr. D/P Cell	½	NPTF	¾	Bridge	I	¾	NPTF
D/P, P. Diaph	3	FLGD	3	-	-	3	FLGD
Temperature							
Thermowell (6, 7, & 8)	1.5	FLGD	-	-	-	1.5	FLGD
Temp. Instrument	½ 1, ¾	NPTM FLGD	- -	- -	- -	- 1, ¾	INT/C FLGD

Notes:

(1) Welding boss per ASME B16.11 or forged steel branch outlet (refer to paragraph 8.2.1).

(2) Seal or bridge welding per Standard Drawing AB-036521 (refer to paragraph 8.2.1).

(3) Orifice flange assembly per ASME B16.36. DP flowmeter design shall meet ISO 5167.

(4) Pressure including differential pressure instrument types.

(5) Standpipe per Standard Drawing AB-036521 may be used for each relevant application, unless otherwise specified in the purchase order.

(6) Assembly and detail of thermowell may refer to in API RP 551.

(7) Flanged thermowell (1-½ in.) is the minimum size to be used.

(8) Wake frequency calculations shall meet ASME PTC 19.3.

(9) Drain and vent is ¾ inch minimum.

Also refer to Section 8.2.

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Document History

16 May 2024	Major	Adopt IOGP S-716 for Instrumentation tubing and fittings. Delete all requirements covered in the IOGP
25 March 2021	Editorial	Editorial revision to extend due date to 2024 & cancelled reference SAEP-318 had been removed.
02 May 2019	Editorial	Editorial revision to comply with content information requirement
14 May 2018	Editorial	Editorial revision to paragraphs 7.2.2, 7.4, and 7.5
6 August 2017	Major	Major revision to prevent instrument tubing failures in for severe corrosive environment; eliminate problems caused by improper selection, design of P, DP, level instruments, and analyzer systems; and promote wireless and fiberglass for enclosures and cable trays.
7 November 2013	Editorial	Editorial revision to changed primary contact.
26 February 2012	Minor	Minor revision to relax the requirement to position pressure instruments on liquid duty below the process connection where there are physical restrictions, i.e., low point sumps.

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ATTACHMENT-09

Engineering Standard

21 October 2024

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

Document Responsibility: Paints and Coatings Standards Committee

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Summary of Changes

Paragraph Number		Change Type (Addition, Modification, Deletion, New)	Technical Change(s)
Previous Revision 23 May 2019	**Current Revision** 21 October 2024		
3	3	Modification,	Followed standard statement for References.
3.1	3.1	New	Added SAES-H-003, 09-SAMSS-070, and 09-SAMSS-113 in the References.
3.1	3.1	Deletion	SAES-P-104 and 09-SAMSS-101 were removed from the References.
3.2	3.2	New	SSPC-Guide 12 was added in the References.
4	4	Modification	Changed Corrosive Atmosphere to Highly Corrosive (C5) Atmosphere and Medium Corrosive Atmosphere to Mildly Corrosive (C1-C4) Atmosphere to align with SAES-A-134.
5.3.2	5.3.2	Modification	Changed the requirement on adequate nearby washing facilities for splashes on body or eyes.
5.4.1.4	5.4.1.4	Modification	Air receiver requirement was clarified.
5.4.1.5	5.4.1.5	Modification	Added calibration of inspection equipment.
5.4.5.7	5.4.5.7	Modification	Clarified hoses requirement.
None	5.5	New	Added illumination requirement on work areas.
Table 5.2	Table 5.2	Modification	Removed all old material stock numbers.
6.1.6	6.1.6	Modification	Operating conditions were clarified.
6.1.4	6.1.4	Modification	Added “Abrasive Materials” in addition to Coatings
6.3.4	6.3.4	Modification	Clarified abrasives recycling systems’ requirements.
6.5.3	6.5.3	Modification	Added reference standard on illumination.
7.1.A	7.1.A	Modification	Changed Medium Corrosive Atmosphere to Mildly Corrosive

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Paragraph Number		Change Type (Addition, Modification, Deletion, New)	Technical Change(s)
Previous Revision 23 May 2019	**Current Revision** 21 October 2024		
			(C1-C4) Atmosphere to align with SAES-A-134.
7.1.A	7.1.A	Modification	Removed APCS-26/26T from New Construction column
7.1.A	7.1.A	New	Added APCS-1D under new and maintenance.
7.1.B	7.1.B	Modification	Changed Corrosive Atmosphere to Highly Corrosive (C5) Atmosphere to align with SAES-A-134.
7.1.B Remarks 1, 2 &3	7.1.B Remarks 1, 2 &3	Modification	Clarified the operating temperature range for APCS-1A, APCS-1B and APCS-1C.
7.1.E Remarks 3	7.1.E Remarks 3	Modification	Changed to requirement for galvanized structures.
7.1.G Remarks 1	7.1.G Remarks 1	Modification	Clarified requirement if coating is required.
None	7.1.H Remarks 9	New	Provided reference standard for galvanizing requirements.
None	7.2.A Remarks 2	New	Coating system to use for carbon steel or galvanized steel embedded on concrete was specified.
None	7.4.2 Note 5	New	Action to take for coating systems not included in the Over-Coating Chart was provided.
8.2.2	8.2.2	Modification	Changed the reference ISO standard for testing reclaimed garnet.
9.1.5	9.1.5	Modification	Vendor-related coating procedures reviewer was included.
9.2.2	9.2.2	Modification	Clarified the requirements when skinning of coatings is present.
9.3.5.a	9.3.5.a	Modification	SSPC-PA 2 required Restriction Level for DFT was specified.
None	9.3.8	New	Requirements regarding over-spray were added.
All APCS Specifications	All APCS Specifications	Modification	Removed all old material stock numbers.

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Paragraph Number		Change Type (Addition, Modification, Deletion, New)	Technical Change(s)
Previous Revision 23 May 2019	**Current Revision** 21 October 2024		
APCS-2C Specification	APCS-2C Specification	Modification	Maximum Service Pressure value was aligned with 09-SAMSS-067 test pressure value for this APCS.
APCS-2E Specification	APCS-2E Specification	Modification	Maximum Service Pressure value was aligned with 09-SAMSS-067 test pressure value for this APCS.
APCS-2E Specification	APCS-2E Specification	Modification	Number of coats was clarified. Provided a wider range for DFT.
APCS-2G Specification	APCS-2G Specification	Modification	Maximum Service Pressure value was aligned with 09-SAMSS-067 test pressure value for this APCS.
APCS-2H Specification	APCS-2H Specification	Modification	Maximum Service Pressure value was aligned with 09-SAMSS-067 test pressure value for this APCS.
APCS-113A Specification	APCS-113A Specification	Modification	Added soil side of tank bottoms, and buried structures as other uses for this APCS.
Attachment A	Attachment A	Modification	Holiday Detector, Dust Test Tape and Chloride Tester were added.
Attachment C	Attachment C	Modification	Added Dust Level and Residual Chloride under Abrasive Blasting, and Holiday Test and Adhesion Test after Topcoat application.

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1 Scope

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

1.2 This Standard does not apply to building, infrastructures and community facilities, powder coatings, offshore facilities nor decorative coatings unless specified in other mandatory Saudi Aramco Engineering Standards.

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

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

2 Conflicts and Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed to the EK&RD Manager.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302.

3 References

All referenced specifications, standards, codes, drawings, and similar material are considered part of this Engineering Standard to the extent specified, applying the latest version, unless otherwise stated.

Saudi Aramco References

Saudi Aramco Engineering Procedures

SAEP-302	Waiver of a Mandatory Saudi Aramco Engineering Requirement
SAEP-303	Engineering Reviews of Project Documentation
SAEP-316	Performance Qualification Requirements of Coating Personnel
SAEP-1200	Qualification Procedures for Protective Coatings and Abrasive Blasting Materials

Saudi Aramco Materials System Specification

09-SAMSS-035	Qualification Requirements for Alkyd Coating System (APCS-4 and APCS-6)
09-SAMSS-060	Packaging Requirements for Coatings
09-SAMSS-067	Qualification Requirements for Coatings Intended for Internal Protection of Equipment
09-SAMSS-069	Qualification Requirements of Coatings for Atmospheric Service
09-SAMSS-070	Qualification Requirements of Epoxy Coating Systems for Splash Zone (APCS-19C)
09-SAMSS-071	Qualification Requirements for High Temperature External Coatings (APCS-11A/B/C) and (APCS-17A/B)
09-SAMSS-087	Qualification Requirements for Epoxy Coatings Applied on Damp Steel Surfaces
09-SAMSS-107	Qualification and Application Requirements of Fluoropolymer/Ceramic Coatings on Fasteners
09-SAMSS-113	The Requirements of External Liquid Coatings for Buried Pipelines and Piping (APCS 113A)
12-SAMSS-007	Fabrication of Structural and Miscellaneous Steel

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Saudi Aramco Engineering Standards

SAES-A-134	External Corrosion Protection Requirements
SAES-A-302	Aviation Fuel Quality Assurance Design Requirement
SAES-B-067	Safety Identification and Safety Colors
SAES-H-002V	Approved Saudi Aramco Data Sheets for Pipeline and Piping Coatings
SAES-H-003	Protective Coatings for Industrial Concrete Structures
SAES-H-005	Thermal Spray Aluminum Coating by Arc Spray Process for Structure Materials Against Atmospheric Environment (APCS-30TSA)
SAES-H-101V	Approved Saudi Aramco Data Sheets - Paints and Coatings
SAES-H-102	Safety Requirements for Coating Applications

Saudi Aramco Best Practices

SABP-H-001	Selection and Application of Reinforced Fiber Glass Lay-up System for repair of Storage Tank and Vessels

Saudi Aramco Inspection Requirement

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

Saudi Aramco General Instruction

GI-0002.100	Work Permit System
GI-0006.021	Abrasive Blasting Operations

Other References

American Society for Testing and Materials (ASTM)

ASTM A123/123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A385/385M	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM D7393	Standard Practice for Indicating Oil in Abrasives
ASTM E1575	Standard Practice for Pressure Water Cleaning and Cutting

Association for Materials Protection and Performance (AMPP)

NACE SP0178	Design, Fabrication, and Surface Finish Practices or Tanks and Vessels to Be Lined for Immersion Service
SSPC-AB 2	Cleanliness of Recycled Ferrous Metallic Abrasive
SSPC-Guide 12	Guide for Illumination of Industrial Painting Projects
SSPC-PA 2	Procedure for Determining Conformance to Dry Coating Thickness Requirements
SSPC-PA 6	Fiberglass-Reinforced Plastic (FRP) Linings Applied to Bottoms of Carbon Steel Aboveground Storage Tanks

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SSPC-SP 1	Solvent Cleaning
SSPC-SP 2	Hand Tool Cleaning
SSPC-SP 3	Power Tool Cleaning
SSPC-SP 5	White Metal Blast Cleaning
SSPC-SP 6	Commercial Blast Cleaning
SSPC-SP 7	Brush-off Blast Cleaning
SSPC-SP 10	Near White Blast Cleaning
SSPC-SP 16	Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
SSPC-SP WJ-1	Waterjet Cleaning of Metals-Clean to Bare Substrate
SSPC-SP WJ-2	Waterjet Cleaning of Metals-Very Thorough Cleaning

International Organization for Standardization (ISO)

ISO 8501	Visual Assessment of Surface Cleanliness
ISO 8502	Tests for the Assessment of Surface Cleanliness
ISO 8503	Surface Roughness Characteristics of Blast-Cleaned Steel Substrates
ISO 8504	Surface Preparation Methods
ISO 11124	Specifications for Metallic Blast-Cleaning Abrasives
ISO 11125	Test Methods for Metallic Blast-Cleaning Abrasives
ISO 11126	Specifications for Non-Metallic Blast-Cleaning Abrasives
ISO 11127	Test Methods for Non-Metallic Blast-Cleaning Abrasives
ISO 12944	Paints & Varnish-Corrosion Protection of Steel Structure by Protective Paint System

National Fire Protection Association (NFPA)

NFPA 70	National Electric Code

4 Terminology

Acronyms

ISO	International Organization for Standardization
AMPP	Association for Materials Protection and Performance
DFT	Dry Film Thickness
WFT	Wet Film Thickness
APCS	Approved Protective Coating Systems

Definitions

Approved Product: A coating material that meets the requirements of the applicable APCS and SAMSS. Only approved products shall be used in Saudi Aramco. These requirements shall apply to all standards under the SAES-H-series.

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Highly Corrosive (C5) Atmosphere	Industrial areas with high humidity, aggressive atmosphere and coastal areas with high salinity identified was Highly Corrosive or Severely Corrosive as per Table 1 of SAS-A-134.
Maintenance Coating/Painting	Application of coating to preserve the useful state of an existing coating. Repairing is the most common method to maintain a coating. Complete replacement of an existing coating is not maintenance coating.
Mildly Corrosive (C1-C4) Atmosphere	Urban and industrial atmospheres with moderate sulfur dioxide pollution, identified as Mildly Corrosive as per Table 1 of SAES-A-134.
New Construction Coating	Application of coating on a completely new and uncoated facility, equipment or machinery. New coating also applies to the coating application on completely bare substrate that was previously coated.
Thick Film Coating	Coatings with an average dry film thickness greater than 20 mils (500 microns).
Thin Film Coating	Coatings with an average dry film thickness of 20 mils (500 microns) or less.
Thixotropic Coating	A type of coating that thickens or gels in a relatively short time when at rest, but readily becomes more fluid when agitated or stirred.
Stripe Coat	A coat of paint applied only to edges or to welds on steel structures before or after a full coat is applied to the entire surface. The stripe coat is intended to give those areas sufficient film build to resist corrosion.
Sweep Blast Cleaning	A fast pass of fine nonmetallic abrasive blasting pattern at low pressure (< 275 kPa / 40 psi) over a surface to remove loose material and to roughen the surface sufficiently to successfully accept a coat of paint. This method of cleaning is specified as SSPC-SP 7, Brush-off Blast Cleaning, or as SSPC-SP16, Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
Ultra-High Pressure Water Cleaning	Removal of surface contaminants (cleaning) by jetting with water at a pressure in excess of 25,000 psi (170 MPa).
Vessels	Where referred to in this standard, the term "vessels" includes, but is not necessarily limited to columns, traps, drums, heat exchangers, and boilers.
Wet-on-Wet Coating Application	Technique of coating application where additional coating passes are employed over a coating that is still wet, making the composite film dries as a whole. A wet coat applied over another wet coat is considered one coat of application.

5 Health, Safety and Environment

These are minimum safety requirements that are applicable to both shop and field coating (including surface preparation). Safety requirements of SAES-H-102 shall be complied.

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5.1 Fire and Explosion Prevention

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

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

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

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

5.2 Ventilation

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

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

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

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

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

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

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

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

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

5.2.4.1 Blast cleaning or spray coating is in progress.

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

5.3 Health Hazards

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

5.3.2 Adequate washing facilities shall be readily available nearby the coating operation job site so whenever that coatings or solvents can be immediately removed if splashed on the body or in the eyes.

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

5.3.4 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.

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5.3.5 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.

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

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

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

5.4 Equipment Hazards

5.4.1 Power tools

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

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

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

5.4.1.4 Air receivers shall be used as surge tanks between compressors and blasting pots and shall be manufactured and stamped in accordance with international Norms, Unfired Pressure Vessels. These shall be hydrotested at a pressure as recommended by the vessel manufacturer at ambient temperature using clean water. These vessels shall be revalidated by hydro-testing by a Saudi Aramco approved agency at least annually and the test certificates shall be submitted to the Saudi Aramco Inspector for verification.

5.4.1.5 All measuring devices, inspection, and safety equipment like pressure relief valves, gauges, and devices (but not limited to these) shall be calibrated by Saudi Aramco approved 3rd party agency and the report shall be submitted to Saudi Aramco Inspector for verification.

5.4.2 Abrasive Blasting (including automated equipment)

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

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

5.4.2.3 The blast cleaning hose shall be of the standard static dissipating type with external couplings, proper stamping, in good condition and without any damage. Safety whip check (safety wire) shall be provided to high pressure line 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.

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5.4.4 Coating Preparation and Equipment Cleaning

5.4.4.1 Coating preparation and equipment cleaning shall be performed under the supervision of the coating crew supervisor. Coatings shall be mixed in an open area or in an adequately ventilated area. Use eye protection (goggles), respirators, protective gloves and other safety equipment.

5.4.4.2 Electrically driven power mixers shall be grounded.

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

5.4.5 Airless Spray Coating Application

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

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

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

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

5.4.5.5 Hoses, pumps, and accessories shall never be operated at pressures exceeding their rated pressure. In no case shall the working pressure in the coating line exceed 34.5 MPa (5000 psi). If pressure is expected to exceed 34.5 MPa (5000 psi), a safety pressure relief valve shall be used on the 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 Painting hoses shall be grounded and of an 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).

5.5 Working area shall have proper illumination system as per SSPC-Guide 12 or equivalent.

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

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Volume of Confined Area		Required Air Mover Capacity	
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 Air-fed Hood and Filter 1000129995 1000129991		Respirator; Chemical Cartridge 1000128213		Dust Respirator 1000128165		Face Shield (1) 10000129345	
	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		Gloves; Leather 1000124493		Gloves; Rubber 1000129636		Hearing Protection 10000127803 10000127807	
	O	C	O	C	O	C	O	C
Surface Preparation								

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Type of Work to be Performed	Goggles Safety Impact 1000129810		Gloves; Leather 1000124493		Gloves; Rubber 1000129636	Hearing Protection 10000127803 10000127807	
Wire Brushing, Chipping, Scrapping & Grinding	X	x	x	x		x	X
							x x
Blast Cleaning Operator Other workmen In Vicinity	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 x
Polyurethane			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 to address the averted condition (e.g. if novel technology is applied):

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

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

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

d) Adverse weather conditions exist such as, but not restricted to below situations. Job can only continue if proper and complete isolation of the area are done to prevent the harmful effects of the weather conditions.

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.

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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, m/n 1000022130 and m/n (s/n 1000022131).

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

6.1.4 Any approved coating or abrasive material that is subjected to modifications and/or reformulations, or replacement including change of names or re-branding shall be requalified in accordance with SAEP-1200.

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

6.1.6 Operating conditions shall refer to the type of service, maximum operating temperature, and maximum operating pressure as minimum. Operating parameters shall be the basis for coating selection, not the design parameters.

6.1.7 For service / operating / exposure / application conditions not covered by the SAES-H standards but are involved with the item/s to be coated, the approved coating manufacturer of the selected coating or coating system shall be requested to confirm in writing the suitability of their product/s to the concerned conditions. A formal letter shall be submitted to the end-user regarding the suitability confirmation including a 5-year minimum coating performance warranty based on the involved conditions prior to the purchase and application of the coating or coating system. Relevant 3rd party laboratory tests report shall be provided together with the letter as proof of the confirmed suitability.

6.1.8 Tanks, vessels and equipment manufacturer's standard coating shall only be acceptable after meeting the following two conditions:

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

b) The coating can be maintenance coated with standard Saudi Aramco's Approved Protective Coating Systems (APCS). Manufacturer shall provide compatibility confirmation letter on this regard.

6.1.9 Airless spray shall be the acceptable method of application for all coatings under the APCS listed in this standard. Brush application shall only be used for touch-up repair. Other methods of application shall only be acceptable if specified in SAES-H-101V or SAES-H-002V. The use of rollers shall not be allowed.

6.1.10 New and non-approved coatings and abrasives intended to be used in Saudi Aramco shall be qualified first in accordance with SAEP-1200.

6.1.11 For coating applications in countries with strict VOC regulations, equivalent coating products that are adjusted to meet such strict requirements can be accepted provided that proof of equivalence to Saudi Aramco approved coatings must be submitted. Acceptable proofs are FT-IR analysis and comparative assessment report of the physical and performance properties of

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the concerned coatings that are equivalent to each other. FT-IR analysis must show that the concerned coatings are similar or the same and that their difference was only on VOC content.

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 sheets.

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-polymerizing coating materials must be stored in air-conditioned storage area to maintain the temperatures recommended in the Manufacturer's data sheet.

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

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

6.2.5 Coatings which have exceeded the shelf life given in the Saudi Aramco Data Sheet (SAES-H-101V or SAES-H-002V) shall be quarantined and must not be used thereafter.

6.3 Abrasive Materials

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

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

6.3.3 Abrasive materials specification and qualification requirements shall be in accordance with ISO 11124, ISO 11125, ISO 11126, and ISO 11127 series whichever shall apply.

6.3.4 Recycling systems of abrasives shall be permitted only in shops provided that the recycled abrasives shall have same quality and performance as required by applicable ISO standard specification and qualification requirements. Cleanliness of recycled ferrous metallic abrasives shall be in accordance with SSPC-AB 2.

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 as per SSPC-SP1 before abrasive blasting.

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

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

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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.

Note:

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

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

6.5.3 High intensity floodlights or spotlights shall be installed in vessels, tanks, and other poorly illuminated locations for visibility as per SSPC Guide 12.

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.

6.5.6 Air compressors used to supply breathing air shall be third party certified quarterly by a Saudi Aramco recognized testing agency.

6.6 Cleaning

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

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

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

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

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

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6.6.6 Wet abrasive blasting can be used where abrasive blasting is not permitted because of the risk of damage to process equipment. The cleaned surface shall be dry at the time of painting.

6.6.7 Salt remover solutions can be used if accepted by coating manufacturers through a confirmation letter.

7 Coating system Selection

7.1 Exterior Surfaces, Atmospheric Exposure

	Coating System		
Description	**New**	**Maintenance**	**Remarks**
A. Mildly Corrosive (C1-C4) Atmospheric Exposure (e.g. tanks, vessels, equipment, non-galvanized)	APCS-1A APCS-1B APCS-1C APCS-1D APCS-1E APCS-1F APCS-4 APCS-5A APCS-6 APCS-22A APCS-22B	APCS-1A APCS-1B APCS-1C APCS-1D APCS-1E APCS-1F APCS-4 APCS-5A APCS-6 APCS-22A APCS-22B APCS-26 APCS-26T	1. Use APCS-4 on steel operating up to 80°C when an aluminum finish is required such as GOSP Traps and Water Tanks. 2. Use APCS-6 on steel operating up to 70°C when a finish color other than aluminum is required. 3. Use APCS-1B on steel operating between the upper service temperature limits of APCS-4 and APCS-6 up to 120°C °C dry heat. 4. Use APCS-22A or APCS-22B on steel operating up to 120°C dry heat, that is located outdoors and that will be coated in the field when surfaces will be damp during application. 5. APCS-1B on top wind girders, the top shell course above these girders, skirts, and the center deck of floating roofs. 6. Use APCS-1B on the inside surface of the top shell course in external floating roof tanks. 7. Coating is not required on the roof underside of both internal/external floating roof tanks. 8. When necessary, APCS-5A can be used on facilities storing or transporting hydrocarbons and other fluids.
B. Highly Corrosive (C5) Atmospheric Exposure	APCS-1A APCS-1B APCS-1D APCS-1E	APCS-1B APCS-1C APCS-1E APCS-1F	1. Use APCS-1A on steel in wetted and/or corrosive industrial environments operating at temperatures of 81 to 120°C and

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	Coating System		
Description	**New**	**Maintenance**	**Remarks**
(e.g. tanks, vessels, equipment, non-galvanized)	APCS-22A APCS-22B	APCS-22A APCS-22B APCS-26 APCS-26T	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 of 81 to 120°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 of 81 to 120°C and located indoors or outdoors. b. To maintain systems APCS-1A and APCS-1B. 4. Use APCS-1D on steel in wetted and/or corrosive industrial environments operating up to 80°C and located outdoors. 5. Use APCS-1E on steel in direct contact with splashed and spilled chemicals (e.g., tanks and vessels in chemical services): a. Operating up to 80°C and located outdoors. b. To maintain systems APCS-1D and APCS-1E. 6. Use APCS-1F for maintenance painting steel in wetted and/or corrosive industrial environments: a. Operating at temperatures up to 80°C and located indoors or outdoors. b. To maintain systems APCS-1D and APCS-1E.

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	Coating System		
Description	**New**	**Maintenance**	**Remarks**
			7. Use APCS-22A or APCS-22B on steel operating up to 120°C that is located outdoors and that will be coated in the field when surfaces will be damp during application. 8. APCS-26 can be used on steel operating up to 120°C to maintain systems APCS-1A, APCS-1B and APCS-1C. 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. 11. Coating is not required on the roof underside of both internal/external floating roof tanks.
C. Insulated Surface **(**e.g. tanks, vessels, heat exchanger, equipment, valves and piping)	APCS-2A APCS-2C APCS-11C APCS-17A TSA	APCS-2A APCS-2C APCS-11C APCS-17A	1 Corrosion protection under Insulation shall be in accordance with SAES-A-134. If coating is required, the recommended coating systems for selection are as follows: a. Use APCS-2A for temperatures below 90°C. b. Use APCS-2C for temperatures up to 175°C. c. Use APCS-17A/B for temperature range of 175°C to 400°C. d. APCS-17A/B shall never be used where operating temperature can drop below 175°C e. Use APCS-11C for temperature range of 400°C to 650°C or where APCS17A/B cannot be used. f. Thermal Spray Aluminum (TSA)

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	Coating System		
Description	**New**	**Maintenance**	**Remarks**
			coating can be used for temperatures up to 595°C. Application shall be according to SAES-H-005. 2 Corrosion protection of insulated stainless steel and other corrosion resistant alloys shall be in accordance with SAES-A-134. The recommended coating systems, if coating is required, are: a. Use APCS-2A for temperatures between 50°C and 90°C. b. Use APCS-2C for temperatures between 90°C and 175°C. c. Use APCS-11C for temperature range of 175°C to 650°C. Do not exceed the maximum service temperature limitation of the selected approved coating under APCS-11C. 3 Handling precautions and impact/abrasion protection shall be taken during transportation and construction of coated equipment or piping. It is recommended to apply this coating type in the field site. 4 The cured coating of stainless-steel surface shall not contain low melting metals or zinc and any leachable chlorides and halides. 5 Use APCS-2A on carbon steel or stainless-steel operating at cold/cryogenic temperature below -10°C.
D. Elevated Temperature (Uninsulated) **(**e.g. Tanks, vessels, equipment, boilers, stacks, heaters, heat	APCS-11A APCS-11B APCS-11C APCS-5B	APCS-11A APCS-11B APCS-11C APCS-5B	1. Use APCS-11A on steel operating between 120°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

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	Coating System		
Description	**New**	**Maintenance**	**Remarks**
exchangers, reactors and stack)			be below 50% during coating application. 2. Use APCS-11B on steel operating between 400°C and 540°C. 3. APCS-11C can be used up to 650°C which require less cleaning and surface preparation than APCS-11A. 4. Temperature Indicating Paint (TIP) can be used as topcoat over conventional APCS coatings on hydrogen reactors, refractory lined heaters, and stacks. There are no available APCS or coating's SAMSS for TIPs. Therefore, manufacturer shall submit a confirmation letter for the suitability of their product to proponent. 5. Use APCS-5B as a top coat only for personal protection up to 120°C.
E. Coating under Fireproofing	APCS-1B	APCS-1B	1. Use APCS-1B primer only prior to the installation of intumescent fireproofing material on bare carbon steel. 2. Use the complete system of APCS-1B before the installation of cementitious fireproofing on bare carbon steel 3. For galvanized structures, apply APCS-1B primer prior to application of cementitious or intumescent fireproofing. 4. The intermediate and top coats of APCS-1B are used over both fireproofing systems in outdoor installations. 5. Selection of fireproofing materials shall be as per Loss Prevention Department's approval. 6. Galvanized steel shall be prepared in accordance with SSPC-SP 16 prior to application of APCS-1B primer.

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	Coating System		
Description	**New**	**Maintenance**	**Remarks**
F. Auxiliary Equipment Engineered Equipment (i.e., Cranes, Launchers, Receivers, skid mounted items, etc.) "Off-the-Shelf" Equipment (i.e., Valves, Pumps, Actuators)	See Remarks	See Remarks	1. "Engineered Equipment" are items specifically designed and fabricated for Saudi Aramco and shall be coated with Saudi Aramco approved systems or products meeting the requirements of ISO 12944. 2. Manufacturer's standard coating system can be accepted after complying with the requirements of para. 6.1.8. 3. No additional coating is required when manufacturer's standard finish meets the requirements of para. 6.1.8.
G. Fasteners; Carbon Steel and Low Alloy	See Remarks	See Remarks	1. Corrosion protection for fasteners shall be in accordance with SAES-A-134. If coating is required, coating application shall be done in accordance with 09-SAMSS-107.
H. Galvanized Steel	APCS-1B APCS-1E APCS-12 APCS-22A APCS-22B APCS-26 APCS-26T	APCS-1B APCS-1C APCS-1E APCS-12 APCS-22A APCS-22B APCS-26 APCS-26T	1. Corrosion protection for galvanized steel shall be in accordance with SAES-A-134. 2. If coating is required, contaminations on galvanized surface shall be removed in accordance with SSPC-SP1. Surface preparation of galvanized steel shall be according to SSPC-SP16. 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-22A or APCS-22B on galvanized steel operating up to 120°C that is located outdoors and that will be coated in the field when surfaces will be damp during application. 6. Use APCS-1C primer only to touch-up and repair galvanizing that will not be coated with another system. 7. Refer to paragraph 7.1.E for

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Description	Coating System		Remarks
	New	Maintenance	
			galvanized steel requiring fireproofing materials. 8. Use APCS-12 only for galvanized steel floors and decks that require non-slip properties. 9. Galvanizing requirements shall be in accordance with 12-SAMSS-007.
I. Stainless Steel	APCS-1B APCS-1E APCS-11C	APCS-1B APCS-1E APCS-11C	1. Corrosion protection for un-insulated stainless steel and other corrosion resistant alloys shall be in accordance with SAES-A-134. 2. If coating is required, the recommended coating systems are: a. APCS-1B for temperatures up to 120°C. b. APCS-11C for temperatures above 120°C. c. For UV-protection if color and gloss retention are required, APCS-1E shall be used up to 80°C.
J. Aluminum	APCS-26 APCS-26T APCS-22A APCS-22B	APCS-26 APCS-26T APCS-22A APCS-22B	1. Corrosion protection for Aluminum shall be in accordance with SAES-A-134. 2. If coating is required, lightly abrade the aluminum surface using sweep blasting according to SSPC-SP16 prior to coating application. 3. Use APCS-26 on aluminum operating up to 120°C and located indoors or outdoors. 4. Use APCS-26T on aluminum operating up to 80°C, located outdoors. 5. Use APCS-22A or APCS-22B on aluminum located outdoors and operating up to 120°C and that will be coated in the field when surfaces will be damp during application.
K. Steel Structures and Accessories	See Remarks	See Remarks	1. Corrosion protection for Steel Structures and Accessories shall be in accordance with SAES-A-134. 2. Hot dip galvanizing shall follow

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Description	Coating System		Remarks
	New	Maintenance	
			requirements of 12-SAMSS-007. 3. If coating is needed, selection shall be in accordance with paragraphs 7.1.A or 7.1.B as appropriate. 4. See paragraph 7.1.H when coating galvanized items.
L. Steel Floors (except Grating)	APCS-12	APCS-12	1. Applied over carbon steel and galvanized steel floors and decks except grating.
M. Steel Grating	See Remarks	See Remarks	1. Shall be hot dip galvanized in accordance with ASTM A123/123M and ASTM A385/385M. Liquid applied coatings shall not be used in lieu of galvanizing. 2. See paragraph 7.1.H for galvanizing repair.

7.2 Exterior Surfaces, Buried

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

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7.3 Interior Coatings for Plant Equipment

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

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Description	Coating System		Remarks
	New	Maintenance	
			APCS-2E or APCS-2H. The sides of the pontoon of the internal floating roof will be coated.
C. Interior of Water Tanks: Raw Water for Industrial Use	APCS-2A APCS-2C APCS-2E APCS-2G APCS-2H	APCS-2A APCS-2C APCS-2E APCS-2G APCS-20A APCS-20B	1. Select the appropriate coating depending on service and temperature. 2. APCS-20A or APCS-20B are used for renovation of badly corroded tanks. 3. Coat entire interior including all internals except anodes.
D. Interior of Water Tanks: Potable and Domestic Water	APCS-2B	APCS-2B	1. Use APCS-2B on tanks operating up to 90 °C. 2. Coat entire interior including all internals except anodes.
E. Interior of Aviation Fuel and Kerosene Storage Tanks	APCS-2D	APCS-2D	1. Coating shall be in accordance with SAES-A-302. 2. The recommended coating for aviation fuel tanks is APCS-2D.
F. Chemical Tanks	See Remark	See Remark	1. Minimum and maximum operating temperature and pressure involved with the tank shall be determined by end-user or proponent including the name of the chemical, % composition, pH, and concentration. The approved coating manufacturers shall be requested to provide their recommended APCS for this tank in writing including a formal letter confirming the suitability of their APCS plus 5-year coating performance warranty to the service conditions involved with the concerned tank. Suitability confirmation shall be supported with lab. tests report from their R&D or from reputable 3rd party lab.
G. Interior of Hot Water Tanks; Demineralized Water, Boiler Skim Water Tanks, Boiler Blow Down, etc.	APCS-2C APCS-2H	APCS-2C APCS-2H	1. Select the appropriate coating depending on type of service, and maximum operating temperature and pressure involved. 2. Coat entire interior including all internals except anodes.
H. Interior of Gas/Oil/Water	APCS-2A APCS-2C	APCS-2A APCS-2C	1. For GOSP traps, degassers, and WOSEP's in wet sour service, coat

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Description	Coating System		Remarks
	New	Maintenance	
Separators, Desalters, and Dehydrators, Gas Slug Catchers	APCS-2E APCS-2H	APCS-2E APCS-2H	entire interior surface including all internals except anodes and heating coils. 2. For wet sweet service, coat 0.3 m above maximum expected water level. 3. For desalters and dehydrators, coat the bottom 60% including all internals except anodes up to this level. Coat the last 25-50 mm of the tips of the grid, if needed. 4. APCS-2H and APCS-2E are solvent free, fast cure coating and can be applied in a single coat. 5. APCS-2E or APCS-2H are recommended for slug catchers.
I. Heat Exchanger	See Remark	See Remark	1. Coating for internal tubes, covers and tube sheet shall be in accordance with manufacturer's standard coating system. Para. 6.1.8 in this standard shall be complied.
J. Interior of Launchers and Receivers, in crude and water service	APCS-2E APCS-28	APCS-2E APCS-28	1. Coat the entire interior of launchers and receivers up to the main block valve.
K. Amine service	APCS-2G APCS-2H APCS-27	APCS-2G APCS-2H APCS-27	1. Coating selection shall be based on operating conditions. Confirmation letter and lab test report must be provided by coating manufacturer. Para. 6.1.7 shall be complied.

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7.4 Coating Compatibility

7.4.1 Purpose

The Over-coating 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 Over-coating Chart

EXISTING \ OVER-COAT	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	N
Chlorinated Rubber	N	N	N	N	N	N
Vinyl Ester	N	N	N	N	N	N
Phenolic Epoxy	Y(3)	Y(3)	Y(3)	Y(3)	N	N

Y = Yes **N = No** **Y(3) = See Note 3**

EXISTING \ OVER-COAT	Silicone Alkyd	Polyurethane Enamel	Bituminous	Chlorinated Rubber
Epoxy (2)	N	Y	Y(3)	Y(1)
Coal Tar Epoxy (2)	N	Y(3)	Y(3)	Y(1)
Epoxy Mastic (2)	N	Y	Y(3)	N
Epoxy Enamel (2)	N	Y	N	N
Zinc Silicate	Y	Y	N	Y
Alkyd	N	N	Y	N
Silicone Alkyd	Y	N	N	N
Polyurethane Enamel	N	Y	N	N
Bituminous	N	N	Y	N
Chlorinated Rubber	N	N	N	Y

Y = Yes **N = No**

Notes:

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

(2) Inter-coat intervals must be observed.

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

(4) Coating manufacturer must be contacted for compatibility confirmation whenever their coating will be applied over an existing coating from other manufacturer. Compatibility confirmation letter shall be provided to end-user prior to coating purchase and application.

(5) For other coating systems that are not covered by above table, compatibility confirmation shall be required from concerned coating manufacturer for evaluation.

8 Surface Preparation

8.1 General

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

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

8.1.3 The use of air receivers in the blasting system is mandatory. The use of after cooler in the blasting system such as suitable air filters, separators and traps shall be provided and installed in the coolest part of the system and shall be regularly emptied to prevent carryover of water and oil. Compressed air supply equipment, hoses and fittings shall be free of oil, moisture and contamination. The inspector shall check and approve the air quality at the start and mid-point of each 8-hour period. This shall be conducted and determined as follows:

Attach a piece of blotter paper to a clip board, then hold it approximately 45 – 60 cm in front of the blast nozzle during air flow only, with a nozzle pressure of 388 kPa (50 psig) for approximately one minute.
The satisfactory results shall be no water or oil contamination on the blotter paper, and therefore operation is allowed to start or continue.
In case of unsatisfactory results, i.e., contaminants are evident the equipment deficiencies shall be corrected and air stream shall be tested.

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

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

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

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

8.1.7 When additional areas are blasted adjacent to newly primed areas, at least 50mm of the previously primed area shall be re-blasted, with the abrasive directed away from the coated surface.

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8.1.8 Conduct of abrasive blasting operations shall comply with GI-0006.021.

8.2 Abrasive Materials

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

8.2.2 The use of reclaimed slag abrasives is prohibited. The use of reclaimed garnet is permitted provided it meets the requirements of ISO 11126-10 and ASTM D7393 for oil contamination.

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

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

8.3 Requirements before abrasive blasting

8.3.1 The substrate shall not contain oil, grease or lubricant

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

8.3.3 After blasting, test the substrate for the chloride content. Residual chloride shall not exceed 40 mg/m^2 for external coatings and 20 mg/m^2 for internal coatings. Wash down the surface with sweet water to remove chloride contamination. Chloride test shall follow the water wash down until the correct value is achieved in accordance with ISO 8502-6 or equivalent.

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

8.4 Clean the substrate after abrasive blasting

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

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

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

9 Coating Application

9.1 Coating System Selection

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

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

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

9.1.4 For projects, the service/exposure/operating conditions involved in each equipment and facility that requires coating shall be established/defined during the design stage for proper coating system selection as per SAEP-303. The applicable coating system APCS and RAL number (color code) shall be selected by the project designer during the design stage. Color selection shall be in accordance with SAES-B-067. The selected RAL number shall be approved by project proponent and Loss Prevention Department (LPD) if not covered by SAES-B-067.

9.1.5 The coating procedure for all new projects shall be submitted to Saudi Aramco for review and approval. The procedure shall be reviewed and approved by Saudi Aramco Approved Level II Coating Inspector from Project Inspection. Vendor-related coating procedures shall be submitted to Vendor Inspection for review and approval.

9.2 Coating Preparation

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

9.2.2 On recently opened containers, coating skins shall be cut and removed before application. If any skinning is found on new coating cans, it shall be quarantined and not used.

Prior to application, the 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, a power mixer shall be used regardless of the quantity.

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

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

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

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

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

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9.3 Coating Application

9.3.1 In multi-coat applications, primer, intermediate coat, and topcoats shall be of contrasting colors and from the same coating manufacturer. Contrast color requirement shall not be applicable for high temperature service (400°C & above) coating systems APCS-11B and APCS-11C.

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

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

9.3.4 Recoating intervals shall be as given in the Saudi Aramco Data Sheet. (See SAES-H-101V or SAES-H-002V). If additional information is needed, the latest manufacturer Materials Technical Data Sheet can be used.

9.3.5 The finished coating film shall have the following characteristics:

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

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

c) Uniform in appearance.

Note:

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

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

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

Note:

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

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

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

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9.3.8 Overspray to existing coated pipes and equipment shall be avoided. Proper masking or covering of these coated items shall be done to protect from overspray prior to coating application.

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

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

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

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

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

9.4.5 All coated tanks, vessels, and other structures in immersion services shall be holiday checked using a wet sponge at 67.5 volts if coating thickness does not exceed 500 microns. A small amount of a wetting agent shall be added to the water to aid in finding holidays. Dry spark tester shall be used for holiday detection if the coating dry film thickness exceeds 500 microns. Holidays shall be repaired in accordance with paragraph 9.6.

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

Exception:

Not applicable for APCS-20 series.

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

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

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

9.5.3 Coating shall be applied in a single coat "Wet-On-Wet" method to achieve the required film thickness. Only airless spraying equipment with high pump ratios (as recommended in the product data sheet) shall be used.

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

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

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9.6 Repair Procedure

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

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

9.6.2 Clean defective area by solvent or detergent wash.

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

9.6.4 For areas greater than 0.1 m^2, blast clean to obtain the metal surface pre-treatment originally specified. Feather edge the coating at least 50 mm beyond bare metal.

9.6.5 Remove dust and debris by brush or vacuum.

9.6.6 Apply coating by brush for areas less than 0.1 m^2 and by spray for areas greater than 0.1 m^2 to the original specification except that the first coat of a multi-coat system shall be thinned.

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

10 Inspection and Testing

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

a) New construction
b) Major renovation
c) Internal coatings for immersion service

Qualification of coating personnel in these categories shall be according to SAEP-316.

10.1 Quality Control Equipment

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

10.2 Quality Control Records

10.2.1 Quality Control Equipment Check Sheet (Attachment B)

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

10.2.2 Daily Job Log

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

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10.2.3 In-process Inspection Sheet (Attachment C)

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

10.2.4 Coatings and Equipment Log (Attachment D)

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

10.2.5 Final Acceptance Report

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

10.2.6 Non-Conformance Report

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

10.3 Additional Inspection Requirements Applicable to Purchase Orders

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

11 Approved Protective Coating Systems

11.1 Index

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

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

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

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

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

APCS - 1F Epoxy/Polyurethane Coating System for Atmospheric Service (with Zinc-Rich Epoxy Primer)

APCS - 2A Epoxy Coating System for General Immersion Service (Self-Priming)

APCS - 2B Epoxy Coating System for Potable Water Immersion Service (Self-Priming)

APCS - 2C Epoxy Coating System for Immersion Service, at Temperatures up to 120°C

APCS - 2D Epoxy Coating System for Interior of Steel Aviation Fuel Storage Tanks and Piping

APCS - 2E Solvent Free Epoxy Coating for Immersion Service at Temperature up to 93°C

APCS - 2G Glass Flake Reinforced Vinyl Ester Coating for Immersion Service at Temperature up to 90°C

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APCS - 2H	*100% Solid, Glass Flake Epoxy Coating for Immersion Service up to 105°C*
APCS - 3	*Coal Tar Epoxy Coating System for Immersion & Buried for Steel and Concrete*
APCS - 4	*Aluminum-Pigmented Alkyd Coating System*
APCS - 5A	*Heat Reflective Coating*
APCS - 5B	*Hot Insulating Coating*
APCS - 6	*Alkyd Enamel Coating System*
APCS - 9	*Chlorinated Rubber Coating System*
APCS - 10	*Bituminous Paint for Moderate Temperature, Buried or Immersion Service (Self-Priming)*
APCS - 11A	*High Temperature Coating System for Atmospheric Service between 150°C - 400°C*
APCS - 11B	*Very High Temperature Coating System for Atmospheric Service between 400°C - 540°C*
APCS - 11C	*Air-Drying, Single Component, High Heat External Coating for Bare and Insulated Carbon Steel & Austenitic Stainless at Service*
APCS - 12	*Non-Skid Epoxy Coating System for Floors and Decks*
APCS - 17A	*Inorganic Zinc Primer, Solvent Based*
APCS - 17B	*Inorganic Zinc Primer, Water Based*
APCS - 19C	*Glass Flake Reinforced Epoxy Coating Systems for Offshore Structural Steel at Splash Zone*
APCS - 20A	*Fiberglass Reinforced Coatings, Hand Lay-Up*
APCS - 20B	*Chopped Fiberglass Reinforced Epoxy Coatings, Spray Applied*
APCS - 22A	*Epoxy Coating for Application on Damp Steel Surfaces; Two-Coat System*
APCS - 22B	*Epoxy Coating for Application on Damp Steel Surfaces; One-Coat System*
APCS - 26	*Epoxy Mastic Coating (Self-Priming)*
APCS - 26T	*Epoxy Mastic/Polyurethane Coating System*
APCS - 27	*Solvent Free Two-component Ultra Hybrid Epoxy Coating System for Immersion Service at Temperature up to 150°C*
APCS - 28	*Specialty Coating Systems for Pumps, Valves, Piping Fitting and Exchanger Boxes*
APCS-113A	*High-Build Liquid Epoxy Coatings for Renovation of Pipelines buried in Subkha and dry soils*

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

11.3 The APCS coating systems shall not be used under conditions that violate service limitations or other requirements in the applicable APCS data sheets. Only approved products shall be used.

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

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

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APCS - 1A

1 Type of Coating

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

2 General Data

2.1 Typical Use

Severe atmospheric exposure, and offshore construction.

2.2 Service Condition Limitations

Maximum Service Temperature: 120°C

2.3 Purchase Specifications

2.3.1 Primer: 09-SAMSS-071

2.3.2 Topcoats: 09-SAMSS-069

2.4 SAP Material Numbers

2.4.1 Primer: 1000194146 / 1000194182 solvent or water based.

Thinner: 1000198445

2.4.2 Topcoat: 1000194629, 1000194797 or 1000194960 depending on color.

Thinner: 1000198452

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up:Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) 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 or 1000160374

4 Dry Film Thickness Requirements

4.1 Each Coat

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

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

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

Note:

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

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APCS - 1B

1 Type of Coating

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

2 General Data

2.1 Typical Use

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

2.2 Service Condition Limitations

Maximum Service Temperature: 120°C

2.3 Purchase Specifications

2.3.1 Primer: 09-SAMSS-069

2.3.2 Topcoats: 09-SAMSS-069

2.4 SAP Material Numbers

2.4.1 Primer: 1000194626

Thinner: 1000198455

2.4.2 Topcoat: 1000194629, 1000194797 or 1000194960 depending on color.

Thinner: 1000198452

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068, 1000161203 or 1000160374

4 Dry Film Thickness Requirements

4.1 Each Coat

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

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

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

Note:

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

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APCS - 1C

1 Type of Coating

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

2 General Data

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

2.2 Service Condition Limitations

Maximum Service Temperature: 120°C

2.3 Purchase Specifications: 09-SAMSS-069

2.4 SAP Material Numbers

2.4.1 Primer: 1000195348, 1000195361or 1000195361 depending on can size

Thinner:1000198449

2.4.2 Topcoat: 1000194629, 1000194797 or 1000194960 depending on color.

Thinner:1000198452

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: 25-40 micrometers, minimum-maximum

Abrasive: 1000161068, 1000161203 or 1000160374

4 Dry Film Thickness Requirements

4.1 Each Coat

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

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

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

Note:

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

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APCS - 1D

1 Type of Coating

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

2.4.1 Primer: 1000194146 / 1000194182 solvent or water based.

Thinner: 1000198445

2.4.2 Intermediate coat: 1000194629, 1000194797 or 1000194960 depending on color.

Thinner: 1000198452

2.4.3 Topcoat: 1000194672, 1000194675, 1000194793, 1000194795 or 1000194851 depending on color.

Thinner:1000198479

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up:Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) 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 or 1000160374

4 Dry Film Thickness Requirements

4.1 Each Coat

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

4.1.2 Intermediate Coat: One coat, 100-150 micrometers, minimum-maximum

4.1.3 Topcoat: One coat, 25-65 micrometers, minimum-maximum

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

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Note:

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

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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

2.4.1 Primer: 1000194626

Thinner: 1000198455

2.4.2 Intermediate coat: 1000194629, 1000194797 or 1000194960 depending on color.

Thinner: 1000198452

2.4.3 Topcoat: 1000194672, 1000194675, 1000194793, 1000194795 or 1000194851 depending on color.

Thinner: 1000198479

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up:Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068, 1000161203 or 1000160374

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1 Primer: One coat, 50-100 micrometers, minimum-maximum

4.1.2 Intermediate Coat: One coat, 100-150 micrometers, minimum-maximum

4.1.3 Topcoat: One coat, 25-65 micrometers, minimum-maximum

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

Note:

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

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APCS - 1F

1 Type of Coating

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

2 General Data

2.1 Typical Use

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

2.2 Service Condition Limitations

Maximum Service Temperature: 80°C

2.3 Purchase Specifications: 09-SAMSS-069

2.4 SAP Material Numbers

2.4.1 Primer: 1000195348, 1000195361 or 1000195361 depending on can size.

Thinner: 1000198449

2.4.2 Intermediate coat: 1000194629, 1000194797 or 1000194960 depending on color.

Thinner: 1000198452

2.4.3 Topcoat: 1000194672, 1000194675, 1000194793, 1000194795 or 1000194851 depending on color.

Thinner: 1000198479

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up:Sa 2-1/2 (SSPC-SP 10)St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: 25-40 micrometers, minimum-maximum

Abrasive: 1000161068, 1000161203 or 1000160374

4 Dry Film Thickness Requirements

4.1 Each Coat

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

4.1.2 Intermediate Coat: One coat, 125-175 micrometers, minimum-maximum

4.1.3 Topcoat: One coat, 25-65 micrometers, minimum-maximum

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

Note:

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

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APCS - 2A

1 Type of Coating

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

2 General Data

2.1 Typical Use

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

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 90°C

2.2.2 Maximum Service Pressure: 6890 kPa (1000 psig)

2.2.3 Requires 7 days curing time at 25°C

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers

Coating: 1000195232 (09-612-425) or 1000195235 (09-612-453) depending on color

Thinner: 1000198377

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP 5)

3.1.2 Touch-up:Sa 3 (SSPC-SP 5)

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068 or 1000160374

4 Dry Film Thickness Requirements

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

4.2 Total System: Three coats, 270-375 micrometers, minimum-maximum

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

4.4 Succeeding coats shall be of contrasting colors.

Note:

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

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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 (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

Coating: 1000195317 or 1000195341 depending on color

Thinner: 1000198372

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP 5)

3.1.2 Touch-up:Sa 3 (SSPC-SP 5)

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068 or 1000160374

4 Dry Film Thickness Requirements

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

4.2 Total System: Three coats, 270-375 micrometers, minimum-maximum.

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

4.4 Succeeding coats shall be of contrasting colors.

Note:

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

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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: 6890 kPa (1000 psi)

2.2.3 Requires 7 days curing time at 25°C

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers

2.4.1 Primer: 1000194295

2.4.2 Topcoat: 1000194298 or 1000194352 depending on color

Thinner: 1000198483

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP 5)

3.1.2 Touch-up:Sa 3 (SSPC-SP 5)

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068 or 1000160374

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1 Primer: One coat, see Saudi Aramco data sheets (SAES-H-101V) for the primer dry film thickness.

4.1.2 Topcoats:Two coats 125 micrometers, maximum per coat

4.2 Total System: Three coats, 270-375 micrometers, minimum-maximum

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

4.4 Succeeding coats shall be of contrasting colors.

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

Note:

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

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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): EI 1541 and MIL-PRF-2323D

2.4 SAP Material Numbers

2.4.1 Primer (Yellow): 1000194354

2.4.2 Topcoat (White): 1000194357

2.4.3 Thinner: 1000198458

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP 5)

3.1.2 Touch-up: Sa 3 (SSPC-SP 5)

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068 or 1000160374

4 Dry Film Thickness Requirements

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

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

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

Note:

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

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APCS - 2E

1 Type of Coating

Solvent Free Phenolic Epoxy Coating for 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: 6890 kPa (1,000 psig)

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers

Coating: 1000608683, 1000608684 or 1000608685 depending on can size

Thinner: 1000653652

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP 5)

3.1.2 Touch-up:Sa 3 (SSPC-SP 5)

3.2 Profile: 60 - 100 micrometers, minimum-maximum

Abrasive: 1000161168 or 1000160377

4 Dry Film Thickness Requirements

4.1 Total System: 1 coat or 2 coats, 500 - 700 micrometers, minimum-maximum.

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

4.3 Succeeding coats shall be of contrasting colors.

Note:

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

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APCS - 2G

1 Type of Coating

Glass Flake Vinyl Ester Coating System

2 General Data

2.1 Typical Use

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

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 90°C

2.2.2 Maximum Service Pressure: 6890 kPa (1,000 psig)

2.2.3 Not suitable for demineralized water and polar solvents

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers

Coating: 1000709300

Inhibitor (Retarder): 1000709303

Cleaner: 1000709301

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP 5)

3.1.2 Touch-up:Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: 65-100 micrometers, minimum-maximum

Abrasive: 1000161168 or 1000160377

4 Dry Film Thickness Requirements

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

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

Note:

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

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APCS - 2H

1 Type of Coating

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

2 General Data

2.1 Typical Use

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

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 105°C

2.2.2 Maximum Service Pressure: 6890 kPa (1,000 psig)

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers

Coatings: 1000813296

Thinners: Manufacturer thinners

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP 5)

3.1.2 Touch-up: Sa 3 (SSPC-SP 5)

3.2 Profile: 75 - 100 microns, minimum-maximum

Abrasive: 1000161168 or 1000160377

4 Dry Film Thickness Requirements

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

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

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

Note:

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

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APCS - 3

1 Type of Coating

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

2 General Data

2.1 Typical Use

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

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature (Immersion): 70°C

2.2.2 Not for use in pressure vessels.

2.2.3 Not suitable for use in direct sunlight.

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers

Coating: 1000194372; Red, 1000194375; Black

Thinner: 1000198441

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial for steel: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP 10)

3.1.3 Initial for concrete:Follow surface preparation per SAES-H-003

3.2 Profile for steel: 65-100 micrometers, minimum-maximum

3.3 Profile for concrete: As per ICRI 03730

Abrasive: 1000161168 or 1000160377

4 Dry Film Thickness Requirements

4.1 Each Coat for steel: Two coats, 300 micrometers, maximum per coat

4.2 Total coating for steel: Minimum two coats, 400-600 micrometers, minimum-maximum

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

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

Note:

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

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APCS - 4

1 Type of Coating

Aluminum - Pigmented Alkyd Coating System.

2 General Data

2.1 Typical Use

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

2.2 Service Condition Limitations

Maximum Service Temperature: 80°C

2.3 Purchase Specifications: 09-SAMSS-035

2.4 SAP Material Numbers

2.4.1 Primer: 1000197976 or 1000198011 depending on can size

2.4.2 Topcoat: 1000196402

Thinner: 1000198474

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2 (SSPC-SP 6)

3.1.2 Touch-up:Sa 2 (SSPC-SP 6)
St 3 (SSPC-SP 3) for areas less than 1.0 m^2

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068, 1000161203 or 1000160374

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1 Primer: Two coats, 45-65 micrometers per coat, minimum-maximum

4.1.2 Topcoat: One coat,-25-50 micrometers, maximum per coat

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

Note:

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

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APCS - 5A

1 Type of Coating

Heat Reflective Coating

2 General Data

2.1 Typical Use

External top-coating system to reduce impact of solar heat and minimize evaporation losses.

2.2 Service Condition Limitations

Maximum Service Temperature: 120°C.

Used over an approved primer of APCS-1A, APCS-1B or APCS-1C.

2.3 Purchase Specifications

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

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

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

2.4 SAP Material Numbers

Radiant Heat Coat: 1000769612

Clear Coat: 1000769613

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10) (Depends on used primer)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2
Use APCS - 1C (zinc-rich epoxy) as primer for repair.

3.2 Profile: 40-65 micrometers, minimum - maximum

Abrasive: 1000161068, 1000161203 or 1000160374

4 Total Dry Film Thickness Requirements

300 – 500 microns, minimum- maximum

Note:

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

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APCS - 5B

1 Type of Coating

Hot Insulating Coating System for personal protection.

2 General Data

2.1 Typical Use

Thermal insulation for personal protection on hot substrate.

2.2 Service Condition Limitations

Maximum Service Temperature: 120 °C, if primed with epoxy coating.

Can be used for higher temperatures, if primed with IOZ, primer of APCS-1A. Lab test report must be provided for the specified temperature in the product data sheet.

Used with an approved primer of APCS-1A, APCS-1B or APCS-1C.

2.3 Purchase Specifications

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

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

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

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

2.4 SAP Material Numbers

Hot Insulating Coating: 1000769611

3 Surface Preparation Requirements for Carbon Steel

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP 10)

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

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

Abrasive for carbon steel: 1000161068, 1000161203 or 1000160374

4 Surface Preparation Requirements for stainless steel

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

5 Dry Film Thickness Requirements

5.1 Hot Insulating Coating450 to 550 microns, DFT can be increased for additional temperature reduction.

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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-035

2.4 SAP Material Numbers

2.4.1 Primer: 1000197976 or 1000198011 depending on can size.

2.4.2 Topcoat: 1000195487, 1000195490, 1000195495, 1000195532, 1000195571, 1000195577, 1000195631, 1000195637, 1000195650, 1000195683, 1000195685, 1000195687, 1000195689, 1000195742, 1000195745, 1000195747, 1000195749, 1000195801, 1000195803 or 1000195831 depending on color.

2.4.3 Thinner: 1000198474 (09-738-340)

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2 (SSPC-SP 6)

3.1.2 Touch-up:Sa 2 (SSPC-SP 6)
St 3 (SSPC-SP 3) for areas less than 1.0 m^2

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068, 1000161203 or 1000160374

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1 Primer: Two coats, 45-65 micrometers per coat, minimum-maximum

4.1.2 Topcoat: One coat, 35-50 micrometers per coat, minimum-maximum

4.2 Total System: Three coats, 125-180 micrometers, minimum-maximum

Note:

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

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Saudi Aramco: Company General Use

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

2.4.1 Primer: 1000196351

2.4.2 Topcoat: 1000196312, 1000196317, 1000196355, 1000196359 depending on color.

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

Initial: Metallic Surfaces: Sa 2-1/2 (SSPC-SP 10)

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

Touch-up: Metallic Surfaces: Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for area less than 0.1 m^2

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

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068, 1000161203 or 1000160374

4 Dry Film Thickness Requirements

4.1 Each Coat

4.1.1 Primer: One coat, 50-75 micrometers, minimum-maximum

4.1.2 Topcoat: One coat, 50-100 micrometers, minimum-maximum

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

Note:

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

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Saudi Aramco: Company General Use

APCS - 10

1 Type of Coating

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

2 General Data

2.1 Typical Use

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

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 60°C

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

2.3 Purchase Specification: None

2.4 SAP Material Numbers

Coating: 1000194025, 1000194029 or 1000194032 depending on can size.

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level, Initial and Touch-up

3.1.1 Pipelines in hydrocarbon service and all pipelines in road and camel crossings:

Sa 2 (SSPC-SP 6), St 3 (SSPC-SP 3) if less than 3 m long

3.1.2 General Steelwork: St 3 (SSPC-SP 3)

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

Note:

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

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Saudi Aramco: Company General Use

APCS - 11A

1 Type of Coating

High Temperature Coating System for Atmospheric Service between 120°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: 120°C-400°C

2.3 Purchase Specifications

2.3.1 Primer: 09-SAMSS-071

2.3.2 Topcoat: 09-SAMSS-071

2.4 SAP Material Numbers

2.4.1 Primer: 1000194146 / 1000194182 solvent or water based.

2.4.2 Thinner: 1000198445

2.4.3 Topcoat: 1000196488

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-Up: Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: 40-65 micrometers, minimum - maximum

Abrasive: 1000161068 or 1000160374

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

Note:

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

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Saudi Aramco: Company General Use

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-071

2.4 SAP Material Numbers

2.4.1 Self Priming: 1000196502

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP 5)

3.1.2 Touch-up: Sa 3 (SSPC-SP 5)

3.2 Profile: 25 micrometers, maximum

Abrasive: 1000161068 or 1000160374

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

Note:

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

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Saudi Aramco: Company General Use

APCS - 11C

1 Type of Coating

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

2 General Data

2.1 Uses: Steel in atmospheric/insulated service at elevated temperatures. Not generally recommended for shop applications or when handling is required after coating.

2.2 Service Condition Limitations

Maximum Service Temperature: 650 °C (1202°F)

2.3 Purchase Specifications: 09-SAMSS-071

- SAP Material Numbers:

3 Surface Preparation Requirements

Carbon Steel

Use solvent cleaning as per SSPC-SP 1 and abrasive blasting as per commercial blast cleanliness level per SSPC-SP 6

Stainless Steel

Remove all grease, oil, dirt, drawing and other foreign matter using the SSPC-SP 1 "Solvent Cleaning" method with non-chlorinated solvents. Abrasive blast the surface as per SSPC-SP 6.

4 Dry Film Thickness Requirements

System 1: Ambient Steel Application - (when substrate is in ambient condition during Painting)

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

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

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

System 2: Hot Steel Application (300-500°F) - (when substrate is in Hot Condition during Painting)

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

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

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

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

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Saudi Aramco: Company General Use

APCS - 12

1 Type of Coating

Non-Skid Epoxy Coating System for Floors and Decks

2 General Data

2.1 Typical Use

Nonskid surface on interior and exterior floors and walkways.

2.2 Service Condition Limitations

Maximum Service Temperature: 120°C

2.3 Purchase Specifications

2.3.1 Primer: 09-SAMSS-069

2.3.2 Topcoats: 09-SAMSS-069

2.3.3 Aggregate:Non-skid aggregate shall be provided by the coating material manufacturer subject to approval by Saudi Aramco.

2.4 SAP Material Numbers

2.4.1 Primer: 1000194626, 1000195348 or 1000195361 depending on generic type and can size.

Thinner: 1000198455 for epoxy primer, and 1000198449 for zinc rich primer.

2.4.2 Topcoat: 1000194629, 1000194797 or 1000194960 depending on color.

Thinner: 1000198452

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2.

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068, 1000161203 or 1000160374

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 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

Note:

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

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Saudi Aramco: Company General Use

APCS - 17A

1 Type of Coating

Inorganic Zinc Primer, Solvent-Based

2 General Data

2.1 Typical Uses

Under thermal insulations for temperature range of 175°C to 400°C.

2.2 Coating Application Limitations

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

2.3 Service Condition Limitations

Maximum Service Temperature: 400°C

2.4 Purchase Specification: 09-SAMSS-071

2.5 SAP Material Numbers

2.5.1 Coating: 1000194146

2.5.2 Thinner: 1000198445

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up:Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068 or 1000160374

4 Dry Film Thickness Requirements

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

Note:

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

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Saudi Aramco: Company General Use

APCS - 17B

1 Type of Coating

Inorganic Zinc Primer, Water-Based.

2 General Data

2.1 Typical Uses

Under thermal insulations for temperature range of 175°C to 400°C.

2.2 Coating Application Limitations

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

2.3 Service Condition Limitations

Maximum Service Temperature: 400°C

2.4 Purchase Specification: 09-SAMSS-071

2.5 SAP Material Number: 1000194182

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up:Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: 40-65 micrometers, minimum - maximum

Abrasive: 1000161068 or 1000160374

4 Dry Film Thickness Requirements

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

Note:

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

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Saudi Aramco: Company General Use

APCS - 19C

1 Type of Coating

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

2 General Data

2.1 Typical Use

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

2.2 Service Conditions and Limitations

2.2.1 Maximum Service Temperature: 93°C

2.2.2 Not suitable for Hot Risers in Splash Zone.

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

2.3 Purchase Specification: 09-SAMSS-070

2.4 SAP Material Numbers:

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

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial (New Construction): SSPC-SP 5 (Sa 3)

3.1.2 Touch-up and Recoat: SSPC-SP 6 (Sa 2)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

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

Abrasive: 1000161068, 1000161203 and 1000160374

4 Dry Film Thickness Requirements

Total System:

4.1 New Construction: Two coats @ 500-750 microns per coat and total of 1000 -1500 microns

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

Note:

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

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Saudi Aramco: Company General Use

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

2.4.1 Primer: None

2.4.2 Resin: None

2.4.3 Fiberglass Mat: None

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

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

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: As recommended by the Coating Manufacturer.

4 Other Requirements

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

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

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

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 shall be applied in accordance with SABP-H-001 when storage tanks and vessels repaired on bottom area.

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Saudi Aramco: Company General Use

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

2.4.1 Primer: None

2.4.2 Epoxy Resin: None

2.4.3 Chopped Fiberglass: None

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10).

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

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) 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.

Note:

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

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Saudi Aramco: Company General Use

APCS – 22A

1 Type of Coating

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

2 General Data

2.1 Typical Use

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

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 120°C

2.2.2 Not normally suitable for immersion service.

2.3 Purchase Specifications: 09-SAMSS-087

2.4 SAP Material Numbers

2.4.1 Primer: 1000194560 or 1000195239 depending on can size

2.4.2 Topcoat: 1000194565, 1000194568, 1000194590, 1000195273, 1000195277 or 1000195314 depending on color and can size.

2.4.3 Thinner: 1000198471

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: 40-65 micrometers, minimum-maximum

Abrasive: 1000161068, 1000161203 or 1000160374

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

Note:

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

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Saudi Aramco: Company General Use

APCS - 22B

1 Type of Coating

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

2 General Data

2.1 Typical Use

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

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 120°C

2.2.2 Not normally suitable for immersion service.

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

2.4 SAP Material Numbers

2.4.1 Coating: 1000647350, 1000647351, 1000647352, 1000647353, 1000669337, 1000669338, 1000669339 or 1000669590 depending on color.

2.4.2 Thinner: 1000647354

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 2-1/2 (SSPC-SP 10)

3.1.2 Touch-up: Sa 2-1/2 (SSPC-SP 10)
St 3 (SSPC-SP 3) for areas less than 0.1 m^2

3.2 Profile: 40-65 micrometers, minimum - maximum

Abrasive: 1000161068, 1000161203 or 1000160374

4 Dry Film Thickness Requirements

4.1 Total System: One coat, 350-500 micrometers for atmospheric service

400-575 micrometers for splash zone service

Note:

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

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Saudi Aramco: Company General Use

APCS - 26

1 Type of Coating

Epoxy Mastic Coating (Self-Priming)

2 General Data

2.1 Typical Use

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

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

c) A maintenance coating over existing sound coatings.

d) For new steel structures in medium corrosive atmosphere.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 120°C

2.2.2 Not suitable for buried service.

2.3 Purchase Specification: 09-SAMSS-069

2.4 SAP Material Numbers

2.4.1 Coating: 1000194381, 1000194386, 1000194401, 1000194407, 1000194420), 1000194427, 1000194471 or 1000194476 depending on color.

2.4.2 Thinner: 1000198487

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 New Construction: Sa 2-1/2 (SSPC-SP 10)

Touch-Up: Sa 2-1/2 (SSPC-SP 10)
St 2 (SSPC-SP 2) for areas less than 0.1 m^2

3.1.2 Maintenance Coating Steel Surfaces

Exposed Steel: Sa 2 (SSPC-SP 6) for areas greater than 0.1 m^2
St 2 (SSPC-SP 2) 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, 1000161203 or 1000160374

4 Dry Film Thickness Requirements

4.1 For Maintenance over Existing Sound Coating

4.1.1 Total System: One coat, 125-200 micrometers minimum-maximum
(above the thickness of any existing coating).

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4.2 For New Construction

4.2.1 Each Coat: Two coats, 150-200 microns, minimum-maximum, per coat

4.2.2. Total System: 300-400 microns

Note:

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

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Saudi Aramco: Company General Use

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 increasing chemical resistance.

c) A maintenance coating over existing sound coatings.

d) For new steel structures in medium corrosive atmosphere.

2.2 Service Condition Limitations

2.2.1 Maximum Service Temperature: 80°C

2.2.2 Not suitable for buried service.

2.3 Purchase Specifications: 09-SAMSS-069

2.4 SAP Material Numbers:

2.4.1 Primer: 1000194381, 1000194386, 1000194401, 1000194407, 1000194420, 1000194427 or 1000194471 depending on color.

Thinner: 1000198487

2.4.2 Topcoat: 1000194672, 1000194675, 1000194793, 1000194795 or 1000194851 depending on color

Thinner: 1000198479

3 Surface Preparation Requirements

3.1 Minimum Cleanliness Level

3.1.1 New Bare Steel: Sa 2-1/2 (SSPC-SP 10)

Touch-Up: Sa 2 (SSPC-SP 6)
St 2 (SSPC-SP 2) for areas less than 0.1 m^2

3.1.2 Maintenance Coating:

Exposed Steel: Sa 2-1/2 (SSPC-SP 5) for areas greater than 0.1 m^2
St 2 (SSPC-SP 2) 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.

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3.2 Profile: New Coating 40-65 micrometers, min. – max.

Maintenance Coating: N/A

Abrasive: 1000161068, 1000161203 or 1000160374

4 Dry Film Thickness Requirements

4.1 For Maintenance over Existing Sound Coating

Each Coat

4.1.1 Primer: One coat, 125-200 micrometers, minimum-maximum,

4.1.2 Topcoat: One coat, 25-65 micrometers

Total system: Two coats, 150-265 micrometers, minimum-maximum above the thickness of any existing coating.

4.2 For New Construction

4.2.1 Primer: Two coats, 300 – 400 microns, minimum-maximum, primer total

4.2.2 Topcoat One coat, 40 – 60 microns, minimum-maximum

4.2.3 Total System: 340 – 460 microns minimum-maximum

Note:

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

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Saudi Aramco: Company General Use

APCS - 27

1 Type of Coating

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

2 General Data

2.1 Typical Use

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

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

2.3 Purchase Specification: 09-SAMSS-067

2.4 SAP Material Numbers:

2.4.1 Brush Grade: 1000767602

2.4.2 Spray Grade: 1000767601

3 Surface Preparation

3.1 Minimum Cleanliness Level

3.1.1 Initial: Sa 3 (SSPC-SP 5)

3.1.2 Touch-up: Sa 3 (SSPC-SP 5)

3.2 Profile:65 - 100 microns, minimum - maximum

Abrasive: 1000161063, 1000161200 or 1000160377

4 Application and Dry Film Thickness Requirements

4.1 **Application:** Single coat application by airless equipment as recommended in the product data sheet

Stripe Coating: Weld lines, appurtenances, welded brackets, nozzles, and corners shall be stripe-coated by brush prior to coating spray application.

4.2 **Total Thickness**: For Amines and Other Chemicals: One or two coats; 600 - 1000 microns

For Gas, Crude Oil and Water: One coat, 400 - 600 microns

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

Note:

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

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Saudi Aramco: Company General Use

APCS - 28

1 Type of Coating

Internal Liquid Coating Systems for Pumps, Valves and Exchanger Boxes

2 General Data

2.1 Typical Use

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

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

2.3 Purchase Specifications: 09-SAMSS-067

2.4 SAP Material Numbers:

3 Surface Preparation Requirements

3.1 Soluble salts on the steel substrate shall be less than 20 mg/m^2 prior to coating application.

3.2 Minimum Cleanliness Level

3.2.1 New Bare Steel: Sa 3 (SSPC-SP 5)

Touch-Up: Sa 2.5 (SSPC-SP 10)

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

3.2.2 Maintenance Coating:

Exposed Steel: Sa 2.5 (SSPC-SP 10) for areas greater than 0.1 m^2

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

Abrasive: 1000161063, 1000161200 or 1000160377

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

Products approved under APCS-28 are selected from other approved coating systems.

Note:

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

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APCS 113A

1 Type of Coating

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

2 General Data

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

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

b) SAP Material Number: 1000686070

c) Maximum Service Temperature Limitations:

1) 120°C in dry soil.
2) 90°C in Subkha soil.

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

e) Purchase Specification: 09-SAMSS-113.

3 Surface Preparation and Coating Application Requirements

a) Cleanliness: Near White Metal (SSPC-SP 10)
Surface Profile: 50 to 100 microns (2 to 4 mils)

Use abrasives SAP M/N 1000161068 and 1000160374.

b) Test the steel substrate for chloride salts contamination. Substrates with residual chlorides exceeding 20 mg/m^2 shall be decontaminated by fresh water high-pressure wash.

c) Dry Film Thickness:

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

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

e) Compatible Repair Coatings: APCS-113A.

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

Note:

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

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Appendices

Appendix A: Quality Control Equipment Kit

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

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Appendix 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: _____

_____

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Appendix 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 _____

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Appendix C: In Process (Inspection Sheet)

Date: _____

Time: _____ To _____

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

Remarks: _____

_____

C. Abrasive Blasting		
1. Dew Point - Start _____, Mid-Point _____	_____	_____
2. Substrate Temp-Start _____, Mid-Point _____	_____	_____
3. Nozzle Press. - Start _____, Mid-Point _____	_____	_____
4. Anchor Pattern-Start _____, Mid-Point _____	_____	_____
5. Degree of Cleanliness:		
Start (Sa) _____	_____	_____
Mid-Point (Sa) _____	_____	_____
6. Dust Level - Start _____, Mid-Point _____	_____	_____
7. Residual Chloride – Start _____, Mid-Point _____	_____	_____

Remarks:

_____

_____

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Appendix C (Cont'd)

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

Remarks: _____

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

Remarks: _____

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Appendix 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 Properly to the Start and During Painting	_____	_____
2.	Ventilation Acceptable? (Circle) Yes No	_____	_____
3.	Mixing Acceptable? (Circle) Yes No	_____	_____
4.1	Ratio of Thinning - (If Req) _____	_____	_____
5.	Dew Point: Start _____, Mid-Point _____	_____	_____
6.	Substrate Temp: Start _____, Mid-Point _____	_____	_____
7.	Average Wet Film Thickness _____	_____	_____
8.	Average Dry Film Thickness _____	_____	_____
9.	Final Curing Time Time _____ At Steel Temp _____	_____	_____
10.	Holiday Test After Full Cure (Circle) Yes No	_____	_____
11.	Adhesion Test After Full Cure (Circle) Yes No	_____	_____
* 12.	Top Coat Acceptable (Circle) Yes No	_____	_____

Remarks: _____

_____

* Indicates Mandatory Saudi Aramco Inspection Points

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Appendix D: Paints/Coatings and Equipment Log

Plant No. _____ Plant Name _____
Equipment No. _____ Type _____
Service Fluid _____ Working Pressure _____ Temp. _____
Previous Coating _____ Shop/Field Applied _____

Contractor Organization:
Name _____ Reg. No. _____ Phone No. _____
Work Started _____ Work Completed _____

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

Coating Specification: APCS _____
Primer Prod. No. _____ Topcoat Prod. No. _____
Mfg. Date _____ Mfg. Date _____
Batch No. _____ Batch No. _____
Color _____ Color _____
SAMS Stock No. _____ SAMS Stock No. _____
Amount at Job Site _____ Amount at Job Site _____

Storage Temperature: _____ °C Max
Coating Applied by (Brush-Airless-Conventional) _____

Remarks: _____

_____

Crew Supervisor: Name _____ Signature _____

Saudi Aramco Inspector: Name _____ Signature _____

Mailing Address _____ Phone No. _____

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Table 1 – Dew Point Calculation Chart Ambient Air Temperature

(Degrees Celsius)

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

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

Table 2 – Calculating DFT, WFT and Theoretical Coverage

Dry Film Thickness (DFT):

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

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

Theoretical Coverage:

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

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

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Document History

21 October 2024	Major Revision	Major revision to align with other coating standards and international standards and to clarify several mandatory requirements.
23 May 2019	Major Revision	Major revision to align to latest editions of ISO and ASTM, re-align atmospheric definitions to latest edition of ISO 12944, add more APCS for coating selection, provide specifications for metallic abrasives, modify the applicability of coating performance warranties, align coating requirements to SAES-A-134, introduce new technologies for surface preparation, clarify the requirements to address concerns of standard's users, and enhance several APCS specifications.
21 February 2018	Editorial Revision	Editorial revision to modify paragraph (4), (6.1.7), (6.3.4), (7.1.F Remark 2), and (7.3.F Remark1).

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ATTACHMENT-10

Engineering Standard

30 June 2021

SAES-H-101V

Approved Saudi Aramco Data Sheets - Paints and Coatings

Document Responsibility: Paints and Coatings Standards Committee

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Summary of Changes

Paragraph Number		Change Type (Addition, Modification, Deletion)	Technical Change(s)
Previous Revision (16 October 2017)	Current Revision (30 June 2021)		
1.1	1.1	Modification	Clarified Scope of document.
3	3	Addition	Added other relevant Saudi Aramco standards.
4.10	4.10	Modification	Clarified requirements on colors of coatings.
None	4.11	Addition	Provided requirement when coating shelf-life is exceeded.
5	5	Addition	Added Approved Coatings List by APCS" (New).
6	6	Modification	Changed from "List of Approved Abrasive Materials" to "Approved Manufacturers and Products (Including New Approvals)".
5.k. APCS-3	6.k.	Deletion	Hempel's Coal Tar Epoxy Mastic 35670 Data Sheet under APCS-3 was deleted due to coating manufacturer's advice.
5.m	6.m	Addition	Added the Data Sheets for the approved products of Mascoat. (New)
5.n	6.n	Additions	Added Sakaphen's Approved Products and Data Sheets (New).

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Paragraph Number		Change Type (Addition, Modification, Deletion)	Technical Change(s)
Previous Revision (16 October 2017)	Current Revision (30 June 2021)		
5.n. APCS-11A/B/C	6.0 APCS-11A/B/C	Modification	Sherwin Williams" Approved Products under APCS-11A/B/C were corrected.
5.o	6.p APCS-2E	Modification / Addition	Sigma's Approved Products and Data Sheets were placed from para. 5.o to para. 6.p and Approved Product and Data Sheet under APCS-2E was added.
5.o	6.o	Deletion	Sherwin Williams Express cote HCR was removed from APCS-2H, due to resin production issues.
5.r	6.r	Addition	Added Tesla's Approved Products and Data Sheets (New) (Nano Coating Technologies).

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1 Scope

1.1 This standard covers approved coating systems and the minimum mandatory requirements on the proper use of Approved Protective Coating Systems (APCS) in SAES-H-001, SAES-H-002, SAES-H-003, and SAES-H-004.

1.2 This standard does not apply to architectural finishes and decorative coating applications.

2 Conflicts and Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed to the EK&RD Manager.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302.

3 References

All referenced specifications, standards, codes, drawings, and similar material are considered part of this engineering standards to the extent specified, applying the latest version, unless otherwise stated.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedures

SAEP-302	Waiver of a Mandatory Saudi Aramco Engineering Requirement

Saudi Aramco Engineering Standards

SAES-B-067	Safety Identification and Safety Colors
SAES-H-001	Coating Selection and Application Requirements for Industrial Plants and Equipment
SAES-H-002	Internal and External Coatings for Steel Pipelines and Piping
SAES-H-003	Protective Coatings for Industrial Concrete Structures
SAES-H-004	Protective Coating Selection and Application Requirements for Offshore Structures and Facilities

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Saudi Aramco Materials System Specifications

09-SAMSS-060 Packaging and Labeling Requirements for Coatings

4 General Requirements

4.1 Approved coatings shall be used properly in accordance with the Data Sheets in this standard. Packaging requirements shall be in accordance with 09-SAMSS-060.

4.2 Only the specified application method/s in this standard shall be used.

4.3 Use of forced-curing on ambient-cured liquid coatings shall only be allowed as per coating manufacturer's approval and detailed procedure. The detailed forced-curing procedure shall be signed by coating manufacturer. Coating manufacturer shall supervise the implementation of their forced-curing procedure and shall provide in writing a coating performance warranty of minimum five (5) years with regards to the use of forced-curing on their product.

4.4 The specifications of the APCS in the SAES-H standards listed in Section 3 of this document are mandatory and shall be complied. The Data Sheets in this standard does not provide the specifications of the APCS but rather give important information on how to properly use the approved coatings to meet the requirements and specifications of the APCS.

4.5 Coating manufacturer's product data sheets shall be used for newly approved coatings not yet listed in this standard.

4.6 Detailed product application instructions (PAI) shall be provided by coating manufacturer when required. PAI shall not deviate or shall not be in conflict with the requirements and specifications of the APCS.

4.7 Coating manufacturers shall not issue any Product Data Sheets that are in conflict with the information of the Data Sheets in this standard.

4.8 This standard shall prevail over coating manufacturer's product data sheets if there are conflicts.

4.9 Products without indicated SAP Material Number (M/N) in this standard shall refer to the corresponding SAP M/N of the APCS in the SAES-H standards.

4.10 For color coding and identification, refer to SAES-B-067. All inquiries regarding color coding shall be directed to Loss Prevention Department.

4.11 Coatings which have exceeded the shelf life given in the approved data sheet must not be used.

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5 Approved Coatings List by APCS

APCS-1A

1. Interzinc 22 + Intergard 410	AkzoNobel
2. Carbozinc 11 + Carboguard 893SG	Carboline
3. Galvosil 15780 + Hempadur Mastic (45880/45881)	Hempel
4. Resist 78 + Penguard Express + Penguard FC	Jotun
5. Zinc Clad II Ethyl Silicated + Macropoxy 646	Sherwin Williams
6. SigmaZinc 158 + SigmaCover 410	Sigma
7. Tnemec Series 90-98 + Tnemec Series 66	Tnemec

Water-based Primer + Epoxy Topcoat

1. Resist 5WF + Penguard Express + Penguard FC	Jotun
2. Silguard SC 7550 + SigmaCover 410	Sigma

APCS-1B

1. Intergard 291 + Intergard 410	AkzoNobel
2. Carboguard 893SG	Carboline
3. Hempadur HB Primer 17300 or 15570 + Hempadur Mastic (45880/45881)	Hempel
4. Penguard Express ZP + Penguard Express + Penguard FC	Jotun
5. Macropoxy 646	Sherwin Williams
6. SigmaCover 410 (Alu) + SigmaCover 410	Sigma
7. Tnemec Series 66	Tnemec

APCS-1C

1. Interzinc 52 + Intergard 410	AkzoNobel
2. Carbozinc 858 + Carboguard 893SG	Carboline
3. Hempadur Zinc 17360 + Hempadur Mastic (45880/45881)	Hempel
4. Barrier 77 + Penguard Express + Penguard FC	Jotun
5. Zinc Clad IV Organic Zinc Rich Epoxy Primer + Macropoxy 646	Sherwin Williams
6. SigmaZinc 102HS + SigmaCover 410	Sigma

APCS-1D

1. Interzinc 22 + Intergard 410 + Interthane 990	AkzoNobel
2. Carbozinc 11 + Carboguard 893SG + Carbothane 134 Series (134HP)	Carboline
3. Galvosil 15780 + Mastic (45880/45881) + Hempathane 55210	Hempel
4. Resist 78 + Penguard Express + Penguard FC + Hardtop XP	Jotun
5. Zinc Clad II Ethyl Silicated + Macropoxy 646 + Hi-Solids Polyurethane	Sherwin Williams
6. SigmaZinc 158 + SigmaCover 410 + SigmaDur Gloss 7528	Sigma
7. Tnemec Series 90-98 + Tnemec Series 73	Tnemec

Water-based Primer + Epoxy Intermediate Coat + Polyurethane Topcoat

1. Resist 5WF + Penguard Express + Hardtop XP	Jotun
2. Silguard SC 7550 + SigmaCover CM 7456 + SigmaDur Gloss 7528	Sigma

APCS-1E

1. Intergard 291 + Intergard 410 + interthane 990	AkzoNobel
2. Carboguard 893SG + Carboguard 893SG + Carbothane 134 Series (134HP)	Carboline
3. Hempadur HB Primer 17300 or 15570 + Hempadur Mastic (45880/45881) + Hempathane 55210	Hempel
4. Penguard Express ZP + Penguard Express + Hardtop XP	Jotun

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5. Macropoxy 646 + Macropoxy 646 + Hi-Solids Polyurethane	Sherwin Williams
6. SigmaCover 410 (Alu) + SigmaCover 410 + SigmaDur Gloss 7528	Sigma
7. Tnemec Series 66 + Tnemec series 73	Tnemec

APCS-1F

1. Interzinc 52 + Intergard 410 + Interthane 990	AkzoNobel
2. Carbozinc 858 + Carboguard 893SG + Carbothane 134 Series (134HP)	Carboline
3. Hempadur Zinc 17360 + Hempadur Mastic (45880/45881) + Hempathane 55210	Hempel
4. Barrier 77 + Penguard Express + Hardtop XP	Jotun
5. Zinc Clad IV Organic Zinc Rich Epoxy Primer + Macropoxy 646 + Hi-Solids Polyurethane	Sherwin Williams
6. SigmaZinc 102HS + SigmaCover 410 + SigmaDur Gloss 7528	Sigma

APCS-2A

1. Interline 399	AkzoNobel
2. Plasite 7159	Carboline
3. Hempadur 85671	Hempel
4. Tankguard A.R.	Jotun
5. Phenicon HS	Sherwin Williams
6. PhenGuard 930 + PhenGuard 935 + PheGuard 940	Sigma

APCS-2B

1. Hempadur 85671	Hempel
2. Tankguard 412	Jotun
3. PhenGuard 930 + PhenGuard 935 + PheGuard 940	Sigma

APCS-2C

1. Interline 399	AkzoNobel
2. Plasite 7159	Carboline
3. Hempadur 85671	Hempel
4. Tankguard A.R.	Jotun
5. Phenicon HS	Sherwin Williams
6. PhenGuard 930 + PhenGuard 935 + PheGuard 940	Sigma

APCS-2D

1. Interline 925	AkzoNobel
2. Phenoline 187 primer + Phenoline 187 top coat	Carboline
3. Hempadur 85210	4. Tankguard Storage Jotun
5. Phenicon HS	Sherwin Williams

APCS-2E

1. Plasite 4550 Series (4550/4550s)	Carboline
2. Nova-Plate UHS	Sherwin Williams
3. Novaguard 7453	Sigma

APCS-2G

1. Interline 955	AkzoNobel
2. Plasite 4301HT	Carboline
3. Polyglass VEF	Corrocoat
4. Vinyl Ester GF 35910	Hempel
5. Sakaflake 900	Sakaphen

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6. Cor-Cote VEN FF	Sherwin Williams

APCS-3

1. Bitumastic 300M	Carboline
2. Targuard Coal Tar Epoxy	Sherwin Williams
3. Sigma C-200a Coal Tar	Sigma

APCS-4

1. Interprime 409 + Intertherm 891	AkzoNobel
2. Carbocoat GP-40 + Carbocoat GP-40 Aluminum	Carboline
3. Hempel's ZP Alkyd Primer 12090 + Hempel's Silvium 51570	Hempel
4. Pilot Primer + Bengalac Silver Aluminum	Jotun
5. Kem Kromik Universal Metal Primer + Industrial Aluminum Paint	Sherwin Williams
6. Sigmarine 24 + Sigma Aluminum Paint SA35	Sigma
7. Tnemec Series 37H + Tnemec Series 43-46	Tnemec

APCS-5A

1. Carbotherm 3300	Carboline
2. Ceratech 901 + Clear Coat 50	Ceratech Coaitngs
3. Zeffle IR	Daikinchem
4. Delta T Industrial Thermal Insulating Coating	Mascoat
5. Supertherm	Supertherm Inc
6. Tank Shield + YThermo Shield Clear Coat	Thermo-Shield Inc.

.

APCS-5B

1. Carbotherm 551	Carboline
2. Ceramic Cover CC-100	Envirotrol Inc.
3. Delta T Industrial Thermal Insulating Coating	Mascoat

APCS-6

1. Interprime 409 + Interlac 665	AkzoNobel
2. Carbocoat GP 40 + Carbocoat GP 62	Carboline
3. Hempel's ZP Alkyd Primer 12090 + Hempalin 52140	Hempel
4. Pilot Primer + Pilot II	Jotun
5. Kem Kromik Universal Metal Primer + Industrial enamel	Sherwin Williams
6. Sigmarine 24 + Sigma Enamel SA21	Sigma
7. Tnemec Series 37H + Tnemec 43-36 or Series 2H	Tnemec

APCS-9

1. Interchlor 37	AkzoNobel
2. Carboline 3630	Carboline
3. Hempatex 46330	Hempel

APCS-10

1. Nitoproof 120	Fosam
2. Hempinol Hi-Build 10270	Hempel
3. Sigma Vokote 63	Sigma

APCS-11A

1. Interzinc 22 + Intertherm 50	AkzoNobel
2. Carbozinc 11 + Thermaline 4700	Carboline
3. Galvosil 15780 + Hempel's Silicone aluminum 56910 or 56940	Hempel
4. Resist 78 or Resist 5WF + Solvalitt AL	Jotun

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5. Zinc Clad II Ethyl Silicate Inorganic Zinc Primer + Heat-Flex M505	Sherwin Williams
6. SigmaZinc 158 or Silguard SC 7550 + SigmaTherm 540	Sigma

APCS-11B

1. Intertherm 50	AkzoNobel
2. Thermaline 4700 Aluminum	Carboline
3. Hempel's Silicone aluminum 56910 or 56940	Hempel
4. Solvalitt AL	Jotun
5. Heat-Flex M505	Sherwin Williams
6. SigmaTherm 540	Sigma

APCS-11C

1. Intertherm 751CSA	AkzoNobel
2. Versiline CUI 56990	Hempel
3. Heat-Flex Hi-Temp 1200	Sherwin Williams

APCS-12

(Same products approved in APCS-1B except that an aggregate is added in APCS-12.)

APCS-17A

1. Interzinc 22	AkzoNobel
2. Carbozinc 11	Carboline
3, Galvosil 15780	Hempel
4. Resist 78	Jotun
5. Zinc Clad II Ethyl silicate Inorganic Zinc Primer	Sherwin Williams
6. SigmaZinc 158	Sigma

APCS-17B

1. Carbozinc 11WB	Carboline
2. Resist 5 WF	Jotun
3. Silguard SC7500	Sigma

APCS-19C

1. Interzone 1000	AkzoNobel
2. Carboguard 703GF	Carboline
3. Hempadur Multi-Strength GF35870	Hempel
4. Euronavy PE35	Sherwin Williams

APCS-20A

1. Carboguard 151-2 (Hand Lay-Up)	Carboline
2. Araldite GY257	Ciba Speciality
3. Hempel's Epoxy Resin System 05500	Hempel
4. Tankguard Storage + Chemtech GM clear	Jotun
5. Dura-Plate UHS	Sherwin Williams

APCS-20B

1. Carboguard 151-2 (Spray Applied)	Carboline
2. Sprayfibre 35890	Hempel
3. Dura-Plate UHS	Sherwin Williams

APCS-22A

1. Interseal 414 + Interzone 954	AkzoNobel

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2. Carboguard 690	Carboline
3. Hempadur 45070	Hempel
4. Jotamastic 80 + Penguard FC	Jotun
5. Euronavy ES301	Sherwin Williams
6. SigmaCover 410 (Alu) + SigmaCover 410	Sigma
7. Teslan 1101 ZN-CNT + Teslan 3100	Tesla Nanocoatings

APCS-22B

1. Interzone 954	AkzoNobel
2. Carboguard 690GF	Carboline
3. Enronavy PE35	Sherwin Williams

APCS-26

1. Interseal 738	AkzoNobel
2. Carboguard 890	Carboline
3. Hempadur Mastic (45880/45881)	Hempel
4. Jotamastic 80	Jotun
5. Macropoxy 646	Sherwin Williams
6. Sigmacover 410 (Alu) + Sigmacover 410	Sigma
7. Tnemec Series 135	Tenemec

APCS-26T

1. Interseal 738 + Interthane 990	AkzoNobel
2. Carboguard 890 + Carbothane 134 Series (134HP)	Carboline
3. Hempadur Mastic (45880/45881) + Hempathane 55210	Hempel
4. Jotamastic 80 + Hardtop XP	Jotun
5. Macropoxy 646 + hi-Solids Polyurethane	Sherwin Williams
6. SigmaCover 410 (Alu) + Sigmacover 410 + Sigmadur Gloss 7528	Sigma
7. Tnemec Series 135 + Tenemec Series 73	Tenemec

APCS-27

1. Belzona 1591 (Brush Grade)	Belzona
2. Durapol UHT (Brush Grade)	Duraplo Ltd.
3. Durapol UHT (Spray Grade)	Durapol Ltd.

APCS-28

1. Belzona 1391T	Belzona
2. Belzona 1391S	Belzona
3. Corroglass 600 Series (602/632/652)	Corrocoat
4. Polyglass VEF	Corrocoat

.**APCS-113A**

1. Intrzone 485	AkzoNobel
2. Flint-Coat 227	Bond-Coat
3. Hempadur 87540	Hempel
4. Sigmaline 2000	Sigma

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6 Approved Manufacturers and Products

a. AkzoNobel – Approved Products

APCS-1A

Interzinc 22	Inorganic Zinc Primer, Solvent-Based
Intergard 410	Epoxy Topcoat

APCS-1B

Intergard 291	Epoxy Primer

Use Epoxy Topcoat of APCS-1A as topcoat

APCS-1C

Interzinc 52	Zinc-Rich Epoxy Primer

Use Epoxy Topcoat of APCS-1A as topcoat

APCS-1D

Use APCS-1A as primer and intermediate coat

Interthane 990	Polyurethane Topcoat

APCS-1E

Use APCS-1B as primer and intermediate coat
Use Polyurethane Topcoat of APCS-1D as topcoat

APCS-1F

Use APCS-1C as primer and intermediate coat
Use Polyurethane Topcoat of APCS-1D as topcoat

APCS-2A/2C

Interline 399	Epoxy Novolac

APCS-2D

Interline 925	Primer and Topcoat

APCS-2G

Interline 955	Vinyl Ester: Glass Flake Reinforced

APCS-4

Interprime 409	Zinc Phosphate Alkyd Primer
Intertherm 891	Aluminum Topcoat

APCS-6

Use Alkyd Primer of APCS-4 as primer

Interlac 665	Alkyd Topcoat

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AkzoNobel – Approved Products (Cont'd)

APCS-9

Interchlor 37*	Chlorinated Rubber Coating

APCS-11A

Use primer of APCS-1A

Intertherm 50	Heat Resistant Topcoat: Aluminum

APCS-11B

Use Heat Resistant Coating of APCS-11A

APCS-11C

Intertherm 751 CSA	Heat Resistant Cold Spray Aluminum

APCS-12

Use primer and topcoat of APCS-1B

APCS-17A

Use primer of APCS-1A

APCS-19C

Interzone 1000	Glass Flake Epoxy

APCS-22A

Interseal 414	Epoxy Primer
Interzone 954	Epoxy Topcoat

APCS-22B

Interzone 954	One-Coat Epoxy

APCS-26

Interseal 738	Epoxy Mastic

APCS-26T

Use APCS-26 as primer and Polyurethane Topcoat of APCS-1D as topcoat

APCS-113A

Interzone 485	Ultra High Build Epoxy

**Note: Refer to coating manufacturer's product date sheet for Interchlor 37.*

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A

Type of Coating	:	Inorganic Zinc Silicate Primer, Solvent-Based
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interzinc 22
SAP M/N (SAMS S/N)	:	1000194146 (09-611-958)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	Base: 6 months Powder: 12 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	QHA285
	2.1.2 Hardener (Curing Agent)	:	QHA027
2.2	Mixing Ratio by volume	:	3 Parts Base : 1 Part Powder
2.3	Thinner	:	International GTA803
	SAP M/N (SAMS S/N)	:	1000198445 (09-738-220)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	4hrs at 25°C; 2Hrs at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = 55%; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	103 µm
3.4	Typical Dry Film Thickness Per Coat	:	65 µm

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A - Interzinc 22 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 25 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon Steel

3.8 Surface Preparation Requirements : Abrasive Blast to Sa 2½

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	9hrs	Extended	3hrs	7days	7days
20°C	4hrs	Extended	2½hrs	6days	6days
30°C	3hrs	Extended	2hrs	4days	4days
40°C	1½hrs	Extended	1hr	2days	2days
50°C	1hr	Extended	1hr	2days	2days

i. data quoted is determined at 55% relative humidity
ii. Prior to overcoating, verify a value of 4 via ASTM D4752 MEK rub test

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip Range 15-21 thou
Total output pressure ≥1592psi

Air Spray (Pressure Pot) : Aircap 704 or 765. Fluid Tip E

Brush : For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 63%

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A - Interzinc 22 (Cont'd)

4.2	Product Weight	(ASTM D1475)	:	2.44Kg/L
4.3	Viscosity	(ASTM D562)	:	70-80 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	19°C (Mixed)
4.5	Approved Color/s	:	Green Grey	
4.6	Finish	:	Matt	

5. Special Instructions: At relative humidities below 55%, a low humidity cure accelerator must be used

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APCS-1A/1B/1C/1D/1E/1F

Type of Coating	:	Epoxy Intermediate or Topcoat
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Intergard 410
SAP M/N (SAMS S/N)	:	1000194629 (09-612-364), 1000194797 (09-612-369) or 1000194960 (09-612-375)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	EM series depend on color
	2.1.2 Hardener (Curing Agent - C.A.)	:	EBA744
2.2	Mixing Ratio by volume	:	4 Parts Base : 1 Part C.A.
2.3	Thinner	:	International GTA220
	SAP M/N (SAMS S/N)	:	1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	4 hrs at 25°C 2 hrs at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = N/A; Max = 85%
3.3	Typical Wet Film Thickness per Coat	:	167 to 250µm
3.4	Typical Dry Film Thickness per Coat	:	100 to 150µm

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F - Intergard 410 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 24 m^2/L

3.6 Minimum Number of Coats : 1 as Intermediate, 2 as Topcoat

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	24hrs	10days	24hrs	10days	10days
20°C	12hrs	7days	12hrs	8days	8days
30°C	8hrs	5days	8hrs	6days	6days
40°C	5hrs	4days	5hr	4days	4days
50°C	4hr	3days	4hr	4days	4days

Before overcoating after exposure in a contaminated environment, clean the surface of Intergard 410 thoroughly by high pressure fresh water washing and allow to dry.

3.8 Recommended Application Equipment

Airless (A/L) Spray : Tip Range 18 - 23 thou
Total output pressure ≥2,500psi

Conventional Spray : Aircap 704 or 765. Fluid Tip E

Brush : For stripe coating / touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F - Intergard 410 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	60%
4.2	Product Weight	(ASTM D1475)	:	1.3 Kg/L
4.3	Viscosity	(ASTM D562)	:	97-107 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	30°C (Mixed)
4.5	Approved Color/s	:	Red, Gray, Yellow	
4.6	Finish	:	Semi-Gloss	

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E

Type of Coating	:	Epoxy Primer
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Intergard 291
SAP M/N (SAMS S/N)	:	1000194626 (09-612-362)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum		:	2 years

2. Mixing

2.1	No. of Components		:	2
	2.1.1	Base	:	EPA530
	2.1.2	Hardener (Curing Agent – C.A.)	:	EPA501
2.2	Mixing Ratio by volume		:	4 Parts Base : 1 Part C.A.
2.3	Thinner		:	International GTA220
	SAP M/N (SAMS S/N)		:	1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements		:	up to 5% by Volume
2.5	Induction Time		:	None
2.6	Pot Life		:	6 hrs at 25°C 2 hrs at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = N/A; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	142 µm
3.4	Typical Dry Film Thickness Per Coat	:	75 µm

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APCS-1B/1E - Intergard 291 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	21 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Carbon Steel, Stainless Steel, Galvanized Steel
3.8	Surface Preparation Requirements	:	CS: Abrasive Blast Sa2½ SS: Sweep blast to 50µm profile GS: Sweep blast to 50µm profile

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	24hrs	12 months	24hrs	7days	7days
20°C	16hrs	12 months	16hrs	6days	6days
30°C	12hrs	12 months	12hrs	5days	6days
40°C	8hrs	12 months	8hr	4days	4days
50°C	6hr	12 months	6hr	3days	3days

Before overcoating after exposure in a contaminated environment, clean the surface of Intergard 291 thoroughly by high pressure fresh water washing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Range 15 - 21 thou Total output pressure ≥2200 psi
Conventional Spray	:	Aircap 704 or 765. Fluid Tip E
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	53%

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E - Intergard 291 (Cont'd)

4.2	Product Weight	(ASTM D1475)	:	1.32 Kg/L
4.3	Viscosity	(ASTM D562)	:	56-66 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	23°C (Mixed)
4.5	Approved Color/s	: Red		
4.6	Finish	: Matt		

5. Special Instructions: This product will not cure adequately below 5°C. Intergard 291 is suitable for use as a primer for intumescent Fire Proofing Protective System.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1C/1F

Type of Coating	:	Zinc-Rich Epoxy Primer (Organic Zinc Primer)
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interzinc 52
SAP M/N (SAMS S/N)	:	1000195348 (09-612-580) or 1000195361 (09-612-590)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	12 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	EPA142
	2.1.2 Hardener (Curing Agent – C.A.)	:	EPA177
2.2	Mixing Ratio by volume	:	4 Parts Base : 1 Part C.A.
2.3	Thinner	:	International GTA220
	SAP M/N (SAMS S/N)	:	1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	5 hrs at 25°C 2 hrs at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min: N/A; Max: 85%
3.3	Typical Wet Film Thickness Per Coat	:	110 µm
3.4	Typical Dry Film Thickness Per Coat	:	65 µm

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1C/1F - Interzinc 52 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 23.6 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon Steel

3.8 Surface Preparation Requirements : Abrasive Blast to Sa 2½

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	8hrs	Extended	8hrs	7days	7days
20°C	5hrs	Extended	5hrs	6days	6days
30°C	4hrs	Extended	4hrs	4days	4days
40°C	2hrs	Extended	2hr	2days	2days
50°C	2hr	Extended	2hr	2days	2days

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip Range 17 - 21 thou
Total output pressure ≥2,503 psi

Conventional Spray : Aircap 704 or 765. Fluid Tip E

Brush : For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 59%

4.2 Product Weight (ASTM D1475) : 2.52 Kg/L

4.3 Viscosity (ASTM D562) : 80-90 Krebbs Units

4.4 Flash Point (ASTM D93 or D56) : 29°C (Mixed)

4.5 Approved Color/s : Grey

4.6 Finish : Matt

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E /1F/26T

Type of Coating	:	Polyurethane Topcoat
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interthane 990
SAP M/N (SAMS S/N)	:	1000194672 (09-612-365), 1000194675 (09-612-366), 1000194793 (09-612-367), 1000194795 (09-612-368) or 1000194851 (09-612-371)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum		:	2 years

2. Mixing

2.1	No. of Components		:	2
	2.1.1	Base	:	PH Series depend on Color
	2.1.2	Hardener (Curing Agent – C.A.)	:	PHA046
2.2	Mixing Ratio by volume		:	6 Parts Base : 1 Part C.A.
2.3	Thinner		:	International GTA713
	SAP M/N (SAMS S/N)		:	1000198479 (09-738-345)
2.4	Minimum-Maximum Thinning Requirements		:	up to 5% by Volume
2.5	Induction Time		:	None
2.6	Pot Life		:	2 hrs. at 25°C 45 mins at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = 20%; Max = 80%
3.3	Typical Wet Film Thickness Per Coat	:	88 µm

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T - Interthane 990 (Cont'd)

3.4 Typical Dry Film Thickness Per Coat : 50 µm

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 23 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	10hrs	Extended	10hrs	7days	7days
20ºC	6hrs	Extended	6hrs	5days	5days
30°C	5hrs	Extended	5hrs	4days	4days
40ºC	4hrs	Extended	4hr	3days	3days
50°C	3hr	Extended	3hr	2days	2days

Before overcoating after exposure in a contaminated environment, clean the surface of Interthane 990 thoroughly by high pressure fresh water washing and allow to dry.

3.8 Recommended Application Equipment

Airless (A/L) Spray : Tip Range 13 - 18 thou
Total output pressure ≥ 2,200 psi

Air Spray (Pressure Pot) : Aircap 704 or 765. Fluid Tip E

Brush : For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 57%

4.2 Product Weight (ASTM D1475) : 1.21 to 1.3 Kg/L

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T - Interthane 990 (Cont'd)

4.3	Viscosity	(ASTM D562)	:	70 - 80 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	35°C (Mixed)
4.5	Approved Color/s	:	Yellow (RAL 1023), White (RAL 9010), Grey (RAL 7038), Red (RAL 3000), Green (IPL549)	
4.6	Finish	:	High Gloss	

5. Special Instructions:

Like the other polyurethanes, the applicator should wear an air fed hood when spraying. Use either APCS-1A, 1B or 1C (see data sheets) as primer and intermediate coat. For APCS-26T, use APCS-26 as primer. Dry film thickness (DFT) must be in accordance with APCS-1D, 1E, 1F, 26T of SAES-H-001.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C

Type of Coating	:	Epoxy Novolac
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interline 399
SAP M/N (SAMS S/N)	:	1000683474 (09-000-496) or 1000658840 (09-000-472)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum		:	12 months

2. Mixing

2.1	No. of Components		:	2
	2.1.1	Base	:	TLA390, TLA391, TLA393
	2.1.2	Hardener (Curing Agent)	:	TLA399
2.2	Mixing Ratio by volume		:	5 Parts Base: 1 Part Cure Agent
2.3	Thinner		:	International GTA220
	SAP M/N (SAMS S/N)		:	1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements		:	up to 5% by Volume
2.5	Induction Time		:	None
2.6	Pot Life		:	2 hrs at 25°C 1 hrs at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = 20%; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	135 µm
3.4	Typical Dry Film Thickness Per Coat	:	90 µm

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C - Interline 399 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 27 m^2/L

3.6 Minimum Number of Coats : 2

3.7 Applicable Substrate : Carbon Steel (CS)

3.8 Surface Preparation Requirements : CS: Abrasive Blast Sa 2½ (SSPC SP10)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	36 hrs	5 days	36 hrs	12 days	12 days
20°C	20 hrs	4 days	20 hrs	6 days	6 days
30°C	18 hrs	3 days	18 hrs	5 days	5 days
40°C	16 hrs	2 days	16 hrs	4 days	4 days
50°C	12 hrs	1 day	12 hrs	3 days	3 days

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip Range 17 - 21 thou
Total output pressure ≥2,500 psi

Conventional Spray : Aircap 704 or 765. Fluid Tip E

Brush : For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 67%

4.2 Product Weight (ASTM D1475) : 1.85 Kg/L

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C - Interline 399 (Cont'd)

4.3	Viscosity	(ASTM D562)	:	80 - 90 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	24°C (Mixed)
4.5	Approved Color/s	:	Grey, White, Red	
4.6	Finish	:	Matt	

5. Special Instructions: This product will not cure adequately below 5°C.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2D

Type of Coating	:	Epoxy Primer
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interline 925
SAP M/N (SAMS S/N)	:	1000194354 (09-612-316) and 1000194357 (09-612-317)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	18 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	THA125
	2.1.2 Hardener (Curing Agent)	:	THA126/127
2.2	Mixing Ratio by volume	:	3 Parts Base: 1 Part Cure Agent
2.3	Thinner	:	DO NOT THIN
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	None
2.6	Pot Life	:	1 hrs at 25°C 30 mins at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = 20%; Max = 80%
3.3	Typical Wet Film Thickness Per Coat	:	300 µm
3.4	Typical Dry Film Thickness Per Coat	:	300 µm

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APCS-2D - Interline 925 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	40 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Carbon Steel (CS)
3.8	Surface Preparation Requirements	:	CS: Abrasive Blast Sa 2½ (SSPC SP10)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	36 hrs	2 days	36 hrs	12 days	12 days
20°C	20 hrs	2 days	24 hrs	6 days	6 days
30°C	12 hrs	1 days	20 hrs	5 days	5 days
40°C	7 hrs	12 hrs	16 hrs	4 days	4 days
50°C	5 hrs	8 hrs	12 hrs	3 days	3 days

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Range 21 - 26 thou Total output pressure ≥3,000 psi
Conventional Spray	:	Aircap 704 or 765. Fluid Tip E
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2D - Interline 925 (Cont'd)

4.2	Product Weight	(ASTM D1475)	:	1.52 Kg/L
4.3	Viscosity	(ASTM D562)	:	125 - 150 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	101°C (Mixed)
4.5	Approved Color/s	: Yellow, White		
4.6	Finish	: Gloss		

5. Special Instructions: This product will not cure adequately below 10°C

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G

Type of Coating	:	Glass Flake Vinyl Ester
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interline 955
SAP M/N (SAMS S/N)	:	1000709300 (09-000502) and 1000709303 (09-000-505)

1. Storage

1.1	Shelf life, sheltered storage @ 20°C maximum		:	6 months

2. Mixing

2.1	No. of Components		:	2
	2.1.1	Base	:	TEA600
	2.1.2	Hardener (Curing Agent – C.A.)	:	TEA150 (Retarder TEA075)
2.2	Mixing Ratio by volume		:	98 Parts Base: 2 Parts C.A.
2.3	Thinner		:	DO NOT THIN
	SAP M/N (SAMS S/N)		:	
2.4	Minimum-Maximum Thinning Requirements		:	N/A
2.5	Induction Time		:	None
2.6	Pot Life		:	40 mins at 25°C 40 mins at 40°C (with retarder)

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = 20%; Max = 80%
3.3	Typical Wet Film Thickness Per Coat	:	706 to 1,176 µm

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G - Interline 955 (Cont'd)

3.4 Typical Dry Film Thickness Per Coat : 600 – 1,000 µm

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 34 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon Steel (CS)

3.8 Surface Preparation Requirements : CS: Abrasive Blast Sa2½ (SSPC SP10)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	6 hrs	3 days	8 hrs	10 days	10 days
20°C	5 hrs	1 day	6 hrs	6 days	6 days
30°C	5 hrs	1 day	6 hrs	5 days	5 days
40°C	5 hrs	12 hrs	6 hrs	4 days	4 days
50°C	5 hrs	8 hrs	4 hrs	3 days	3 days

Note: Material temperatures must be kept at or below 35°C during storage and application.

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip Range 25 - 35 thou
Total output pressure ≥3,000 psi

Conventional Spray : Not recommended

Brush : For stripe coating / touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G - Interline 955 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	85%
4.2	Product Weight	(ASTM D1475)	:	1.2 Kg/L
4.3	Viscosity	(ASTM D562)	:	N/A
4.4	Flash Point	(ASTM D93 or D56)	:	32°C (Mixed)
4.5	Approved Color/s	: Yellow, White		
4.6	Finish	: Semi-Gloss		

5. Special Instructions: Refrigerated storage (ideally <20°C) of materials during transport and storage is critical.

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APCS-4/6

Type of Coating	:	Alkyd Primer
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interprime 409
SAP M/N (SAMS S/N)	:	1000197976 (09-708-113)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum		:	2 years

2. Mixing

2.1	No. of Components		:	1
	2.1.1	Base	:	CPA449/CPA409
	2.1.2	Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio by volume		:	N/A
2.3	Thinner		:	International GTA004
	SAP M/N (SAMS S/N)		:	1000198472 (09-738-340)
2.4	Minimum-Maximum Thinning Requirements		:	up to 5% by Volume
2.5	Induction Time		:	None
2.6	Pot Life		:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = N/A; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	94 µm
3.4	Typical Dry Film Thickness Per Coat	:	50 µm

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APCS-4/6 - Interprime 409 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 21 m^2/L

3.6 Minimum Number of Coats : 2

3.7 Applicable Substrate : Carbon Steel (CS)

3.8 Surface Preparation Requirements : CS = Abrasive Blast Sa2½, St3

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	24 hrs	Extended	24 hrs	7 days	7 days
20°C	16 hrs	Extended	16 hrs	6 days	6 days
30°C	12 hrs	Extended	12 hrs	5 days	6 days
40°C	8 hrs	Extended	8 hrs	4 days	4 days
50°C	6 hrs	Extended	6 hrs	3 days	3 days

Before overcoating after exposure in a contaminated environment, clean the surface of Interprime 409 thoroughly by high pressure fresh water washing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip Range 15 - 19 thou
Total output pressure ≥2,500 psi

Conventional Spray : Aircap 704 or 765. Fluid Tip E
Atomizing Pressure 40 - 60psi

Brush : For stripe coating / touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4/6 - Interprime 409 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	53%
4.2	Product Weight	(ASTM D1475)	:	1.36 Kg/L
4.3	Viscosity	(ASTM D562)	:	55-65 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	32°C (Mixed)
4.5	Approved Color/s	: Red, Grey		
4.6	Finish	: Matt		

5. Special Instructions: This product will not cure adequately below 5°C.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4

Type of Coating	:	Aluminum Alkyd Topcoat
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Intertherm 891
SAP M/N (SAMS S/N)	:	1000196402 (09-686-354)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum		:	2 years

2. Mixing

2.1	No. of Components		:	1
	2.1.1	Base	:	HTA002
	2.1.2	Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio by volume		:	N/A
2.3	Thinner		:	International GTA004
	SAP M/N (SAMS S/N)		:	1000198472 (09-738-340)
2.4	Minimum-Maximum Thinning Requirements		:	up to 5% by Volume
2.5	Induction Time		:	None
2.6	Pot Life		:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = N/A; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	52 µm
3.4	Typical Dry Film Thickness Per Coat	:	25 µm

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APCS-4 - Intertherm 891 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 19 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	24 hrs	Extended	48 hrs	7 days	7 days
20°C	24 hrs	Extended	36 hrs	6 days	6 days
30°C	20 hrs	Extended	24 hrs	5 days	6 days
40°C	16 hrs	Extended	16 hrs	4 days	4 days
50°C	12 hrs	Extended	12 hrs	3 days	3 days

Before overcoating after exposure in a contaminated environment, clean the surface of Intertherm 891 thoroughly by high pressure fresh water washing and allow to dry.

3.8 Recommended Application Equipment

Airless (A/L) Spray : Tip Range 13 - 16 thou
Total output pressure ≥1,600 psi

Conventional Spray : Aircap 704 or 765. Fluid Tip E
Atomizing Pressure 40 - 60psi

Brush : For stripe coating / touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4 - Intertherm 891 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	48%
4.2	Product Weight	(ASTM D1475)	:	1.00 Kg/L
4.3	Viscosity	(ASTM D562)	:	60-64 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	43°C (Mixed)
4.5	Approved Color/s	:	Aluminum	
4.6	Finish	:	Matt	

5. Special Instructions: This product will not cure adequately below 5°C.

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APCS-6

Type of Coating	:	Alkyd Topcoat
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interlac 665
SAP M/N (SAMS S/N)	:	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)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	CL Coded Series
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio by volume	:	N/A
2.3	Thinner	:	International GTA004
	SAP M/N (SAMS S/N)	:	1000198474 (09-738-340)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	N/A

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APCS-6 - Interlac 665 (Cont'd)

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = 20%; Max = 80%
3.3	Typical Wet Film Thickness Per Coat	:	104 µm
3.4	Typical Dry Film Thickness Per Coat	:	50 µm
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	19 m^2/L
3.6	Minimum Number of Coats	:	1

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	24 hrs	Extended	48 hrs	7 days	7 days
20°C	12 hrs	Extended	12 hrs	5 days	5 days
30°C	10 hrs	Extended	10 hrs	4 days	4 days
40°C	8 hrs	Extended	8 hrs	3 days	3 days
50°C	6 hrs	Extended	6 hrs	2 days	2 days

Before overcoating after exposure in a contaminated environment, clean the surface of Interlac 665 thoroughly by high pressure fresh water washing and allow to dry.

3.8 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Range 13 - 19 thou Total output pressure ≥2,000 psi
Conventional Spray	:	Aircap 704 or 765. Fluid Tip E Atomizing pressure 40 to 60 psi
Brush	:	For stripe coating / touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-6 - Interlac 665 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	48%
4.2	Product Weight	(ASTM D1475)	:	0.9 to 1.1 Kg/L
4.3	Viscosity	(ASTM D562)	:	62 - 72 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	40°C (Mixed)
4.5	Approved Color/s:	Black (Ral9005), Blue (Ral5000), Grey (Ral7023), Green (Ral6005/6021), Orange, Red (Ral3009/3002) White (Ral9010), Yellow (Ral1021), Beige (Mun10YR8/4) Blue (Ral5019), violet (Ral4001), Green (Mun2.5G3/6) Ivory (Mun2.5Y9/4), Navy Blue (Mun2.55PB2.5/6), Orange (Mun10YR5/12), Brown (Mun10R3/4), Yellow (Mun2.58/16)		
4.6	Finish:	High Gloss		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11A/11B

Type of Coating	:	Heat Resistant Silicone Primer/Topcoat
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Intertherm 50
SAP M/N (SAMS S/N)	:	1000196488 (09-687-325)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	12 months

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	HTA097
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio by volume	:	N/A
2.3	Thinner	:	International GTA007
	SAP M/N (SAMS S/N)	:	(09-740-416)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = 30%; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	56 µm
3.4	Typical Dry Film Thickness Per Coat	:	25 µm

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11A/11B - Intertherm 50 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	18 m^2/L	
3.6	Minimum Number of Coats	:	1 (APCS 11A); 2 (APCS11B)	
3.7	Applicable Substrate	:	CS	
3.8	Surface Preparation Requirements	:	Abrasive blast Sa 3 or Sa 2½	

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	16 hrs	Extended	16 hrs	7 days	7 days
20°C	14 hrs	Extended	14 hrs	6 days	6 days
30°C	10 hrs	Extended	10 hrs	5 days	6 days
40°C	6 hrs	Extended	6 hrs	4 days	4 days
50°C	4 hrs	Extended	4 hrs	3 days	3 days

Before overcoating after exposure in a contaminated environment, clean the surface of Intertherm 50 thoroughly by high pressure fresh water washing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Not Recommended
Conventional Spray	:	Aircap 704 or 765. Fluid Tip E Atomizing Pressure 40-60psi
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	45%

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11A/11B - Intertherm 50 (Cont'd)

4.2	Product Weight	(ASTM D1475)	:	1.13 Kg/L
4.3	Viscosity	(ASTM D562)	:	49-59 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	23°C (Mixed)
4.5	Approved Color/s	: Aluminum		
4.6	Finish	: Matt		

5. Special Instructions: This product will not cure adequately below 5°C. Avoid over application above 40µm DFT per coat.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11C

Type of Coating	:	Heat Resistant Cold Spray Aluminum Coating
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Intertherm 751CSA
SAP M/N (SAMS S/N)	:	1000196488 (09-687-325)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	12 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	HTA398
	2.1.2 Hardener (Curing Agent)	:	HTA399
2.2	Mixing Ratio by volume	:	54 Parts : 1 Part
2.3	Thinner	:	International GTA007
	SAP M/N (SAMS S/N)	:	(09-740-416)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = 30%; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	164 µm
3.4	Typical Dry Film Thickness Per Coat	:	100 µm

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APCS-11C - Intertherm 751CSA (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	24 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Carbon steel. Stainless steel
3.8	Surface Preparation Requirements	:	CS = Abrasive blast Sa 3 or Sa 2½, SS = Sweep blast to 40 µm profile

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	24 hrs	7 days	48 hrs	7 days	7 days
20°C	20 hrs	7 days	24 hrs	6 days	6 days
30°C	16 hrs	7 days	16 hrs	5 days	6 days
40°C	12 hrs	7 days	12 hrs	4 days	4 days
50°C	10 hrs	5 days	8 hrs	3 days	3 days

Before overcoating after exposure in a contaminated environment, clean the surface of Intertherm 751CSA thoroughly by high pressure fresh water washing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Range 15 - 19 thou Total output pressure ≥2,000 psi
Airspray (Pressure Pot)	:	Aircap 704 or 765. Fluid Tip E Atomizing Pressure 40 - 60psi
Brush	:	For stripe coating / touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11C - Intertherm 751CSA (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	61%
4.2	Product Weight	(ASTM D1475)	:	1.28Kg/L
4.3	Viscosity	(ASTM D562)	:	49-59 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	25°C (Mixed)
4.5	Approved Color/s	:	Aluminum	
4.6	Finish	:	Matt	

5. Special Instructions:

This product will not cure adequately below 5°C. Avoid over application above 175µm DFT per coat. Suitable for operating temperatures up to maximum 400ºC (752ºF).

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-12

Type of Coating	:	Epoxy Topcoat
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Intergard 410
SAP M/N (SAMS S/N)	:	1000194629 (09-612-364), 1000194797 (09-612-369), or 1000194960 (09-612-375)

Use primer and topcoat of APCS-1B and refer to APCS-12 of Saudi Aramco Engineering Standard SAES-H-001 for application of aggregate.

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APCS-19C

Type of Coating	:	Glass Flake Epoxy
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interzone 1000
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	18 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	EAA490
	2.1.2 Hardener (Curing Agent - C.A.)	:	EAA489
2.2	Mixing Ratio by volume	:	3½ Parts Base : 1 Part C.A.
2.3	Thinner	:	International GTA220
	SAP M/N (SAMS S/N)	:	1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	1 hr at 25°C 30 mins at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = N/A; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	543-815 µm

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APCS-19C - Interzone 1000 (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	:	500 - 750 µm
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	37 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Carbon Steel (CS)
3.8	Surface Preparation Requirements	:	CS = Abrasive Blast Sa 2½

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	26 hrs	7 days	26 hrs	7 days	7 days
20°C	12 hrs	4 days	12 hrs	6 days	6 days
30°C	8 hrs	2 days	8 hrs	4 days	4 days
40°C	5 hrs	1 day	5 hrs	3 days	3 days
50°C	3 hrs	1 day	3 hrs	3 days	3 days

Before overcoating after exposure in a contaminated environment, clean the surface of Interzone 1000 thoroughly by high pressure fresh water washing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Range 36 - 43 thou Total output pressure ≥3,000 psi Minimum pump Ratio 45:1
Airspray (Pressure Pot)	:	Aircap 62. Fluid Tip AC
Brush	:	For stripe coating / touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-19C - Interzone 1000 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	92%
4.2	Product Weight	(ASTM D1475)	:	1.3 Kg/L
4.3	Viscosity	(ASTM D562)	:	N/A
4.4	Flash Point	(ASTM D93 or D56)	:	56°C (Mixed)
4.5	Approved Color/s	:	Grey (other colors upon request)	
4.6	Finish	:	Not Applicable	

5. Special Instructions: Do not use at cure temperatures below 5°C.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A

Type of Coating	:	Epoxy Primer, damp tolerant
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interseal 414
SAP M/N (SAMS S/N)	:	1000104560 (09-612-352) ; 1000195239 (09-612-459)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	EPA414
	2.1.2 Hardener (Curing Agent – C.A.)	:	EPA415
2.2	Mixing Ratio by volume	:	4 Parts Base : 1 Part C.A.
2.3	Thinner	:	International GTA220
	SAP M/N (SAMS S/N)	:	1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	5 hrs at 25°C 2 hrs at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = N/A; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	91 µm
3.4	Typical Dry Film Thickness Per Coat	:	50 µm

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A - Interseal 414 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	22 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Carbon Steel (CS); Stainless Steel (SS)
3.8	Surface Preparation Requirements	:	CS = Abrasive Blast Sa2½, St3; SS = Sweep blast to 50 µm profile

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	20 hrs	Extended	20 hrs	7 days	7 days
20°C	12 hrs	Extended	12 hrs	6 days	6 days
30°C	8 hrs	Extended	8 hrs	5 days	6 days
40°C	6 hrs	Extended	6 hrs	4 days	4 days
50°C	2 hrs	Extended	2 hrs	3 days	3 days

Before overcoating after exposure in a contaminated environment, clean the surface of Interseal 414 thoroughly by high pressure fresh water washing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Range 18 - 21 thou Total output pressure ≥2,200 psi
Conventional Spray	:	Aircap 704 or 765. Fluid Tip E
Brush	:	For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A - Interseal 414 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	55%
4.2	Product Weight	(ASTM D1475)	:	1.5 Kg/L
4.3	Viscosity	(ASTM D562)	:	125-150 Krebbs Units
4.4	Flash Point	(ASTM D93 or D56)	:	35°C (Mixed)
4.5	Approved Color/s	:	Red	
4.6	Finish	:	Matt	

5. Special Instructions: This product will not cure adequately below 10°C.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A/22B

Type of Coating	:	Epoxy Primer & Intermediate & Topcoat
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interzone 954
SAP M/N (SAMS S/N)	:	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)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	18 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	EA Series
	2.1.2 Hardener (Curing Agent – C.A)	:	EAA964
2.2	Mixing Ratio by volume	:	4 Parts Base : 1 Part C.A.
2.3	Thinner	:	International GTA220
	SAP M/N (SAMS S/N)	:	1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	1½ hrs at 25°C 45 mins at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	5°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = N/A; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	353 µm

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A/22B Interzone 954 (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	:	300 µm
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	34 m^2/L
3.6	Minimum Number of Coats	:	2 for APCS-22A, 1 for APCS-22B
3.7	Applicable Substrate	:	Carbon Steel (CS) ; Stainless Steel (SS)
3.8	Surface Preparation Requirements	:	CS = Abrasive Blast Sa 2½, St3; SS = Sweep blast to 50 µm profile

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	24 hrs	Extended	24 hrs	8 days	8 days
20ºC	18 hrs	Extended	18 hrs	6 days	6 days
30°C	8 hrs	Extended	8 hrs	4 days	4 days
40ºC	3 hrs	Extended	3 hrs	3 days	3 days
50°C	2 hrs	Extended	2 hrs	3 days	3 days

Before overcoating after exposure in a contaminated environment, clean the surface of Interzone 954 thoroughly by high pressure fresh water washing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Range 21 - 26 thou Total output pressure ≥2,500 psi Minimum pump Ratio 45:1

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A/22B - Interzone 954 (Cont'd)

Airspray (Pressure Pot)	:	Aircap 62. Fluid Tip AC Atomizing pressure 40 – 60 psi
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	85%
4.2	Product Weight	(ASTM D1475)	:	1.62 Kg/L
4.3	Viscosity	(ASTM D562)	:	115 - 125 Krebs Units
4.4	Flash Point	(ASTM D93 or D56)	:	33°C (Mixed)
4.5	Approved Color/s	:	Grey, Yellow, Black, White, Red, Orange, Blue	
4.6	Finish	:	Gloss	

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26/26T

Type of Coating	:	Epoxy Mastic
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interseal 738
SAP M/N (SAMS S/N)	:	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)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	EY series
	2.1.2 Hardener (Curing Agent – C.A.)	:	EYA001
2.2	Mixing Ratio by volume	:	6.4 Parts Base : 1 Part C.A.
2.3	Thinner	:	International GTA220
	SAP M/N (SAMS S/N)	:	1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	4 hrs at 25°C 2 hrs at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = N/A; Max = 85%
3.3	Typical Wet Film Thickness Per Coat	:	313 µm

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26/26T - Interseal 738 (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	:	250 µm
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	32 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Carbon Steel (CS); Stainless Steel (SS)
3.8	Surface Preparation Requirements	:	CS- Abrasive Blast Sa 2½, St 2/3; SS- Sweep blast to 50 µm profile

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	4 days	14 days	3 days	8 days	8 days
20ºC	24 hrs	7 days	24 hrs	6 days	6 days
30°C	20 hrs	5 days	18 hrs	4 days	4 days
40ºC	16 hrs	3 days	14 hrs	3 days	3 days
50°C	12 hrs	2 days	12 hrs	3 days	3 days

Before overcoating after exposure in a contaminated environment, clean the surface of Interseal 738 thoroughly by high pressure fresh water washing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Range 21 - 26 thou Total output pressure ≥2,800 psi
Conventional Spray	:	Not recommended
Brush	:	For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26/26T - Interseal 738 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	80%
4.2	Product Weight	(ASTM D1475)	:	1.4 Kg/L
4.3	Viscosity	(ASTM D562)	:	114 – 124 Krebs Units
4.4	Flash Point	(ASTM D93 or D56)	:	23°C (Mixed)
4.5	Approved Color/s	:	Aluminum, White, Orange, Red, Yellow, Grey, Black	
4.6	Finish	:	Not applicable	

5. Special Instructions: This product is not intended for use at temperatures below 10°C.

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26T Topcoat

Type of Coating	:	Polyurethane Topcoat
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interthane 990
SAP M/N (SAMS S/N)	:	1000194672 (09-612-365), 1000194675 (09-612-366), 1000194793 (09-612-367), 1000194795 (09-612-368) or 1000194851 (09-612-371)

Use APCS-26/26T as primer and Polyurethane Topcoat of APCS-1D as topcoat.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-113A

Type of Coating	:	Ultra High Build Epoxy
Manufacturer	:	AkzoNobel Middle East
Product Name	:	Interzone 485
SAP M/N (SAMS S/N)	:	09-000-497

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum		:	2 years

2. Mixing

2.1	No. of Components		:	2
	2.1.1	Base	:	EAA485
	2.1.2	Hardener (Curing Agent – C.A.)	:	EAA486
2.2	Mixing Ratio by volume		:	4 Parts Base : 1 Part C.A.
2.3	Thinner		:	International GTA203
	SAP M/N (SAMS S/N)		:	09-000-498
2.4	Minimum-Maximum Thinning Requirements		:	up to 5% by Volume
2.5	Induction Time		:	None
2.6	Pot Life		:	45 mins at 25°C 30 mins at 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C to 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min = N/A; Max = 85%
3.3	Typical Wet Film Thickness per Coat	:	1,010 µm
3.4	Typical Dry Film Thickness per Coat	:	1,000 µm
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	40 m^2/L

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-113A - Interzone 485 (Cont'd)

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon Steel (CS)
3.8 Surface Preparation Requirements : CS = Abrasive Blast Sa2½

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum#	To Handle	To Service	Full Cure
10°C	72hrs	4days	72hrs	8days	8days
20°C	24hrs	3days	24hrs	6days	6days
30°C	16hrs	2days	16hrs	4days	4days
40°C	12hrs	1day	12hrs	3days	3days
50°C	8hrs	1day	8hrs	3days	3days

#Overcoating with self
Before overcoating after exposure in a contaminated environment, clean the surface of Interzone 485 thoroughly by high pressure fresh water washing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Range 30 thou Total output pressure ≥4,000 psi Advised pump Ratio 64:1
Conventional Spray	:	Not recommended
Brush	:	For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-113A - Interzone 485 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	99%
4.2	Product Weight	(ASTM D1475)	:	1.10 Kg/L
4.3	Viscosity	(ASTM D562)	:	Not applicable
4.4	Flash Point	(ASTM D93 or D56)	:	63°C (Mixed)
4.5	Approved Color/s	: Grey		
4.6	Finish	: Semi-Gloss		

5. Special Instructions: Do not use at cure temperatures below 10°C.

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Saudi Aramco: Company General Use

b. Belzona – Approved Products

APCS-27
Belzona 1591

APCS-28
Belzona 1391S / Belzona 1391T

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-27

Type of Coating	:	Solvent-Free Ultra Hybrid Epoxy Coating, Brush Grade
Manufacturer	:	Belzona
Product Name	:	Belzona 1591
SAP M/N (SAMS S/N)	:	1000767601

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	3 years

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Curing Agent)	:	10.5 : 1 by volume
2.3	Thinner	:	None
2.4	Minimum-Maximum Thinning Requirements	:	N / A
2.5	Induction Time	:	None
2.6	Pot Life	:	50 minutes @ 20°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 18°C to 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: Max. 85%
3.3	Typical Wet Film Thickness Per Coat	: 600 – 1,000 microns
3.4	Typical Dry Film Thickness Per Coat	: 600 – 1,000 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 40 m^2 / liter
3.6	Minimum Number of Coats	: 1

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-27 - Belzona 1591 (Cont'd)

3.7 Applicable Substrate : CS, MS, SS

3.8 Surface Preparation Requirements : Sa 2 ½, 3 mils (75 microns)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
20°C			16 hours	5 days	
30°C			4 hours	20 hours	
40°C			2.5 hours	5.5 hours	

3.10 Recommended Application Equipment

Airless (A/L) Spray : N / A

Conventional Spray : N / A

Brush (Stiff Bristled) : stripe coat and regular application

Plastic Applicator (provided with the product) : regular application

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	1.86 – 2.06 Kg/L
4.3	Viscosity	(ASTM D562)	:	100 – 200 poise
4.4	Flash Point	(ASTM D93 or D56)	:	74°C (PMCC Method)
4.5	Approved Color/s:	Dark Brown		
4.6	Finish:	Semi-Gloss		

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28

Type of Coating	:	Spray Grade, Liquid Coating
Manufacturer	:	Belzona
Product Name	:	Belzona 1391S
SAP M/N (SAMS S/N)	:	1000180328, 1000180337, and 1000180390

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	3 years

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Curing Agent)	:	4 : 1 by volume
2.3	Thinner	:	None
2.4	Minimum-Maximum Thinning Requirements	:	N / A
2.5	Induction Time	:	None
2.6	Pot Life	:	45 minutes @ 20°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10°C to 40°C
3.2	Minimum-Maximum Allowable Relative Humidity	: 85%
3.3	Typical Wet Film Thickness Per Coat	: 375 microns
3.4	Typical Dry Film Thickness Per Coat	: 375 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 40 m^2 / Liter
3.6	Minimum Number of Coats	: 2

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Belzona 1391S (Cont'd)

3.7 Applicable Substrate : CS, MS, SS

3.8 Surface Preparation Requirements : Sa 2½, 3 mils

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval * Minimum	Maximum	To Handle	To Service	Full Cure
10°C	12 – 16 hours	48 hours	32 hours	96 hours	96 hours
20°C	6 – 8 hours	24 hours	10 hours	48 hours	48 hours
30°C	3 – 4 hours	18 hours	8 hours	20 hours	20 hours
40°C	1.5 – 2 hours	8 hours	4 hours	14 hours	14 hours

* The recoat interval values provided here are for humidity levels of >50%

3.10 Recommended Application Equipment

Airless (A/L) Spray : Plural component heated airless spray

Conventional Spray : N / A

Brush : For stripe coat

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	1.60 – 1.76 Kg/L
4.3	Viscosity	(ASTM D562)	:	44 poise
4.4	Flash Point	(ASTM D93 or D56)	:	100°C (PMCC Method)
4.5	Approved Color/s	Blue, Grey		
4.6	Finish	Semi-Gloss		

5. Special Instructions: For valves, piping, fitting, and exchanger boxes.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28

Type of Coating	:	Brush Grade, Liquid Coating
Manufacturer	:	Belzona
Product Name	:	Belzona 1391T
SAP M/N (SAMS S/N)	:	1000180328, 1000180337, and 1000180390

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	3 years

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Curing Agent)	:	4 : 1 by volume
2.3	Thinner	:	None
2.4	Minimum-Maximum Thinning Requirements	:	N / A
2.5	Induction Time	:	None
2.6	Pot Life	:	45 minutes @ 20°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10°C to 40°C
3.2	Minimum-Maximum Allowable Relative Humidity	: 85%
3.3	Typical Wet Film Thickness Per Coat	: 450 microns
3.4	Typical Dry Film Thickness Per Coat	: 450 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 40 m^2 / Liter
3.6	Minimum Number of Coats	: 2
3.7	Applicable Substrate	: CS, MS, SS

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Belzona 1391T (Cont'd)

3.8 Surface Preparation Requirements : Sa 2½, 3 mils

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval * Minimum	Maximum	To Handle	To Service	Full Cure
20°C	12 – 16 hours	24 hours	24 hours	Post cure recommended	
30°C	6 – 8 hours	24 hours	12 hours	48 hours	48 hours
40°C	3 – 4 hours	12 hours	5 hours	24 hours	24 hours

* The recoat interval values provided here are for humidity levels of <50%

3.10 Recommended Application Equipment

Airless (A/L) Spray : N / A

Conventional Spray : N / A

Brush (Stiff Bristled) : stripe coat and regular application

Plastic Applicator (provided with the product) : regular application

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	1.79 – 1.95 Kg/L
4.3	Viscosity	(ASTM D562)	:	100 – 200 poise
4.4	Flash Point	(ASTM D93 or D56)	:	100°C (PMCC Method)
4.5	Approved Color/s:	Blue, Grey		
4.6	Finish:	Gloss		

5. Special Instructions: For valves, piping, fitting, and exchanger boxes

Saudi Aramco: Company General Use

c. Carboline – Approved Products

APCS-1A
Carbozinc 11 — Inorganic Zinc Primer: Solvent Based
Carboguard 893 SG — Epoxy Topcoat

APCS-1B
Carboguard 893 SG — Epoxy Primer and Topcoat

APCS-1C
Carbozinc 858 — Organic Zinc Epoxy Primer
Use Epoxy Topcoat of APCS-1A

APCS-1D
Use APCS-1A as primer and intermediate coat
Carbothane 134 Series (134 HP) — Polyurethane Topcoat

APCS-1E
Use APCS-1B as primer and intermediate coat
Use Polyurethane Topcoat of APCS-1D

APCS-1F
Use APCS-1C as primer and intermediate coat
Use Polyurethane Topcoat of APCS-1D

APCS-2A/C
Plasite 7159 — Epoxy

APCS-2D
Phenoline 187 Primer — Epoxy Phenolic
Phenoline 187 Finish — Epoxy Phenolic

APCS-2E
Plasite 4550 Series (Plasite 4550 / Plasite 4550S) — Novolac Epoxy

APCS-2G
Plasite 4301HT — Novolac Epoxy Vinyl-Ester

APCS-3
Bitumastic 300M — Coal Tar Epoxy

APCS-4
Carbocoat GP-40 — Alkyd Primer
Carbocoat GP-40 Aluminum Finish — Alkyd Topcoat Aluminum Color

APCS-5A
Carbotherm 3300 — Waterborne Acrylic

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Saudi Aramco: Company General Use

Carboline – Approved Products (Cont'd)

APCS-5B
Carbotherm 551 Waterborne Epoxy

APCS-6
Use Alkyd Primer of APCS-4
Carbocoat GP 62 Alkyd Topcoat

APCS-9
Carboline 3630 Chlorinated Rubber

APCS-11A
Use primer of APCS-1A
Thermaline 4700 Silicone Topcoat

APCS-11B
Thermaline 4700 Aluminum Silicone Aluminum, Self-Priming System

APCS-12
Use Primer and Topcoat of APCS-1B

APCS-17A
Use Primer of APCS-1A

APCS-17B
Carbozinc 11 WB Inorganic Zinc Primer: Water Based

APCS-19C
Carboguard 703GF Glass-filled Epoxy

APCS-20A
Carboguard 151-2 (Hand Lay-Up) Fiberglass Reinforced Epoxy

APCS-20B
Carboguard 151-2 (Spray Applied) Fiberglass Reinforced Epoxy

APCS-22A
Carboguard 690 Epoxy

APCS-22B
Carboguard 690 GF Glass-filled Epoxy

APCS-26
Carboguard 890 Epoxy Mastic

APCS-26T
Use APCS-26 as primer and Polyurethane Topcoat of APCS-1D as topcoat

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A

Type of Coating	:	Inorganic Zinc Primer, Solvent Based
Manufacturer	:	Carboline
Product Name	:	Carbozinc 11
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	Base: 12 months : Zinc: 24 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	1:22 by weight
2.3	Thinner	:	Thinner# 26, or #254
2.4	Thinning Requirements	:	6%
2.5	Induction Time	:	N/A
2.6	Pot Life (mixture)	:	8 hours @24°C

3. Application

3.1	Maximum Allowable Substrate Temperature	:	93°C
3.2	Typical Wet Film Thickness per Coat	:	N/A
3.3	Typical Dry Film Thickness Per Coat	:	50-75 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	24.9 m^2/l
3.5	Minimum Number of Coats	:	1

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A - Carbozinc 11 (Cont'd)

3.6 Drying Time

Substrate Temperature	Recoat Interval To Handle	Minimum	Maximum	To Immersion
10°C	1 hour	24 hours	Unlimited	N/A
30°C	¾ hour	18 hours	Unlimited	N/A
50°C	¼ hour	16 hours	Unlimited	N/A

3.7 Recommended Equipment

Airless Spray:	Pump Ratio:	30:1
	Liters/Min Output:	11 min
	Material Line:	9.5 mm ID min
	Tip Size:	0.48 – 0.58 mm
	Output Pressure:	10.3 – 13.8 MPa
Conventional Spray:	Material Line:	9.5 mm ID min
	Fluid Tip:	1.8 mm
Brush:	Not recommended	

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	: 85% zinc in dry film
4.2	Product Weight	(ASTM D1475)	: 10 kg
4.3	Viscosity	(ASTM D562)	:
4.4	Flash Point	(ASTM D93 or D56)	: Base: 13°C Zinc: N/A
4.5	Approved Colors:	Green, Grey	
4.6	Finish:	Flat	

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F

Type of Coating	:	Epoxy Primer, Intermediate, or Topcoat
Manufacturer	:	Carboline
Product Name	:	Carboguard 893 SG
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	36 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	1:1 by volume
2.3	Thinner	:	Thinner #10
2.4	Thinning Requirements	:	12% by volume
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	4 hours

3. Application

3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
3.2	Typical Wet Film Thickness Per Coat	:	175 microns
3.3	Typical Dry Film Thickness Per Coat	:	100 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	24 m^2/l
3.5	Minimum Number of Coats	:	2

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APCS-1A/1B/1C/1D/1E/1F - Carboguard 893 SG (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	24 hrs	24 hrs	365 days	N/A
30°C	4 hrs	4 hrs	365 days	N/A
50°C	1 hrs	1 hr	365 days	N/A

3.7 Recommended Equipment

Airless Spray:

Pump Ratio:	30:1 (min.)
GPM Output:	2.5 (min.)
Material Hose:	3/8" I.D. (min.)
Tip Size:	.017" –.021"
Output PSI:	2,100 – 2,300
Filter Size:	60 mesh

Conventional Spray: Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .070" I.D. fluid tip, and appropriate air cap.

Brush : Medium bristle brush for stripe coat and touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	62%
4.2	Product Weight	(ASTM D1475)	:	12 lbs
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 24°C / Part B: 24°C
4.5	Approved Colors:	Yellow, Orange, Red, Grey,		
4.6	Finish:	Satin		

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1C/1F

Type of Coating	:	Organic Zinc Epoxy Primer
Manufacturer	:	Carboline
Product Name	:	Carbozinc 858
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	2:1 approx. by weight
2.3	Thinner	:	Thinner #33
2.4	Thinning Requirements	:	up to 10% by volume
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	4 hours

3. Application

3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
3.2	Typical Wet Film Thickness Per Coat	:	125 microns
3.3	Typical Dry Film Thickness Per Coat	:	75 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	25 m^2/l
3.5	Minimum Number of Coats	:	1

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APCS-1C/1F - Carbozinc 858 (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	5 hrs	5 hrs	Unlimited	N/A
30°C	2 hrs	30 mins	Unlimited	N/A
50°C	30 min	30 mins	Unlimited	N/A

3.7 Recommended Equipment

Airless Spray:	Pump Ratio:	30:1 (min.)
	GPM Output:	2.5 (min.)
	Material Hose:	3/8" I.D. (min.)
	Tip Size:	017" –.023"
	Output PSI:	2,000 – 2,200
	Filter Size:	60 mesh
Conventional Spray :	Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .070" I.D. fluid tip and appropriate air cap.	
Brush:	For stripe coat and touch-up only	

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	64%
4.2	Product Weight	(ASTM D1475)	:	20 lbs
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 24°C Part B: 24°C
4.5	Approved Colors:	Grey-Green		
4.6	Finish:	Matte		

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T Topcoat

Type of Coating	:	Aliphatic Polyurethane Topcoat
Manufacturer	:	Carboline
Product Name	:	Carbothane 134 Series (134 HP)
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	4:1 by volume
2.3	Thinner	:	Thinner #25
2.4	Thinning Requirements	:	0-15% by volume
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	4 hours

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	4°C – 49°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10% - 80%
3.3	Typical Wet Film Thickness Per Coat	:	100 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 – 75 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	26 m^2/l
3.6	Minimum Number of Coats	:	1

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F Topcoat - Carbothane 134 Series (134HP) (Cont'd)

3.7 Drying Time

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	8 hours	Unlimited	8 hours	7 days	7 days
20°C	4 hours	Unlimited	4 hours	3 days	3 days
30°C	1 hours	Unlimited	1 hours	1 day	1 day
40°C	45 min	Unlimited	45 min	1 day	1 day
50°C	30 min	Unlimited	30 min	1 day	1 day

3.8 Recommended Equipment

Airless Spray:	Pump Ratio:	30:1 (min.)
	GPM Output:	3.0 (min.)
	Material Hose:	3/8" I.D. (min.)
	Tip Size:	.015"-.017"
	Output PSI:	2,100 – 2,400
	Filter Size:	60 mesh
Conventional Spray:	Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .070" I.D. fluid tip, and appropriate air cap.	
Brush:	Medium, natural bristle brush for stripe coat and touch-up only	

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	65%
4.2	Product Weight	(ASTM D1475)	:	1,30 – 1,40 Kg/L
4.3	Viscosity	(ASTM D562)	:	1000 – 3000 cPs
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 32°C Part B: 53°C
4.5	Approved Colors:	Yellow, Orange, Red, Green, Grey, Aluminum		
4.6	Finish:	Gloss		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/C

Type of Coating	:	Epoxy, Amine-cured
Manufacturer	:	Carboline
Product Name	:	Plasite 7159
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	4:1 by volume
2.3	Thinner	:	Thinner #19
2.4	Thinning Requirements	:	up to 10% by volume
2.5	Induction Time	:	30 minutes
2.6	Pot Life (mixture)	:	8 hours

3. Application

3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
3.2	Typical Wet Film Thickness Per Coat	:	175 microns
3.3	Typical Dry Film Thickness Per Coat	:	125 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	27 m^2/l
3.5	Minimum Number of Coats	:	3

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APCS-2A/C - Plasite 7159 (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	12 hrs	12 hrs	96 hrs	14 days
30°C	8 hrs	8 hrs	48 hrs	6-7 days
50°C	3 hrs	3 hrs	24 hrs	3-4 days

3.7 Recommended Equipment

Airless Spray:	Pump Ratio:	30:1 (min.)
	GPM Output:	2.5 (min.)
	Material Hose:	3/8” I.D. (min.)
	Tip Size:	.017” –.023”
	Output PSI:	2,000 – 2,200
	Filter Size:	60 mesh
Conventional Spray :	Pressure pot equipped with dual regulators, 3/8” I.D. minimum material hose, .070” I.D. fluid tip, and appropriate air cap.	
Brush :	For stripe coat and touch-up only	

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	68%
4.2	Product Weight	(ASTM D1475)	:	12.5 lbs
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 108°C Part B: 104°C
4.5	Approved Colors:	Ivory, Light Grey		
4.6	Finish:	Flat		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2D

Type of Coating	:	Epoxy Phenolic
Manufacturer	:	Carboline
Product Name	:	Phenoline 187 Primer
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	36 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	4:1 by volume
2.3	Thinner	:	Thinner # 2
2.4	Thinning Requirements	:	up to 25% by volume
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	4 hours

3. Application

3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
3.2	Typical Wet Film Thickness Per Coat	:	190 microns
3.3	Typical Dry Film Thickness Per Coat	:	125 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	25.6 m^2/l
3.5	Minimum Number of Coats	:	1

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APCS-2D - Phenoline 187 Primer (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	24 hrs	96 hrs	30 days	NR
30°C	12 hrs	12 hrs	7 days	7 days
50°C	6 hrs	6 hrs	2 days	4 days

3.7 Recommended Equipment

Airless Spray :

Pump Ratio:	30:1 (min.)
GPM Output:	3.0 (min.)
Material Hose:	3/8" I.D. (min.)
Tip Size:	0.015" – 0.019"
Output PSI:	2,000 – 2,300
Filter Size:	60 mesh

Conventional Spray : Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, 0.055 – 0.070" I.D. fluid tip, and appropriate air cap.

Brush : For touch-up only

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	65%
4.2	Product Weight	(ASTM D1475)	:	12.5 lbs
4.3	Viscosity	(ASTM D562)	:	Part A - Brookfield #4 spindle @ 10 RPM is 20,000 – 40,000 cps Part B – No requirement (as supplied)
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 19°C / Part B: 20°C
4.5	Color:	Light Gray, Light Ivory, White, Red		
4.6	Finish:	Flat		

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APCS-2D

Type of Coating	:	Epoxy Phenolic
Manufacturer	:	Carboline
Product Name	:	Phenoline 187 Finish
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	36 months for off-white color (1898); 6 months for grey color (C703)

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	4:1 by volume
2.3	Thinner	:	Thinner #2
2.4	Thinning Requirements	:	up to 12% by volume
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	4 hours

3. Application

3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
3.2	Typical Wet Film Thickness Per Coat	:	190 microns
3.3	Typical Dry Film Thickness Per Coat	:	125 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	25.6 m^2/l
3.5	Minimum Number of Coats	:	1

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APCS-2D - Phenoline 187 Finish (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	24 hrs	96 hrs	30 days	NR
30°C	12 hrs	12 hrs	7 days	7 days
50°C	6 hrs	6 hrs	2 days	4 days

3.7 Recommended Equipment

Airless Spray:

Pump Ratio:	30:1 (min.)
GPM Output:	3.0 (min.)
Material Hose:	3/8" I.D. (min.)
Tip Size:	0.015" – 0.019"
Output PSI:	2,000 – 2,200
Filter Size:	60 mesh

Conventional Spray : Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, 0.055-0.070" I.D. fluid tip and appropriate air cap.

Brush: For touch-up only

4. Technical Properties

4.1 Volume Solids (ASTM D2697) : 63%

4.2 Product Weight (ASTM D1475) : 12.5 lbs

4.3 Viscosity (ASTM D562) :
Part A - Brookfield #4 spindle @ 10 RPM is 20,000 – 40,000 cps
Part B – No requirement (as supplied)

4.4 Flash Point (ASTM D93 or D56) : Part A: 19°C / Part B: 20°C

4.5 Color: Light Gray, Light Ivory, White

4.6 Finish: Flat

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2E

Type of Coating	:	Novolac Epoxy
Manufacturer	:	Carboline
Product Name	:	Plasite 4550 Series (Plasite 4550 / Plasite 4550 S)
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	6 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	4:1 by volume
2.3	Thinner	:	Not Recommended
2.4	Thinning Requirements	:	Not Recommended
2.5	Induction Time	:	Not Applicable
2.6	Pot Life (mixture)	:	10 minutes

3. Application

3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
3.2	Typical Wet Film Thickness Per Coat	:	500 microns
3.3	Typical Dry Film Thickness Per Coat	:	500 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	40 m^2/l
3.5	Minimum Number of Coats	:	1

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APCS-2E - Plasite 4550 Series (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum*	Maximum	To Immersion
10°C	12 hrs	12 hrs	36 hrs	48 hours
30°C	8 hrs	8 hrs	24 hrs	36 hours
50°C	3 hrs	3 hrs	24 hrs	24 hours

* Material may be recoated immediately; however the dry to handle times will govern if the material has to be "walked-on".

3.7 Recommended Equipment

(Plural-component)

Airless Spray:	Pump Ratio:	30:1 (min.)
	GPM Output:	2.5 (min.)
	Material Hose:	3/8" I.D. (min.)
	Material Temp:	Part A (43°C); Part B (35°C)
	Tip Size:	.017" – .035"
	Output PSI:	2000 – 2200
	Filter Size:	60 mesh
Conventional Spray:	Not recommended	
Brush:	For stripe coat and touch-up only	

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	12.5 lbs
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 94°C / Part B: 106°C
4.5	Approved Colors:	Light Grey, White, Light Blue, Tile Red		

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APCS-2G

Type of Coating	:	Novolac Epoxy Vinyl Ester, Glass Flake-Filled
Manufacturer	:	Carboline
Product Name	:	Plasite 4301 HT
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	4:1 by volume
2.3	Thinner	:	None
2.4	Thinning Requirements	:	None
2.5	Induction Time	:	Not Applicable
2.6	Pot Life (mixture)	:	30 minutes

3. Application

3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
3.2	Typical Wet Film Thickness Per Coat	:	550 microns
3.3	Typical Dry Film Thickness Per Coat	:	500 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	34 m^2/l
3.5	Minimum Number of Coats	:	1

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APCS-2G - Plasite 4301 HT (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	12 hrs	12 hrs	7 days	96 hours
30°C	5 hrs	5 hrs	7 days	48 hours
50°C	2 hrs	2 hrs	3 hrs	24 hours

3.7 Recommended Equipment

Airless Spray:	Pump Ratio:	30:1 (min.)
	GPM Output:	2.5 (min.)
	Material Hose:	3/8” I.D. (min.)
	Tip Size:	.020” – .035”
	Output PSI:	1,800 – 2,200
	Filter Size:	60 mesh
Conventional Spray:	Pressure pot equipped with dual regulators, 3/8” I.D. minimum material hose, .070” I.D. fluid tip, and appropriate air cap.	
Brush:	For stripe coat and touch-up only	

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	85% (practical)
4.2	Product Weight	(ASTM D1475)	:	10.2 lbs
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 31°C Part B: 80°C
4.5	Approved Colors:	Gray		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-3

Type of Coating	:	Coal Tar Epoxy
Manufacturer	:	Carboline
Product Name	:	Bitumastic 300 M
SAP M/N (SAMS S/N)	:	

1.	Storage			
	1.1	Shelf life, sheltered storage @ 35°C maximum	:	Part A: 12 months Part B: 36 months
2.	Mixing			
	2.1	No. of Components	:	2
	2.2	Mixing Ratio (Base : Hardener)	:	4:1 by volume
	2.3	Thinner	:	Thinner #10
	2.4	Thinning Requirements	:	16% by volume
	2.5	Induction Time	:	Not required
	2.6	Pot Life (mixture)	:	2 hours
3.	Application			
	3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
	3.2	Typical Wet Film Thickness Per Coat	:	300 microns
	3.3	Typical Dry Film Thickness Per Coat	:	200 microns
	3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	29 m^2/l
	3.5	Minimum Number of Coats	:	2

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APCS-3 - Bitumastic 300 M (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	10 hrs	10 hrs	24 hours	14 days
30°C	6 hrs	6 hrs	24 hours	3 days
50°C	3 hrs	3 hrs	24 hours	2 days

3.7 Recommended Equipment

Airless Spray:	Pump Ratio:	30:1 (min.)
	GPM Output:	2.5 (min.)
	Material Hose:	3/8" I.D. (min.)
	Tip Size:	.023" – .035"
	Output PSI:	2,100 – 2,500
	Filter Size:	60 mesh
Conventional Spray:	Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .070" I.D. fluid tip, and appropriate air cap.	
Brush:	Medium bristle brush for stripe coat and touch-up only	

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	74%
4.2	Product Weight	(ASTM D1475)	:	11 lbs
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 24°C Part B: 24°C
4.5	Approved Colors:	Black, Red		

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4/6

Type of Coating	:	Zinc Phosphate Pigmented Alkyd Primer (Lead Free)
Manufacturer	:	Carboline
Product Name	:	Carbocoat GP-40
SAP M/N (SAMS S/N)	:	

1.	Storage			
	1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 months at 75°F / 24°C
2.	Mixing			
	2.1	No. of Components	:	1
	2.2	Mixing Ratio	:	Not applicable
	2.3	Thinner	:	Carboline Thinner # 45
	2.4	Thinning Requirements	:	5% – 10%
	2.5	Induction Time	:	Not required
	2.6	Pot Life (mixture)	:	N/A
3.	Application			
	3.1	Maximum Allowable Substrate Temperature	:	49°C
	3.2	Typical Wet Film Thickness Per Coat	:	108 microns
	3.3	Typical Dry Film Thickness Per Coat	:	50 microns
	3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	18.4 m^2 / l
	3.5	Minimum Number of Coats	:	2

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APCS-4/6 - Carbocoat GP-40 (Cont'd)

3.6 Drying Time

Substrate Temperature	Recoat Interval To Handle	Minimum	Maximum	To Immersion
10°C	16 H	24 H	N/A	N/A
30°C	4 H	8 H	N/A	N/A
50°C	N/A	N/A	N/A	N/A

3.7 Recommended Equipment

Airless Spray:	Graco, Binks, De Vilbiss Pump Ratio: 30:1 (min)
Conventional Spray:	Pressure pot equipped with dual regulators
Brush:	Natural bristle brush

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	46%
4.2	Product Weight	(ASTM D1475)	:	22.6 kg
4.3	Viscosity	(ASTM D562)	:	80 – 90 KU
4.4	Flash Point	(ASTM D93 or D56)	:	102°F / 39°C
4.5	Approved Colors:	Red, Grey, Off-White		
4.6	Finish:	Flat		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4 Aluminum Topcoat

Type of Coating	:	Alkyd Topcoat, Aluminum Color
Manufacturer	:	Carboline
Product Name	:	Carbocoat GP-40 Aluminum Topcoat
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 months at 75°F / 24°C

2. Mixing

2.1	No. of Components	:	1
2.2	Mixing Ratio	:	Not applicable
2.3	Thinner	:	Carboline Thinner # 45
2.4	Thinning Requirements	:	Not required
2.5	Induction Time	:	Not recommended
2.6	Pot Life (mixture)	:	

3. Application

3.1	Maximum Allowable Substrate Temperature	:	122°F (50°C)
3.2	Typical Wet Film Thickness Per Coat	:	100 – 150 microns
3.3	Typical Dry Film Thickness Per Coat	:	50 – 75 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	18.4 m^2 / l @ 25 microns
3.5	Minimum Number of Coats	:	1 - 2

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APCS-4 - Carbocoat GP-40 Aluminum Topcoat (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	3 H	3 H	16 H	24 H
30°C	30 minutes	30 minutes	3 H	7 H
50°C	20 minutes	20 minutes	1 H	4 H

3.7 Recommended Equipment

Airless Spray	:	Graco, De Vilbis Pump Ratio: 30:1 (min)
Conventional Spray	:	Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .043" I.D. fluid tip, and appropriate air cap.
Brush	:	Use a synthetic bristle brush.

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	46%
4.2	Product Weight	(ASTM D1475)	:	25 kg
4.3	Viscosity	(ASTM D562)	:	80 – 90 KU
4.4	Flash Point	(ASTM D93 or D56)	:	102°F (39°C)

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APCS-5A

Type of Coating	:	Waterborne Acrylic
Manufacturer	:	Carboline
Product Name	:	Carbotherm 3300
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 months

2. Mixing

2.1	No. of Components	:	1
2.2	Mixing Ratio	:	Not applicable
2.3	Thinner	:	Not required
2.4	Thinning Requirements	:	None
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	Indefinite

3. Application

3.1	Maximum Allowable Substrate Temperature	:	300°F/149°C
3.2	Typical Wet Film Thickness Per Coat	:	550 microns
3.3	Typical Dry Film Thickness Per Coat	:	500 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	35.4 m^2/l
3.5	Minimum Number of Coats	:	As needed

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APCS-5A - Carbotherm 3300 (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	6 hrs	6 hrs	Indefinite	NR
30°C	2 hrs	2 hrs	Indefinite	NR
50°C	1 hrs	1 hrs	Indefinite	NR

3.7 Recommended Equipment

Airless Spray:	Pump Ratio:	30:1 (min.)
	GPM Output:	3.0 (min.)
	Material Hose:	3/8" I.D. (min.)
	Tip Size:	0.021" – 0.025"
	Output PSI:	1,800 – 2,200
	Filter Size:	None
Conventional Spray:	Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, 0.070" I.D. fluid tip, and appropriate air cap.	
Brush:	For touch-up only	

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	90%
4.2	Product Weight	(ASTM D1475)	:	6.9 lbs
4.3	Viscosity	(ASTM D562)	:	Brookfield #5 spindle @ 10 RPM is 12,000 to 18,000 cps
4.4	Flash Point	(ASTM D93 or D56)	:	>200°F/93°C

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APCS-5B

Type of Coating	:	Waterborne Epoxy
Manufacturer	:	Carboline
Product Name	:	Carbotherm 551
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	16 : 1 by volume
2.3	Thinner	:	Not required
2.4	Thinning Requirements	:	None
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	1 hour

3. Application

3.1	Maximum Allowable Substrate Temperature	:	250°F/121°C
3.2	Typical Wet Film Thickness Per Coat	:	1,220 microns
3.3	Typical Dry Film Thickness Per Coat	:	1,000 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	32.3 m^2/l
3.5	Minimum Number of Coats	:	As needed

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APCS-5B - Carbotherm 551 (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	10 hrs	10 hrs	Indefinite	NR
30°C	3 hrs	3 hrs	Indefinite	NR
50°C	1 hr	1 hr	Indefinite	NR

3.7 Recommended Equipment

Airless Spray :

Pump Ratio:	30:1 (min.)
GPM Output:	3.0 (min.)
Material Hose:	3/8" I.D. (min.)
Tip Size:	0.021" – 0.025"
Output PSI:	1,800 – 2,200
Filter Size:	None

Conventional Spray : Pressure pot equipped with dual regulators, 1/2" I.D. minimum material hose, 0.070" I.D. fluid tip, and appropriate air cap.

Brush : For touch-up only

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	82%
4.2	Product Weight	(ASTM D1475)	:	6.35 lbs
4.3	Viscosity	(ASTM D562)	:	Part A: Brookfield #5 spindle @ 10 RPM is 9,000 to 15,000 cps Part B: Brookfield #4 spindle @ 20 RPM is 1,800 to 2,800 cps
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: >200°F/93°C Part B: 99°F/37°C

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APCS-6

Type of Coating	:	Modified Alkyd, Topcoat
Manufacturer	:	Carboline
Product Name	:	Carbocoat GP 62
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 months at 75°F / 24°C

2. Mixing

2.1	No. of Components	:	1
2.2	Mixing Ratio	:	Not applicable
2.3	Thinner	:	Carboline Thinner # 85
2.4	Thinning Requirements	:	Allowed up to 13%
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	N/A

3. Application

3.1	Maximum Allowable Substrate Temperature	:	49°C
3.2	Typical Wet Film Thickness Per Coat	:	106 – 160 microns
3.3	Typical Dry Film Thickness Per Coat	:	50 – 75 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	18.8 m^2 / l
3.5	Minimum Number of Coats	:	1

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APCS-6 - Carbocoat GP 62 (Cont'd)

3.6 Drying Time

Substrate Temperature	Recoat Interval To Handle	Minimum	Maximum	To Immersion
10°C	10 H	10 H	72 H	N/A
30°C	4 H	4 H	24 H	N/A
50°C	N/A	N/A	N/A	N/A

3.7 Recommended Equipment

Airless Spray:	Graco, Binks, De Vilbiss Pump Ratio: 30:1 (min)
Conventional Spray:	Pressure pot equipped with dual regulators
Brush:	Synthetic bristle brush

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	47%
4.2	Product Weight	(ASTM D1475)	:	18 kg approx.
4.3	Viscosity	(ASTM D562)	:	150 – 180 seconds
4.4	Flash Point	(ASTM D93 or D56)	:	50°F / 10°C
4.5	Approved Colors:	Various Colors		
4.6	Finish:	Gloss		

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APCS-9

Type of Coating	:	Chlorinated Rubber
Manufacturer	:	Carboline
Product Name	:	Carboline 3630
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 months at 75°F / 24°C

2. Mixing

2.1	No. of Components	:	1
2.2	Mixing Ratio	:	Not applicable
2.3	Thinner	:	Carboline Thinner # 10
2.4	Thinning Requirements	:	Allowed up to 13%
2.5	Induction Time	:	Not required

3. Application

3.1	Maximum Allowable Substrate Temperature	:	49°C
3.2	Typical Wet Film Thickness Per Coat	:	187 microns
3.3	Typical Dry Film Thickness Per Coat	:	75 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	16 m^2 / l
3.5	Minimum Number of Coats	:	1

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APCS-9 – Carboline 3630 (Cont'd)

3.6 Drying Time

Substrate Temperature	Recoat Interval To Handle	Minimum	Maximum	To Immersion
10°C	10 H	10 H	3 days	N/A
30°C	4 H	4 H	24 H	N/A
50°C	N/A	N/A	N/A	N/A

3.7 Recommended Equipment

Airless Spray	:	Graco, De Vilbis Pump Ratio: 30:1 (min)
Conventional Spray	:	Pressure pot equipped with dual regulators
Brush	:	Synthetic bristle brush.

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	40%
4.2	Product Weight	(ASTM D1475)	:	25.8 kg approx.
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	10°C

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APCS-11A

Type of Coating	:	Silicone, Topcoat
Manufacturer	:	Carboline
Product Name	:	Thermaline 4700
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 month

2. Mixing

2.1	No. of Components	:	1
2.2	Mixing Ratio	:	Not Applicable
2.3	Thinner	:	Not required.
2.4	Thinning Requirements 235 for hot surface applications exceeding 66°C	:	10% by volume with Thinner #
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	Not Applicable

3. Application

3.1	Maximum Allowable Substrate Temperature	:	148°C
3.2	Typical Wet Film Thickness Per Coat	:	100 microns
3.3	Typical Dry Film Thickness Per Coat	:	50 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	19 m^2/l
3.5	Minimum Number of Coats	:	1

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APCS-11A - Thermaline 4700 (Cont'd)

3.6 Drying Time

Substrate Temperature	Recoat Interval To Handle	Minimum	Maximum	To Immersion
10°C	24 hrs	10 hrs	Unlimited	Not Applicable
30°C	8 hrs	4 hrs	Unlimited	Not Applicable
50°C	4 hrs	2 hrs	Unlimited	Not Applicable

3.7 Recommended Equipment

Airless Spray:	Not Recommended
Conventional Spray:	Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .070" I.D. fluid tip, and appropriate air cap.
Brush:	Medium bristle brush

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	48%
4.2	Product Weight	(ASTM D1475)	:	12 lbs
4.3	Viscosity	(ASTM D562) : Brookfield viscosity (Spindle #3 @ 100 rpm): 300 – 900 cps typical		
4.4	Flash Point	(ASTM D93 or D56)	:	25°C
4.5	Approved Colors:	Black, Grey, Aluminum		
4.6	Finish:	Gloss		

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APCS-11B

Type of Coating	:	Silicone Aluminum, Self-Priming
Manufacturer	:	Carboline
Product Name	:	Thermaline 4700 Aluminum
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	24 month

2. Mixing

2.1	No. of Components	:	1
2.2	Mixing Ratio	:	Not Applicable
2.3	Thinner	:	Not required
2.4	Thinning Requirements	:	10% by volume with Thinner # 235 for hot surface application exceeding 66°C
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	Not Applicable

3. Application

3.1	Maximum Allowable Substrate Temperature	:	148°C
3.2	Typical Wet Film Thickness Per Coat	:	100 microns
3.3	Typical Dry Film Thickness Per Coat	:	50 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	19 m^2/l
3.5	Minimum Number of Coats	:	2

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APCS-11B - Thermaline 4700 Aluminum (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	24 hrs	10 hrs	Unlimited	Not Applicable
30°C	8 hrs	4 hrs	Unlimited	Not Applicable
50°C	4 hrs	2 hrs	Unlimited	Not Applicable

3.7 Recommended Equipment

Airless Spray:	Not Recommended
Conventional Spray:	Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .070" I.D. fluid tip, and appropriate air cap.
Brush:	Medium bristle brush

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	48%
4.2	Product Weight	(ASTM D1475)	:	12 lbs
4.3	Viscosity	(ASTM D562) : Brookfield viscosity (Spindle #3 @ 100 rpm): 300 – 900 cps typical		
4.4	Flash Point	(ASTM D93 or D56)	:	25°C
4.5	Approved Color:	Aluminum		
4.6	Finish:	Gloss		

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APCS-12

Type of Coating	:	Epoxy Primer and Topcoat
Manufacturer	:	Carboline
Product Name	:	Carboguard 893 SG
SAP M/N (SAMS S/N)	:	

Use primer and topcoat of APCS-1B and APCS-12 in SAES-H-001 for application of aggregates.

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APCS-17B

Type of Coating	:	Inorganic Zinc Primer, Water Based
Manufacturer	:	Carboline
Product Name	:	Carbozinc 11 WB
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum :	Base : 24 months Zinc : 24 months

2. Mixing

2.1	No. of Components	: 2
2.2	Mixing Ratio (Base : Hardener) by weight	: Base: 0.70 gal to Zinc Filler: 14.6 lbs
2.3	Thinner	: Water
2.4	Thinning Requirements	: Up to 20%
2.5	Induction Time	: Not required
2.6	Pot Life (mixture)	: 8 hours @24°C

3. Application

3.1	Maximum Allowable Substrate Temperature	: 140°F/60°C
3.2	Typical Wet Film Thickness Per Coat	: N/A
3.3	Typical Dry Film Thickness Per Coat	: 75-100 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 23.6 m^2/l
3.5	Minimum Number of Coats	: One

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APCS-17B - Carbozinc 11 WB (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	10 min	36 hours	Unlimited	N/A
30°C	5 min	18 hours	Unlimited	N/A
50°C	2 min	10 hours	Unlimited	N/A

3.7 Recommended Equipment

Airless Spray:	Pump Ratio: 30:1 Liters/Min Output: 11 min Material Line: 9.5 mm ID min Tip Size: 0.48 – 0.58 mm Output Pressure: 10.3-13.8 MPa
Conventional Spray:	Material Line: 9.5 mm ID min Fluid Tip: 1.8 mm
Brush:	Not recommended

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	: 60% (83% zinc in dry film)
4.2	Product Weight	(ASTM D1475)	: 11.4 kg
4.3	Viscosity	(ASTM D562)	: Base (Part A) Spindle #2 at 100 RPM -- 100 to 250 cps Zinc Filler Type II -- N/A
4.4	Flash Point	(ASTM D93 or D56)	Base: >200°F/93°C Zinc: N/A

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APCS-19C

Type of Coating	:	Epoxy, Amine Cured
Manufacturer	:	Carboline
Product Name	:	Carboguard 703 GF
SAP M/N (SAMS S/N)	:	

1.	Storage			
	1.1	Shelf life, sheltered storage @ 35°C maximum	:	18 months at 75 °F / 24 °C
2.	Mixing			
	2.1	No. of Components	:	3 Components
	2.2	Mixing Ratio (Base : Hardener)	:	5 : 1 by volume + 1 bag Glass Flake (3.125kg)
	2.3	Thinner	:	Not recommended
	2.4	Thinning Requirements	:	Not recommended
	2.5	Induction Time	:	Not required
	2.6	Pot Life (mixture)	:	30 minutes at 24 °C
3.	Application			
	3.1	Maximum Allowable Substrate Temperature	:	52 °C
	3.2	Typical Wet Film Thickness Per Coat	:	400 - 3125 microns
	3.3	Typical Dry Film Thickness Per Coat	:	400 – 3125 microns
	3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	39 m^2 / l
	3.5	Minimum Number of Coats	:	2

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APCS-19C - Carboguard 703 GF (Cont'd)

3.6 Drying Time

Substrate Temperature	Recoat Interval To Handle	Minimum	Maximum	To Immersion
10°C	24 H	24 H	14 days	14 days
30°C	6 H	6 H	7 days	7 days
50°C	1.3 H	1.3 H	4.5 H	2 days

3.7 Recommended Equipment

Airless Spray	:	Graco, De Vilbis Pump Ratio: 45:1 (min)
Conventional Spray	:	Not recommended
Brush	:	For touch up and limited areas only

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	95 %
4.2	Product Weight	(ASTM D1475)	:	35.5 kg approx.
4.3	Viscosity	(ASTM D562)	:	90 – 105 KU
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: > 392 °F (200 °C) Part B: > 205 °F (96 °C) Part C: > Not Applicable
4.5	Color:	Gray, Buff		
4.6	Finish:	Eggshell		

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APCS-20A

Type of Coating	:	Modified Epoxy Polyamide
Manufacturer	:	Carboline
Product Name :		Carboguard 151-2 (Hand Lay-Up)
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	36 months at 75 °F / 24 °C

2. Mixing

2.1	No. of Components	:	2 Components
2.2	Mixing Ratio (Base : Hardener)	:	2: 1 by volume
2.3	Thinner	:	Not recommended
2.4	Thinning Requirements	:	Not recommended
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	85 minutes at 24 °C

3. Application

1st LAYER GRE LAMINATION

- Prepare Carboguard 151-2 (Part A&B) resin mix for GRE Laminate application in the ratio (2:1) as per Datasheet.
- Apply resin mixture by using brush or roller at WFT of 900 microns.
- Hand lay 1st layer chopped strand mats (minimum 300 gram/m²) with 10 cm overlap on adjacent mats (DFT-1200 microns)
- Compact GRE mat by rolling with steel rollers and ensure mat layer is completely wet with resin mix.

2nd LAYER GRE LAMINATION

- Ensure correct over-coating time as per the data-sheet is maintained and Prepare Carboguard 151-2 (Part A&B) resin mix for GRE Laminate application in the ratio(2:1) as Datasheet.
- Apply resin mixture by using brush or roller at WFT of 900 microns.

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APCS-20A - Carboguard 151-2 Hand Lay-Up (Cont'd)

- Hand lay 2nd layer chopped strand mats (Minimum 300 gram/m²) with 10cm overlap on adjacent mat
- Compact GRE mat by rolling with steel roller and ensure mat layers are completely wet with resin mix (DFT-1200 microns.)

3rd LAYER SURFACE TISSUE LAMINATION

- After Curing/Drying (Follow the over coating interval as per data-sheet) Prepare Carboguard 151-2(Part A&B) resin mix for Surface tissue application in the ratio(2:1) as per Datasheet.
- Apply resin mixture by using brush or roller at WFT of 300 microns.
- Hand lay tissue layer with 10 cm overlap on adjacent layers. (300-microns)
- Compact tissue layer with steel rollers and mat layers wet with resin mix.
- Rollout and remove any entrapped air in between.

FINAL COAT (GEL COAT)

- The whole laminate shall be coated with Carboguard 151-2(Part A&B) resin as a seal coat using brush / roller or Airless spray. (Min:50 microns)

3.1	Maximum Allowable Substrate Temperature	:	40 °C
3.2	Typical Wet Film Thickness Per Coat	:	**Laminate (glass fiber Matt):** 50-56 mils (1200-1400 microns) wet, according to specification. **Gel Coat:** 10-20 mils (250-300 microns)
3.3	Typical Dry Film Thickness Per Coat	:	Same as WFT
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness (gel coat)	:	39.6 m^2 / l
3.5	Minimum Number of Coats	:	2

3.6 Drying Time

Substrate Temperature	Recoat Interval To Handle	Minimum	Maximum	To Immersion
10°C	56 H	56 H	96 H	12 days
30°C	12 H	12 H	48 H	3 days
50°C	6 H	6 H	24 H	2 days

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APCS-20A - Carboguard 151-2 Hand Lay-Up (Cont'd)

3.7 Recommended Equipment

Airless Spray	:	Graco, De Vilbis Pump Ratio: 2:1 (min)
Conventional Spray	:	Two component airless units are recommended
Brush	:	Recommended for small areas and touch-up only. Use natural bristle brush applying with full strokes. Avoid re-brushing. Use short nap mohair roller with phenolic core.

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	99 %
4.2	Product Weight	(ASTM D1475)	:	1.690 lbs/768 kg approx.
4.3	Viscosity	(ASTM D562)	:	Part A: 80-120 KU Part B: 75 – 140 KU
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 200 °F (93 °C) Part B: 200 °F (93 °C)

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APCS-20B

Type of Coating	:	Modified Epoxy Polyamide
Manufacturer	:	Carboline
Product Name	:	Carboguard 151-2 (Spray Applied)
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	36 months at 75 °F / 24 °C

2. Mixing

2.1	No. of Components	:	2 Components
2.2	Mixing Ratio (Base : Hardener)	:	2: 1 by volume
2.3	Thinner	:	Not recommended
2.4	Thinning Requirements	:	Not recommended
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	85 minutes at 24 °C

3. Application

- Prior to application of the gel coat, the entire surface to be coated should be abraded to remove any protruding fiberglass strands or other irregularities. The surface should then be vacuum cleaned.

- Requires special airless spray equipment with heated tanks and hoses, and in-line mixing. Consult Carboline for availability of equipment and application specialist to assist with the application. Carboguard 151-2 is designed to be applied at the specified film thickness in a single coat, multiple pass application. Brush application should be used for stripe coats and touch-up only.

- Airless spray using heated plural component equipment capable of accurate proportioning. Recommended tip sizes are as follows: 27-36 thou (0.68-0.91 mm) for laminate application; 31-36 thou(0.79-0.91 mm) for gel coat application. Spray apply Carboguard 151-2 together with the chopped 450 kg per m^2 fiberglass roving, then consolidate to a 50-56 mils (1250-1400 microns) dry film thickness laminate by rolling the mixture with a ribbed roller. Consult

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APCS-20B - Carboguard 151-2 Spray Applied (Cont'd)

specified record minimum for application of gel coat [unreinforced 10-20 mils (250-500 microns) dry film thickness], giving an overall system minimum thickness of 60-76 mils (1500-1900 microns) dry film thickness.

3.1	Maximum Allowable Substrate Temperature	:	40 °C
3.2	Typical Wet Film Thickness Per Coat	:	**Laminate (glass fiber reinforced):** 50-56 mils (1250-1400 microns) wet, according to specification. **Gel Coat:** 10-20 mils (250-500 microns)
3.3	Typical Dry Film Thickness Per Coat	:	Same as WFT
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness (gel coat)	:	39.6 m^2 / l
3.5	Minimum Number of Coats	:	1

3.6 Drying Time

Substrate Temperature	Recoat Interval To Handle	Minimum	Maximum	To Immersion
10°C	56 H	56 H	96 H	14 days
30°C	12 H	12 H	48 H	7 days
50°C	6 H	6 H	24 H	2 days

3.7 Recommended Equipment

Airless Spray	:	Pump Ratio: 30:1 (min) GPM Output:3.0 (min.) Material Hose:3/8” I.D. (min.) Tip Size: .017-.021” Output PSI:2100-2300 Filter Size: 60 mesh *Teflon packings are recommended and available from pump manufacturer. Use 45:1 pump ratio for elevated applications and ½" I.D. for hose lengths greater than 60'

Manufacturer - Approved Saudi Aramco Data Sheet

Saudi Aramco: Company General Use

APCS-20B - Carboguard 151-2 Spray Applied (Cont'd)

Conventional Spray	:	Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, .070" I.D. fluid tip and appropriate air cap.
Brush	:	Use a medium bristle brush

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	99 %
4.2	Product Weight	(ASTM D1475)	:	1.690 lbs/768 kg approx.
4.3	Viscosity	(ASTM D562)	:	Part A: 80-120 KU Part B: 75 – 140 KU
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 200 °F (93 °C) Part B: 200 °F (93 °C)

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A

Type of Coating	:	Epoxy
Manufacturer	:	Carboline Company
Product Name	:	Carboguard 690
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	Part A: 24 months Part B: 12 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (Base : Hardener)	:	4:1 by volume
2.3	Thinner	:	Thinner #2
2.4	Thinning Requirements	:	12% by volume
2.5	Induction Time	:	Not required
2.6	Pot Life (mixture)	:	1.5 hours

3. Application

3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
3.2	Typical Wet Film Thickness Per Coat	:	175 microns
3.3	Typical Dry Film Thickness Per Coat	:	100-150 microns
3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	31 m^2/l
3.5	Minimum Number of Coats	:	2

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A - Carboguard 690 (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	12 hrs	12 hrs	30-60 days	20 days
30°C	2 hrs	2 hrs	30-60 days	6 days
50°C	1 hrs	1 hrs	30-60 days	2-3 days

3.7 Recommended Equipment

Airless Spray:	Pump Ratio:	30:1 (min.)
	GPM Output:	2.5 (min.)
	Material Hose:	3/8” I.D. (min.)
	Tip Size:	.017”-.021”
	Output PSI:	2000-2500
	Filter Size:	60 mesh
Conventional Spray:	Pressure pot equipped with dual regulators, 3/8” I.D. minimum material hose, .070” I.D. fluid tip and appropriate air cap.	
Brush:	Medium bristle brush	

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	80%
4.2	Product Weight	(ASTM D1475)	:	13 lbs
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 33°C / Part B: 27°C
4.5	Approved Colors:	Yellow, Black, Light Grey		
4.6	Finish:	Semi-Gloss		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22B

Type of Coating	:	Epoxy, Glass-Filled
Manufacturer	:	Carboline
Product Name	:	Carboguard 690 GF
SAP M/N (SAMS S/N)	:	

1.	Storage			
	1.1	Shelf life, sheltered storage @ 35°C maximum	:	Part A: 24 months Part B: 12 months Glass Flake: 60 months
2.	Mixing			
	2.1	No. of Components	:	3
	2.2	Mixing Ratio (Base : Hardener)	:	4:1 by volume (liquids)
	2.3	Thinner	:	Thinner #2
	2.4	Thinning Requirements	:	12% by volume
	2.5	Induction Time	:	Not required
	2.6	Pot Life (mixture)	:	1.5 hours
3.	Application			
	3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
	3.2	Typical Wet Film Thickness Per Coat	:	400 microns
	3.3	Typical Dry Film Thickness Per Coat	:	300 microns
	3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	32 m^2/l
	3.5	Minimum Number of Coats	:	1

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22B - Carboguard 690 GF (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	12 hrs	12 hrs	30-60 days	20 days
30°C	2 hrs	2 hrs	30-60 days	6 days
50°C	1 hrs	1 hrs	30-60 days	2-3 days

3.7 Recommended Equipment

Airless Spray:	Pump Ratio:	30:1 (min.)
	GPM Output:	2.5 (min.)
	Material Hose:	3/8” I.D. (min.)
	Tip Size:	.035”-.041”
	Output PSI:	2000-2500
	Filter Size:	None
Conventional Spray:	Pressure pot equipped with dual regulators, 3/8” I.D. minimum material hose, .110” I.D. fluid tip and appropriate air cap.	
Brush:	Medium bristle brush	

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	80%
4.2	Product Weight	(ASTM D1475)	:	15 lbs
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 33°C / Part B: 27°C
4.5	Approved Colors:	Yellow, Black, Light Grey		
4.6	Finish:	Semi-Gloss		

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26

Type of Coating	:	Epoxy Mastic, Self-Priming
Manufacturer	:	Carboline
Product Name	:	Carboguard 890
SAP M/N (SAMS S/N)	:	

1.	Storage			
	1.1	Shelf life, sheltered storage @ 35°C maximum	:	Part A: 36 months Part B: 12 months
2.	Mixing			
	2.1	No. of Components	:	2
	2.2	Mixing Ratio (Base : Hardener)	:	1:1 by volume
	2.3	Thinner	:	Thinner #33
	2.4	Thinning Requirements	:	12% by volume
	2.5	Induction Time	:	Not required
	2.6	Pot Life (mixture)	:	3 hours
3.	Application			
	3.1	Maximum Allowable Substrate Temperature	:	140°F/60°C
	3.2	Typical Wet Film Thickness Per Coat	:	175 microns
	3.3	Typical Dry Film Thickness Per Coat	:	100-150 microns
	3.4	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	30 m^2/l
	3.5	Minimum Number of Coats	:	2

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26 - Carboguard 890 (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	To Immersion
10°C	12 hrs	12 hrs	30-60 days	NR
30°C	4 hrs	4 hrs	30-60 days	3-5 days
50°C	2 hrs	2 hrs	30-60 days	2-3 days

3.7 Recommended Equipment

Airless Spray:	Pump Ratio:	30:1 (min.)
	GPM Output:	2.5 (min.)
	Material Hose:	3/8” I.D. (min.)
	Tip Size:	.017”-.021”
	Output PSI:	2100-2300
	Filter Size:	60 mesh
Conventional Spray:	Pressure pot equipped with dual regulators, 3/8” I.D. minimum material hose, .070” I.D. fluid tip and appropriate air cap.	
Brush:	Medium bristle brush	

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	75%
4.2	Product Weight	(ASTM D1475)	:	13 lbs
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	Part A: 32°C / Part B: 23°C
4.5	Approved Colors:	Yellow, Orange, Red, Black, Light Grey, Aluminum		
4.6	Finish:	Gloss		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26T

Type of Coating	:	Epoxy Mastic, Self-Priming
Manufacturer	:	Carboline
Product Name	:	Carboguard 890
SAP M/N (SAMS S/N)	:	

Use APCS-26 Data Sheet.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26T

Type of Coating	:	Aliphatic Polyurethane Topcoat
Manufacturer	:	Carboline
Product Name	:	Carbothane 134 Series (134 HP)
SAP M/N (SAMS S/N)	:	

Use APCS-1D/E/F Topcoat Data Sheet.

Saudi Aramco: Company General Use

d. CeraTech – Approved Products

APCS-5A

CeraTech 901*

ClearCoat 50*

*Note: Refer to coating manufacturer's Product Data Sheets for the above products.

Saudi Aramco: Company General Use

e. Ciba S. C. – Approved Materials

APCS-20A

Araldite GY 257	Fiberglass Reinforced Epoxy: Hand Applied

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A

Type of Coating	:	Fiberglass Reinforced Epoxy; Hand-Applied
Manufacturer	:	Ciba Specialty Chemicals, Switzerland
Product Name	:	Araldite GY 257 (Curing Agents HY 830 and HY 850)
SAMS S/N	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	3
2.2	Mixing Ratio	:	100:52:8; GY 257: HY 830: HY 850 (by weight)
2.3	Thinner	:	N/A (clean up only)
	SAMS S/N	:	None
2.4	Thinning Requirements	:	Nil
2.5	Induction Time	:	Not Applicable
2.6	Pot Life (GY 257 + HY 830 + HY 850); Measured with TECAM gel timer @ 65% relative humidity. (1 kg. mixture)	:	3 hrs. 45 mins. @ 20°C

3. Installation Procedure

3.1 Surface Preparation

3.1.1 The surface is degreased and cleaned to ensure the removal of all oil, grease, salts, dirt, and other surface contaminants prior to further surface preparation.

3.1.2 Prior to the start of the blasting work, all the surface irregularities including weld spatters, weld fluxes, rough capping, etc., shall be removed or smoothed using mechanical tools. The surface is blasted to SA 2 ½ (near white metal).

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A - Araldite GY 257 (Cont'd)

3.1.3 Blasted surfaces shall be vacuumed or blown clean, and extra care should be taken to avoid contamination of the blast cleaned surface. Severe corrosion, undercuts, or weld porosity (larger than 1 inch in diameter) should be reported for remedial work

3.1.4 Priming shall take place while surface preparation is still fresh (directly after blasting and before oxidation). The overall steel surfaces such as the shell wall, support column, tank floor, and bottom shall be primed with a solvent based epoxy to a dry film thickness (DFT) of 25-30 microns (~1 mil).

3.2 Caulking

Caulking shall be applied on all sharp edges, mainly between shell and floor, between floor plates, in and around sumps, around connection between pipes and hull, and around support pipes.

3.2.1 For the area between the shell and the floor, the amount of filler will determine the sharpness of the turn. The sharper the turn, the more difficult it becomes to construct a laminate that is free from wrinkles and air bubbles, and therefore must be avoided. Use minimal epoxy filler as necessary to make the turn. A throat of approximately 5 cm is usually adequate.

3.2.2 Caulking between the floor plates shall be applied directly before lamination, and while the epoxy mortar is still wet, lamination on the floor can proceed.

3.3 Landing Plates

In floating roof tanks, steel panel may be inserted under the support legs. Landing plates (~6 mm thick) are first blast cleaned and primed on both sides, and the lamination system is applied to one side only. While still wet, sand (clean and dry) is sprinkled on the perimeter to provide for subsequent mechanical bond. While blast cleaning is in progress, work shall start on the landing legs in the following manner:

3.3.1 The welds on the striker plate are caulked.

3.3.2 Two to three hydraulic jacks are placed around the leg on timber spreaders, clear of the area to be lined, and the roof is lifted about 15 mm. The pin holding the leg is removed, and the leg is raised.

3.3.3 The area under the leg is cleaned.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A - Araldite GY 257 (Cont'd)

3.3.4 The lining is applied so it extends 10 cm from the landing plate. The lining should be resin rich in the center.

3.3.5 The prepared plate is placed, laminate side up, and forced slightly in the wet laminate. The system is allowed to set, the leg is lowered, the pin replaced and the jacks are released.

3.3.6 Any gaps between the landing plate and the striker plate should be filled with epoxy mortar (caulking).

3.4 Laminate Application

3.4.1 Apply a generous amount of epoxy mix (~500 microns) onto the primed steel surface, as evenly as possible.

3.4.2 Apply one layer of 450 g/m² fiberglass chopped strand mat (CSM) to the wet epoxy mix.

3.4.3 Embed fully to remove wrinkles and roll with steel roller to remove trapped air. Add resin where required and consolidate well with steel roller.

3.4.4 Apply a second generous coating of Epoxy mix.

3.4.5 Apply the second layer of 450 g/m² fiberglass CSM with a 50% of the nominal width of the mat overlap on the previous layer in order to achieve a 2 layer system. Care should be taken to ensure the second layer is overlapping the previous one with the untrimmed edge.

3.4.6 Repeat smoothing and rolling as in step 3.4.3 and add resin mix if required.

3.4.7 Lay a surfacing tissue of 30 g/m² in such a manner that it overlaps the mat without aligning with mat edge, and ensuring that the strands of mat are not exposed or protruding @ the laminate surface.

3.4.8 Repeat smoothing and rolling as in step 3.4.3.

3.4.9 Apply a fourth coat of Epoxy mix/ gel coat to give a resin rich finish.

3.5 Repair of Defects

3.5.1 Air inclusion shall be cut out to a tapered edge, sanded around, and application of mat and tissue carried out with an overlap of 50mm on the sound laminate. If the overcoating interval was exceeded, the overlap shall be of 100 mm.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A - Araldite GY 257 (Cont'd)

3.5.2 Overlaps of less than 30mm shall be patched with a strip 100 mm wide.

3.5.3 Areas where the laminate does not appear to be resin rich shall be patched with an extra layer of surface tissue and resin.

3.6 Maximum Allowable Substrate Temperature : 55°C

3.7 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Maximum	Full Cure
20°C	30 Hours	20 Hours	40 Hours	30 Hours
40°C	10 Hours	7 Hours	15 Hours	11 Hours
50°C	3 Hours	3 Hours	7 Hours	5 Hours

In case overcoating interval is past the maximum limit, abrade the cured film with sand paper or sweep blast prior to application of fresh coat.

3.8 Recommended Equipment

Hand application only.

4. Technical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	1.12 kg/l
4.3	Viscosity (@25°C)	(ASTM D562)	:	1,400 m Pa S
4.4	Flash Point	(ASTM D93 or D56)	:	138°C (GY 257) 183°C (HY 830) 163°C (HY 850)

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A - Araldite GY 257 (Cont'd)

Related Materials:

1. Fiberglass Mat: Vetrotex® M4 40 P3 (Emulsion bonded) by Vetrotex International, Scandinavian Glass fiber (MK 12) by Owens Corning or equivalent.
2. Surfacing Tissue: Fiberil® T 1773; 30-40 g/m²; Manufactured by Carl Freudenberg.
3. Primer: Hempel's Hempadur 15590 or approved equivalent.
4. Caulking (either):

    4.1 100 parts resin mix and 20 parts Aerosil 202, Cabosil or equivalent

    4.2 Hempadur Caulking 3588

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f. Corrocoat – Approved Products

APCS-2G
Polyglass VEF Vinyl Ester

APCS-28
Corroglass 600 Series Vinyl Ester
(Corroglass 602, 632, 652)

APCS-28
Polyglass VEF Vinyl Ester

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G

Type of Coating	:	Vinyl Ester Coating
Manufacturer	:	Corrocoat
Product Name	:	Polyglass VEF
SAP M/N (SAMS S/N)	:	Base plus catalyst in one box 1000709300 (09-000-502); Retarder 1000709303 (09-000-505)

1. Storage

1.1 Store in accordance with manufacturers recommendations.
Shelf life, sheltered storage @ 20°C maximum: 6 months
Base and catalyst (Hardener) 6 months, stored at temperatures below 20°C, away from heat sources and out of direct sunlight. Frequent temperature cycling will shorten storage life. See 'Other Information Shelf Life Corrocoat Data Sheet 8/02'

2. Mixing

2.1 No. of Components : 3 (Three)

2.2 Mixing Ratio : Base 19.6 liters : Hardener 400 ml : Retarder 50 ml (see Note in 7 Special Instructions)

2.3 Thinner : N/A
See Note in 7 Special Instructions

Cleaning Agent : Styrene Monomer Inhibited
SAP M/N (SAMS S/N) : 1000709301 (09-000-503-00)

Cleaning Solvent : Methyl Ethyl Ketone or Acetone must be used within the pot life of the product for cleaning spray equipment and lines.

2.4 Minimum-Maximum Thinning Requirements : N/A
See Note in 7 Special Instructions

2.5 Induction Time : N/A

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G - Polyglass VEF (Cont'd)

2.6	Pot Life Pot Life will vary significantly with temperature but generally 50 – 60 minutes using P 2.45 catalyst. See note in Section 7	:	At 20°C w/out Retarder- 50 mins At 30°C w/out Retarder- 30 mins At 20°C with Retarder- 50 mins At 30°C with Retarder- 30 mins

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature: Substrate Temp at least 3°C above dewpoint		Min 0°C – Max 90°C Refer to Corrocoat Technical Services for application at high temperatures
3.2	Minimum-Maximum Allowable Relative Humidity Substrate Temp at least 3°C above dewpoint	:	Min 0% – Max 90% RH
3.3	Typical Wet Film Thickness Per Coat	:	800 microns
3.4	Typical Dry Film Thickness Per Coat	:	Approx. 700 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	39.6 m^2/L This is a theoretical figure Only. Coating would never be applied at this film thickness
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Carbon Steel Stainless Steel/ Stainless Alloys Aluminum Cast Iron/Steel Other Non- Ferrous Alloys Concrete with appropriate primer

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G - Polyglass VEF (Cont'd)

3.8 Surface Preparation Requirements:

On metallic substrates

Abrasive Blast Cleaning to a Cleanliness Standard/Equivalent Cleanliness Standard of Sa 2 ½ near Sa 3 with a minimum surface profile of 50 microns using the appropriate approved type of abrasive. Non-ferrous abrasive for nonferrous substrates.

On concrete substrates

Abrasive Blast Cleaning to remove all surface contaminants, surface laitance and weak frangible material. Followed by priming with appropriate primer in accordance with Corrocoat Procedures detailed in Corrocoat User Data Sheet SP5 Concrete Preparation and Priming

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum*	Maximum	To Handle	To Service **	Full Cure
10°C	5 hrs	3 days	24 hrs	6 days	6 days
20ºC	2 ½ hrs	2 days	18 hrs	4 days	4 days
30°C	1 ¾ hrs	1½ days	12 hrs	3 days	3 days
40ºC	1 hr	1 day	6 hrs	1½ days	1½ days
50°C	< 1 hr	6 hrs	6 hrs	1 day	1 day

* There is no minimum overcoating time on the Polyglass VEF, this product is solvent free and may be overcoated as soon as the previous coat has gelled and can support the weight of the next coat. In practice this is generally for tank coating the time period before you can walk on the coating to apply the next coat. All values assume good ventilation.

** Immersion times will depend on the service environment and should be checked with Corrocoat/Hertel OTC for the actual service duty. For reference purposes we have assumed a medium service duty oil process vessel.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G - Polyglass VEF (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	: Pump ratio 45:1 minimum Spray Tip Size 0.031 to 0.035 inch Fluid pressure : 3000 psi Spray Hose : 3/8 inch bore
Conventional Spray	: Not Recommended
Brush	: For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 99%

Corrocoat assesses Volume Solids in accordance with BS-ISO EN 3251:2008
Nominally greater than 99%. This material contains volatile liquid monomers, convertible to solids. In consequence volume solids and WFT/DFT ratios will vary, dependent on polymerization conditions. As guidance, a wet film of 500microns will normally achieve approximately 425microns DFT.

4.2 Product Weight (ASTM D1475) : 1.19 Kg/L
Corrocoat assesses Product Weight in accordance with BS 3900: Part A12 1975

Base: 1.19 gcm^3 Hardener: 1.07 gcm^3

4.3 Viscosity (ASTM D562) :
Corrocoat assesses Viscosity in accordance with BS 2782: Part 7 M730B 1994

25,000 – 40,000 Centipoise

4.4 Flash Point (ASTM D93 or D56) : 28 °C
Corrocoat assesses Flash Point in accordance with BS 900: Part A9 1986

Flash Point: 28 °C

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G - Polyglass VEF (Cont'd)

4.5 Approved Color/s : Standard. Off White.
Other colors are available on request but the addition of dyes adversely affects chemical resistance and air inhibition suppressant is required for color stability.

4.6 Finish : Semi-Gloss

5. Special Instructions:

Reference item 2.3

Polyglass VEF is **adversely** affected by the addition of **solvents** and their use is prohibited.

Reference Item 2.4

Thinning can be achieved by the addition of no more than 1 liter of styrene monomer per 20 liters of Polyglass. It should be noted that dilution with styrene may affect hold up and chemical resistance.

Reference Item 2.6

*At high ambient temperatures retarder may be used to extend pot life but should be added to the base and thoroughly mixed before addition of the hardener in accordance with the manufacturer procedures.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28

Type of Coating	:	High Build Vinyl Ester Glassflake Lining Material
Manufacturer	:	Corrocoat
Product Name	:	**Corroglass 602**
SAP M/N (SAMS S/N)	:	

1. Storage

1.1 Store in accordance with manufacturers recommendations. Shelf life, sheltered storage @ 20°C maximum: 6 months Base and catalyst (Hardener) 6 months, stored at temperatures below 20°C, away from heat sources and out of direct sunlight. Frequent temperature cycling will shorten storage life. See 'Other Information Shelf Life Corrocoat Data Sheet 8/02'

2. Mixing

2.1	No. of Components	: 2 (Two)
2.2	Mixing Ratio	: Base 19.6 liters: Hardener 400 ml
2.3	Thinner See Note in 7 Special Instructions	: N/A
	Cleaning Agent	: Styrene Monomer Inhibited
	SAP M/N (SAMS S/N)	: 1000709301 (09-000-503-00)
	Cleaning Solvent	: Methyl Ethyl Ketone or Acetone must be used within the pot life of the product for cleaning equipment.
2.4	Minimum-Maximum Thinning Requirements See Note in 7 Special Instructions	: N/A
2.5	Induction Time	: N/A

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Corroglass 602 (Cont'd)

2.6	Pot Life Pot Life will vary significantly with temperature but generally 40 - 50 minutes at 20°C using P 2 catalyst. See note in Section 7	:	At 20°C - 40mins At 30°C - 30mins

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature Substrate Temp at least 3°C above dewpoint	: Min 0°C – Max 90°C Refer to Corrocoat Technical Services for application at high temperatures
3.2	Minimum-Maximum Allowable Relative Humidity Substrate Temp at least 3°C above dewpoint	: Min 0% – Max 90% RH
3.3	Typical Wet Film Thickness Per Coat	: 1000 microns
3.4	Typical Dry Film Thickness Per Coat	: Approx. 950 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 39.6 m^2/L This is a theoretical figure Only. Coating would never be applied at this film thickness
3.6	Minimum Number of Coats	: One
3.7	Applicable Substrate	: The Substrate will previously be coated with a primer layer of Corroglass 632 or previously applied Corroglass 602 as per APCS-28
3.8	Surface Preparation Requirements	: Corroglass 602 must be applied over primer coat of Corroglass 632 or previously applied Corroglass 602 within the overcoating time of the system used.

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Corroglass 602 (Cont'd)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum*	Maximum	To Handle	To Service **	Full Cure
10°C	5 hrs	2 days	24 hrs	6 days	6 days
20°C	2 ½ hrs	2 days	18 hrs	4 days	4 days
30°C	1 ¾ hrs	1½ days	12 hrs	3 days	3 days
40°C	1 hr	1 day	6 hrs	1½ days	1½ days
50°C	< 1 hr	6 hrs	6 hrs	1 day	1 day

* There is no minimum overcoating time on the Corroglass 602, this product is solvent free and may be overcoated as soon as the previous coat has gelled and can support the weight of the next coat. All values assume good ventilation.

** Immersion times will depend on the service environment and should be checked with Corrocoat/Hertel OTC for the actual service duty.

3.10 Recommended Application Equipment : Brush, Trowel, or Float

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 99.8%

Corrocoat assesses Volume Solids in accordance with BS-ISO EN 3251:2008 Nominally greater than 99%. This material contains volatile liquid monomers, convertible to solids. In consequence volume solids and WFT/DFT ratios will vary, dependent on polymerization conditions. As guidance, a wet film of 1000microns will normally achieve approximately 950 microns DFT.

4.2 Product Weight (ASTM D1475) : 1.19 Kg/L
Corrocoat assesses Product Weight in accordance with BS 3900: Part A12 1975

Base: 1.19 gcm^3 Hardener: 1.07 gcm^3

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Corroglass 602 (Cont'd)

4.3 Viscosity (ASTM D562) :
Corrocoat assesses Viscosity in accordance with BS 2782: Part 7 M730B 1994

200,000 – 350,000 Centipoise

4.4 Flash Point (ASTM D93 or D56) : 38°C
Corrocoat assesses Flash Point in accordance with BS 900: Part A9 1986

Flash Point 38 °C

4.5 Approved Color/s : Standard. Off White

4.6 Finish : Flat

5. Special Instructions:

Reference item 2.3

Corroglass 602 is **adversely** affected by the addition of **solvents** and their use is prohibited.

Reference Item 2.4

Where a less viscous material is required the addition of Corroglass 632 will lower the viscosity without a significant effect on performance

Reference Item 2.6

*At high ambient temperatures pot life can be adjusted by trained applicators in accordance with Corrocoat procedures.

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28

Type of Coating	:	Medium Build Vinyl Ester Glassflake Lining Material
Manufacturer	:	Corrocoat
Product Name	:	**Corroglass 632**
SAP M/N (SAMS S/N)	:	

1. Storage

Store in accordance with manufacturers recommendations.
Shelf life, sheltered storage @ 20°C maximum: 6 months Base and catalyst (Hardener) 6 months, stored at temperatures below 20°C, away from heat sources and out of direct sunlight. Frequent temperature cycling will shorten storage life. See 'Other Information Shelf Life Corrocoat Data Sheet 8/02'

2. Mixing

2.1	No. of Components	: 2 (Two)
2.2	Mixing Ratio	: Base 19.6 liters: Hardener 400 ml
2.3	Thinner See Note in 7 Special Instructions	: N/A
	Cleaning Agent	: Styrene Monomer Inhibited
	SAP M/N (SAMS S/N)	: 1000709301 (09-000-503-00)
	Cleaning Solvent:	Methyl Ethyl Ketone or Acetone must be used within the pot life of the product for cleaning equipment.
2.4	Minimum-Maximum Thinning Requirements	: N/A
2.5	Induction Time	: N/A

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Corroglass 632 (Cont'd)

2.6	Pot Life Pot Life will vary significantly with temperature but generally 40 - 50 minutes at 20°C using P 2 catalyst. See note in Section 7	: At 20°C - 40 mins At 30°C - 30 mins

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature Substrate Temp at least 3°C above dewpoint	: Min 0°C – Max 90°C Refer to Corrocoat Technical Services for application at high temperatures
3.2	Minimum-Maximum Allowable Relative Humidity Substrate Temp at least 3°C above dewpoint	: Min 0% – Max 90% RH
3.3	Typical Wet Film Thickness Per Coat	: 150 - 300 microns
3.4	Typical Dry Film Thickness Per Coat	: Approx. 125 - 275 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 39.6 m^2/L This is a theoretical figure Only. Coating would never be applied at this film thickness
3.6	Minimum Number of Coats	: One
3.7	Applicable Substrate	: Carbon Steel Stainless Steel/ Stainless Alloys Aluminum Cast Iron/Steel Other Non- Ferrous Alloys Concrete with appropriate primer Corroglass 632 can be applied over primer coat of Corroglass 632 or previously applied Corroglass 602 within the overcoating time of the system used.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 Corroglass 632 (Cont'd)

3.8 Surface Preparation Requirements :

On metallic substrates

Abrasive Blast Cleaning to a Cleanliness Standard/Equivalent Cleanliness Standard of Sa 2 ½ near Sa 3 with a minimum surface profile of 75 microns using the appropriate approved type of abrasive. Non-ferrous abrasive for non-ferrous substrates.

On concrete substrates

Abrasive Blast Cleaning to remove all surface contaminants, surface laitance and weak frangible material. Followed by priming with appropriate primer in accordance with Corrocoat Procedures detailed in Corrocoat User Data Sheet SP5 Concrete Preparation and Priming

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum*	Maximum	To Handle	To Service **	Full Cure
10°C	5 hrs	2 days	24 hrs	6 days	6 days
20°C	2 ½ hrs	2 days	18 hrs	4 days	4 days
30°C	1 ¾ hrs	1½ days	12 hrs	3 days	3 days
40°C	1 hr	1 day	6 hrs	1½ days	1½ days
50°C	< 1 hr	6 hrs	6 hrs	1 day	1 day

* There is no minimum overcoating time on the Corroglass 632, this product is solvent free and may be overcoated as soon as the previous coat has gelled and can support the weight of the next coat. All values assume good ventilation.

** Immersion times will depend on the service environment and should be checked with Corrocoat/Hertel OTC for the actual service duty.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 Corroglass 632 (Cont'd)

3.10 Recommended Application Equipment : Brush

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 99.8%

Corrocoat assesses Volume Solids in accordance with BS-ISO EN 3251:2008 Nominally greater than 99%. This material contains volatile liquid monomers, convertible to solids. In consequence volume solids and WFT/DFT ratios will vary, dependent on polymerization conditions. As guidance, a wet film of 300microns will normally achieve approximately 275 microns DFT.

4.2 Product Weight (ASTM D1475) : 1.22 Kg/L
Corrocoat assesses Product Weight in accordance with BS 3900: Part A12 1975

Base: 1.22 gcm^3 Hardener: 1.07 gcm^3

4.3 Viscosity (ASTM D562) :
Corrocoat assesses Viscosity in accordance with BS 2782: Part 7 M730B 1994

45,000 – 65,000 Centipoise

4.4 Flash Point (ASTM D93 or D56) : 38 °C
Corrocoat assesses Flash Point in accordance with BS 900: Part A9 1986

Flash Point 38 °C

4.5 Approved Color/s : Standard. Off White

4.6 Finish : Flat

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 Corroglass 632 (Cont'd)

5. Special Instructions:

Reference item 2.3

Corroglass 632 is **adversely** affected by the addition of **solvents** and their use is prohibited.

Reference Item 2.6

*At high ambient temperatures pot life can be adjusted by trained applicators in accordance with Corrocoat procedures.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28

Type of Coating	:	Surface Veil Vinyl Ester Glassflake Lining Material
Manufacturer	:	Corrocoat
Product Name	:	**Corroglass 652**
SAP M/N (SAMS S/N)	:	

1. Storage

1.1 Store in accordance with manufacturers recommendations.
Shelf life, sheltered storage @ 20°C maximum : 6 months
Base and catalyst (Hardener) 6 months, stored at temperatures below 20°C, away from heat sources and out of direct sunlight. Frequent temperature cycling will shorten storage life. See 'Other Information Shelf Life Corrocoat Data Sheet 8/02'

2. Mixing

2.1	No. of Components	: 2 (Two)
2.2	Mixing Ratio	: Base 19.6 liters : Hardener 400 ml
2.3	Thinner See Note in 7 Special Instructions	: N/A
	Cleaning Agent SAP M/N (SAMS S/N)	: Styrene Monomer Inhibited : 1000709301 (09-000-503-00)
	Cleaning Solvent	: Methyl Ethyl Ketone or Acetone must be used within the pot life of the product for cleaning equipment.
2.4	Minimum-Maximum Thinning Requirements	: N/A
2.5	Induction Time	: N/A

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Corroglass 652 (Cont'd)

2.6	Pot Life Pot Life will vary significantly with temperature but generally 25 - 30 minutes at 20°C using P 2 catalyst.	:	At 20°C - 25 – 30 mins At 30°C - 15 – 20 mins

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature: Substrate Temp at least 3°C above dewpoint		Min 0°C – Max 90°C Refer to Corrocoat Technical Services for application at high temperatures
3.2	Minimum-Maximum Allowable Relative Humidity Substrate Temp at least 3°C above dewpoint	:	Min 0% – Max 90% RH
3.3	Typical Wet Film Thickness Per Coat	:	200 microns
3.4	Typical Dry Film Thickness Per Coat	:	Approx. 175 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	39.6 m^2/L This is a theoretical figure Only. Coating would never be applied at this film thickness
3.6	Minimum Number of Coats	:	One
3.7	Applicable Substrate	:	The Substrate will previously be coated Corroglass 600 series materials as per APCS 28
3.8	Surface Preparation Requirements	:	Corroglass 652 is applied over Corroglass 600 series materials within the overcoating time of the material used.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Corroglass 652 (Cont'd)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum*	Maximum	To Handle	To Service **	Full Cure
10°C	5 hrs	2 days	24 hrs	6 days	6 days
20ºC	2 ½ hrs	2 days	18 hrs	4 days	4 days
30°C	1 ¾ hrs	1½ days	12 hrs	3 days	3 days
40ºC	1 hr	1 day	6 hrs	1½ days	1½ days
50°C	< 1 hr	6 hrs	6 hrs	1 day	1 day

* There is no minimum overcoating time on the Corroglass 652, this product is solvent free and may be overcoated as soon as the previous coat has gelled and can support the weight of the next coat. All values assume good ventilation.

** Immersion times will depend on the service environment and should be checked with Corrocoat/Hertel OTC for the actual service duty.

3.10 Recommended Application Equipment : Brush

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 99.8%

Corrocoat assesses Volume Solids in accordance with BS-ISO EN 3251:2008
Nominally greater than 99%. This material contains volatile liquid monomers, convertible to solids. In consequence volume solids and WFT/DFT ratios will vary, dependent on polymerization conditions. As guidance, a wet film of 200microns will normally achieve approximately 175 microns DFT.

4.2 Product Weight (ASTM D1475) : 1.18 Kg/L
Corrocoat assesses Product Weight in accordance with BS 3900: Part A12 1975

Base: 1.18 gcm^3 Hardener: 1.07 gcm^3

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Corroglass 652 (Cont'd)

4.3 Viscosity (ASTM D562) :
Corrocoat assesses Viscosity in accordance with BS 2782: Part 7 M730B 1994

25,000 – 35,000 Centipoise

4.4 Flash Point (ASTM D93 or D56) : 38 °C
Corrocoat assesses Flash Point in accordance with BS 900: Part A9 1986

Flash Point 38 °C

4.5 Approved Color/s : Standard. Off White

4.6 Finish : Semi-Gloss

5. Special Instructions:

Reference item 2.3

Corroglass 652 is **adversely** affected by the addition of **solvents** and their use is prohibited.

Reference Item 2.4

Thinning can be achieved by the addition of up to a maximum, of no more than 1 liter of styrene monomer per 20 liters of Corroglass 652. It should be noted that dilution with styrene may substantially affect chemical resistance of this product.

Reference Item 2.6

*At high ambient temperatures pot life can be adjusted by trained applicators in accordance with Corrocoat procedures.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28

Type of Coating	:	Vinyl Ester Coating: One-coat
Manufacturer	:	Corrocoat Ltd.
Product Name	:	**Polyglass VEF**
SAP M/N (SAMS S/N)	:	Base plus catalyst in one box 1000709300 (09-000-502); Retarder 1000709303 (09-000-505)

1. Storage

1.1 Store in accordance with manufacturers recommendations.
Shelf life, sheltered storage @ 20°C maximum : 6 months
Base and catalyst (Hardener) 6 months, stored at temperatures below 20°C, away from heat sources and out of direct sunlight. Frequent temperature cycling will shorten storage life. See 'Other Information Shelf Life Corrocoat Data Sheet 8/02'

2. Mixing

2.1 No. of Components : 3 (Three)

2.2 Mixing Ratio : Base 19.6 liters : Hardener 400 ml : Retarder 50 ml (see Note in 7 Special Instructions)

2.3 Thinner : N/A
See Note in 7 Special Instructions

Cleaning Agent : Styrene Monomer Inhibited
SAP M/N (SAMS S/N) : 1000709301 (09-000-503-00)

Cleaning Solvent : Methyl Ethyl Ketone or Acetone must be used within the pot life of the product for cleaning spray equipment and lines

2.4 Minimum-Maximum Thinning Requirements : N/A
See Note in 7 Special Instructions

2.5 Induction Time : N/A

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Polyglass VEF (Cont'd)

2.6	Pot Life Pot Life will vary significantly with temperature but generally 50 – 60 minutes using P 2.45 catalyst. See note in Section 7	:	At 20°C w/out Retarder- 50 mins At 30°C w/out Retarder- 30 mins At 20°C with Retarder- 50 mins At 30°C with Retarder- 30 mins

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature Substrate Temp at least 3°C above dewpoint	: Min 0°C – Max 90°C Refer to Corrocoat Technical Services for application at high temperatures
3.2	Minimum-Maximum Allowable Relative Humidity Substrate Temp at least 3°C above dewpoint	: Min 0% – Max 90% RH
3.3	Typical Wet Film Thickness Per Coat	: 800 microns
3.4	Typical Dry Film Thickness Per Coat	: Approx. 700 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 39.6 m^2/L This is a theoretical figure Only. Coating would never be applied at this film thickness
3.6	Minimum Number of Coats	: 2 (Two)
3.7	Applicable Substrate	: Carbon Steel Stainless Steel/ Stainless Alloys Aluminum Cast Iron/Steel Other Non- Ferrous Alloys Concrete with appropriate primer

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Polyglass VEF (Cont'd)

3.8 Surface Preparation Requirements:

On metallic substrates

Abrasive Blast Cleaning to a Cleanliness Standard/Equivalent Cleanliness Standard of Sa 2 ½ near Sa 3 with a minimum surface profile of 50 microns using the appropriate approved type of abrasive. Non-ferrous abrasive for non-ferrous substrates.

On concrete substrates

Abrasive Blast Cleaning to remove all surface contaminants, surface laitance and weak frangible material. Followed by priming with appropriate primer in accordance with Corrocoat Procedures detailed in Corrocoat User Data Sheet SP5 Concrete Preparation and Priming.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum*	Maximum	To Handle	To Service **	Full Cure
10°C	5 hrs	3 days	24 hrs	6 days	6 days
20ºC	2 ½ hrs	2 days	18 hrs	4 days	4 days
30°C	1 ¾ hrs	1½ days	12 hrs	3 days	3 days
40ºC	1 hr	1 day	6 hrs	1½ days	1½ days
50°C	< 1 hr	6 hrs	6 hrs	1 day	1 day

* There is no minimum overcoating time on the Polyglass VEF, this product is solvent free and may be overcoated as soon as the previous coat has gelled and can support the weight of the next coat. In practice this is generally for tank coating the time period before you can walk on the coating to apply the next coat. All values assume good ventilation.

**Immersion times will depend on the service environment and should be checked with Corrocoat/Hertel OTC for the actual service duty. For reference purposes we have assumed a medium service duty oil process vessel.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Polyglass VEF (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	: Pump ratio 45:1 minimum Spray Tip Size 0.031 to 0.035 inch Fluid pressure : 3000 psi Spray Hose : 3/8 inch bore
Conventional Spray	: Not Recommended
Brush	: For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 99%

Corrocoat assesses Volume Solids in accordance with BS-ISO EN 3251:2008 Nominally greater than 99%. This material contains volatile liquid monomers, convertible to solids. In consequence volume solids and WFT/DFT ratios will vary, dependent on polymerization conditions. As guidance, a wet film of 500microns will normally achieve approximately 425microns DFT.

4.2 Product Weight (ASTM D1475) : 1.19 Kg/L
Corrocoat assesses Product Weight in accordance with BS 3900: Part A12 1975

Base: 1.19 gcm^3 Hardener: 1.07 gcm^3

4.3 Viscosity (ASTM D562) :
Corrocoat assesses Viscosity in accordance with BS 2782: Part 7 M730B 1994

25,000 – 40,000 Centipoise

4.4 Flash Point (ASTM D93 or D56) : 28°C
Corrocoat assesses Flash Point in accordance with BS 900: Part A9 1986

Flash Point: 28 °C

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-28 - Polyglass VEF (Cont'd)

4.5 Approved Color/s : Standard. Off White.
Other colors are available on request but the addition of dyes adversely affects chemical resistance and air inhibition suppressant is required for color stability.

4.6 Finish : Semi-Gloss

5. Special Instructions:

Reference item 2.3

Polyglass VEF is **adversely** affected by the addition of **solvents** and their use is prohibited.

Reference Item 2.4

Thinning can be achieved by the addition of no more than 1 liter of styrene monomer per 20 liters of Polyglass. It should be noted that dilution with styrene may **affect hold up** and chemical resistance.

Reference Item 2.6

*At high ambient temperatures retarder may be used to extend pot life but should be added to the base and thoroughly mixed before addition of the hardener in accordance with the manufacturers procedures.

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Saudi Aramco: Company General Use

g. Daikin – Approved Products

APCS-5A

Zeffle IR Coating*

*Note: Refer to coating manufacturer's Product Data Sheets for the above product.

Saudi Aramco: Company General Use

h. Durapol – Approved Products

APCS-27

Durapol UHT (Spray Grade) / Durapol UHT (Brush Grade)	Epoxy

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-27

Type of Coating	:	Solvent Free Ultra Hybrid Epoxy
Manufacturer	:	DuraPol Limited
Product Name	:	DuraPol UHT (Spray Grade) / DuraPol UHT (Brush Grade)
SAP M/N (SAMS S/N):		DuraPol UHT (Spray) Grade - 1000767601 (09-000-519) DuraPol UHT (Brush Grade) - 1000767602 (09-000-520)

1. Storage

1.1	Shelf Life, sheltered storage @ 35°C maximum	: 3 years

2 Mixing

2.1	No. of Components	: 2
	2.1.1 Base	: UHT Base
	2.1.2 Hardener (Curing Agent)	: UHT Hardener
2.2	Mixing Ratio	: 310: 23 (Base: Hardener)
2.3	Thinner	: Not Applicable
2.4	Minimum-Maximum Thinning Requirements	: Not Applicable
2.5	Induction time	: 0
2.6	Pot Life	: 75 minutes

3 Application

3.1	Minimum-Maximum Allowable Substrate Temperature: 20°C Min., 60°C Max.	
3.2	Minimum-Maximum Allowable Relative Humidity	: 0% Min., 90% Max.
3.3	Typical Wet Film Thickness Per Coat	: 800 microns
3.4	Typical Dry Film Thickness Per Coat	: 800 microns

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Manufacturer – Approved Saudi Aramco Data Sheet

APCS-27 - DuraPol UHT (Cont'd)

3.5	Theoretical Coverage @ 25 microns DFT	: 23 m^2 / L
3.6	Minimum Number of Coats	: 1
3.7	Applicable Substrate	: CS, GS, SS, Al, Thermal Spray, Hastalloy, Super Duplex
3.8	Surface Preparation Requirements	: Sa3 Cleanliness : Profile: 75 – 100 microns

3.9 Drying time at specified DFT

Substrate Temperature	Recoat Interval	To Handle	To Service	Full Cure
10°C	Not applicable	----------	Not Recommended	----------
20°C	Not applicable	160 minutes	4 days	4 days
30°C	Not applicable	120 minutes	3 days	3 days
40°C	Not applicable	90 minutes	2 days	3 days
50°C	Not applicable	60 minutes	2 days	3 days

* Cure for rapid return to service: 24 hours at +20°C folllowed by 12 hours using hot air between 60°C to 90°C. This is requirement for concentrated acid service.

3.10 Recommended Application Equipment

Airless Spray:	63:1 ratio or greater pump. All internal filters in pump and gun removed. Use a 23 thou reversible fluid tip i.e. 623. Use new spray hoses.
Conventional Spray:	Not Applicable
Brush:	For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer – Approved Saudi Aramco Data Sheet

APCS-27 - DuraPol UHT (Cont'd

4 Physical Properties

4.1	Volume Solids (ASTM D2697)	: 100%
4.2	Product Weight (ASTM D1475)	: 1.9 KG/L
4.3	Viscosity (ASTM D562)	: 25,000 cPoise
4.4	Flash Point (ASTM D93 or D56)	: >120°C
4.5	Approved Colors	: Dark Brown, Black
4.6	Finish	: Semi-Gloss

5. Special Instructions

5.1 Store at 30°C approximately 24 hours prior to using

Mix Base and Hardener using an electric power mixer with helical paddle the diameter of which is approximately 1/3 diameter of the product tin.

Never mix part kits

Do not apply repair onto first coat without first sweep blasting. Avoid at all cost repair overlap onto coating not sweep blasted.

Always degrease the metallic surface using an approved alkaline water based degreaser before power washing with fresh water and then grit blasting.

Always apply coating to final full thickness before moving to a new section. Never apply fresh coating onto overspray or coating that has been applied +10 minutes earlier even if it looks wet.

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Saudi Aramco: Company General Use

i. Envirotrol – Approved Products

APCS-5B
Ceramic Cover CC-100*

*Note: Refer to coating manufacturer's Product Data Sheets for the above product.

Saudi Aramco: Company General Use

j. Fosam – Approved Products

APCS-10

Nitoproof 120	Bituminous Coating

Saudi Aramco: Company General Use

Manufacturer-Approved Saudi Aramco Data Sheet

APCS-10

Type of Coating	:	Bituminous Coating: Self-Priming
Manufacturer	:	Fosam Co.
Product Name	:	Nitoproof 120
SAP M/N (SAMS S/N)	:	1000194025 (09-611-715), 1000194029 (09-611-720) or 1000194032 (09-611-725)

1.	Storage			
	1.1	Shelf life, sheltered storage @ 35°C maximum	:	1-½ years
2.	Mixing			
	2.1	No. of Components	:	One
	2.2	Mixing Ratio	:	N/A
	2.3	Thinner	:	Solvent 102
		SAMS S/N	:	None
	2.4	Thinning	:	Maximum 5% by volume when required
	2.5	Induction Time	:	N/A
	2.6	Pot Life	:	N/A
3.	Application			
	3.1	Maximum Allowable Substrate Temperature	:	°C
	3.2	Typical Wet Film Thickness Per Coat	:	500 micrometers
	3.3	Typical Dry Film Thickness Per Coat	:	325 micrometers
	3.4	Theoretical Coverage @ 25 Micrometers	:	13 m^2/l
	3.5	Minimum Number of Coats (Spray Application)	:	Three for buried. Four for immersion.

Saudi Aramco: Company General Use

Manufacturer-Approved Saudi Aramco Data Sheet

APCS-10 - Nitoproof 120 (Cont'd)

3.6 Drying Time

Substrate Temperature	To Handle	Recoat Interval Minimum	Recoat Interval Maximum	To Immersion Water*	To Immersion Buried*
10°C	8 to 16 Hours	12 Hours	None	7 Days	7 Days
30°C	2 to 4 Hours	4 Hours	None	7 Days	7 Days
50°C	30 Minutes	2 Hours	None	4 Days	4 Days

* After full cure

3.7 Recommended Equipment

Airless Spray	:	Tip Size: 0.026 inch Fluid Pressure: 2,030 psi
Conventional Spray	:	Not recommended
Brush	:	Touch-up/repair

4. Technical Properties

4.1	Volume Solids (ASTM D2697)	:	65%
4.2	Product Weight (ASTM D1475)	:	1.17 kg/l
4.3	Viscosity (ASTM D562)	:	KU
4.4	Flash Point (ASTM D93 or D56)	:	37°C

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Saudi Aramco: Company General Use

k. Hempel – Approved Products

APCS-1A

Galvosil 15780	Inorganic Zinc Primer, Solvent-Based
Hempadur Mastic 45880/45881	Epoxy Topcoat

APCS-1B

Hempadur HB Primer 17300 or	Epoxy Primer, with Zinc Phosphate
Hempadur 15570	Epoxy Primer, with MIO

Use Epoxy Topcoat of APCS-1A as topcoat

APCS-1C

Hempadur Zinc 17360	Zinc-Rich Epoxy Primer

Use Epoxy Topcoat of APCS-1A as topcoat

APCS-1D

Use APCS-1A as primer and intermediate coat

Hempathane Topcoat 55210	Polyurethane Topcoat

APCS-1E

Use APCS-1B as primer and intermediate coat
Use Polyurethane Topcoat of APCS-1D as topcoat

APCS-1F

Use APCS-1C as primer and intermediate coat.
Use Polyurethane Topcoat of APCS-1D as topcoat

APCS-2A/B/C

Hempadur 85671	Phenolic Epoxy

APCS-2D

Hempadur 85210	Epoxy Primer and Topcoat

APCS-2G

Hempel’s Vinyl Ester GF 35910	Vinyl Ester, with Glass Flakes

APCS-4

Hempel's ZP Alkyd Primer 12090	Zinc Phosphate Alkyd Primer
Hempel’s Silvium 51570	Aluminum Topcoat

APCS-6

Use Alkyd Primer of APCS-4

Hempalin 52140	Alkyd Topcoat

Saudi Aramco: Company General Use

Hempel - Approved Products (Cont'd)

APCS-9
Hempatex 46330 — Chlorinated Rubber, Self-Priming

APCS-10
Hempinol HB 10270 — Bituminous Coating

APCS-11A
Use primer of APCS-1A
Hempel's Silicone Aluminum 56910 or Hempel's Silicone Acrylic 56940 — Heat Resistant Aluminum Topcoat

APCS-11B
Hempel's Silicone Aluminum 56910 — Heat Resistant Coating, Self-Priming

APCS-11C
Versiline CUI 56990 — Inorganic Copolymer Coating

APCS-12
Use primer and topcoat of APCS-1B

APCS-17A
Use primer of APCS-1A

APCS-19C
Hempadur Multi-Strength GF 35870 — Glass Flake Reinforced Polyester/ Epoxy

APCS-20A
Hempel's Epoxy Resin System 05500 — Fiberglass Reinforced Epoxy, Hand Lay-Up

APCS-20B
Hempel's Sprayfiber 35890 — Fiberglass Reinforced Epoxy, Hand Spray-Applied

APCS-22A
Hempadur 45070 — Epoxy

APCS-26
Hempadur Mastic 45880/45881 — Epoxy Mastic

APCS-26T
Use APCS-26 as primer and Polyurethane Topcoat of APCS-1D as topcoat

APCS-113A
Hempadur 87540

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A

Type of Coating	:	Inorganic Zinc Primer, Solvent-Based
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempel's Galvosil 15780
SAP M/N (SAMS S/N)	:	1000194146 (09-611-958)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	6 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	15789 Liquid
	2.1.2 Hardener (Curing Agent)	:	97170 / 97140 Zinc Dust
2.2	Mixing Ratio (Base: Curing Agent)	:	10 L liquid: 17 Kg Zinc Dust
2.3	Thinner	:	Hempel's 08700
	SAP M/N (SAMS S/N)	:	1000198445 (09-738-220)
2.4	Minimum-Maximum Thinning Requirements	:	up to 50% by Volume
2.5	Induction Time	:	Nil
2.6	Pot Life	:	9 hours @ 25ºC 3 hours @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10-40°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	50-75%
3.3	Typical Wet Film Thickness Per Coat	:	100 microns
3.4	Typical Dry Film Thickness Per Coat	:	65 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A - Hempel's Galvosil 15780 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 26.4 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon steel

3.8 Surface Preparation Requirements:

Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Abrasive blasting with sharp abrasive to minimum Sa 2½ (ISO8501-1:2007) with a surface profile equivalent to Rugotest No. 3, BN10, Keane-Tator Comparator, min.3.0 G/S, or ISO Comparator rough Medium (G). In case of new steel to be exposed to no more than medium aggressive (industrial) environment and without any extraordinary demands to lifetime, a surface preparation degree of SSPC-SP6 may suffice.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	4 days	None	4 hours		
30°C	1 day	None	1 hour		
50°C	6 hours	None	¼ hour		

* Before overcoating after exposure in a contaminated environment, clean thoroughly by high pressure sweet water hosing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip size: 0.019 to 0.023 inch
Fluid pressure: 1,500 psi

Conventional Spray : Tip size: 0.070 to 0.085 inch
Atomizing pressure: 20 to 35 psi

Brush : For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A - Hempel's Galvosil 15780 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	64 to 68%
4.2	Product Weight	(ASTM D1475)	:	2.37 to 2.43Kg/L
4.3	Viscosity	(ASTM D562)	:	67 to 73 KU
4.4	Flash Point	(ASTM D93 or D56)	:	14°C
4.5	Approved Color/s:	19840 Metal Gray		
4.6	Finish:	Flat		

5. Special Instructions:

Topcoating is done when the inorganic zinc primer is fully cured.
The minimum overcoating time is valid @75% relative humidity and sufficient ventilation.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E//1F

Type of Coating	:	Epoxy Primer, Intermediate or Topcoat, Polyamide-Cured
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur Mastic 45880 (Winter Version) Hempadur Mastic 45881 (Summer Version)
SAP M/N (SAMS S/N)	:	1000194629 (09-612-364), 1000194797 (09-612-369) Or 1000194960 (09-612-375)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	45889
	2.1.2 Hardener (Curing Agent)	:	95880 (Winter) / 95881(Summer)
2.2	Mixing Ratio (Base : Curing Agent)	:	3:1 by Volume
2.3	Thinner	:	Hempel's 08450
	SAP M/N (SAMS S/N)	:	1000198572 (09-738-260)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5-10%
2.5	Induction Time	:	Nil
2.6	Pot Life	:	2¼ hours @ 25ºC ¾ hours @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10-50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min. N/A - Max. 85%

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E//1F - Hempadur Mastic 45880/45881 (Cont'd)

3.3	Typical Wet Film Thickness Per Coat	:	125-138 microns
3.4	Typical Dry Film Thickness Per Coat	:	100-110 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	30.8 m^2/L
3.6	Minimum Number of Coats	:	2

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
20ºC	7 hours	Extended	10 hours		7 days
30°C	6 hours	Extended	8 hours		5 days
40ºC	4 hours	Extended	6 hours		
50°C	2 hours	Extended	4 hours		

* Before overcoating after exposure in a contaminated environment, clean thoroughly by high pressure sweet water hosing and allow to dry. If maximum overcoating interval is exceeded, roughening of the surface is necessary to ensure intercoat adhesion.

3.8 Recommended Application Equipment:

Airless (A/L) Spray	:	Tip size: 0.017 to 0.023 inch Fluid pressure: 3,600 psi
Conventional Spray	:	No
Brush	:	For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E//1F - Hempadur Mastic 45880/45881 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	80+/-1%
4.2	Product Weight	(ASTM D1475)	:	1.37 to 1.43 Kg/L
4.3	Viscosity	(ASTM D562)	:	105 to 115 KU
4.4	Flash Point	(ASTM D93 or D56)	:	35°C
4.5	Approved Color/s:	50630 / Red, 13600/ Grey, 20300/Yellow Other shades available subject for confirmation and requirement related to final coat		
4.6	Finish:	Semi-Gloss		

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E

Type of Coating	:	Epoxy Primer, with Zinc Phosphate
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur HB Primer 17300
SAP M/N (SAMS S/N)	:	1000194626 (09-612-362)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	17309
	2.1.2 Hardener (Curing Agent)	:	95010
2.2	Mixing Ratio (Base : Curing Agent)	:	5:1 by volume
2.3	Thinner	:	Hempel's 08450
	SAP M/N (SAMS S/N)	:	1000198445 (09-738-280)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	Nil
2.6	Pot Life	:	3 hours @ 25ºC 1 hours @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	20-50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 85%
3.3	Typical Wet Film Thickness Per Coat	:	135 microns
3.4	Typical Dry Film Thickness Per Coat	:	75 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E - Hempadur HB Primer 17300 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 22.4 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Steel and other metal

3.8 Surface Preparation Requirements:

New steel: Abrasive blasting to Sa 2½. For temporary protection, if required, use a suitable shop primer. All damage of shop primer and contamination from storage and fabrication should be thoroughly cleaned prior to final painting. For repair and touch-up use HEMPADUR HB PRIMER 17300.

Other metals and light alloys: Thorough degreasing and removal of any salty contamination. Abrasive sweeping to create a suitable dense anchor profile.

Repair and maintenance: Remove oil and grease, etc. with suitable detergent. Remove salt and other contaminants by (high pressure) fresh water cleaning. Clean damaged areas thoroughly by power tool cleaning to St 3 (minor areas) or by abrasive blasting to min. Sa 2, preferably to Sa 2½. Improved surface preparation will improve the performance of HEMPADUR HB PRIMER 17300.Feather edges to sound intact areas. Dust off residues. Touch up to full film thickness.
On pit-corroded surfaces, excessive amounts of salt residues may call for high pressure water jetting, wet abrasive blasting, alternatively dry abrasive blasting, high pressure fresh water hosing, drying, and finally, dry abrasive blasting again.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	10 days	60 days	6 hours		
30°C	2½ hours	18 days	1½ hours		
50°C	1 hour	7 days	1 hour		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E - Hempadur HB Primer 17300 (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.021 inch
Conventional Spray	:	Tip Size: 0.021 inch
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	54 to 58%
4.2	Product Weight	(ASTM D1475)	:	1.47 to 1.53 Kg/L
4.3	Viscosity	(ASTM D562)	:	75 to 80 KU
4.4	Flash Point	(ASTM D93 or D56)	:	26ºC
4.5	Approved Color/s:	21780 Yellow		
4.6	Finish:	Flat		

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E

Type of Coating	:	Epoxy Primer, with Micaceous Iron Oxide (MIO)
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur 15570
SAP M/N (SAMS S/N)	:	1000194626

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	15579
	2.1.2 Hardener (Curing Agent)	:	95570
2.2	Mixing Ratio (Base: Curing Agent)	:	3:1 by volume
2.3	Thinner	:	Hempel's 08450
	SAP M/N (SAMS S/N)	:	1000198445
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	Nil
2.6	Pot Life	:	1½ hours @ 25ºC ½ hours @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	20-50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 85%
3.3	Typical Wet Film Thickness Per Coat	:	140 microns

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E - Hempadur 15570 (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	:	75 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	21.6 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Steel, stainless steel and other metal

3.8 Surface Preparation Requirements:

New steel: Abrasive blasting to Sa 2½ (ISO 8501-1:2007). For temporary protection, if required, use a suitable shop primer. All damage of shop primer and contamination from storage and fabrication should be thoroughly cleaned prior to final painting. For repair and touch-up use: HEMPADUR 15570.

Other metals and light alloys: Thorough degreasing and (light) abrasive sweeping to remove contamination and to secure adhesion - surface profile depending on later exposure.

Stainless steel: (e.g. ballast tanks of chemical carriers) to be abrasive blast cleaned to a uniform, sharp, dense profile (Rugotest No. 3, BN9a, ISO Comparator Medium (G), Keane-Tator Comparator 2.0 G/S) corresponding to Rz minimum 50 micron. Any salts, grease, oil, etc. to be removed before abrasive blasting is commenced.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	8 hours	None	16 hours		
30°C	3 hours	None	4 hours		
50°C	1 hour	None	1 hour		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E - Hempadur 15570 (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.019 to 0.021 inch
Fluid pressure	:	2,500 psi
Conventional Spray	:	N/A
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	52 to 56%
4.2	Product Weight	(ASTM D1475)	:	1.37 to 1.43 Kg/L
4.3	Viscosity	(ASTM D562)	:	90 to 94 KU
4.4	Flash Point	(ASTM D93 or D56)	:	25ºC
4.5	Approved Color/s:	12430 (MIO) Reddish Grey		
4.6	Finish:	Flat		

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1C/1F

Type of Coating	:	Zinc Rich Epoxy Primer
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur Zinc 17360
SAP M/N (SAMS S/N)	:	1000195348 (09-612-580) or 1000195361 (09-612-590)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	17369
	2.1.2 Hardener (Curing Agent)	:	97040
2.2	Mixing Ratio (Base : Curing Agent)	:	4:1 by Volume
2.3	Thinner	:	Hempel's 08450
	SAP M/N (SAMS S/N)	:	1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	Nil
2.6	Pot Life	:	1½ hours @ 25ºC ½ hour @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 to 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	80 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	26 m^2/L

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1C/1F - Zinc Rich Epoxy Primer 17360 (Cont'd)

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon Steel

3.8 Surface Preparation Requirements:

Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Abrasive blasting to Sa 2½ (ISO 8501-1:2007) with a sharp-edged surface profile corresponding to Rugotest No. 3, BN9a, Keane-Tator Comparator, 2.0 G/S, 2 S, or ISO Comparator, Medium (G).

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	4 hours	None	5 hours		
30°C	1 hour	None	1 hour		
50°C	½ hour	None	½ hour		

* Before overcoating after exposure in a contaminated environment, clean thoroughly by high pressure sweet water hosing and allow to dry.

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip size: 0.017 to 0.021 inch
Fluid pressure: 2,200 psi

Conventional Spray :

Brush : For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 63 to 67%

4.2 Product Weight (ASTM D1475) : 2.67 to 2.73 Kg/L

4.3 Viscosity (ASTM D562) : 69 to 101 KU

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1C/1F - Zinc Rich Epoxy Primer 17360 (Cont'd)

4.4	Flash Point	(ASTM D93 or D56)	:	24°C
4.5	Approved Color/s:	19840 / Metal Gray		
4.6	Finish:	Flat		

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T TOPCOAT

Type of Coating	:	Polyurethane Topcoat, Aliphatic
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempathane Topcoat 55210
SAP M/N (SAMS S/N)	:	1000194672 (09-612-365), 1000194675 (09-612-366), 1000194793 (09-612-367), 1000194795 (09-612-368) or 1000194851 (09-612-371)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	55219
	2.1.2 Hardener (Curing Agent)	:	95370
2.2	Mixing Ratio (Base : Curing Agent)	:	7:1 by Volume
2.3	Thinner	:	Hempel's 08080
	SAP M/N (SAMS S/N)	:	1000198479 (09-738-345)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	Nil
2.6	Pot Life	:	3 hours @ 25ºC 1 hour @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10-50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	50-75%
3.3	Typical Wet Film Thickness Per Coat	:	95 microns

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APCS-1D/1E/1F/26T TOPCOAT - Hempathane Topcoat 55210 (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	:	50 microns	
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	20.8 m^2/L	
3.6	Minimum Number of Coats	:	1	

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	12 hours	None	24 hours		
20ºC	6 hours	None	12 hours		7 days
30°C	3 hours	None	6 hours		3.5 days
40ºC	1.5 hours	None	4 hours		
50°C	45 minutes	None	2 hours		

3.8 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.017 to 0.019 inch Fluid pressure: 2,200 psi
Conventional Spray	:	No
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	51%
4.2	Product Weight	(ASTM D1475)	:	1.17 to 1.23 Kg/L
4.3	Viscosity	(ASTM D562)	:	65 to 70 KU

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T TOPCOAT - Hempathane Topcoat 55210 (Cont'd)

4.4	Flash Point (ASTM D93 or D56):	33°C
4.5	Approved Color/s:	50630 / Red, 13600/ Grey, 20300/Yellow, 47050/Green, 10000/White Other shades available subject for confirmation and requirement related to final coat
4.6	Finish:	Glossy

5. Special Instructions:

For APCS-1D, use APCS-1A as primer and intermediate coat.
For APCS-1E use APCS-1B as primer and intermediate coat.
For APCS-1F, use APCS-1C as primer and intermediate coat.
For APCS-26T, use APCS-26 as primer.

The film formation may be adversely affected by light rain, high humidity and/or condensation during application and the following interval after application: 8 hours, 20°C/68°F

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C

Type of Coating	:	Phenolic Epoxy: Amine Adduct Cured
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur 85671
SAP M/N (SAMS S/N)	:	1000195232 (09-612-425) or 1000195235 (09-612-453) for APCS-2A; 1000195317 (09-612-518) or 1000195341 (09-612-546) for APCS-2B; And 1000194295 (09-612-312), 1000194298 (09-612-313) or 1000194352 (09-612-314) for APCS-2C

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	85675
	2.1.2 Hardener (Curing Agent)	:	97371
2.2	Mixing Ratio (Base : Curing Agent)	:	8.8 : 1.2 by volume
2.3	Thinner	:	Hempel's 08450

SAP M/N (SAMS S/N): 1000198377 (09-738-140) for APCS-2A, 1000198372 (09-738-100) for APCS-2B, and 1000198483 (09-738-380) for APCS-2C

2.4	Minimum-Maximum Thinning Requirements	:	up to 10% by Volume
2.5	Induction Time	:	15 mins. @ 20ºC
2.6	Pot Life	:	2¼ hours @ 25ºC ¾ hour @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10-50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C - Hempadur 85671 (Cont'd)

3.3	Typical Wet Film Thickness Per Coat	:	150 microns
3.4	Typical Dry Film Thickness Per Coat	:	100 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	27.2 m^2/L
3.6	Minimum Number of Coats	:	3
3.7	Applicable Substrate	:	Carbon Steel, Concrete

3.8 Surface Preparation Requirements :

New steel: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Abrasive blasting to near white metal Sa 2½ (ISO8501-1:2007) with a surface profile corresponding to Rugotest No. 3, BN10a, Keane-Tator Comparator3.0 G/S, or ISO Comparator Rough Medium (G). Apply immediately after cleaning. All damage of shop primer and contamination from storage and fabrication should be thoroughly cleaned prior to over coating.

Repair and maintenance: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Old steel surfaces having been exposed to salt water, excessive amounts of salt residues in pitting may call for abrasive blasting, high pressure fresh water hosing, drying, and finally, dry abrasive blasting again.

Concrete: Remove slip agent and other possible contaminants by emulsion washing followed by high pressure hosing with fresh water. Remove scum layer and loose matter to a hard, rough and uniform surface, preferably by abrasive blasting, possibly by other mechanical treatment or acid etching. Seal surface with suitable sealer, as per relevant painting specification.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C - Hempadur 85671 (Cont'd)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	1.5 days	50 days	25 hours	18 days	
20°C	1 day	21 days		7 days	
30°C	12 hours	10 days	5 hours	3.5 days	
40°C	8 hours	7 days		3 days	
50°C	3 hours	3 days	1 hour	2 days	

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.018 to 0.021 inch Fluid pressure: 2,900 psi
Conventional Spray	:	No
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	66 to 70%
4.2	Product Weight	(ASTM D1475)	:	1.67 to 1.73Kg/L
4.3	Viscosity	(ASTM D562)	:	88 to 95 KU
4.4	Flash Point	(ASTM D93 or D56)	:	24°C
4.5	Approved Color/s:	42070 / Light Green, 50900/Light Red, 11150/Light Grey		
4.6	Finish:	Flat		

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APCS-2B

Type of Coating	:	Phenolic Epoxy: Amine Adduct Cured
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur 85671
SAP M/N (SAMS S/N)	:	1000195232 (09-612-425) or 1000195235 (09-612-453) for APCS-2A; 1000195317 (09-612-518) or 1000195341 (09-612-546) for APCS-2B; and 1000194295 (09-612-312), 1000194298 (09-612-313) or 1000194352 (09-612-314) for APCS-2C

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	85675
	2.1.2 Hardener (Curing Agent)	:	97371
2.2	Mixing Ratio (Base: Curing Agent)	:	8.8 : 1.2 by volume
2.3	Thinner	:	Hempel's 08450

SAP M/N (SAMS S/N): 1000198377 (09-738-140) for APCS-2A, 1000198372 (09-738-100) for APCS-2B, and 1000198483 (09-738-380) for APCS-2C

2.4	Minimum-Maximum Thinning Requirements	:	up to 10% by Volume
2.5	Induction Time	:	15 mins. @ 20ºC
2.6	Pot Life	:	2¼ hours @ 25ºC ¾ hour @ 40ºC

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APCS-2B Hempadur 85671 (Cont'd)

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10-50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	150 microns
3.4	Typical Dry Film Thickness Per Coat	:	100 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	27.2 m^2/L
3.6	Minimum Number of Coats	:	3
3.7	Applicable Substrate	:	Carbon steel, Concrete

3.8 Surface Preparation Requirements:

New steel: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Abrasive blasting to near white metal Sa 2½ (ISO8501-1:2007) with a surface profile corresponding to Rugotest No. 3, BN10a, Keane-Tator Comparator3.0 G/S, or ISO Comparator Rough Medium (G). Apply immediately after cleaning. All damage of shop primer and contamination from storage and fabrication should be thoroughly cleaned prior to over coating.

Repair and maintenance: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Old steel surfaces having been exposed to salt water, excessive amounts of salt residues in pitting may call for abrasive blasting, high pressure fresh water hosing, drying, and finally, dry abrasive blasting again.

Concrete: Remove slip agent and other possible contaminants by emulsion washing followed by high pressure hosing with fresh water. Remove scum layer and loose matter to a hard, rough and uniform surface, preferably by abrasive blasting, possibly by other mechanical treatment or acid etching. Seal surface with suitable sealer, as per relevant painting specification.

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APCS-2B - Hempadur 85671 (Cont'd)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	90 hours	45 days	25 hours	18 days	
20°C	36 hours	21 days		10 days	
30°C	18 hours	14 days	5 hours	7 days	
40°C	10 hours	8 days		4 days	
50°C	5 hours	3 days	2 hours	2 days	

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.018 to 0.021 inch Fluid pressure: 2,900 psi
Conventional Spray	:	No
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	66 to 70%
4.2	Product Weight	(ASTM D1475)	:	1.67 to 1.73Kg/L
4.3	Viscosity	(ASTM D562)	:	88 to 95 KU
4.4	Flash Point	(ASTM D93 or D56)	:	24°C
4.5	Approved Color/s:	42070 / Light Green, 50900/Light Red, 11150/Light Grey, 11630 / Off-white		
4.6	Finish:	Flat		

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APCS-2D

Type of Coating	:	Epoxy, Amine Adduct Cured, Primer/Topcoat
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur 85210
SAP M/N (SAMS S/N)	:	1000194354 (09-612-316) or 1000194357 (09-612-317)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	85219
	2.1.2 Hardener (Curing Agent)	:	89110
2.2	Mixing Ratio (Base : Curing Agent)	:	4 : 1 by volume
2.3	Thinner	:	Hempel's 08450
	SAP M/N (SAMS S/N)	:	1000198458 (09-738-290)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	Nil
2.6	Pot Life	:	1½ hours @ 25ºC ½ hour @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	15-50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	150 microns

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APCS-2D - Hempadur 85210 (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	:	100 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	26.4 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Carbon Steel

3.8 Surface Preparation Requirements:

Abrasive blasting to near white metal Sa 2 ½ with a surface profile corresponding to Rugotest No. 3, BN10, Keane-Tator Comparator, 3.0 G/S, or ISO Comparator, Rough Medium (G).

3.9 Drying Time:

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	30 hours	8 days	30 hours	18 days	
20ºC	12 hours	3 days		11 days	10 days
30°C	6 hours	36 hours	5 hours	5 days	
40ºC	4 hours	18 hours		3 days	
50°C	2 hours	10 hours	1 hour	2 days	

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.021 inch Fluid pressure: 2,175 psi
Conventional Spray	:	No
Brush	:	For stripe coating / touch-up only

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APCS-2D - Hempadur 85210 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	64 to 68%
4.2	Product Weight	(ASTM D1475)	:	1.37 to 1.43 Kg/L
4.3	Viscosity	(ASTM D562)	:	70 to 75 KU
4.4	Flash Point	(ASTM D93 or D56)	:	35°C
4.5	Approved Color/s:	21240/Yellow, 11630/ Off White		
4.6	Finish:	Semi-Flat		

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APCS-2G

Type of Coating	:	Vinyl Ester, with Glass Flakes
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempel's Vinyl Ester GF 35910
SAP M/N (SAMS S/N)	:	1000709300; 1000709303; 1000709301

1. Storage

1.1	Shelf life, sheltered storage @ 20°C maximum	:	6 months

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio (By Volume)	:	98: 2
2.3	Thinner	:	N/A
	SAP M/N (SAMS S/N)	:	
2.4	Thinning Requirements	:	None or maximum 5% Hempel's Cleaner 99910 Cleaning of tools Hempel's Thinner 08960
2.5	Induction Time	:	Nil
2.6	Pot Life	:	45 mins @ 25°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	Max. 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 85%
3.3	Typical Wet Film Thickness Per Coat	:	725 micrometers
3.4	Typical Dry Film Thickness Per Coat	:	600 micrometers

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APCS-2G - Hempel's Vinyl Ester GF 35910 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	40 m²/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Carbon Steel

3.8 Surface Preparation:

New steel: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high-pressure fresh water cleaning. Minimum surface profile corresponding to Rugotest No. 3, BN11a, Keane-Tator Comparator, 5.5 G/S, or ISO Comparator Coarse (G) - or as per specification for the subsequent coat(s). After blasting, clean the surface carefully from abrasives and dust.

Repair and maintenance: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. On pit-corroded surfaces, excessive amounts of salt residues may call for high pressure water jetting, wet abrasive blasting or, alternatively, dry abrasive blasting, high pressure fresh water hosting, drying, and finally dry abrasive blasting again.

Galvanized, Zinc primed steel etc.: Metallic zinc inhibits the curing process - the product is not compatible with galvanized steel or other zinc coated substrates. Steel primed with zinc dust containing pre-fabrication primers must be re-blasted to min. Sa 2½-3 to remove all traces of zinc.

3.9 Drying Time

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle
10°C	12 Hours	3 Days	11 hrs
20°C	5 Hours	2 Days	6 hrs
30°C	4 Hours	1 Day	3 hrs

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APCS-2G - Hempel's Vinyl Ester GF 35910 (Cont'd)

3.10 Recommended Application Equipment

Airless Spray	:	Tip size 0.030 to 0.060 inch (Reversible Tip) Fluid pressure 4,050 psi
Conventional Spray	:	N/A
Trowel/Brush	:	For touch-up only.

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	1.2 to 1.3 Kg/L
4.3	Viscosity	(ASTM D562)	:	105 to 115 KU
4.4	Flash Point	(ASTM D93 or D56)	:	28°C (82°F)
4.5	Approved Color/s		:	11630/ Off white
4.6	Finish		:	Flat

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APCS-4/6

Type of Coating	:	Zinc Phosphate Alkyd Primer
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempel's ZP Alkyd Primer 12090
SAP M/N (SAMS S/N)	:	1000197976 (09-708-133) or 1000198011 (09-708-137)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	N/A
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Hempel's 08230
	SAP M/N (SAMS S/N)	:	1000198474 (09-738-340)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	Max. 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	98 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	19.6 m^2/L

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APCS-4/6 - Hempel's ZP Alkyd Primer 12090 (Cont'd)

3.6 Minimum Number of Coats : 2

3.7 Applicable Substrate : Steel

3.8 Surface Preparation Requirements:

New steel: Abrasive blasting to Sa 2 (ISO 8501-1:1988) is recommended. For temporary protection, if required, use a suitable shop primer. All damage of shop primer and contamination from storage and fabrication should be thoroughly cleaned prior to final painting. For repair and touch-up use: HEMPEL'S ZP ALKYD PRIMER 12090.

Maintenance: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Remove all rust and loose material by abrasive blasting or power tool cleaning. Dust off residues. Touch up bare spots to full film thickness.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval		To Handle	To Service	Full Cure
	Minimum	Maximum			
10°C	18 hours	15 days	12 hours		
30°C	5 hours	2 days	5 hours		
50°C	1.5 hours	1 day	2 hours		

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.018 inch Fluid pressure: 2,200 psi
Conventional Spray	:	No
Brush	:	For stripe coating / touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4/6 - Hempel's ZP Alkyd Primer 12090 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	48 to 51%
4.2	Product Weight	(ASTM D1475)	:	1.25 to 1.30Kg/L
4.3	Viscosity	(ASTM D562)	:	75 to 80 KU
4.4	Flash Point	(ASTM D93 or D56)	:	38°C
4.5	Approved Color/s	:	2020S/ Yellow	
4.6	Finish	:	Flat	

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APCS-4

Type of Coating	:	Aluminum Topcoat
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempel's Silvium 51570
SAP M/N (SAMS S/N)	:	1000196402 (09-686-354)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum		:	2 years

2. Mixing

2.1	No. of Components		:	1
	2.1.1	Base	:	N/A
	2.1.2	Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio		:	N/A
2.3	Thinner		:	N/A`
	SAP M/N (SAMS S/N)		:	N/A
2.4	Minimum-Maximum Thinning Requirements		:	N/A
2.5	Induction Time		:	N/A
2.6	Pot Life		:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	below 120- 200°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	98 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	19.6 m^2/L

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APCS-4 Topcoat - Hempel's Silvium 51570 (Cont'd)

3.6 Minimum Number of Coats : 1

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	18 hours	None	1.5 days		
20°C	11 hours				
30°C	5 hours	None	8 hours		
40°C	3 hours				
50°C	2 hours	None	3 hours		

3.8 Recommended Application Equipment

Airless (A/L) Spray: Tip size: 0.017 inch, Fluid pressure: 1,500 psi

Conventional Spray: No

Brush: For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 36 to 40%

4.2 Product Weight (ASTM D1475) : 0.97 to 1.03 Kg/L

4.3 Viscosity (ASTM D562) : 51 to 57 KU

4.4 Flash Point (ASTM D93 or D56) : 38°C

4.5 Approved Color/s : 19000/ Aluminum

4.6 Finish : Glossy

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-6

Type of Coating	:	Alkyd Enamel Topcoat, Glossy
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempalin Enamel 52140
SAP M/N (SAMS S/N)	:	1000195487 (09-630-753), 1000195490 (09-630-758), 1000195495 (09-630-763), 1000195532 909-630-768), 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)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	N/A
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Hempel’s thinner 08230`
	SAP M/N (SAMS S/N)	:	1000198474 (09-738-340)
2.4	Minimum-Maximum Thinning Requirements	:	5% maximum
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	50°C maximum

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-6 Topcoat - Hempalin Enamel 52140 (Cont'd)

3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	75 microns
3.4	Typical Dry Film Thickness Per Coat	:	35 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	18.4 m^2/L
3.6	Minimum Number of Coats	:	1

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	16 hours	None	2 days		
20°C	10 hours				
30°C	5 hours	None	12 hours		
40°C	4 hours				
50°C	2 hours	None	8 hours		

3.8 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.018 inch Fluid pressure: 2,200 psi
Conventional Spray	:	Tip size
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	41 to 45%, 44 to 48%

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APCS-6 Topcoat - Hempalin Enamel 52140 (Cont'd)

4.2	Product Weight	(ASTM D1475)	:	0.87 - 0.93 kg/l, 1.07 - 1.13 kg/l
4.3	Viscosity	(ASTM D562)	:	75 to 80 KU
4.4	Flash Point	(ASTM D93 or D56)	:	38°C

4.5 Approved Color/s :

12170/Light Grey, 40730/Green, 19990/Black, 30100/Blue, 42340/Green, 60270/Brown, 10000/White, 40640/Green, 40980/Green, 50040/Orange, 50630/Red, 50800/Red, 21410/Yellow, 2016S/Caterpillar Yellow, 31420/Blue,7604S/Heather

4.6 Finish : Glossy

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-9

Type of Coating	:	Chlorinated Rubber, Self-Priming
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempatex Hi- Build 46330
SAP M/N (SAMS S/N)	:	1000196351 (09-685-442), 1000196312 (09-685-436), 1000196317 (09-685-438), 1000196355 (09-685-448), 1000196359 (09-685-450)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	N/A
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Hempel's 08080
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	Max. 40°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	120 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 microns

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APCS-9 - Hempatex Hi-Build 46330 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	16.8 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Steel, Concrete

3.8 Surface Preparation Requirements:

New steel: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Abrasive blasting to Sa 2½ (ISO 8501-1:1988).For temporary protection, if required, use a suitable shop primer. All damage of shop primer and contamination from storage and fabrication should be thoroughly cleaned prior to final painting.

Repair and maintenance: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Remove all rust and loose material by abrasive blasting or power tool cleaning. Dust off residues. Touch up bare spots to full film thickness.

Concrete: Remove slip agent and other possible contaminants by emulsion washing followed by high pressure hosing with fresh water. Remove scum layer and loose matter to a hard, rough and uniform surface, preferably by abrasive blasting, possibly by other mechanical treatment. Seal surface with suitable sealer, as per relevant painting specification.

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APCS-9 Hempatex Hi-Build 46330 (Cont'd)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	16 hours	none	1 day		
20ºC	8 hours				
30°C	5 hours	None	8 hours		
40ºC	2 hours				
50°C	1.5 hours	None	2 hours		

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.021 to 0.023 inch Fluid pressure: 2,200 psi
Conventional Spray	:	
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	40 to 44%
4.2	Product Weight	(ASTM D1475)	:	1.37 to 1.43 Kg/L
4.3	Viscosity	(ASTM D562)	:	80 to 90 KU
4.4	Flash Point	(ASTM D93 or D56)	:	32°C
4.5	Approved Color/s	:	50630/ Red, 13600/Grey, 42260/Green	
4.6	Finish	:	Flat	

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-10

Type of Coating	:	Bituminous
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempinol HB 10270
SAP M/N (SAMS S/N)	:	1000194025 (09-611-715), 1000194029 (09-611-720) or 1000194032 (09-611-725)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	N/A
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Hempel's 08080
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	Max. 45°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	605 microns
3.4	Typical Dry Film Thickness Per Coat	:	375 microns

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APCS-10 - Hempinol HB 10270 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	24.8 m^2/L
3.6	Minimum Number of Coats	:	2 for buried service 3 for immersion service
3.7	Applicable Substrate	:	Steel and Concrete

3.8 Surface Preparation Requirements:

New steel: Abrasive blasting to minimum Sa 2 or mechanical cleaning to St 3. For temporary protection, if required, use a suitable shop primer. All damage of Shop primer and contamination from storage and fabrication should be thoroughly cleaned prior to final painting. For repair and touch-up use HEMPINOL HB 10270.

Concrete: Remove slip agent and other possible contaminants by emulsion washing followed by high pressure hosing with fresh water. Remove scum layer and loose matter to a hard, rough and uniform surface, preferably by abrasive blasting, possibly by other mechanical treatment or acid etching. Seal surface with suitable sealer, e.g. HEMPADUR SEALER 05990, or apply HEMPINOL HB 10270 directly on concrete, diluted 10 – 20 % with HEMPEL'S THINNER 08080.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	2 days	none	3 days	7 days	
30°C	18 hours	None	1 day	5 days	
50°C	-	None	18 hours	3 days	

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.021 to 0.031 inch Fluid pressure: 2,900 psi
Conventional Spray	:	No
Brush	:	For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-10 - Hempinol HB 10270 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	60 to 64%
4.2	Product Weight	(ASTM D1475)	:	1.19 to 1.21 Kg/L
4.3	Viscosity	(ASTM D562)	:	More than 141 KU
4.4	Flash Point	(ASTM D93 or D56)	:	38°C
4.5	Approved Color/s	:	19990/Black	
4.6	Finish	:	Flat	

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 11A

Type of Coating	:	Heat Resistant Aluminum Topcoat
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempel's Silicone Aluminum 56910
SAP M/N (SAMS S/N)	:	1000196488 (09-687-325)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	N/A
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Hempel's 08080
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	Max. 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	75 microns
3.4	Typical Dry Film Thickness Per Coat	:	25 microns

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11A - Hempel's Silicone Aluminum 56910 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 14 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	2 days	none	12 hours		
30°C	18 hours	None	4 hours		
50°C	8 hours	None	1.5 hours		

- Before overcoating after exposure in a contaminated environment, clean thoroughly by high pressure fresh water Hosing and allow to dry.

3.8 Recommended Application Equipment

Airless (A/L) Spray : Tip size: 0.017 inch
Fluid pressure: 1,800 psi

Conventional Spray :

Brush : For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 33 to 37%

4.2 Product Weight (ASTM D1475) : 1.07 to 1.13 Kg/L

4.3 Viscosity (ASTM D562) : 59 to 65 KU

4.4 Flash Point (ASTM D93 or D56) : 25°C

4.5 Approved Color/s : 19000/ Aluminum

4.6 Finish : Semi-Flat

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11A

Type of Coating	:	Heat Resistant Aluminum Topcoat
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempel's Silicone Acrylic 56940
SAP M/N (SAMS S/N)	:	1000196488 (09-687-325)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	N/A
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Hempel's 08080
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	up to 15%
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	Max. 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	85 microns
3.4	Typical Dry Film Thickness Per Coat	:	25 microns

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11A - Hempel's Silicone Acrylic 56940 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers : 11.6 m^2/L
Dry Film Thickness 21.2 microns (colors)

3.6 Minimum Number of Coats : 1

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	16 hours	none	7 hours		
30°C	5 hours	None	2 hours		
50°C	1.5 hours	None	½ hour		

- Before overcoating after exposure in a contaminated environment, clean thoroughly by high pressure fresh water Hosing and allow to dry.

3.8 Recommended Application Equipment

Airless (A/L) Spray : Tip size: 0.017 inch
Fluid pressure: 1,800 psi

Brush : For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 27 to 31%

4.2 Product Weight (ASTM D1475) : 1.07 to 1.13 Kg/L

4.3 Viscosity (ASTM D562) : 59 to 65 KU

4.4 Flash Point (ASTM D93 or D56) : 25°C

4.5 Approved Color/s : 19000/ Aluminum
4.6 Finish : Semi-Flat

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11B

Type of Coating	:	Heat Resistant Aluminum Coating, Self-Priming
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempel's Silicone Aluminum 56910
SAP M/N (SAMS S/N)	:	1000196502 (09-687-330)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	N/A
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Hempel's 08080
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	Max. 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	75 microns
3.4	Typical Dry Film Thickness Per Coat	:	25 microns

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11B - Hempel's Silicone Aluminum 56910 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 14 m^2/L

3.6 Minimum Number of Coats : 2

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	2 days	none	12 hours		
20°C	24 hours	None			
30°C	18 hours	None	4 hours		
40°C	12 hours	None			
50°C	8 hours	None	1.5 hours		

3.8 Recommended Application Equipment

Airless (A/L) Spray : Tip size: 0.017 inch
Fluid pressure: 1,800 psi

Brush : For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 33 to 37%

4.2 Product Weight (ASTM D1475) : 1.07 to 1.13 Kg/L

4.3 Viscosity (ASTM D562) : 59 to 65 KU

4.4 Flash Point (ASTM D93 or D56) : 25°C

4.5 Approved Color/s : 19000/ Aluminum

4.6 Finish : Semi-Flat

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APCS-11C

Type of Coating	:	Single component inorganic copolymer coating
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	VERSILINE CUI 56990
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year at 25°C

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	N/A
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Hempel's Thinner 08080
	SAP M/N (SAMS S/N)	:	None
2.4	Minimum-Maximum Thinning Requirements	:	Up to 5% (A/L spray/Brush); 10% (Air spray) by Volume
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C-200°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	40-80%
3.3	Typical Wet Film Thickness Per Coat	:	200 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11C - VERSILINE CUI 56990 (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	:	150 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	29.6 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Carbon Steel and Stainless Steel
3.8	Surface Preparation Requirements	:	Carbon Steel – Abrasive blasting to near white metal Sa 2½ (ISO 8501-1:2007) with a surface profile corresponding to Rugotest No. 3, BN10a, Keane-Tator Comparator 3.0 G/S, or ISO Comparator Rough Medium (G). Stainless Steel - Abrasive blast cleaned to Sa 2½, ISO 8501-1:2007. Abrasive blasting should be carried out using non-metallic abrasives to achieve a sharp and angular dense surface profile with no blank spots. (Consult HEMPEL for more details)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	12 hrs	Extended*	24 hrs	36 hrs	NA**
20°C	6 hrs	Extended*	12 hrs	18 hrs	NA**
30°C	3 hrs	Extended*	6 hrs	9 hrs	NA**
40°C	2 hrs	Extended*	4 hrs	6 hrs	NA**
50°C	1.5 hrs	Extended*	3 hrs	4.5 hrs	NA**

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APCS-11C - VERSILINE CUI 56990 (Cont'd)

Minimum curing temperature is 10C
*Applicable when the system has not been in service at temperatures higher than ambient.
**Please note that VERSILINE CUI 56990 utilizes two separate curing mechanisms.

1) At ambient conditions, the coating will behave like a physical drying paint wherein as the solvent evaporates only little crosslinking takes place.

2) When exposed to heat the second curing mechanism will set in resulting in irreversible crosslinking. After crosslinking the film is fully cured and maximum corrosion protection is reached. It cannot be dissolved in solvent and it will be hard at any temperature. Full curing is achieved after approx. 24 h at 200°C or 5 hours 250°C.

3.10 Recommended Application Equipment

Airless (A/L) Spray:	Large pump is preferred with a pump capacity of 8-12 liters/minute Minimum 45:1 Pump ratio, Nozzle orifice: 0.017”-0.021”, Nozzle pressure: 125-200 bar (Spray data are indicative and subject to adjustment)
Brush:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	74%
4.2	Product Weight	(ASTM D1475)	:	1.9 kg/l
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	29°C
4.5	Approved Color/s		:	10710; 19360; 15730
4.6	Finish		:	Flat
4.7	Maximum operating temperature		:	650°C

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APCS-11C - VERSILINE CUI 56990 (Cont'd)

5. Special Instructions:

Please note until heat cured, care in handling should be observed as the film can become soft at elevated temperatures above approx. 70°C. Heating to 100 deg C for 5 days will start the crosslinking process and therefore harden the coating

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-12

Type of Coating	:	Epoxy Topcoat, Polyamide Cured
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur Mastic 45580 / 45881
SAP M/N (SAMS S/N)	:	1000194629 (09-612-364), 1000194797 (09-612-369) Or 1000194960 (09-612-375)

Use primer and topcoat of APCS-1B and refer to APCS-12 of Saudi Aramco Engineering Standard SAES-H-001 for application of aggregate (Hempel's Anti-Slint 67500)

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APCS-19C

Type of Coating	:	Glass Flake Reinforced Epoxy
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur Multi-Strength GF 35870
SAP M/N (SAMS S/N)	:	1000788243, 1000788244

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum		:	1 year

2. Mixing

2.1	No. of Components		:	2
	2.1.1	Base	:	35879
	2.1.2	Hardener (Curing Agent)	:	98870
2.2	Mixing Ratio (Base : Curing Agent)		:	3:1 by Volume
2.3	Thinner		:	Hempel's Thinner 08450
	SAP M/N (SAMS S/N)		:	
2.4	Minimum-Maximum Thinning Requirements		:	5%
2.5	Induction Time		:	Nil
2.6	Pot Life		:	1 hour @ 20ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10-50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	875 microns
3.4	Typical Dry Film Thickness Per Coat	:	750 microns

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APCS-19C - Hempadur Multi-Strength GF 35870 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	28.7 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Steel

3.8 Surface Preparation Requirements:

New steel: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Abrasive blasting to near white metal Sa 2½ with a surface profile corresponding to Rugotest No. 3, BN10, Keane-Tator Comparator 3.0 G/S, or ISO Comparator Rough Medium (G). After blasting, clean the surface carefully from abrasives and dust.

Maintenance: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Remove all rust and loose material by wet or dry abrasive blasting or power tool cleaning. Feather edges to sound and intact areas. After wet abrasive blasting hose down the surface with fresh water and allow drying. Touch up bare spots to full film thickness when the surface has become visually dry.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	20 hours	75 days			
20°C	8 hours	30 days			
30°C	4 hours	15 days			
40°C	2 hours	9 days			
50°C	1 hour	5 days			

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APCS-19C - Hempadur Multi-Strength GF 35870 (Cont'd)

3.10 Recommended Application Equipment

Airless Spray	:	Standard heavy duty airless spray equipment: Recommended pump ratio minimum 45:1 Pump output: 12 L/min. (theoretical)
Conventional Spray	:	N/A
Trowel/Hand	:	Not suitable

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	87%
4.2	Product Weight	(ASTM D1475)	:	1.3 Kg/L
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	35ºC
4.5	Approved Color/s	:	27230, 17380	
4.6	Finish	:	Glossy	

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A

Type of Coating	:	Fiberglass Reinforced Epoxy: Hand Applied
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempel's Epoxy Resin 05500
SAP M/N (SAMS S/N)	:	None

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	05509
	2.1.2 Hardener (Curing Agent)	:	98500
2.2	Mixing Ratio (Base : Curing Agent)	:	1.8:1 by Volume
2.3	Thinner	:	N/A
	SAP M/N (SAMS S/N)	:	N/A
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	Nil
2.6	Pot Life	:	3 hours @ 25ºC 1 hour @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	15- 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	500 microns
3.4	Typical Dry Film Thickness Per Coat	:	500 microns

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APCS-20A - Hempel's Epoxy Resin 05500 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : steel, concrete

3.8 Surface Preparation Requirements:

Steel: Abrasive blasting to Sa 2½ or Sa 3 depending on area of use. Surface profile corresponding to Rugotest No. 3 BN11, Keane-Tator Comparator 5.5 G/S, or ISO Comparator, Coarse (G). Oil and grease must be removed with suitable detergent, salt and other contaminants by (high pressure) fresh water cleaning prior to blasting. After blasting clean the surface carefully from abrasives and dust. The blasted and cleaned surface may advantageously be primed with HEMPADUR 15590, at a dry film thickness of 30 to 50 micron. Avoid a higher dry film thickness of the primer.

Concrete: The concrete must be of good quality and fully cured, e.g. 28 days for normal Portland cement, and completely dry with a humidity content in the surface below 4%. The concrete must also be controlled for absence of capillary water action or for subsoil water.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	54 hours	54 days	54 hours	16 days (water)	
30°C	14 hours	14 days	14 hours	3½ days (water)	
50°C	4 hour	4 days	4 hours	2 days (water)	

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A - Hempel's Epoxy Resin 05500 (Cont'd)

3.10 Recommended Application Equipment

As indicated in below Section 5 Special Instructions.

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	1.07 to 1.13 Kg/L
4.3	Viscosity	(ASTM D562)	:	More than 140 KU
4.4	Flash Point	(ASTM D93 or D56)	:	N/A
4.5	Approved Color/s	:		
4.6	Finish	: Glossy		

5. Special Instructions:

Application: **Application of resin and glassfiber mat:**

Apply HEMPEL'S EPOXY RESIN 05500 by means of **medium pile (mohair) rollers** in a wet film thickness of 500-600 micron. Ensure a homogeneous wet film distribution and proper film formation during application. Roll out the full glassfiber mat (e.g. HEMPEL'S GLASSFIBER MAT 690SA), straighten the mat by pulling gently at both ends simultaneously and lay the mat on the wet resin. In case working with the full length of the mat is difficult and shows a high density of wrinkles, cutting the mat in lengths of 6 to 8 meters is recommended.

For application on the side shell, lengths of 3 to 4 meters may be considered in order to prevent sagging of the coating systems at longer lengths. Press the glassfiber mat into the resin, using **serrated/split-washer rollers**. It is important that this process is maintained for a sufficient period of time, using an adequate pressure, in order to flatten and saturate the mat and expel all (entrapped) air from the coating system. Apply additional resin and repeat the rolling procedure in order to ensure a proper saturation. This process should be completed before HEMPEL'S EPOXY RESIN 05500 has reached the end of its pot life. **Small serrated/split-washer rollers** are recommended for usage on areas like corners and joints.

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APCS-20A - Hempel's Epoxy Resin 05500 (Cont'd)

The overlap of the glassfiber mat from side shell on the tank bottom should be at least 30 cm. A minimum overlap of 10 cm between adjacent mats is recommended. Do not allow overlaps of mats to be positioned on the same location as welding seams or areas that have been treated with a filler or epoxy resin-silica sand mixture.

Wrinkles in the mat must be avoided at all times.

If they are not removed by the process described above, they should be eliminated while the epoxy resin is still wet, by making an incision in the center of the wrinkle with a sharp knife, followed by pressing with a **serrated roller**.

Stripe Coating:

Edges corners, manual welds and placed difficult to cover properly, should be stripe coated (touched up) with HEMPEL'S EPOXY RESIN 05500 either before or after application of the first coat of epoxy resin and glassfiber mat. Normally, a minimum of two stripe coats is recommended in order to achieve the specified dry film thickness.

Application of surface tissue:

It is recommended to apply a layer of surface tissue (e.g. HEMPEL'S GLASSFIBER SURFACING TISSUE 691SA), shortly after application of the first coat of epoxy resin and glassfiber mat. This surface tissue has the purpose to imbed fibers from the glassfiber mat which are protruding through the epoxy resin and is applied in accordance with the same procedure as for the application of the glassfiber mat (apply epoxy resin, lay out mat, saturate). If rectified by the given condition of the first coat of epoxy resin and glassfiber mat, it may be considered to apply the second coat of epoxy resin without surface tissue. When this stage is completed, the glassfiber system will have a typical (total) dry film thickness of approximately 1000-1200 micron.

Application of sealer coat:

When the full glassfiber-epoxy resin system is through dry (after approximately 24 hours at 20°C/68°C), the surface should be sanded down with **emery paper (grit 240-320)** to remove any protruding glass fibers and imbedded or fairly adhering contamination. After sanding, clean the surface thoroughly (for dust) by means of an industrial vacuum cleaner. Apply one seal coat of HEMPEL'S EPOXY RESIN 05500 at a wet film thickness of 300 micron.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20B

Type of Coating	:	Fiberglass Reinforced Epoxy: spray applied
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur Spray-fiber 35890
SAP M/N (SAMS S/N)	:	None

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	35899
	2.1.2 Hardener (Curing Agent)	:	95890
2.2	Mixing Ratio (Base : Curing Agent)	:	2:1 by Volume
2.3	Thinner	:	N/A
	SAP M/N (SAMS S/N)	:	N/A
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	N/A
2.6	Pot Life	:	30 minutes @ 20ºC @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	15- 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%
3.3	Typical Wet Film Thickness Per Coat	:	1,250 microns
3.4	Typical Dry Film Thickness Per Coat	:	1,250 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20B - Hempel's Spray Fiber 35890 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	steel and concrete
3.8	Surface Preparation Requirements	:	

Steel: Abrasive blasting to Sa 2½ or Sa 3, depending on area of use. Surface profile corresponding to Rugotest No. 3 BN 11, Keane-Tator Comparator 5.5 G/S, or ISO Comparator, Coarse (G). Oil and grease must be removed with suitable detergent, salt and other contaminants by (high pressure) fresh water cleaning prior to blasting. After blasting, clean the surface carefully from abrasives and dust. The blasted and cleaned surface may advantageously be primed with HEMPADUR 15590.

Concrete: Remove slip agent and other possible contaminants by emulsion cleaning followed by high pressure hosing with fresh water. Remove scum layer and loose matter to a hard, rough and uniform surface, preferably by abrasive blasting, possibly by other mechanical treatment, flame cleaning or acid etching. Seal surface with suitable sealer, e.g. HEMPADUR SEALER 05990 (furthermore, see Product Data Sheet for 05990).

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	1 day	2.5 days	1 day	16 days	
30°C	12 hours	1 days	12 hours	3½ days	
50°C	4 hour	10 hours	4 hours	2 days	

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20B Hempel's Spray Fiber 35890 (Cont'd)

3.10 Recommended Application Equipment:

Airless Spray (for primer)

Trowel (for caulking compound)

Aluminum/Stainless Steel serrated Rollers (for pressing of chopped fiberglass)

Specialized 'Graco' hydrocat with fiber chopper

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	1.17 to 1.23 Kg/L
4.3	Viscosity	(ASTM D562)	:	100 to 120 KU
4.4	Flash Point	(ASTM D93 or D56)	:	>60ºC
4.5	Approved Color/s	:	60090/Brown	
4.6	Finish	:	Glossy	

5. Special Instructions:

5.1 Abrasive blast clean to Sa 2½ with surface profile Rugotest no. 3 BN11 min

5.2 Apply one coat of primer (Hempadur 155900) to a dry film thickness of 40 microns.

5.3 When dry but within 30 days and by using modified 'Graco' Hyrdocat, apply Hempel's Sprayfiber 3588 caulking material to all welds, plate laps, fillets and other areas of sharp dimensional changes.

5.4 When dry but within three days @ 20ºC apply a mixture of Hempel's Sprayfiber 35890 and a chopped fiberglass. The mixture is applied by a modified 'Graco' hydrocat to a minimum of 1,250 microns dry film thickness. The fiberglass is applied @ approximately 450 g/m^2.

5.5 When dry but within two days @ 20ºC, apply a gelcoat of Sprayfiber 35890 by using a Graco hydrocat. The dry film thickness should be 350 microns minimum.

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APCS-20B - Hempel's Spray Fiber 35890 (Cont'd)

5.6 The system shall have a minimum total of 1,600 microns film thickness.

5.7 Required materials in addition to Hempel's Spray Fiber 35890:

5.7.1 Primer: Hempadur 15590

5.7.2 Caulking Compound: Mixture of Hempel's Epoxy Resin 35890 and Hempel's Anti Slint 67500. Approx. 2.0 – 2.5 kgs 67500 to 750 ml of mixed resin 35890.

5.7.3 Hempadur Multi-Mil 85490: Filler for deep pitting

5.7.4 Hempel's Glassfiber roving 689SA

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A

Type of Coating	:	Epoxy, Polyamine Cured
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur 45070
SAP M/N (SAMS S/N)	:	Primer: 09-612-352/357/358/359/360/361/459/462/465/467; 1000194560 (09-612-352) or 1000195239 (09-612-459); 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)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	45079
	2.1.2 Hardener (Curing Agent)	:	97070
2.2	Mixing Ratio (Base : Cueing Agent)	:	4:1 by Volume
2.3	Thinner	:	Hempel's thinner 08450
	SAP M/N (SAMS S/N)	:	1000198471 (09-738-300)
2.4	Minimum-Maximum Thinning Requirements	:	5% maximum
2.5	Induction Time	:	Nil
2.6	Pot Life	:	1½ hours @ 25ºC ½ hour @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A - Hempadur 45070 (Cont'd)

3.3	Typical Wet Film Thickness Per Coat	:	205 microns
3.4	Typical Dry Film Thickness Per Coat	:	150 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	29.2 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	steel

3.8 Surface Preparation Requirements:

Repair and maintenance: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Clean damaged areas thoroughly by power tool cleaning to St 3 (spot-repairs) or by abrasive blasting to min. Sa 2, preferably to Sa 2½(ISO 8501-1:1988). Improved surface preparation will improve the performance. As an alternative to dry cleaning, water jetting to min. WJ-3, preferably WJ-2 (NACE No. 5/SSPC-SP 12), may be used. A flash-rust degree of maximum FR-2 (Hempel's standard) is acceptable before application. Feather edges to sound and intact areas. Dust off residues. Touch up bare spots to full film thickness. On pit-corroded surfaces, excessive amounts of salt residues may call for high pressure water jetting, wet abrasive blasting, alternatively dry abrasive blasting, high pressure fresh water hosting, drying, and finally dry abrasive blasting again.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	32 hours	10 days	32 hours		
20ºC	16 hours	5 days	16 hours		
30°C	10 hours	3-5 days	10 hours		
40ºC	6-9 hours	1½ days	6 hours		
50°C	4 hours	1 day	4 hours		

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A - Hempadur 45070 (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Size 0.021 to 0.023 inch Fluid pressure 3,600 psi
Conventional Spray	:	N/A
Trowel/Hand	:	Touch up
Brush	:	Touch up

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	71 to 75%
4.2	Product Weight	(ASTM D1475)	:	1.37 to 1.43 Kg/L
4.3	Viscosity	(ASTM D562)	:	105 to 115 KU
4.4	Flash Point	(ASTM D93 or D56)	:	35ºC
4.5	Approved Color/s	:	11630/Off White, 17380/Grey, 23550/Yellow, 50806/Red	
4.6	Finish	:	Flat	

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26

Type of Coating	:	Epoxy Mastic, Polyamine Cured
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur Mastic 45880 (Winter Version) / Hempadur Mastic 45881 (Summer Version)
SAP M/N (SAMS S/N)	:	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)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	45889
	2.1.2 Hardener (Curing Agent)	:	95880 (Winter) / 95881 (Summer)
2.2	Mixing Ratio (Base : Curing Agent)	:	3:1 by Volume
2.3	Thinner	:	Hempel's 08450
	SAP M/N (SAMS S/N)	:	1000198572 (09-738-260)
2.4	Minimum-Maximum Thinning Requirements	:	up to 5%
2.5	Induction Time	:	Nil
2.6	Pot Life	:	2¼ hours @ 25ºC ¾ hours @ 40ºC

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10-50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 75%

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26 - Hempadur Mastic 45880 / 45881 (Cont'd)

3.3	Typical Wet Film Thickness Per Coat	:	200 microns 169 microns (Alum.)
3.4	Typical Dry Film Thickness Per Coat	:	150 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	30.8 m^2/L
3.6	Minimum Number of Coats	:	2

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	10 hours	60 days	16 hours		
20°C					7 days
30°C	1 day	None	1 hour		5 days
40°C					
50°C	6 hours	None	¼ hour		

3.8 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size: 0.017 to 0.023 inch Fluid pressure: 3,600 psi
Conventional Spray	:	No
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	75 to 79% 72 to 76% (Aluminum)

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26 - Hempadur Mastic 45880 / 45881 (Cont'd)

4.2	Product Weight	(ASTM D1475)	:	1.37 to 1.43 Kg/L 1.33 to 1.39 kg/l (Aluminum)
4.3	Viscosity	(ASTM D562)	:	105 to 115 KU
4.4	Flash Point	(ASTM D93 or D56)	:	35°C

4.5	Approved Color/s	:	Gray, Black, White, Orange, Red, Yellow, Aluminum
4.6	Finish	:	Semi-Gloss

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26T Topcoat

Type of Coating	:	Aliphatic Polyurethane Topcoat
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempathane Topcoat 55210
SAP M/N (SAMS S/N)	:	1000194672 (09-612-365), 1000194675 (09-612-366), 1000194793 (09-612-367), 1000194795 (09-612-368) or 1000194851 (09-612-371)

Use APCS-26 as primer and Polyurethane Topcoat of APCS-1D as topcoat.

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-113A

Type of Coating	:	100% Solids Epoxy
Manufacturer	:	Hempel Paints (Saudi Arabia) W.L.L.
Product Name	:	Hempadur 87540
SAP M/N (SAMS S/N)	:	1000686070 (09-000-497)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	(87549)
	2.1.2 Hardener (Curing Agent)	:	(97740)
2.2	Mixing Ratio	:	(2:1 by volume)
2.3	Thinner	:	N/A
	SAP M/N (SAMS S/N)	:	N/A
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A for dual feed spray

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 to 90°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Max. 85%
3.3	Typical Wet Film Thickness Per Coat	:	500 to 625 microns
3.4	Typical Dry Film Thickness Per Coat	:	500 to 625 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-113A - Hempadur 87540 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	40 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Steel

3.8 Surface Preparation Requirements :

New steel: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Abrasive grit blasting to minimum Sa 2½ (ISO8501-1:2007). Recommended surface profile is Rz 75-100 micron/3-4 mils, corresponding to Rugotest No. 3, BN10, Keane-Tator Comparator, minimum 3.0 G/S, or ISO Comparator, Medium (G). After blasting clean the surface carefully from abrasives and dust. After blasting, clean the surface carefully from abrasives and dust.

Repair and maintenance: Remove oil and grease etc. thoroughly with suitable detergent. Remove salts and other contaminants by high pressure fresh water cleaning. Abrasive grit blasting to minimum Sa 2½ (ISO 8501-1:2007). Recommended surface profile is Rz 75-100 micron/3-4 mils, corresponding to Rugotest No. 3, BN10, Keane-Tator Comparator, minimum 3.0 G/S, or ISO Comparator, Medium (G). After blasting clean the surface carefully from abrasives and dust. After blasting, clean the surface carefully from abrasives and dust.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	8 hours	3 days	4 hours	6 days (water)	
30°C	3 hours	2 days	1 hour	2 days (water)	
50°C	2 hours	2 days	10 minutes	4 hours (water)	

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-113A - Hempadur 87540 (Cont'd)

3.10 Recommended Application Equipment

Dual Feed Airless Spray	:	Tip size to 0.025 inch Fluid Pressure 2,500 psi
Conventional Spray	:	N/A
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	1.8 Kg/L
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	121ºC

4.5	Approved Color/s	:	50700/Red
4.6	Finish	:	Glossy

Saudi Aramco: Company General Use

I. Jotun – Approved Products

APCS-1A

Resist 78	Inorganic Zinc-Primer: Solvent-Based
Resist 5 WF	Inorganic Zinc Primer: Water-Based
Penguard Express	Epoxy Intermediate Coat
Penguard FC	Epoxy Topcoat

APCS-1B

Penguard Express ZP	Epoxy Primer

Use Epoxy Intermediate Coat and Topcoat of APCS-1A

APCS-1C

Barrier 77	Zinc-Rich Epoxy Primer

Use Epoxy Intermediate Coat and Topcoat of APCS-1A

APCS-1D

Use APCS-1A as primer and intermediate coat

Hardtop XP	Polyurethane Topcoat

APCS-1E

Use APCS-1B as primer and intermediate coat
Use Polyurethane Topcoat of APCS-1D as topcoat

APCS-1F

Use APCS-1C as primer and intermediate coat
Use Polyurethane Topcoat of APCS-1D as topcoat

APCS-2A/2C

Tankguard A.R.	Phenolic Epoxy

APCS-2B

Tankguard 412	Amine Aduct Solvent-Free Epoxy

APCS-2D

Tankguard Storage	Epoxy

APCS-4

Pilot Primer	Zinc Phosphate Primer
Bengalac Silver Aluminum	Alkyd Topcoat: Aluminum

APCS-6

Use Primer of APCS-4

Pilot II	Alkyd Topcoat

Saudi Aramco: Company General Use

Jotun – Approved Products (Cont'd)

APCS-11A
Use primer of APCS-1A

Solvalitt Al	Heat-Resistant Topcoat: Aluminum

APCS-11B

Solvalitt Al	Heat Resistant System: (Self-Priming)

APCS-12
Use APCS-1B as primer, intermediate and topcoat

APCS-17A

Resist 78	Inorganic Zinc-Primer: Solvent-Based

APCS-17B

Resist 5 WF	Inorganic Zinc Primer: Water Based

APCS-20A

Tankguard Storage	Phenolic Epoxy
Chemtech GM Clear	H.S. Epoxy

APCS-22A

Jotamastic 80	Epoxy Primer
Penguard FC	Epoxy Topcoat

APCS-26

Jotamastic 80	Epoxy Mastic

APCS-26T
Use APCS-26 as primer and Polyurethane Topcoat of APCS-1D as topcoat

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A Primer

Type of Coating	:	Inorganic Zinc Primer, Solvent-Based
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Resist 78
SAP M/N (SAMS S/N)	:	1000194146 (09-611-958)

1. Storage

1.1	Shelf life, sheltered storage @ 23 °C maximum	:	Comp A - 6 months Comp B - 48 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Resist 78 - Comp A
	2.1.2 Hardener (Curing Agent)	:	Jotun Zinc 100 - Comp B
2.2	Mixing Ratio (by Volume)	:	9 parts of A : 2.6 parts of B
2.3	Thinner	:	Thinner No. 25
	SAP M/N (SAMS S/N)	:	1000198445 (09-738-220)
2.4	Minimum-Maximum Thinning Requirements	:	0 to 5% by Volume
2.5	Induction Time	:	N/A
2.6	Pot Life	:	8 hours @ 23°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 50 °C
3.2	Minimum-Maximum Allowable Relative Humidity (Jotun Zinc 100 LHA can be used to speed up curing below 60% RH)	:	60 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	90 microns
3.4	Typical Dry Film Thickness Per Coat	:	65 microns

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A Primer – Resist 78 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 28.8 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon Steel

3.8 Surface Preparation Requirements : Sa 2½ (ISO 8501-1)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	13 Hours	None	45 Minutes	13 Hours	*
20°C	8 Hours	None	30 Minutes	8 Hours	*
30°C	4 Hours	None	30 Minutes	4 Hours	*
40°C	1.5 Hours	None	25 Minutes	1.5 Hours	*
50°C	1 Hour	None	20 Minutes	*	*

* Curing Time to be verified by MEK test according to ASTM D4752-87. During and after application, the Relative humidity shall be minimum 50%. Consult Manufacturer application guide.

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip size 0.017 to 0.021 inch
Fluid Pressure 1,400 psi

Conventional Spray : N/A

Brush : Small areas only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 72 ±2%

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A Primer – Resist 78 (Cont'd)

4.2	Product Weight	(ASTM D1475)	:	2.5 Kg/L
4.3	Viscosity	(ASTM D562)	:	N/A
4.4	Flash Point	(ASTM D93 or D56)	:	14 °C
4.5	Approved Color/s	:	Grey	
4.6	Finish	:	matt	

5. Special Instructions: Consult Manufacturer application guide.

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/17B Primer

Type of Coating	:	Inorganic Zinc Primer: Water-Based
Manufacturer	:	Jotun Saudi Company Ltd.
Product Name	:	Resist 5 WF
SAP M/N (SAMS S/N)	:	1000194182 (09-611-969)

1. Storage

1.1	Shelf life, sheltered storage @ 23°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Resist 5 WF Comp A- Liquid
	2.1.2 Hardener (Curing Agent)	:	Resist 5 WF Comp B- Zinc
2.2	Mixing Ratio (by Volume)	:	6.25 parts A : 3.75 parts B
2.3	Thinner	:	Sweet Water
	SAP M/N (SAMS S/N)	:	N/A
2.4	Minimum-Maximum Thinning Requirements	:	Not required
2.5	Induction Time	:	N/A
2.6	Pot Life	:	5 hours @ 25°C 2 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	100 microns
3.4	Typical Dry Film Thickness Per Coat	:	75 microns

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/17B Primer – Resist 5 WF (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	30.0 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Carbon Steel
3.8	Surface Preparation Requirements	:	Sa 2½ (ISO 8501-1)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	1 Day	None	⅔ Hour	*	10 Days
20°C	8 Hours	None	⅔ Hour	*	6 Days
30°C	6 Hours	None	½ Hour	*	5 Days
40°C	5 Hours	None	20 Minutes	*	3 Days
50°C	4 Hours	None	¼ Hour	*	3 Days

* Drying times may change depending on thickness, humidity, airflow etc. Full Cure and To Service are the same. Consult manufacturers Technical Data Sheet and Application Guide for further details.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Via High Pressure pump R-F-W-G-34020
Conventional Spray	:	Tip Size Atomizing Pressure
Brush	:	For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/17B Primer – Resist 5 WF (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	73 to 77%
4.2	Product Weight	(ASTM D1475)	:	2.4 Kg/L
4.3	Viscosity	(ASTM D562)	:	85 to 90 KU
4.4	Flash Point	(ASTM D93 or D56)	:	Non- Flammable

4.5	Approved Color/s	:	Grey
4.6	Finish	:	Matt

5. Special Instructions: Consult manufacturers' Technical Data Sheet and Application Guide for further details.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F Intermediate Coat

Type of Coating	:	Amine cured Epoxy- Intermediate
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Penguard Express
SAP M/N (SAMS S/N)	:	1000194629 (09-612-364)

1. Storage

1.1	Shelf life, sheltered storage @ 23°C maximum		:	24 Months

2. Mixing

2.1	No. of Components		:	2
	2.1.1	Base	:	Penguard Express Comp A
	2.1.2	Hardener (Curing Agent)	:	Penguard Express Comp B
2.2	Mixing Ratio (by Volume)		:	4 parts A : 1 part B
2.3	Thinner		:	Thinner No. 17
	SAP M/N (SAMS S/N)		:	1000198452 (09-738-260)
2.4	Minimum-Maximum Thinning Requirements		:	0-10 %
2.5	Induction Time		:	N/A
2.6	Pot Life		:	2 hours @ 23°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 to 60 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 to 85 %
3.3	Typical Wet Film Thickness Per Coat	:	175 microns
3.4	Typical Dry Film Thickness Per Coat	:	130 microns

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F Intermediate Coat – Penguard Express (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 29.6 m^2/L
3.6	Minimum Number of Coats	: 1
3.7	Applicable Substrate	: CS, GS, Aluminum, Shop primed steel, Coated surfaces, Concrete

3.8 Surface Preparation Requirements

Carbon Steel : Sa 2½

Galvanised steel: Light brush blasting using nonmetallic abrasive leaving a clean, rough and even pattern.

Aluminum: Abrasive blast cleaning to achieve a surface profile using approved nonmetallic abrasive media which is suitable to achieve a sharp and angular surface profile.

Shop primed steel: Abrasive swept or alternatively blasted to Sa 2 of at least 70 % of the surface.

Coated surfaces: Clean, dry and undamaged compatible coating (ISO 12944-4 6.1)

Concrete: Minimum 4 weeks curing. Moisture content maximum 5 %. Prepare the surface by means of enclosed blast shot or diamond grinding and other appropriate means to abrade the surrounding concrete and to remove laitance.
Consult Manufacturer application guide.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	4 Hours	10 Days	6 Hours	8 Days	10 Days
20°C	3 Hours	7 Days	4 Hours	5 Days	7 Days
30°C	2 Hours	6 Days	2.5 Hours	4 Days	6 Days

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F Intermediate Coat – Penguard Express (Cont'd)

40°C	1 Hour	5 Days	2 Hours	3 Days	5 Days
50°C	40 Minutes	3 Days	1.5 Hours	2 Days	3 Days

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.017 to 0.023 inch Fluid pressure 2,100 psi
Conventional Spray	:	Not recommended
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	74% (± 2)
4.2	Product Weight	(ASTM D1475)	:	1.51 Kg/L
4.3	Viscosity	(ASTM D562)	:	300 CPS
4.4	Flash Point	(ASTM D93 or D56)	:	32°C
4.5	Approved Color/s	: Red, Grey, Buff		
4.6	Finish	: matt		

5. Special Instructions: Consult Manufacturer Application Guide.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/22A Topcoat

Type of Coating	:	Polyamide cured Epoxy-Topcoat
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Penguard FC
SAP M/N (SAMS S/N)	:	1000194799, 1000194420, 1000193911

1. Storage

1.1	Shelf life, sheltered storage @ 23 °C maximum	:	24 Months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Penguard FC Comp A
	2.1.2 Hardener (Curing Agent)	:	Penguard FC Comp B
2.2	Mixing Ratio (by Volume)	:	4 parts A : 1 part B
2.3	Thinner	:	Thinner No. 17
	SAP M/N (SAMS S/N)	:	1000198452 (09-738-260)
2.4	Minimum-Maximum Thinning Requirements	:	According to temperature
2.5	Induction Time	:	N/A
2.6	Pot Life	:	2 hours @ 23°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 50 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	130 microns

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APCS-1A/1B/1C/22A Topcoat – Penguard FC (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	:	80 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	24.8 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	CS, SS, GS, Concrete)
3.8	Surface Preparation Requirements	:	**Carbon steel:** Sa 2½ (ISO 8501-1) **Stainless steel:** Abrasive blast cleaning to achieve a surface profile using approved nonmetallic abrasive media which is suitable to achieve a sharp and angular surface profile. **Galvanised steel:** Cleanliness corresponding to description of Sa 1 (ISO 8501-1) **Coated surfaces:** Clean, dry and undamaged compatible coating (ISO 12944-4 6.1)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	15 Hours	3 Months	15 Hours	N/A	8 Days
20°C	10 Hours	3 Months	10 Hours	N/A	5 Days
30°C	6 Hours	3 Months	6 Hours	N/A	3 Days
40°C	4 Hours	2 Months	2 Hours	N/A	2 Days
50°C	3 Hours	1.5 Months	1.5 Hours	N/A	1 Day

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APCS-1A/1B/1C/22A Topcoat – Penguard FC (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.018 to 0.027 inch Fluid pressure 2,100 psi
Conventional Spray	:	Not recommended
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	62% ± 2
4.2	Product Weight	(ASTM D1475)	:	1.4 Kg/L
4.3	Viscosity	(ASTM D562)	:	82 to 100 KU
4.4	Flash Point	(ASTM D93 or D56)	:	28°C
4.5	Approved Color/s	: Grey, Yellow, Red or as per approved		
4.6	Finish	: Semi-Gloss		

5. Special Instructions: Consult Manufacturer Application Guide.

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APCS-1B/1E Primer

Type of Coating	:	Epoxy Primer
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Penguard Express ZP
SAP M/N (SAMS S/N)	:	1000194626

1. Storage

1.1	Shelf life, sheltered storage @ 23°C maximum		:	24 Months

2. Mixing

2.1	No. of Components		:	2
	2.1.1	Base	:	Penguard Express ZP Comp A
	2.1.2	Hardener (Curing Agent)	:	Penguard Express Comp |B
2.2	Mixing Ratio (by Volume)		:	4 parts A : 1 part B
2.3	Thinner		:	Thinner No. 17
	SAP M/N (SAMS S/N)		:	1000198455 (09-738-280)
2.4	Minimum-Maximum Thinning Requirements		:	0-10 %
2.5	Induction Time		:	N/A
2.6	Pot Life		:	2 hours @ 23°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 to 60 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	100 microns
3.4	Typical Dry Film Thickness Per Coat	:	75 microns

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APCS-1B/1E Primer – Penguard Express ZP (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 29.6 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon Steel, Shop primed Steel, Coated surface

3.8 Surface Preparation Requirements : **Carbon steel:** Sa 2½ (ISO 8501-1)
Shop primed steel: Abrasive swept or alternatively blasted to Sa 2 (ISO 8501-1) of at least 70 % of the surface.
Coated surfaces Clean: Clean, dry and undamaged compatible coating (ISO 12944-4 6.1)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	4 Hours	10 Days	15 Hours	8 Days	8 Days
20ºC	3 Hours	10 Days	12 Hours	5 Days	5 Days
30°C	2 Hours	7 Days	10 Hours	4 Days	4 Days
40ºC	1 Hour	5 Days	5 Hours	3 Days	3 Days
50°C	45 Minutes	3 Days	2 Hours	2 Days	2 Days

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip size 0.013 to 0.023 inch
Fluid pressure 2,100 psi

Conventional Spray : Not recommended

Brush : For stripe coating / touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E Primer – Penguard Express ZP (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	74 ±2 %
4.2	Product Weight	(ASTM D1475)	:	1.53 Kg/L
4.3	Viscosity	(ASTM D562)	:	KU
4.4	Flash Point	(ASTM D93 or D56)	:	32°C
4.5	Approved Color/s	: Red		
4.6	Finish	: matt		

5. Special Instructions: Consult Manufacturer Application Guide.

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APCS-1C/1F Primer

Type of Coating	:	Zinc-Rich Epoxy Primer
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Barrier 77
SAP M/N (SAMS S/N)	:	1000195348 or 1000195361

1. Storage

1.1	Shelf life, sheltered storage @ 23°C maximum	:	24 Months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Barrier 77 Comp A
	2.1.2 Hardener (Curing Agent)	:	Barrier/Barrier 77 Comp B
2.2	Mixing Ratio (by Volume)	:	3 parts A : 1 part B
2.3	Thinner	:	Thinner No. 17
	SAP M/N (SAMS S/N)	:	1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements	:	0-5%
2.5	Induction Time	:	N/A
2.6	Pot Life	:	1 day @ 23°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 60 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	75 microns
3.4	Typical Dry Film Thickness Per Coat	:	40 microns

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APCS-1C/1F Primer – Barrier 77 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 21.2 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon steel and Shop primed steel

3.8 Surface Preparation Requirements : **Carbon steel:** Sa 2½ (ISO 8501-1)
Shop primed steel: Abrasive swept or alternatively blasted to Sa 2 (ISO 8501-1) of at least 70% of the surface.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	2 Hours	2 Months	2 Hours		7 Days
20°C	1.5 Hours	1 Month	1.5 Hours		6 Days
30°C	1 Hour	15 Days	1 Hour		2 Days
40°C	40 minutes	7 Days	40 minutes		2 Days
50°C	30 minutes	3 Days	40 minutes		2 Days

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip size 0.015 to 0.021 inch
Fluid Pressure 2,100 psi

Conventional Spray : Not recommended

Brush : For stripe coating / touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 53 ±2%

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APCS-1C/1F Primer – Barrier 77 (Cont'd)

4.2	Product Weight	(ASTM D1475)	:	2.2 Kg/L
4.3	Viscosity	(ASTM D562)	:	85-105 KU
4.4	Flash Point	(ASTM D93 or D56)	:	25°C
4.5	Approved Color/s	:	Grey	
4.6	Finish	:	Flat	

5. Special Instructions: Consult Manufacturer Application Guide.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T Topcoat

Type of Coating	:	Polyurethane Enamel Topcoat
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Hardtop XP
SAP M/N (SAMS S/N)	:	1000194672 (09-612-635), 1000194675 (09-612-366), 1000194793 (09-612-367), 1000194795 (09-612-368) or 1000194851 (09-612-371)

1. Storage

1.1	Shelf life, sheltered storage @ 23°C maximum	:	48 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Hardtop XP Comp A
	2.1.2 Hardener (Curing Agent)	:	Hardtop XP Comp B
2.2	Mixing Ratio (by Volume)	:	8 parts A : 1 part B
2.3	Thinner	:	Jotun Thinner No. 10
	SAP M/N (SAMS S/N)	:	1000198479 (09-738-345)
2.4	Minimum-Maximum Thinning Requirements	:	
2.5	Induction Time	:	N/A
2.6	Pot Life	:	1.5 Hours @ 23 °C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 60 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	80 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 microns

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APCS-1D/1E/1F/26T Topcoat - Hardtop XP (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	25.2 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Coated surfaces
3.8	Surface Preparation Requirements	:	Coated surfaces: Clean, dry and undamaged compatible coating (ISO 12944-4 6.1)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	14 Hours	Extended	14 Hours		14 Days
20°C	9 Hours	Extended	10 Hours		8 Days
30°C	6 Hours	Extended	7 Hours		5 Days
40°C	4 Hours	Extended	4 Hours		3 Days
50°C	3 Hours	Extended	4 Hours		2 Days

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.013 to 0.019 inch Fluid Pressure 2,100 psi
Conventional Spray	:	Tip size 0.011 to 0.019 (HVLP) Tip size 1.1 to 1.9 (pressure pot)
Brush	:	For stripe coating / touch-up

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APCS-1D/1E/1F/26T Topcoat - Hardtop XP (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	63 ±2%
4.2	Product Weight	(ASTM D1475)	:	1.4 Kg/L
4.3	Viscosity	(ASTM D562)	:	190-240 CPS
4.4	Flash Point	(ASTM D93 or D56)	:	30°C
4.5	Approved Color/s	: Yellow, White, Gray, Green, Red		
4.6	Finish	: Gloss		

5. Special Instructions: Consult Manufacturer Application Guide.

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APCS-2A/2C

Type of Coating	:	Phenolic Epoxy
Manufacturer	:	Jotun Saudia Co. Ltd.
Product Name	:	Tankguard AR
SAP M/N (SAMS S/N)	:	1000195232 or 1000195235

1. Storage

1.1	Shelf life, sheltered storage @ 23°C maximum	:	6 Months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Tankguard AR AL Comp A
	2.1.2 Hardener (Curing Agent)	:	Tankguard AR Comp B
2.2	Mixing Ratio (by Volume)	:	6.5 parts A : 1 part B
2.3	Thinner	:	Jotun Thinner No. 23
	SAP M/N (SAMS S/N)	:	1000198377
2.4	Minimum-Maximum Thinning Requirements	:	0-5%
2.5	Induction Time	:	10 min @ 23°C
2.6	Pot Life	:	2 hours @ 23°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 50 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	150 microns
3.4	Typical Dry Film Thickness Per Coat	:	100 microns

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APCS-2A/2C - Tankguard AR (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	27.2 m^2/L
3.6	Minimum Number of Coats	:	3
3.7	Applicable Substrate	:	CS, SS, Aluminum, Concrete
3.8	Surface Preparation Requirements	:	**Carbon Steel**: Sa 2½ (ISO 8501.1) **Stainless Steel**: Abrasive blast cleaning to achieve a surface profile using approved nonmetallic abrasive media which is suitable to achieve a sharp and angular surface profile. **Concrete**: Dry abrasive "Brush Blast" cleaning to NACE No. 4/SSPC-SP 7

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	24 Hours	30 Days	24 Hours	14 Days	14 Days
20ºC	10 Hours	30 Days	10 Hours	7 Days	7 Days
30°C	8 Hours	30 Days	7 Hours	5 Days	5 Days
40ºC	4 Hours	14 Days	4 Hours	3 Days	3 Days
50°C	2 Hours	14 Days	2 Hours	2 Days	2 Days

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APCS-2A/2C - Tankguard AR (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.017 to 0.021 inch Fluid pressure 2,100 psi
Conventional Spray	:	Not Recommended
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	68 ± 2 %
4.2	Product Weight	(ASTM D1475)	:	1.63-1.67 Kg/L
4.3	Viscosity	(ASTM D562)	:	50-120 CPS
4.4	Flash Point	(ASTM D93 or D56)	:	29°C ± 2
4.5	Approved Color/s	:	Aluminum, Aluminum Red toned	
4.6	Finish	:	matt	

5. Special Instructions: Consult Manufacturer Application Guide

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2B

Type of Coating	:	Amine Aduct Solvent Free Epoxy
Manufacturer	:	Jotun Saudia Co. Ltd
Product Name	:	Tankguard 412
SAP M/N (SAMS S/N)	:	1000195317 (09-612-518) or 1000195341 (09-612-546)

1. Storage

1.1	Shelf life, sheltered storage @ 23 °C maximum	:	12 months Comp. A 12 months Comp. B

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Tankguard 412 Comp A
	2.1.2 Hardener (Curing Agent)	:	Tankguard 412 Comp B
2.2	Mixing Ratio (by Volume)	:	2 parts A : 1 part B
2.3	Thinner	:	
	SAP M/N (SAMS S/N)	:	1000198449
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	10 min. 23°C
2.6	Pot Life	:	1 hour at 23°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 60 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	100 microns

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APCS-2B - Tankguard 412 (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	:	100 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	40 m^2/L
3.6	Minimum Number of Coats	:	3
3.7	Applicable Substrate	:	CS, GS, SS, Concrete
3.8	Surface Preparation Requirements	:	**Carbon steel:** Sa 2½ (ISO 8501-1) **Stainless steel:** Abrasive blast cleaning to achieve a surface profile using approved non-metallic abrasive media which is suitable to achieve a sharp and angular surface profile. **Galvanized steel:** Light brush blasting using nonmetallic abrasive leaving a clean, rough and even pattern. **Concrete:** Dry abrasive "Brush Blast" cleaning to NACE No. 4/SSPC-SP 7

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	30 Hours	5 Days	30 Hours	15 Days	15 Days
20°C	12 Hours	5 Days	12 Hours	8 Days	8 Days
30°C	9 Hours	4 Days	9 Hours	6 Days	6 Days
40°C	4 Hours	3 Days	4 Hours	4 Days	4 Days
50°C	3 Hours	2 Days	3 Hours	3 Days	3 Days

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APCS-2B - Tankguard 412 (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.019 to 0.025 inch Fluid pressure 2500 psi
Conventional Spray	:	N/A
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100 %
4.2	Product Weight	(ASTM D1475)	:	1.5 Kg/L
4.3	Viscosity	(ASTM D562)	:	2000-2500 CPS
4.4	Flash Point	(ASTM D93 or D56)	:	100°C
4.5	Approved Color/s	:	Black, Green, Red, White	
4.6	Finish	:	Gloss	

5. Special Instructions: Consult Manufacturer Application Guide

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2D

Type of Coating	:	Modified Amine Cured Epoxy
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Tankguard Storage
SAP M/N (SAMS S/N)	:	Primer 1000194354 (09-612-316); Topcoat 1000194357 (09-612-317)

1. Storage

1.1	Shelf life, sheltered storage @ 23 °C maximum	:	24 months Comp. A 24 months Comp. B

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Tankguard Storage Comp A
	2.1.2 Hardener (Curing Agent)	:	Tankguard Storage Comp B
2.2	Mixing Ratio (by Volume)	:	6.5 part A : 1 part B
2.3	Thinner	:	Jotun Thinner No. 23
	SAP M/N (SAMS S/N)	:	1000198458 (09-738-290)
2.4	Minimum-Maximum Thinning Requirements	:	0-5%
2.5	Induction Time	:	20 minutes
2.6	Pot Life	:	4 hours @ 23°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85%
3.3	Typical Wet Film Thickness Per Coat	:	158 microns
3.4	Typical Dry Film Thickness Per Coat	:	100 microns

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APCS-2D - Tankguard Storage (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 25.2 m^2/L
3.6	Minimum Number of Coats	: 2
3.7	Applicable Substrate	: CS, Coated Surface, GS, SS, Concrete
3.8	Surface Preparation Requirements	**: Carbon steel**: Sa 2½ **Coated surfaces**: Clean, dry and undamaged compatible coating (ISO 12944-4 6.1) **Stainless steel**: Abrasive blast cleaning to achieve surface profile using approved nonmetallic abrasive media which is suitable to achieve a sharp and angular surface profile. **Galvanized steel**: Light brush blasting using nonmetallic abrasive leaving a clean, rough and even pattern. **Concrete**: Dry abrasive "Brush Blast" cleaning to NACE No. 4/SSPC-SP 7

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	24 Hours	30 Days	24 Hours	30 Days	15 Days
20°C	10 Hours	30 Days	10 Hours	30 Days	9 Days
30°C	8 Hours	30 Days	8 Hours	30 Days	5 Days
40°C	4 Hours	30 Days	4 Hours	14 Days	3 Days
50°C	4 Hours	30 Days	4 Hours	14 Days	3 Days

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APCS-2D - Tankguard Storage (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.017 to 0.021 inch Fluid Pressure 2,100 psi
Conventional Spray	:	
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	63±2 %
4.2	Product Weight	(ASTM D1475)	:	1.56 Kg/L
4.3	Viscosity	(ASTM D562)	:	50-120 CPS
4.4	Flash Point	(ASTM D93 or D56)	:	28°C
4.5	Approved Color/s	:	light Grey, Red	
4.6	Finish	:	matt	

5. Special Instructions: Consult Manufacturer Application Guide.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4/6

Type of Coating	:	Alkyd Based-Primer
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Pilot Primer
SAP M/N (SAMS S/N)	:	1000197976 (09-708-133) or 1000198011 (09-708-137)

1. Storage

1.1	Shelf life, sheltered storage @ 23°C maximum	:	24 Months

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	Pilot Primer
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Thinner no.2
	SAP M/N (SAMS S/N)	:	1000198474 (09-738-340)
2.4	Minimum - Maximum Thinning Requirements	:	0 to 5 %
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 40 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	95 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 microns

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APCS-4/6 - Pilot Primer (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	20.8 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	CS, Aluminum
3.8	Surface Preparation Requirements	:	Carbon steel: Sa 2½ (ISO 8501-1) Aluminum: Abrasive blast cleaning to achieve a surface profile using approved nonmetallic abrasive media which is suitable to achieve a sharp and angular surface profile.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	20 Hours	N/A	24 Hours		
20°C	12 Hours	N/A	14 Hours		
30°C	8 Hours	N/A	12 Hours		
40°C	4 Hours	N/A	10 Hours		
50°C	2 Hours	N/A	5 Hours		

* Drying times may change depending on thickness, humidity, airflow etc. Consult manufacturers Technical Data Sheet and Application Guide for further details.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.015 to 0.019inch Fluid Pressure 2,100 psi
Conventional Spray	:	1.1 – 1.9 Atomizing Pressure
Brush	:	For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4/6 - Pilot Primer (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	52 ±2 %
4.2	Product Weight	(ASTM D1475)	:	1.2 to 1.4 kg/l
4.3	Viscosity	(ASTM D562)	:	90 to 94 KU
4.4	Flash Point	(ASTM D93 or D56)	:	36 °C
4.5	Approved Color/s	:	Grey, red	
4.6	Finish	:	Matt	

5. Special Instructions: Consult Manufacturer Application Guide.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4 Topcoat

Type of Coating	:	Alkyd-Based Topcoat: Aluminum Color
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Bengalac Silver Aluminum
SAP M/N (SAMS S/N)	:	1000196402

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum		:	12 Months

2. Mixing

2.1	No. of Components		:	1
	2.1.1	Base	:	Bengalac Aluminum
	2.1.2	Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio		:	
2.3	Thinner		:	Thinner no.2
		SAP M/N (SAMS S/N)	:	1000198474
2.4	Minimum-Maximum Thinning Requirements		:	
2.5	Induction Time		:	N/A
2.6	Pot Life		:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 40 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	0 – 50 %
3.3	Typical Wet Film Thickness Per Coat	:	60 microns
3.4	Typical Dry Film Thickness Per Coat	:	25 microns

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 4 Topcoat - Bengalac Silver Aluminum (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	16.8 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Carbon Steel
3.8	Surface Preparation Requirements	:	The substrate must be sound, clean, dry and free from dust, oil, grease, laitance etc. All traces of foam release agents must be removed. A light sanding with suitable abrasive material is recommended before application. Any resulting dust/loose particles must be removed.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	20 Hours	N/A	12 Hours		
20°C	10 Hours	N/A	8 Hours		
30°C	8 Hours	N/A	4 Hours		
40°C	2 Hours	N/A	1 Hours		
50°C	1 Hours	N/A	1 Hours		

* Drying times may change depending on thickness, humidity, airflow etc. Consult manufacturers Technical Data Sheet and Application Guide for further details.

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APCS- 4 Topcoat - Bengalac Silver Aluminum (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.021 to 0.027 inch Fluid Pressure 2,100 psi
Conventional Spray	:	11-19 (HVLP) 1.1-1.9 mm (Pressure Pot)
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	42±2 %
4.2	Product Weight	(ASTM D1475)	:	0.9 – 1.0 kg/l
4.3	Viscosity	(ASTM D562)	:	140-180 cps at 23°C (ISO 2884)
4.4	Flash Point	(ASTM D93 or D56)	:	36 °C
4.5	Approved Color/s	: Aluminum		
4.6	Finish	:		

5. Special Instructions: Please Consult Manufacturer.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-6 Topcoat

Type of Coating	:	High Gloss Enamel Topcoat
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Pilot II
SAP M/N (SAMS S/N)	:	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)

1. Storage

1.1	Shelf life, sheltered storage @ 23 °C maximum	:	48 Months

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	Pilot II
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	Single Pack
2.3	Thinner	:	Thinner no.2
	SAP M/N (SAMS S/N)	:	1000198474 (09-738-340)
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS - 6 Topcoat – Pilot II (Cont'd)

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 40 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	100 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	19.2 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Coated Surfaces
3.8	Surface Preparation Requirements	:	Coated surfaces: Clean, dry and undamaged compatible coating (ISO 12944-4 6.1)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	24 Hours	N/A	14 Hours		
20ºC	18 Hours	N/A	10 Hours		
30°C	14 Hours	N/A	7 Hours		
40ºC	12 Hours	N/A	3 Hours		
50°C	10 Hours	N/A	2 Hours		

* Drying times may change depending on thickness, humidity, airflow etc. Consult manufacturers Technical Data Sheet and Application Guide for further details.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS - 6 Topcoat – Pilot II (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.015 to 0.019 inch Fluid Pressure 2,100 psi
Conventional Spray	:	0.38 – 0.51mm
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	48±2%
4.2	Product Weight	(ASTM D1475)	:	1.04 kg/L
4.3	Viscosity	(ASTM D562)	:	400-450 cps at 23°C (ISO 2884)
4.4	Flash Point	(ASTM D93 or D56)	:	36 °C

4.5 Approved Color/s:
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) or depending on color

4.6 Finish : Gloss

5. Special Instructions: Consult Manufacturer Application Guide.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS -11A/11B

Type of Coating	:	Silicone Topcoat
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Solvalitt Al
SAP M/N (SAMS S/N)	:	1000196488 (09-687-325)

1. Storage

1.1	Shelf life, sheltered storage @ 23°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	N/A
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	Not Applicable
2.3	Thinner	:	Thinner no.7
	SAP M/N (SAMS S/N)	:	none
2.4	Minimum-Maximum Thinning Requirements	:	0 to 5 % by Volume
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 50 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 – 85 %
3.3	Typical Wet Film Thickness Per Coat	:	70 microns (ALUM.) 60 microns (others)
3.4	Typical Dry Film Thickness Per Coat	:	25 microns

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS – 11A/11B Topcoat – Solvalitt Al (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 14 m^2/L (alum)
3.6	Minimum Number of Coats	: 1
3.7	Applicable Substrate	: CS, GS, SS, Aluminum, etc.)
3.8	Surface Preparation Requirements	: **Carbon steel**: Sa 2½ (ISO 8501-1) **Stainless steel**: Cleanliness and surface profile corresponding to Sa 2½, Fine G (ISO 8503-2) **Aluminum**: The surface shall be hand or machine abraded with non-metallic abrasives or bonded fiber machine or hand abrasive pads to impart a scratch pattern to the surface and to remove all polish from the surface. **Galvanized steel**: Light brush blasting using nonmetallic abrasive leaving a clean, rough and even pattern. **Coated surfaces:** Clean, dry and undamaged compatible coating (ISO 12944-4 6.1)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	5 Hours	Extended	3 Hours	*	*
20°C	4 Hours	Extended	2 Hours	*	*
30°C	3.5 Hours	Extended	2 Hours	*	*
40°C	3 Hours	Extended	1.5 Hours	*	*
50°C	3 Hours	Extended	1.5 Hours	*	*

* (Please consult Manufacture's Technical Data Sheet and Application Guides.)

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS – 11A/11B Topcoat – Solvalitt (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.015 to 0.017 inch Fluid Pressure 1450 psi
Conventional Spray	:	Tip size Atomizing Pressure
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	40+/-2% (Alum) 43+/-2% (others)
4.2	Product Weight	(ASTM D1475)	:	0.9 to 1.2 kg/L (alum.) 1.1 to 1.3 kg/l (others)
4.3	Viscosity	(ASTM D562)	:	100 to 150 cps (alum) 220 to 300 cps (others)
4.4	Flash Point	(ASTM D93 or D56)	:	26 °C
4.5	Approved Color/s	: Aluminum (Al)		
4.6	Finish	: matt		

5. Special Instructions: Consult Manufacturer Application Guide.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS – 20A

Type of Coating	:	Modified Amine Cured Epoxy
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Tankguard Storage
SAP M/N (SAMS S/N)	:	Primer 1000194354 (09-612-316); Topcoat 1000194357 (09-612-317)

1. Storage

1.1	Shelf life, sheltered storage @ 23 °C maximum	:	24 months Comp. A 24 months Comp. B

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Tankguard Storage Comp A
	2.1.2 Hardener (Curing Agent)	:	Tankguard Storage Comp B
2.2	Mixing Ratio	:	6.5 : 1
2.3	Thinner	:	Jotun Thinner No. 23
	SAP M/N (SAMS S/N)	:	1000198458 (09-738-290)
2.4	Minimum-Maximum Thinning Requirements	:	0-5%
2.5	Induction Time	:	20 minutes
2.6	Pot Life	:	4 hours @ 23°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 60 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85 %
3.3	Typical Wet Film Thickness Per Coat	:	158 microns
3.4	Typical Dry Film Thickness Per Coat	:	100 microns

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APCS-20A - Tankguard Storage (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	25.2 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	CS, Coated Surface, GS, SS, Concrete
3.8	Surface Preparation Requirements	:	**Carbon steel**: Sa 2½ (ISO 8501-1) **Coated surfaces**: Clean, dry and undamaged compatible coating (ISO 12944-4 6.1) **Stainless steel**: Abrasive blast cleaning to achieve surface profile using approved nonmetallic abrasive media which is suitable to achieve a sharp and angular surface profile. **Galvanized steel**: Light brush blasting using nonmetallic abrasive leaving a clean, rough and even pattern. **Concrete**: Dry abrasive "Brush Blast" cleaning to NACE No. 4/SSPC-SP 7

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	24 Hours	30 Days	24 Hours	30 Days	15 Days
20°C	10 Hours	30 Days	10 Hours	30 Days	9 Days
30°C	8 Hours	30 Days	8 Hours	30 Days	5 Days
40°C	4 Hours	30 Days	4 Hours	14 Days	3 Days
50°C	4 Hours	30 Days	4 Hours	14 Days	3 Days

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A - Tankguard Storage (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.017 to 0.021 inch Fluid Pressure 2,100 psi
Conventional Spray	:	
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	63±2 %
4.2	Product Weight	(ASTM D1475)	:	1.56 Kg/L
4.3	Viscosity	(ASTM D562)	:	50-120 CPS
4.4	Flash Point	(ASTM D93 or D56)	:	28°C
4.5	Approved Color/s	:	light Grey, Red	
4.6	Finish	:	matt	

5. Special Instructions: Consult Manufacturer Application Guide.

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A

Type of Coating	:	High Solid Epoxy
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Chemtech GM CLEAR
SAP M/N (SAMS S/N)	:	NONE

1. Storage

1.1	Shelf life, sheltered storage @ 23°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Chemtech GM Comp A.
	2.1.2 Hardener (Curing Agent)	:	Chemtech GM Comp B.
2.2	Mixing Ratio	:	2.5 :1 by volume
2.3	Thinner	:	Jotun Thinner no.17
	SAP M/N (SAMS S/N)	:	NONE
2.4	Minimum-Maximum Thinning Requirements	:	According to TEMP.
2.5	Induction Time	:	N/A
2.6	Pot Life	:	30 Minutes @23°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 40°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 – 85%
3.3	Typical Wet Film Thickness Per Coat	:	1,650 microns
3.4	Typical Dry Film Thickness Per Coat	:	1,650 microns

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APCS- 20A – Chemtech GM Clear (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	not applicable
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Carbon Steel
3.8	Surface Preparation Requirements:		Cleanliness and surface profile corresponding to Sa 2½, Medium to Coarse G (ISO 8503-2)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	26 Hours	2 Days	26 Hours	-----	14 Days
20°C	14 Hours	2 Days	14 Hours	-----	8 Days
30°C	10 Hours	20 Hours	10 Hours	-----	6 Days
40°C	7 Hours	16 Hours	7 Hours	-----	3 Days
50°C	5 Hours	12 Hours	5 Hours	-----	2 Days

3.10 Recommended Application

Airless (A/L) Spray	:	Minimum 64:1 Pump Ratio Tip size 0.025-0.031 inch Fluid Pressure 2900 psi
Conventional Spray	:	N/A
Brush	:	For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 20A – Chemtech GM Clear (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100 %
4.2	Product Weight	(ASTM D1475)	:	0.8 kg/L
4.3	Viscosity	(ASTM D562)	:	Viscosity Comp A (ISO-2884) : 2000-2750 CPS Viscosity Comp B (ISO-2884) : 250-350 CPS
4.4	Flash Point	(ASTM D93 or D56)	:	Non flammable
4.5	Approved Color/s	:		Clear, White
4.6	Finish	:		Gloss

5. Special Instructions: Consult Manufacturer Application Guide.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A/26/26T Primer

Type of Coating	:	Epoxy: Damp-Tolerant
Manufacturer	:	Jotun Saudia Company Ltd.
Product Name	:	Jotamastic 80
SAP M/N (SAMS S/N)	:	1000194560 (09-612-352) or 1000195239 (09-612-459)

1. Storage

1.1	Shelf life, sheltered storage @ 23°C maximum	:	48 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	Jotamastic 80 Comp. A
	2.1.2 Hardener (Curing Agent)	:	Jotamastic 80 Comp. B
2.2	Mixing Ratio	:	7:1 by volume
2.3	Thinner	:	Jotun Thinner no.17
	SAP M/N (SAMS S/N)	:	1000198471 (09-738-300)
2.4	Minimum-Maximum Thinning Requirements	:	0 to 10 % by Volume
2.5	Induction Time	:	10 minutes @ 23 ^{0}C
2.6	Pot Life	:	2 hours @25°C 1 hour @40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 60°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	10 - 85%
3.3	Typical Wet Film Thickness Per Coat	:	188 microns
3.4	Typical Dry Film Thickness Per Coat	:	150 microns

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APCS- 22A/26/26T Primer – Jotamastic 80 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	32 m^2/L
3.6	Minimum Number of Coats	:	1-2
3.7	Applicable Substrate	:	CS, Coated Surfaces
3.8	Surface Preparation Requirements	:	**Carbon steel:** Sa 2 (ISO 8501-1) **Shop Primed steel**: Sa 2 (ISO 8501-1) **Coated surfaces**: Clean, dry, and undamaged compatible coating (ISO 12944-4 6.1)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	1 Day	90 Days	1 Day	14 Days	14 Days
20°C	12 Hours	90 Days	12 Hours	9 Days	9 Days
30°C	7 Hours	70 Days	7 Hours	4 Days	4 Days
40°C	4 Hours	60 Days	4 Hours	2 Days	2 Days
50°C	3 Hours	60 Days	3 Hours	2 Days	2 Days

* (Please consult Manufacturer's Technical Data Sheet and Application Guides.)

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip size 0.019 to 0.025 inch Fluid Pressure 2,100 psi
Conventional Spray	:	Not Recommended
Brush	:	For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 22A/26/26T Primer – Jotamastic 80 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	78 to 82 %
4.2	Product Weight	(ASTM D1475)	:	1.50 kg/L
4.3	Viscosity	(ASTM D562)	:	120 to 126 KU
4.4	Flash Point	(ASTM D93 or D56)	:	35 °C

4.5 Approved Color/s: Aluminum, Aluminum red toned, Grey, Red, Green, Off-white, Black

4.6 Finish : Semi-Gloss

5. Special Instructions: Consult Manufacturer Application Guide.

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Saudi Aramco: Company General Use

m. Mascoat – Approved Products

APCS-5A and APCS-5B

Mascoat Industrial - DTI

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-5A/5B

Type of Coating : **Thermal Insulation Coating**

Manufacturer : **Mascoat**

Product Name : **Mascoat Industrial - DTI**

SAP M/N (SAMS S/N) :

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	: 18 months from manufacture date

2. Mixing

2.1	No. of Components	: One, Water Based
	2.1.1 Base	: Acrylic w/ insulation particulate
	2.1.2 Hardener (Curing Agent)	: None
2.2	Mixing Ratio	: N/A
2.3	Thinner:	: Not required
	SAP M/N (SAMS S/N)	:
2.4	Minimum-Maximum Thinning Requirements	: None. Already premixed
2.5	Induction Time	: None. Single component
2.6	Pot Life	: None. Single component

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 15°C (min.), 150°C (max.)
3.2	Minimum-Maximum Allowable Relative Humidity	: Less than 95%
3.3	Typical Wet Film Thickness Per Coat	: 500-600 micon
3.4	Typical Dry Film Thickness Per Coat	: 400-500 micron
3.5	Theoretical Coverage @ 25 Micrometers (DFT)	: 2.6 m^2/liter at 250 microns

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

Mascoat Industrial - DTI - APCS- 5A/5B (Cont'd)

3.6 Minimum Number of Coats : 1-15, each coat is 500 microns

3.7 Applicable Substrate : Primed ferrous, non-primed non-ferrous

3.8 Surface Preparation Requirements : Primed ferrous, non primed non ferrous. Surfarces should be dry and free of any debris. Consult Mascoat application instructions or more detail.

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure (Hours)
10°C	4 hours	no max	10 hours	48 hours	72
20ºC	3 hours	no max	8 hours	36 hours	50
30°C	2 hours	no max	6 hours	24 hours	48
40ºC	1 hour	no max	5 hours	18 hours	36
50°C	45 min	no max	4 hours	12 hours	24

* It is recommend to add heat slowly when putting units from ambient to service. Applications can be applied to hot surfaces up to 150C. This will expedite dry and cure times. Please consult Mascoat for hot application instrtuctions. Heating surface will help to evacuate residual water from coating. If application is sprayed to working equipment (60C or above), recoat time can be reduced and equipment service is immediate.

3.10 Recommended Application Equipment

Airless (A/L) Spray : Airless capable of 1 GPM @ 3000 PSI – Graco pneumatic or gas powered or similar

Conventional Spray : Do not use. Product is not designed for this conventional spray method as it will not convey insulation particulates properly.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

Mascoat Industrial - DTI - APCS- 5A/5B (Cont'd)

	Brush		:	Only for small touchup. Not recommended for large appllications

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	78-80%
4.2	Product Weight	(ASTM D1475)	:	0.6-0.61 kg/liter liquid format 5.0 lbs/gallon liquid format
4.3	Viscosity	(ASTM D562)	:	20-30k cP
4.4	Flash Point	(ASTM D93 or D56)	:	None. Product is water based
4.5	Approved Color/s	:	Signal White (9003) Light Grey (7047) Traffic Black (9017)	
4.6	Finish	:	Flat	

5. Special Instructions:

This coating is designed to reduce surface temperatures and retain heat for energy retention. The product is typically applied in multi coat process and can be sprayed at ambient or on working surfaces.

This coating has passed NACE/ISO criteria for Personnel Protection (5 Ssecond Skin Exposure) purposes to lower surfaces temperatures to acceptable levels as defined by ASTM 1055/1057 and tested to NACE TM21423-2017 for temperatures up to 175C.

For detail of thickness of coating recommendation please consult Mascoat for Energy Retention and Personnel Protection.

Mascoat can also provide a list of compatible primers based on testing performed by Mascoat.

Saudi Aramco: Company General Use

n. Sakaphen – Approved Products

APCS-2G

Sakaflake 900	Vinyl-Ester

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G

Type of Coating	:	Novolac Epoxy Vinyl Ester, Glass Flake-Filled **electrically conductive for flammable liquids**
Manufacturer	:	SÄKAPHEN® GmbH
Product Name	:	SÄKAPHEN® SÄKAFLAKE® 900
SAP M/N (SAMS S/N)	:	1000709300

1. Storage

1.1	Shelf life, sheltered storage @ 20°C maximum	:	6 months

2. Mixing

2.1	No. of Components	:	3
	2.1.1 Base	:	SF900 Black 3K, Comp. A
	2.1.2 Hardener (Curing Agent)	:	SF900 Comp. B
	2.1.3 Accelerator	:	SF900 Comp. C
2.2	Mixing Ratio	:	100 : 2 : 2 (Base : Hardener : Accelerator)

For mixing, make sure to follow latest application guideline by manufacturer

2.3	Thinner	:	DO NOT THIN
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	N/A
2.6	Pot Life	:	60 minutes@ 23°C (can be adjusted to ambient conditions)

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C - 45°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	Min= 20% Max = 80%
3.3	Typical Wet Film Thickness Per Coat	:	700 microns up to 1200 microns
3.4	Typical Dry Film Thickness Per Coat	:	600 - 1000 microns

Manufacturer - Approved Saudi Aramco Data Sheet

Saudi Aramco: Company General Use

APCS – 2G SÄKAPHEN® SÄKAFLAKE® 900 (Black 3K) (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 33,00 m^2/L

Theoretical Coverage @ 1000 Micrometers Dry Film Thickness : 0,80 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon Steel, Stainless Steel, Cast Iron/Steel
Concrete with appropriate primer

3.8 Surface Preparation Requirements : SA 2½ -Sa 3
80-100 microns surface profile

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full cure
10°C	16h	48h*	3 days	8 days	8 days
20°C	12h	24h*	1 day	7 days	7 days
30°C	6h	24h*	0,5 day	4 days	4 days
50°C	3h	12h*	0,5 day	4 days	4 days

* Overcoatable maximum to the point where whipping the surface with styrene will cause temporary tackiness. Given hours are for orientation. During application and during curing proper ventilation is mandatory. Otherwise curing is slowed down or hindered. This applies in particular for vessels with top only access and no bottom outlet. Curing may be accelerate by force cure with hot air after final layer is touch try.

3.10 Recommended Application Equipment

Airless (A/L) Spray : Pump Ratio min. 66:1 with max 500bar / 7000psi pressure
Gun corresponding to pump with appropriate pressure rating
Fluid Hose 3/8" - 1/2" I.D.
Tip Orifice .027" - .031"
Fan Width 40 degrees
Filter Screen Filters must be removed
Conventional Spray : N/A
Brush : For stripe coating / touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS – 2G SÄKAPHEN® SÄKAFLAKE® 900 (Black 3K) (Cont'd)

4. Physical Properties

4.1	Volume Solids	(DIN EN ISO 3251)	:	76-80%
4.2	Product Weight	(DIN 53217-1)	:	1,250 Kg/L
4.3	Viscosity	(EN ISO 2431/DIN EN 535)	:	7000-8000 mPas
4.4	Flash Point	(DIN 53213)	:	33°C
4.5	Approved Color/s	:	Anthracite	
4.6	Finish	:	Matt rough	

5. Special Instructions:

As the coating is electrically conductive, high voltage spark testing is not applicable for pore testing. After application, the coating has to be thoroughly visually inspected for any imperfection.

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Saudi Aramco: Company General Use

o. Sherwin Williams – Approved Products

APCS-1A

Zinc Clad II Ethyl Silicate Inorganic Zinc Rich Coating	Inorganic Zinc Primer: Solvent Based
Macropoxy 646	Epoxy Topcoat

APCS-1B

Macropoxy 646	Epoxy Primer and Topcoat

APCS-1C

Zinc Clad IV Organic Zinc Rich Epoxy Primer	Zinc-Rich Epoxy Primer

Use Epoxy Topcoat of APCS-1A as topcoat

APCS-1D

Use APCS-1A as primer and intermediate coat

Acrolon 890	Polyurethane Topcoat

APCS-1E

Use APCS-1B as primer and intermediate coat
Use Polyurethane Topcoat of APCS-1D as topcoat

APCS-1F

Use APCS-1C as primer and intermediate coat
Use Polyurethane Topcoat of APCS-1D as topcoat

APCS-2A/2C/2D

Phenicon HS	Epoxy Novolac Phenolic

APCS-2E

Nova-Plate UHS	Epoxy Novolac

APCS-2G

Cor-Cote VEN FF	Vinyl-Ester

APCS-3

Targuard Coal Tar Epoxy	Coal Tar Epoxy

Saudi Aramco: Company General Use

Sherwin Williams – Approved Products (Cont.)

APCS-4

Kem Kromik Universal Metal Primer	Alkyd Primer
Industrial Aluminum Paint	Alkyd Enamel Topcoat

APCS-6

Use Alkyd Primer of APCS-4 as primer	
Industrial Enamel	Alkyd Enamel Topcoat

APCS-11A

Use primer of APCS-1A as primer	
Heat-Flex M505	Heat Resistant Topcoat

APCS-11B

Heat-Flex M505	Heat Resistant Coating, Self-Priming

APCS-11C

Heat-Flex Hi-Temp 1200	Heat Resistant Self-Priming System

APCS-12

Use APCS-1B as primer and topcoat

APCS-17A

Use primer of APCS-1A

APCS-19C

Euronavy PE 35*	Solvent-Free Epoxy

APCS-20A

Dura-Plate UHS	Fiberglass Reinforced Epoxy: Hand Lay-Up

APCS-20B

Dura-Plate UHS	Fiberglass Reinforced Epoxy: Spray-Applied

APCS-22A

Euronavy ES301*	Solvent-Free Epoxy

APCS-22B

Euronavy PE 35*	Solvent-Free Epoxy

APCS-26

Macropoxy 646	Epoxy Mastic

Saudi Aramco: Company General Use

Sherwin Williams – Approved Products (Cont.)

APCS-26T

Use APCS-26 as primer and Polyurethane Topcoat of APCS-1D as topcoat

*Refer to coating manufacturer's Product Data Sheet for Euronavy PE 35, Euronavy ES301.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A

Type of Coating	:	Inorganic Ethyl Silicate Zinc-Rich
Manufacturer	:	Sherwin Williams Protective & Marine Coatings
Product Name	:	Zinc Clad II Ethyl Silicate
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	Part E: 9 months Part F: 24 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	B69V3
	2.1.2 Hardener (Curing Agent)	:	B69D11
2.2	Mixing Ratio	:	14.2L : 33.1kg
2.3	Thinner	:	Reducer #58 (R7K58) or Reducer #100 (R2K5)
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	Up to 10% by Volume
2.5	Induction Time	:	N/A
2.6	Pot Life	:	6.5 hours @ 35°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C to 49°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	40-90%
3.3	Typical Wet Film Thickness Per Coat	:	125 microns
3.4	Typical Dry Film Thickness Per Coat	:	75 microns

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A - Zinc Clad II Ethyl Silicate (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	24.3m^2/L
3.6	Minimum Number of Coats	:	1 coat
3.7	Applicable Substrate	:	Steel
3.8	Surface Preparation Requirements	:	Sa 2.5

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	48 hours		3 hours		7 days
20°C	30 hours		2 hours		7 days
30°C	18 hours		1 hour		7 days
40°C	18 hours		20 mins		7 days
50°C	18 hours		10 mins		7 days

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Pressure: 1800 - 2000psi Hose: 3/8" ID Tip: .017" - .021"
Conventional Spray	:	Gun: Binks 95 Fluid Nozzle: 66 Air Nozzle: 63PB Atomization Pressure: 30 - 40 psi Fluid Pressure: 10 - 20 psi
Brush	:	For touch-up only

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A - Zinc Clad II Ethyl Silicate (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	62±2%
4.2	Product Weight	(ASTM D1475)	:	2.5 Kg/L
4.3	Viscosity	(ASTM D562)	:	None available
4.4	Flash Point	(ASTM D93 or D56)	:	13°C
4.5	Approved Color/s	:	Grey-green	
4.6	Finish	:	Flat	

5. Special Instructions:

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F/26

Type of Coating	:	Epoxy Polyamide
Manufacturer	:	Sherwin Williams Protective & Marine Coatings
Product Name	:	Macropoxy 646
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	3 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	M646B
	2.1.2 Hardener (Curing Agent)	:	M646A
2.2	Mixing Ratio	:	1 : 1 by volume
2.3	Thinner	:	C50
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	Up to 10% by Volume
2.5	Induction Time	:	20 mins @ 35°C
2.6	Pot Life	:	2 hours @ 35°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C min, 49°C max
3.2	Minimum-Maximum Allowable Relative Humidity	:	85% maximum
3.3	Typical Wet Film Thickness Per Coat	:	175 microns
3.4	Typical Dry Film Thickness Per Coat	:	125 microns

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F/26 - Macropoxy 646 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 29 m^2/L
3.6	Minimum Number of Coats	: 2
3.7	Applicable Substrate	: Steel, concrete, Aluminum, galvanizing metal
3.8	Surface Preparation Requirements	: Steel: Sa2.5, Concrete: smooth, Aluminum & Galvanizing: SSPC-SP1

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	20 hours	1 year	20 hours	10 days	
20°C	10 hours	1 year	10 hours	7 days	
30°C	6 hours	1 year	6 hours	7 days	
40°C	4 hours	1 year	4 hours	4 days	
50°C	2 hours	1 year	2 hours	4 days	

3.10 Recommended Application

Airless (A/L) Spray : Pump: 30:1
Pressure: 2,800 – 3,000 psi
Hose: 1/4" ID
Tip: .017" - .023"
Filter: 60 mesh

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F/26 - Macropoxy 646 (Cont'd)

Conventional Spray	:	Gun: DeVilbiss MBC-510 Fluid Tip: E Air Nozzle: 704 Atomization Pressure: 60-65 psi Fluid Pressure: 10-20 psi Requires oil and moisture separators
Brush	:	Nylon/Polyester or Natural Bristle

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	72±2%
4.2	Product Weight	(ASTM D1475)	:	1.55 Kg/L
4.3	Viscosity	(ASTM D562)	:	None available
4.4	Flash Point	(ASTM D93 or D56)	:	33°C
4.5	Approved Color/s	:	White & Range of colors	
4.6	Finish	:	Semi-gloss	

5. Special Instructions:

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1C/1F

Type of Coating	:	Organic Zinc Rich Epoxy Primer
Manufacturer	:	Sherwin Williams Protective & Marine Coatings
Product Name	:	Zinc Clad IV
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	18 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	B69A8
	2.1.2 Hardener (Curing Agent)	:	B69V8
2.2	Mixing Ratio	:	8 : 1
2.3	Thinner	:	MEK
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	Up to 5% by Volume
2.5	Induction Time	:	20 mins @ 35°C
2.6	Pot Life	:	4.5 hours @ 35°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 49°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	85% maximum
3.3	Typical Wet Film Thickness Per Coat	:	125 microns
3.4	Typical Dry Film Thickness Per Coat	:	75 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 1C/1F : Zinc Clad IV (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	25.8m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Steel
3.8	Surface Preparation Requirements	:	Minimum Sa 2

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	5.5 hours	N/A	80 mins		10 days
20°C	4.5 hours	N/A	1 hour		10 days
30°C	3.5 hours	N/A	55 mins		10 days
40°C	2 hours	N/A	45 mins		7-10 days
50°C	1 hour	N/A	30 mins		7 days

3.10 Recommended Application

Airless (A/L) Spray:	2000-2300 psi, .019” tip, 3/8” ID hose
Conventional Spray:	Binks 95, 50 psi air pressure
Brush:	For stripe coating / touch-up only, Use natural bristle brush

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 1C/1F - Zinc Clad IV (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	68±2%
4.2	Product Weight	(ASTM D1475)	:	3.17 Kg/L
4.3	Viscosity	(ASTM D562)	:	115 Ku
4.4	Flash Point	(ASTM D93 or D56)	:	27°C
4.5	Approved Color/s	:	Grey-green	
4.6	Finish	:	Flat	

5. Special Instructions:

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T Topcoat

Type of Coating	:	Acrylic Polyurethane
Manufacturer	:	Sherwin Williams
Product Name	:	Acrolon 890
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	Part A 18 months Part B 6 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	B65WC0001
	2.1.2 Hardener (Curing Agent)	:	B65VC0001
2.2	Mixing Ratio	:	10 : 1 by Vol
2.3	Thinner	:	R06K00010
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	10% by Volume
2.5	Induction Time	:	Not recommended
2.6	Pot Life	:	1.5 hours 35°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 43°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	85% Max
3.3	Typical Wet Film Thickness Per Coat	:	74 – 147 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 -100 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T Topcoat – Acrolon 890 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	13.6 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Prepared metal or masonry substrates
3.8	Surface Preparation Requirements	:	Minimum recommended surface preparation:* Iron & Steel: SSPC-SP6/ NACE 3/ Sa 2(ISO 8501-1:2007), 25-50 microns profile* Galvanizing: SSPC-SP1* Concrete/Masonry: SSPC-SP13 / NACE 6Primer required

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	10hr	3 months	10hr	10hr	14 days
20°C	6hr	3 months	6hr	6hr	9 days
30°C	3hr	3 months	3hr	3hr	6 days
40°C	1.5hr	3 months	1.5hr	1.5hr	4 days
50°C	0.5hr	3 months	0.5hr	0.5hr	2 days

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Pump 45:1 min Pressure 15 Mpa min Hose 9.5 mm ID Tip 0.013" - 0.017"(0.33-0.43 mm) Filter: none

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T Topcoat – Acrolon 890 (Cont'd)

Conventional Spray	:	Gun Binks 95 Fluid Nozzle 66 Air Nozzle 68 PB Atomization Pressure 0.5 Mpa Fluid Pressure 0.2 Mpa
Brush	:	Nylon/Polyester Natural Bristle

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	68%±2%
4.2	Product Weight	(ASTM D1475)	:	1.431 Kg/L
4.3	Viscosity	(ASTM D562)	:	75 -90 Ku
4.4	Flash Point	(ASTM D93 or D56)	:	28°C
4.5	Approved Color/s	:	Full range	
4.6	Finish	:	Glossy	

5. Special Instructions:

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C/2D

Type of Coating	:	Epoxy Novolac Phenolic Coating
Manufacturer	:	Sherwin Williams Protective & Marine Coatings
Product Name	:	Phenicon HS
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	3 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	920WA11 (Off White) 920A175 (Light Grey) 920L175 (Blue OAP)
	2.1.2 Hardener (Curing Agent)	:	700C685
2.2	Mixing Ratio	:	4 : 1 by volume
2.3	Thinner	:	N/A
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	Not recommended
2.5	Induction Time	:	None @ 35°C
2.6	Pot Life	:	1 hour @ 35°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	13°C min, 49°C max
3.2	Minimum-Maximum Allowable Relative Humidity	:	85% maximum
3.3	Typical Wet Film Thickness Per Coat	:	175 microns
3.4	Typical Dry Film Thickness Per Coat	:	125 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C/2D – Phenicon HS (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	$29.4 m^2/L$
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Steel, concrete
3.8	Surface Preparation Requirements	:	Steel: Sa 2.5, Concrete: NACE 6

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	48 hours	30 days	48 hours	14 days	
20°C	24 hours	30 days	24 hours	10 days	
30°C	12 hours	30 days	12 hours	6 days	
40°C	8 hours	30 days	8 hours	4 days	
50°C	4 hours	30 days	4 hours	3 days	

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Pressure: 3000 psi minimum Hose: 3/8" - 1/2" ID Tip: .017" - .021" Filter: 60 mesh
Conventional Spray	:	Gun: Binks 95 Tip and Needle: 66/65 Air Cap: 65 PR Atomization Pressure: 65-75 psi Fluid Pressure: 15-20 psi
Brush	:	Nylon/polyester or natural bristle

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C/2D – Phenicon HS (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	75±2%
4.2	Product Weight	(ASTM D1475)	:	1.5 Kg/L
4.3	Viscosity	(ASTM D562)	:	None available
4.4	Flash Point	(ASTM D93 or D56)	:	27°C
4.5	Approved Color/s	:	Off White, Light Grey, Light Blue	
4.6	Finish	:	Semi-Gloss	

5. Special Instructions:

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2E

Type of Coating	:	Epoxy Novolac Amine
Manufacturer	:	Sherwin Williams Protective & Marine Coatings
Product Name	:	Nova-Plate UHS
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	B62-220
	2.1.2 Hardener (Curing Agent)	:	B62V221
2.2	Mixing Ratio	:	4 : 1 by volume
2.3	Thinner	:	N/A
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	Not recommended
2.5	Induction Time	:	N/A
2.6	Pot Life	:	10 minutes @ 35°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C min, 43°C max
3.2	Minimum-Maximum Allowable Relative Humidity	:	85% maximum
3.3	Typical Wet Film Thickness Per Coat	:	200 microns
3.4	Typical Dry Film Thickness Per Coat	:	200 microns

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2E – Nova-Plate UHS (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	38.4 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Steel
3.8	Surface Preparation Requirements	:	Sa 2.5

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	40 hours	21 days	40 hours	8 days	
20°C	24 hours	21 days	24 hours	6 days	
30°C	10 hours	18 days	10 hours	4 days	
40°C	6 hours	14 days	6 hours	4 days	
50°C	2 hours	7 days	2 hours	4 days	

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Unit: 68:1 Pump, minimum Pressure: 6000 psi Hose: 3/8" ID Tip: .019" - .021" Filter: 30 mesh
Conventional Spray	:	N/A
Brush	:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	98±2%
4.2	Product Weight	(ASTM D1475)	:	1.34 Kg/L

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2E – Nova-Plate UHS (Cont'd)

4.3	Viscosity	(ASTM D562)	:	None available
4.4	Flash Point	(ASTM D93 or D56)	:	110°C
4.5	Approved Color/s	:	Light Grey, White, Green	
4.6	Finish	:	Gloss	

5. Special Instructions:

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G

Type of Coating	:	Flake Filled Vinyl Ester Novolac
Manufacturer	:	Sherwin Williams
Product Name	:	Cor-Cote VEN FF
SAP M/N (SAMS S/N)	:	

1. Storage

1.1 Shelf life, sheltered storage @ 35°C maximum : 1 month

2. Mixing

2.1 No. of Components : 2 (3 top coat)
2.1.1 Base : B88-25
2.1.2 Hardener (Curing Agent) : B88R99/B88V99

2.2 Mixing Ratio : See Below.

Premix Part A component separately, using a low-speed drill and Jiffy Blade model ES mixer. Make certain no pigment or glass flake remains on the bottom or sides of the can. Use CHP Cumene Hydrogen Peroxide catalyst at the rate of 2.0 - 4.0 fluid oz. per gallon of Part A, depending on environmental conditions.

Mix with low-speed drill and Jiffy Blade model ES mixer for three minutes and until uniform. For topcoat only: Add 970-C-949 Wax Solution at the rate of 3 – 4 oz per gallon of Part A to obtain a completely tack free surface.

Add wax solution before adding catalyst. If wax solution is cloudy, it will clear with gentle warming. DO NOT USE FLAME TO HEAT THE WAX SOLUTION.

2.3 Thinner : Not recommended

SAP M/N (SAMS S/N) :

2.4 Minimum-Maximum Thinning Requirements : N/A

2.5 Induction Time : None required

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G - Cor-Cote VEN FF (Cont.)

2.6 Pot Life : 25-45 minutes

3. Application

3.1 Minimum-Maximum Allowable Substrate Temperature : 10°C to 32°C

3.2 Minimum-Maximum Allowable Relative Humidity : 85% Max

3.3 Typical Wet Film Thickness Per Coat : 500 – 625 microns

3.4 Typical Dry Film Thickness Per Coat : 375 – 500 microns

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 39.2 m2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Concrete and Steel

3.8 Surface Preparation Requirements : See Below.

Minimum recommended surface preparation:

Iron & Steel:
Atmospheric: SSPC-SP6/NACE 3, 2 mil (50 micron) profile
Immersion: SSPC-SP10/NACE 2, 2-3 mil (50-75 micron) profile

Concrete & Masonry:
Atmospheric: SSPC-SP13/NACE 6, or ICRI No. 310.2, CSP 3-5
Immersion: SSPC-SP13/NACE 6-4.3.1 or 4.3.2, or ICRI No. 310.2, CSP 3-5

3.9 Drying Time at specified DFT 500 microns

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	12 hrs	4 days	16 hrs	16 hrs	48 hrs
20°C	3 hrs	72 hrs	6 hrs	6 hrs	24 hrs
30°C	2 hrs	48 hrs	3 hrs	3 hrs	16 hrs

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2G - Cor-Cote VEN FF (Cont.)

40°C	1 hr	24 hrs	1.5 hrs	1.5 hrs	8 hrs
50°C	0.5 hr	12 hrs	0.75 hrs	0.75 hrs	4 hrs

3.10 Recommended Application Equipment

Airless (A/L) Spray:

Catalyst Injection Spray:
Pump.....Catalyst injection (external mixing)
Pump Ratio .....30:1 with catalyst pump
Gun .....Polycraft or equivalent
Fluid Hose .....3/8" - 1/2" I.D.
Tip Orifice .....036" - .045"
Fan Width.....40 degrees
Fluid Pressure .....2000 - 3000 psi
Filter Screen.....Filters must be removed

Conventional Spray : N/A

Brush : Natural bristle small areas

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	
4.3	Viscosity	(ASTM D562)	:	2,000 cps
4.4	Flash Point	(ASTM D93 or D56)	:	27°C
4.5	Approved Color/s	:	Haze Gray, Tile Red	
4.6	Finish	:	Matte	

5. Special Instructions:

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-3

Type of Coating	:	Polyamide Epoxy Coal Tar Coating
Manufacturer	:	Sherwin Williams Protective & Marine Coatings
Product Name	:	Targuard Coal Tar Epoxy
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	Part A: 8 months unopened Part B: 36 months unopened

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	B69B60 (Black) B69R60 (Red)
	2.1.2 Hardener (Curing Agent)	:	B69V60
2.2	Mixing Ratio	:	4 : 1
2.3	Thinner	:	Xylene, R2K4
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	Up to 10% by Volume
2.5	Induction Time	:	None @ 35°C
2.6	Pot Life	:	1 hour @ 35°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C to 38°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	90% maximum
3.3	Typical Wet Film Thickness Per Coat	:	275 microns
3.4	Typical Dry Film Thickness Per Coat	:	200 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-3 - Targuard Coal Tar Epoxy (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	29 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Concrete, steel, Aluminum, Galvanized metal
3.8	Surface Preparation Requirements	:	Sa 2.5

(Include items 3.7 and 3.8 ONLY for Primer or First Coat of the APCS)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	48 hours	72 hours	72 hours		7-10 days
20°C	28 hours	72 hours	72 hours		7-10 days
30°C	13 hours	48 hours	48 hours		7 days
40°C	5 hours	12 hours	12 hours		2 days
50°C	2.5 hours	8 hours	8 hours		1 day

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Pressure: 3000 psi Hose: 3/8" - 1/2" ID Tip: .017" - .025"
Conventional Spray	:	Gun: Binks 95 Fluid Nozzle: 66 Air Nozzle: 63PB Atomization Pressure: 60 psi Fluid Pressure: 40 psi

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APCS-3 - Targuard Coal Tar Epoxy (Cont'd)

Brush use natural bristle brush		:	For stripe coating / touch-up only,

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	74±2%
4.2	Product Weight	(ASTM D1475)	:	1.3Kg/L
4.3	Viscosity	(ASTM D562)	:	None available
4.4	Flash Point	(ASTM D93 or D56)	:	28°C
4.5	Approved Color/s	:	Black, Red	
4.6	Finish	:	Semi-gloss	

5. Special Instructions:

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4/6 Primer

Type of Coating	:	Modified Phenolic Alkyd Primer
Manufacturer	:	Sherwin Williams Protective & Marine Coatings
Product Name	:	Kem Kromik Universal Metal Primer
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	3 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	B50WZ1
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Not recommended
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	Not recommended
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C min, 49°C max
3.2	Minimum-Maximum Allowable Relative Humidity	:	85% maximum
3.3	Typical Wet Film Thickness Per Coat	:	150 microns
3.4	Typical Dry Film Thickness Per Coat	:	75 microns

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APCS-4/6 Primer - Kem Kromik Universal Metal Primer (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	20.8m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Steel
3.8	Surface Preparation Requirements	:	Sa 2

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	2 hours		2 hours		7 days
20ºC	1.5 hours		1.5 hours		7 days
30°C	55 mins		45 mins		7 days
40ºC	45 mins		25 mins		7 days
50°C	30 mins		15 mins		7 days

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Pressure: 1800-3000 psi Hose: 1/4" ID Tip: .015" - .019" Filter: 60 mesh
Conventional Spray	:	Gun: Binks 95 Fluid Nozzle: 63C Air Nozzle: 63PB Atomization Pressure: 50 psi Fluid Pressure: 15-20 psi
Brush	:	For small areas and touch-up

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4/6 - Kem Kromik Universal Metal Primer (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	53±2%
4.2	Product Weight	(ASTM D1475)	:	1.5 Kg/L
4.3	Viscosity	(ASTM D562)	:	None available
4.4	Flash Point	(ASTM D93 or D56)	:	27°C
4.5	Approved Color/s	:	Red Oxide, Off White, Grey	
4.6	Finish	:	Flat	

5. Special Instructions:

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4 Topcoat

Type of Coating	:	One-package, Interior / Exterior, General Purpose, Leafing Aluminum Paint
Manufacturer	:	Sherwin Williams
Product Name	:	Industrial Aluminum Paint
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	36 months

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	B59S4
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Not recommended. Clean Up Mineral Spirits, R1K4
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 49 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	85% Max
3.3	Typical Wet Film Thickness Per Coat	:	75 microns
3.4	Typical Dry Film Thickness Per Coat	:	25 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4 Topcoat – Industrial Aluminum Paint (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 15.7 m^2/L

3.6 Minimum Number of Coats : 2

3.7 Applicable Substrate : Iron Steel Aluminum Galvanizing Concrete Block & Masonry

3.8 Surface Preparation Requirements:

Iron & Steel: SSPC-SP10, 1 mil profile >200°F (93°C)
SSPC-SP6, 1 mil profile <200 °F (93°C)
* Aluminum: SSPC-SP1
* Galvanizing: SSPC-SP1
* Concrete Block & Masonry: SSPC-SP13/

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	24hrs		24hrs	24hrs	10 days
20°C	18hrs		4-6hrs	24hrs	7 days
30°C	10hrs		3hrs	24hrs	5 days
40°C	6hrs		2hrs	24hrs	3 days
50°C	3hrs		1hr	24hrs	2 days

3.10 Recommended Application Equipment

Airless (A/L) Spray:
Pressure.....2000 psi
Hose.....1/4" ID
Tip .....010"-.012"
Filter .....60 mesh

Conventional Spray:
Gun .....Binks 95
Fluid Nozzle 63C
Air Nozzle.....63PB
Atomization Pressure .....50 psi
Fluid Pressure .....20 psi

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4 Topcoat – Industrial Aluminum Paint (Cont'd)

Brush		:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	40% ± 2%
4.2	Product Weight	(ASTM D1475)	:	9 Kg/L
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	33°C
4.5	Approved Color/s	:	Aluminum	
4.6	Finish	:	Aluminum Sheen	

5. Special Instructions:

Lightly stir before use. Do not shake with mechanical shaker or overly agitate, as a dull, non-uniform, mottled appearance will result.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-6 Topcoat

Type of Coating	:	Medium Oil/Alkyd Enamel Finish
Manufacturer	:	Sherwin Williams Protective & Marine Coatings
Product Name	:	Industrial Enamel
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	3 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	B54 series
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Not recommended
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	Not recommended
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C min, 49°C max
3.2	Minimum-Maximum Allowable Relative Humidity	:	85% maximum
3.3	Typical Wet Film Thickness Per Coat	:	115 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-6 Topcoat – Industrial Enamel (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	16.9 m^2/L
3.6	Minimum Number of Coats	:	2
3.7	Applicable Substrate	:	Existing primer
3.8	Surface Preparation Requirements	:	Clean, dry and free from surface contaminants

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	12 hours		12 hours		7 days
20°C	9 hours		9 hours		7 days
30°C	7 hours		7 hours		6 days
40°C	3 hours		3 hours		3 days
50°C	1 hour		1 hour		2 days

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Pressure: 2500 psi Hose: 1/4" ID Tip: .015" Filter: 100 mesh
Conventional Spray	:	Gun : Binks 95 Fluid Nozzle: 66 Air Nozzle: 63PB Atomization Pressure: 50 psi Fluid Pressure: 20-25 psi
Brush	:	For small areas and touch-up

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APCS-6 Topcoat – Industrial Enamel (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	43±2%
4.2	Product Weight	(ASTM D1475)	:	1.06 Kg/L
4.3	Viscosity	(ASTM D562)	:	None available
4.4	Flash Point	(ASTM D93 or D56)	:	38°C
4.5	Approved Color/s	:	Full range including safety colors	
4.6	Finish	:	Glossy	

5. Special Instructions:

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11A/11B

Type of Coating	:	Silicone-Based Heat Resistant Finish
Manufacturer	:	Sherwin Williams Protective & Marine Coatings
Product Name	:	Heat-Flex M505
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	Heat-Flex M505
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	N/A
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	Not recommended
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	Minimum 10°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	80-85% maximum
3.3	Typical Wet Film Thickness Per Coat	:	81 microns
3.4	Typical Dry Film Thickness Per Coat	:	25 microns

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APCS-11A/11B – Heat-Flex M505 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	12.3 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Silver Brite Hi-Heat system, or zinc/Aluminum metal spray
3.8	Surface Preparation Requirements	:	Clean, dry, and free from contaminants

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	8 hours		30 hours		
20ºC	5 hours		18 hours		
30°C	3 hours		14 hours		
40ºC	2 hours		8 hours		
50°C	1 hour		6 hours		

* **Post-Curing**

If M505 is to be exposed to ambient weathering or moisture before service, it is required that the coating is post-cured by gradually elevating the temperature to a minimum of 205°C and maintaining this temperature for 2 hours.

3.10 Recommended Application

Airless (A/L) Spray	:	Nozzle Size: 0.13” Fan Angle: 60° Operating Pressure: 2000 psi
Conventional Spray	:	Nozzle Size: .050” Atomizing Pressure: 35 psi Fluid Pressure: 2 psi
Brush	:	Suitable for brush application

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11A/11B – Heat-Flex M505 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	31±2%
4.2	Product Weight	(ASTM D1475)	:	1.22 Kg/L
4.3	Viscosity	(ASTM D562)	:	None available
4.4	Flash Point	(ASTM D93 or D56)	:	28°C
4.5	Approved Color/s	:	White, Black, Aluminum	
4.6	Finish	:	Matt	

5. Special Instructions:

Maximum Surface Temperatures:

	No discoloration	**Slight discoloration**
WHITE	250°C	350°C
BLACK	250°C	350°C
ALUMINUM	600°C	See additional note below

Note: Zinc silicate or zinc metal spray should not be used above 400°C, use Aluminum metal spray instead.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11C

Type of Coating	:	Single Component Inert Multipolymeric Matrix Coating
Manufacturer	:	Sherwin Williams
Product Name	:	HEAT-FLEX® HI-TEMP 1200
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	6 months

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	B59A225 GREY B59A226 DARK GREY
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	Not recommended Clean Up Xylene, C2
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 260°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	85% Max

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APCS-11C - HEAT-FLEX® HI-TEMP 1200 (Cont'd)

3.3	Typical Wet Film Thickness Per Coat	:	200 microns
3.4	Typical Dry Film Thickness Per Coat	:	125 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	22.5 m^2/L
3.6	Minimum Number of Coats	:	2 coats
3.7	Applicable Substrate:		Iron Steel and Stainless Steel

3.8 Surface Preparation Requirements:

Iron & Steel: SSPC-SP6, 40-63 micron profile
Or SSPC-SP11, 25-63 micron profile
Stainless Steel: SSPC-SP1. Do not use chlorinated solvents for cleaning

3.10 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	3hrs	None	90mins	24hrs	24hrs
20°C	2hrs	None	60mins	24hrs	24hrs
30°C	2hrs	None	50mins	24hrs	24hrs
40°C	1.5hrs	None	40mins	24hrs	24hrs
50°C	1hr	None	30mins	24hrs	24hrs

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APCS-11C - HEAT-FLEX® HI-TEMP 1200 (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray:

Unit.....30:1 Pump
Pressure.....2,700 – 3,000 psi
Hose.....3/8" ID
Tip .....17-19 thou (0.43-0.48 mm)
Filter .....60 mesh
Reduction .....Not recommended

Conventional Spray:

Fluid Tip .....45-55 thou (1.14-1.40 mm)
Air Nozzle.....20 cfm
Atomization Pressure.....50 psi
Fluid Pressure .....20 - 30 psi
Reduction .....Not recommended

Brush:

Brush.....China bristle, small areas only
Reduction .....Not recommended

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	57% ± 2 %
4.2	Product Weight	(ASTM D1475)	:	1.93 Kg/L
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	31°C

4.5	Approved Color/s	:	Grey, Dark Grey, Aluminum
4.6	Finish	:	Low Sheen

5. Special Instructions:
During application to hot steel, apply coating in several thin passes to allow solvent to escape and to prevent blistering. Allow at least 15-20 minutes between each coat.

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A/20B

Type of Coating	:	Tank Lining
Manufacturer	:	Sherwin Williams
Product Name	:	Dura-Plate UHS
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	36 months

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	
	2.1.2 Hardener (Curing Agent)	:	
2.2	Mixing Ratio	:	4:1 by volume
2.3	Thinner	:	Not recommended Cleanser No. 13
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	None
2.6	Pot Life	:	20 – 30 mins

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 43°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	85% Max
3.3	Typical Wet Film Thickness Per Coat	:	500 microns
3.4	Typical Dry Film Thickness Per Coat	:	500 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A/20B - Duraplate UHS (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	40 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	Steel

3.8 Surface Preparation Requirements:

Minimum recommended surface preparation:
Steel:
Atmospheric: SSPC-SP6/NACE 3/Sa2 50 micron profile or SSPC-SP/NACE WJ-3/NV-2
Immersion: SSPC-SP10/NACE2/Sa2½ 50-75 micron profile or
SSPC- SP/NACE WJ-2/NV-2

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	48 hrs	21 days	48 hrs	10 days	10 days
20°C	18 hrs	14 days	18 hrs	5 days	5 days
30°C	10 hrs	14 days	10 hrs	2 days	4 days
40°C	8 hrs	14 days	8 hrs	24 hrs	3 days
50°C	6 hrs	14 day	6 hrs	24 hrs	3 days

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-20A/20B - Duraplate UHS (Cont'd)

3.10 Recommended Application Equipment

Airless (A/L) Spray:	Unit.....74:1 Pump, minimum Pressure.....6000 psi minimum Hose.....3/8" ID Tip ..... 019" - .021" Filter .....30 mesh
Conventional Spray:	N/A
Brush:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	98% ± 2%, mixed
4.2	Product Weight	(ASTM D1475)	:	1.26 Kg/L
4.3	Viscosity	(ASTM D562)	:	
4.4	Flash Point	(ASTM D93 or D56)	:	>93°C mixed
4.5	Approved Color/s	: White		
4.6	Finish	: Gloss		

5. Special Instructions: Request detailed application instruction from coating manufacturer for using the product under APCS-20A (hand lay-up) or APCS-20B (spray applied).

Saudi Aramco: Company General Use

p. Sigma – Approved Products

APCS-1A

SigmaZinc 158	Inorganic Zinc Primer: Solvent-Based
SigmaCover 410	Epoxy Topcoat

APCS-1B

SigmaCover 410 (Alu)	Epoxy Primer
Use Epoxy Topcoat of APCS-1A as topcoat	

APCS-1C

SigmaZinc 102HS	Organic Zinc Rich Primer
Use Epoxy Topcoat of APCS-1A as topcoat	

APCS-1D

Use APCS-1A as primer and intermediate coat	
SigmaDur Gloss 7528	Polyurethane Topcoat

APCS-1E

Use APCS-1B as primer and intermediate coat	
Use Polyurethane Topcoat of APCS-1D as topcoat	

APCS-1F

Use APCS-1C as primer and intermediate coat	
Use Polyurethane Topcoat of APCS-1D as topcoat	

APCS-2A/2C (with Interchangeable Products)

PhenGuard 930	Epoxy Primer
PhenGuard 935	Epoxy Intermediate Coat
PhenGuard 940	Epoxy Topcoat

APCS-2B (with Interchangeable Products)

PhenGuard 930	Epoxy Intermediate
PhenGuard 940	Epoxy Primer/Topcoat

APCS-2E

Sigma Novaguard 7453	Epoxy Phenolic

APCS-3

Sigma C-200a Coal Tar	Coal Tar Epoxy

APCS-4

Sigmarine 24	Primer
Sigma Aluminum Paint SA35	Aluminum Topcoat

Sigma – Approved Products (Cont'd)

Saudi Aramco: Company General Use

APCS-6

Use APCS-4 primer

Sigma Enamel SA21	Alkyd Topcoat

APCS-10

Vikote 63	Bituminous Coating

APCS-11A

Use primer of APCS-1A as primer

SigmaTherm 540	High Temp. Silicone Coating: Aluminum Topcoat

APCS-11B

SigmaTherm 540	High Temp. Silicone Coating; Aluminum, Self-Priming

APCS-12

Use APCS-1B as Primer and Topcoat

APCS-17A

SigmaZinc 158	Inorganic Zinc Silicate: Solvent-Based

APCS-22A

SigmaCover 410 (Alu)	Epoxy Primer
SigmaCover 410	Epoxy Topcoat

APCS-26

SigmaCover 410 (Alu)	Epoxy Primer
SigmaCover 410	Epoxy Primer/Topcoat

APCS-26T

Use APCS 26 as primer and Polyurethane Topcoat of APCS-1D as topcoat

APCS-113A

Sigmaline 2000

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D/11A/17A Primer

Type of Coating	:	Inorganic Zinc Primer: Solvent-Based
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	SigmaZinc 158
SAP M/N (SAMS S/N)	:	1000194146

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	: 9 months (binder) 24 months (powder) (store moisture free)

2. Mixing

2.1	No. of Components	: 2
	2.1.1 Base	: 7558 - Binder
	2.1.2 Hardener (Curing Agent)	: 7558 - Powder
2.2	Mixing Ratio	: 81:19 (binder : powder) By volume
2.3	Thinner	: Sigma Thinner 90-53
	SAP M/N (SAMS S/N)	: 1000198445 (09-738-220)
2.4	Minimum-Maximum Thinning Requirements	: 0 to 10%
2.5	Induction Time	: Nil
2.6	Pot Life	: 12 hours @ 20°C 8 hours @ 25°C 6 hours @ 30°C 3 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10 - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: 50 - 80%
3.3	Typical Wet Film Thickness Per Coat	: 100-115 micrometers

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS 1A/1D/11A/17A Primer - SigmaZinc 158 (Cont'd)

3.4 Typical Dry Film Thickness Per Coat : 75 micrometers

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 26 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon Steel

3.8 Surface Preparation Requirements : ISO 8501-1 Sa 2½, blasting profile 40 – 70 µm

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service see note 1	Full cure see note 2
10°C	18 hours	none	1 hour		18 hours
20°C	12 hours	none	½ hour		12 hours
30°C	6 hours	none	½ hour		6 hours
40°C	4 hours	none	½ hour		4 hours
50°C	4 hours	none	½ hour		4 hours

Note 1: Material should be fully cured to have its full mechanical and anti-corrosive performance.
Note 2: Relative humidity should be 50% or more for coating to cure.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Size: 0.019 to 0.025 inch Fluid Pressure: 1280 to 1700 psi
Conventional Spray	:	Nozzle Size: 2 mm Nozzle Pressure: 43 psi
Brush	:	For touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 63 to 67%

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS 1A/1D/11A/17A Primer - SigmaZinc 158 (Cont'd)

4.2	Product Weight	(ASTM D1475)	:	2.3 Kg/L
4.3	Viscosity	(ASTM D562)	:	16 – 20 seconds; DIN 4-cup
4.4	Flash Point	(ASTM D93 or D56)	:	16.5°C
4.5	Approved Color/s	1000194146		Greenish grey
4.6	Finish		:	Flat

5. Special Instructions:

Mixing:
1) Take the bag with zinc powder out of the drum.
2) Shake the binder in the jerry can a few times to reach a certain degree of homogenization.
3) Pour about 2/3 of the binder in the empty drum.
4) With the jerry can now reduced in weight and containing more free space, shake it vigorously to obtain a homogeneous mix with no deposits left on the bottom, and add this to the drum.
5) Add the zinc powder gradually to the pigmented binder in the drum and at the same time continuously stir the mixture by using a mechanical mixer (keep the speed low).
6) Stir the zinc dust powder thoroughly through the binder (high speed) and keep stirring till, a homogeneous mixture is obtained.
7) Strain mixture through a 30 - 60 mesh screen.
8) Agitate continuously during application (low speed). The use of a dedicated pump with a constant agitation for a zinc silicate coating is recommended.

Thinner
At application temperature above 30°C addition of max 10% by volume of Thinner 90-53 may be necessary.

DFT:
- average dft 75 µm with a minimum of 60 µm on smooth non pitted, blast cleaned steel
- average dft 100 µm with a minimum of 75 µm on rough or pitted, blast cleaned steel

Upgrading DFT:
Only valid for spray application if the dft is below specification and an extra coat of SigmaZinc 158 has to be applied, SigmaZinc 158 should be thinned down with 25 - 50%

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APCS 1A/1D/11A/17A Primer - SigmaZinc 158 (Cont'd)

Thinner 90-53, in order to obtain a visible wet coat that remains wet for some time.

Overcoating

- SigmaZinc 158 is a moisture curing zinc silicate, this means that it only cures after sufficient take up of water (from the atmosphere or immersion) during and after application; it is recommended that relative humidity and temperature are measured during the curing time
- Before entering service or overcoating, a sufficient degree of cure should be obtained.
- A relative humidity below 50% requires a much longer overcoating time.
- When curing conditions are unfavorable or when reduced overcoat times are desired, curing can be accelerated 4 hours after application by:
    - wetting or soaking with water, keeping the surface wet for the next 2 hours, followed by drying
    - wetting or soaking with a 0.5% ammonia solution, followed by drying
- Before overcoating with topcoats, SigmaZinc 158 should always be visibly dry and checked on sufficient curing
- For measuring of the curing, the MEK rub test according to ASTM 4752 is a suitable method: after 50 double rubs with a cloth soaked in MEK (or alternatively Thinner 90-53) no dissolving of the coating should be observed. A rating of 4 or higher is suitable for overcoating.

In order to avoid possible popping effects (pinholes) it may be required to apply the next coat with extra thinner as a mist-coat followed by a full coat after initial flash-off ***(see Sigma Information sheet 1706, "Zinc Silicates Quality Aspects Application")***

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E Primer

Type of Coating	:	Epoxy Primer: Polyamide-Cured
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	SigmaCover 410 (Alu)
SAP M/N (SAMS S/N)	:	1000194626

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	: 1 year

2. Mixing

2.1	No. of Components	: 2
	2.1.1 Base	: 6823 Base
	2.1.2 Hardener (Curing Agent)	: 6823 Hardener
2.2	Mixing Ratio	: 80:20 (Base : Hardener) By volume
2.3	Thinner	: Thinner 91-92
	SAP M/N (SAMS S/N)	: 1000198455
2.4	Minimum-Maximum Thinning Requirements	: 5 to 10% by Volume
2.5	Induction Time	: Nil
2.6	Pot Life	: 12 hours @ 10°C 6 hours @ 20°C 4 hours @ 25°C 3 hours @ 30°C 2 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10°C - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	: 95 micrometers

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1B/1E Primer – SigmaCover 410 (Alu) (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	: 75 micrometers
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 32 m^2/L
3.6	Minimum Number of Coats	: 1
3.7	Applicable Substrate	: CS (nonferrous possible, check with Sigma .)
3.8	Surface Preparation Requirements	: CS – ISO Sa 2½, blasting profile 40 – 70 µm (non-ferrous metals: sweep blast)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service see note **	Full cure
10°C	24 hours	none*	24 hours		14 days
20°C	8 hours	none*	8 hours		7 days
30°C	6 hours	none*	6 hours		5 days
40°C	4 hours	none*	4 hours		3 days
50°C	3 hours	none*	3 hours		3 days

* This product has an unlimited recoating interval provided the surface is free from chalking and other contamination.
In cases of exposure to direct sunlight or when the surface is contaminated it is recommended that the surface be cleaned and roughened to assure adhesion of the subsequent coating.
The optimum intercoat adhesion is obtained when the subsequent coating is applied before the full cure time of the previous coating has elapsed.

** This product is part of a system, it will reach it maximum physical and chemical resistance when all layers are fully cured, however is resistant to light handling and exposure to sun and rain at the dry to handle time.

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip Size: 0.018-0.021 inch
Fluid Pressure: 2,800 -3,500 psi

Manufacturer - Approved Saudi Aramco Data Sheet

Saudi Aramco: Company General Use

APCS-1B/1E Primer – SigmaCover 410 (Alu) (Cont'd)

	Conventional Spray	:	Nozzle Size: 1.5 - 3 mm Nozzle Pressure: 43 - 57 psi
	Brush	:	For touch-up only

4. Physical Properties

4.1	Volume Solids (ASTM D2697)	:	78 to 82%
4.2	Product Weight (ASTM D1475)	:	1.5 to 1.9 kg/l
4.3	Viscosity (ASTM D562)	:	(12-17 dPa.s depending on color)
4.4	Flash Point (ASTM D93 or D56)	:	20°C
4.5	Approved Color/s	:	1000194626 Aluminum-Grey
4.6	Finish	:	Flat

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1C/1F Primer

Type of Coating	:	Zinc-Rich Primer
Manufacturer	:	Sigma Paints S.A. Ltd
Product Name	:	SigmaZinc 102HS
SAP M/N (SAMS S/N)	:	1000195361 Red-Brown

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	: 1 year

2. Mixing

2.1	No. of Components	: 2
	2.1.1 Base	: 7702 Base
	2.1.2 Hardener (Curing Agent)	: 7702 Hardener
2.2	Mixing Ratio	: 80:20 (base:hardener) By volume
2.3	Thinner	: Thinner 91-92
	SAP M/N (SAMS S/N)	: 1000198449 (09-738-240)
2.4	Minimum-Maximum Thinning Requirements	: 5 to 10% by Volume
2.5	Induction Time	: Nil
2.6	Pot Life	: 12 hours @ 10°C 6 hours @ 20°C 4 hours @ 25°C 3 hours @ 30°C 2 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10°C - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	: 90 micrometers

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1C/1F Primer - SigmaZinc 102HS (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	: 60 micrometers
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 26.4 m^2/L
3.6	Minimum Number of Coats	: 1
3.7	Applicable Substrate	: Carbon Steel
3.8	Surface Preparation Requirements	: ISO-8501-1 Sa2½, blasting profile 40 – 70 µm

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service see note **	Full cure
10°C	24 hours	none*	24 hours		14 days
20°C	8 hours	none*	8 hours		7 days
30°C	6 hours	none*	6 hours		5 days
40°C	4 hours	none*	4 hours		3 days
50°C	3 hours	none*	3 hours		3 days

* Several months when free from zinc salts and contamination.
– zinc rich primers can form zinc salts on the surface; preferably they should not be weathered for long periods before overcoating
– an interval of several months can be allowed under clean interior exposure conditions
– in industrial or marine conditions or if a long recoat interval is required, it is recommended to apply a suitable sealer direct after the minimum recoating interval
– before overcoating any visible surface contamination must be removed by high pressure water cleaning, sandwashing, sweep blasting or mechanical cleaning

** This product is part of a system, it will reach it maximum physical and chemical resistance when all layers are fully cured; however, is resistant to light handling and exposure to sun and rain at the dry to handle time.

3.10 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Size: 0.017 to 0.019 inch Fluid Pressure: 2,130 psi

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1C/1F Primer - SigmaZinc 102HS (Cont'd)

	Conventional Spray		:	Nozzle Size: 1.8-2.2 mm Nozzle Pressure: 43-85 psi
	Brush		:	For touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	64 - 68%
4.2	Product Weight	(ASTM D1475)	:	2.3 – 2.5 Kg/L
4.3	Viscosity	(ASTM D562)	:	5-6 dPa.s
4.4	Flash Point	(ASTM D93 or D56)	:	30.6°C
4.5	Approved Color/s	1000195361		Red Brown
4.6	Finish		:	Flat

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F

Type of Coating	:	Epoxy Intermediate / Topcoat, Polyamide-Cured		
Manufacturer	:	Sigma Paints S.A. Ltd.		
Product Name	:	SigmaCover 410		
SAP M/N (SAMS S/N)	:	1000194629	Red Brown	RAL 8012
		1000194797	Light Grey	RAL 7038
		1000194960	Safety Yellow	RAL 1023

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	: 1 year

2. Mixing

2.1	No. of Components	: 2
	2.1.1 Base	: 6823 Base
	2.1.2 Hardener (Curing Agent)	: 6823 Hardener
2.2	Mixing Ratio	: 80:20 (Base:Hardener) By volume
2.3	Thinner	: Thinner 91-92
	SAP M/N (SAMS S/N)	: 1000198452 (09-738-260)
2.4	Minimum-Maximum Thinning Requirements	: 0 to 10% by volume 30 to 40% for mist-coat
2.5	Induction Time	: Nil
2.6	Pot Life	: 12 hours @ 10°C 6 hours @ 20°C 4 hours @ 25°C 3 hours @ 30°C 2 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10°C - 50°C

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1C/1D/1E/1F – SigmaCover 410 (Cont'd)

3.2 Minimum-Maximum Allowable Relative Humidity : n/a - 80%

3.3 Typical Wet Film Thickness Per Coat : 125 micrometers

3.4 Typical Dry Film Thickness Per Coat : 100 micrometers

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 32 m^2/L

3.6 Minimum Number of Coats : 2

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service see note **	Full cure
10°C	24 hours	none*	24 hours		14 days
20°C	8 hours	none*	8 hours		7 days
30°C	6 hours	none*	6 hours		5 days
40°C	4 hours	none*	4 hours		3 days
50°C	3 hours	none*	3 hours		3 days

* This product has an unlimited recoating interval provided the surface is free from chalking and other contamination.
In cases of exposure to direct sunlight or when the surface is contaminated it is recommended that the surface be cleaned and roughened to assure adhesion of the subsequent coating.
The optimum intercoat adhesion is obtained when the subsequent coating is applied before the full cure time of the previous coating has elapsed.

** This product is part of a system, it will reach it maximum physical and chemical resistance when all layers are fully cured, however is resistant to light handling and exposure to sun and rain at the dry to handle time.

3.8 Recommended Application Equipment

Airless (A/L) Spray : Tip Size: 0.018-0.021 inch
Fluid Pressure: 2,800 - 3,500 psi

Conventional Spray : Nozzle Size: 1.5 - 3 mm
Nozzle Pressure: 43 - 57 psi

Brush : For touch-up only

Manufacturer - Approved Saudi Aramco Data Sheet

Saudi Aramco: Company General Use

APCS-1A/1B/1C/1D/1E/1F – SigmaCover 410 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	78 to 82%
4.2	Product Weight	(ASTM D1475)	:	1.5 to 1.9 kg/l
4.3	Viscosity	(ASTM D562)	:	(12-17 dPa.s depending on color)
4.4	Flash Point	(ASTM D93 or D56)	:	20°C
4.5	Approved Color/s:	1000194629 1000194797 1000194960		Red Brown RAL 8012 Light Grey RAL 7038 Safety Yellow RAL 1023 (Other Colors on request)
4.6	Finish:	Flat		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T Topcoat

Type of Coating	:	Aliphatic Acrylic Polyurethane Topcoat
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	SigmaDur Gloss 7528
SAP M/N (SAMS S/N)	:	1000194672 Yellow RAL 1023, 1000194675 White RAL 9010, 1000194793 Grey RAL 7038, 1000194795 Red RAL 3000, 1000194851 Green 4199

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	7528 Base
	2.1.2 Hardener (Curing Agent)	:	7528 Hardener
2.2	Mixing Ratio	:	88:12 (base:hardener)
2.3	Thinner	:	Thinner 21-06
	SAP M/N (SAMS S/N)	:	1000198479 (09-738-345)
2.4	Minimum-Maximum Thinning Requirements	:	0 – 10%
2.5	Induction Time	:	None
2.6	Pot Life	:	5 hours @ 20°C 4 hours @ 25°C 3 hours @ 30°C 2 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	n/a - 80%

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APCS-1D/1E/1F/26T Topcoat - SigmaDur Gloss 7528 (Cont'd)

3.3	Typical Wet Film Thickness Per Coat	:	90 microns
3.4	Typical Dry Film Thickness Per Coat	:	50 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	22 m^2/L
3.6	Minimum Number of Coats	:	1

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service see note **	Full cure
10°C	8 hours	none*	8 hour		6 days
20°C	6 hours	none*	6 hour		4 days
30°C	5 hours	none*	5 hour		3 days
40°C	2 hours	none*	3 hour		2 days
50°C	2 hours	none*	2 hour		2 days

* Before overcoating after exposure, clean thoroughly by high pressure fresh water and allow to dry.

** This product is part of a system, it will reach it maximum physical and chemical resistance when all layers are fully cured, however is resistant to light handling and exposure to sun and rain at the dry to handle time.

3.8 Recommended Application Equipment

Airless (A/L) Spray	:	Tip Size: 0.011-0.013 inch Fluid Pressure: 2,800 psi
Conventional Spray	:	Tip Size: 1-1.5 Atomizing Pressure: 43-57 psi
Brush	:	For small areas only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	54 - 58%
4.2	Product Weight	(ASTM D1475)	:	1.2 – 1.4 Kg/L

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/1F/26T Topcoat - SigmaDur Gloss 7528 (Cont'd)

4.3	Viscosity	(ASTM D562)	:	6-8 dPa.s 102 – 106 KU	
4.4	Flash Point	(ASTM D93 or D56)	:	33°C	
4.5	Approved Color/s:	1000194672		Yellow	RAL 1023
		1000194675		White	RAL 9010
		1000194793		Grey	RAL 7038
		1000194795		Red	RAL 3000
		1000194851		Green	4199
				(Other colors upon request)	
4.6	Finish:			Gloss	

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C

Type of Coating	:	Epoxy: Phenolic
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	Sigma PhenGuard 930 / Sigma PhenGuard 935 / Sigma PhenGuard 940
SAP M/N (SAMS S/N)	:	1000194295, 1000194298, 1000194352

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	: 1 year

2. Mixing

2.1	No. of Components	: 2
	2.1.1 Base	: 7409/7435/7436
	2.1.2 Hardener (Curing Agent)	: 7409/7435/7436
2.2	Mixing Ratio	: 88:12 (base:hardener)
2.3	Thinner	: Thinner 91-92
	SAP M/N (SAMS S/N)	: 1000198377 (09-738-140)
2.4	Minimum-Maximum Thinning Requirements	: 5 to 10%
2.5	Induction Time	: 20 minutes @ 15°C 15 minutes @ 20°C 10 minutes @ 25°C
2.6	Pot Life	: 6 hours @ 10°C 4 hours @ 20°C 3 hours @ 25°C 1.5 hours @30°C ¾ hour @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10 - 50°C

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-2A/2C – Sigma PhenGuard 930/935/940 (Cont'd)

3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	: 150 micrometers
3.4	Typical Dry Film Thickness Per Coat	: 100 micrometers
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 26.4 m2/L
3.6	Minimum Number of Coats	: 3
3.7	Applicable Substrate	: CS
3.8	Surface Preparation Requirements	: ISO-8501-1 Sa2½

3.9 Drying Time at specified DFT:

For Primer coat:

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To handle	Full Cure See note
10°C	5 days	28 days	36 hours	14 days
15°C	4 days	25 days	36 hours	14 days
20°C	36 hours	21 days	24 hours	10 days
25°C	30 hours	18 days	20 hours	9 days
30°C	24 hours	14 days	16 hours	7 days
35°C	20 hours	10 days	14 hours	6 days
40°C	16 hours	7 days	10 hours	5 days
45°C	12 hours	4 days	8 hours	4 days
50°C	8 hours	3 days	5 hours	4 days

Note: -
- Full cure of Phenguard tank coating system before exposure to media/cargoes without note 4, 7, 8 or 11 and ballast water and tank test with sea water.
- Minimum curing time of Phenguard tank coating system before exposure to media/cargoes with note 4, 7, 8 or 11: 3 months
- For detailed information on resistance and resistance notes, please refer to the latest issue of the Cargo Resistance List (tankselect.sigmacoatings.com).
- For transport of methanol and vinyl acetate monomer, a hot cure is required which cannot be substituted by a service period of 3 months with nonaggressive cargoes

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APCS-2A/2C - Sigma PhenGuard 930/935/940 (Cont'd)

- Adequate ventilation must be maintained during application *and* curing
- The performance of the applied system strongly depends on the curing degree of the first coat at time of recoating. Therefore, overcoating time between 1st and 2nd coat is extended in comparison between 2nd and 3rd coat (see recoat interval)

For second and third coats:

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To handle	Full Cure See note
10°C	36 hours	28 days	36 hours	14 days
15°C	32 hours	25 days	36 hours	14 days
20°C	24 hours	21 days	24 hours	10 days
25°C	20 hours	18 days	20 hours	9 days
30°C	16 hours	14 days	16 hours	7 days
35°C	14 hours	10 days	14 hours	6 days
40°C	12 hours	7 days	10 hours	5 days
45°C	10 hours	4 days	8 hours	4 days
50°C	8 hours	3 days	5 hours	4 days

3.10 Recommended Application Equipment

Airless (A/L) Spray:	Tip Size: 0.018 to 0.021 inch Fluid Pressure: 2,130 psi
Conventional Spray:	Nozzle Size: 2 mm Nozzle Pressure: 43 psi
Brush:	For touch-up only

4. Physical Properties

4.1	Volume Solids (ASTM D2697)	: 66 ± 2%
4.2	Product Weight (ASTM D1475)	: 1.7 Kg/L
4.3	Viscosity (ASTM D562)	: 102 – 123 KU
4.4	Flash Point (ASTM D93 or D56)	: 23.7°C Base, 29.1°C Hardener

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APCS-2A/2C - Sigma PhenGuard 930/935/940 (Cont'd)

4.5	Approved Color/s:	Sigma PhenGuard 930	1000194295	Off White
		Sigma PhenGuard 935	1000194298	Pink
		Sigma PhenGuard 940	1000194352	Grey
4.6	Finish:	Eggshell		

5. Special Instructions:
   - All 3 products / approved shades have the same performance and **are interchangeable**. For example a Grey/Off-White/Grey system is allowed. The re-coating times of any of these products as the first or primer coat will not be affected and need to be treated as per the extended table.
   - Please refer also to PPG/Sigma tank coating procedures
   - 90/10 rule to be followed with regards to applied minimum dry film thickness (DFT)
   - Stripe coating of edges after 1st and 2nd coat required to ensure 300 microns NDFT.
   - Maximum DFT reading for primer should not be over 150 microns
   - Maximum DFT reading for subsequent coats should not be over 200 microns.

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APCS-2B

Type of Coating	:	Epoxy: Phenolic
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	Sigma PhenGuard 930 / Sigma PhenGuard 940
SAP M/N (SAMS S/N)	:	1000194295, 1000194352

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	: 1 year

2. Mixing

2.1	No. of Components	: 2
	2.1.1 Base	: 7409/7435/7436
	2.1.2 Hardener (Curing Agent)	: 7409/7435/7436
2.2	Mixing Ratio	: 88:12 (base:hardener)
2.3	Thinner	: Thinner 91-92
	SAP M/N (SAMS S/N)	: 1000198377 (09-738-140)
2.4	Minimum-Maximum Thinning Requirements	: 5 to 10%
2.5	Induction Time	: 20 minutes @ 15°C 15 minutes @ 20°C 10 minutes @ 25°C
2.6	Pot Life	: 6 hours @ 10°C 4 hours @ 20°C 3 hours @ 25°C 1.5 hours @30°C ¾ hour @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10 - 50°C

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APCS-2B – Sigma PhenGuard 930/940 (Cont'd)

3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	: 150 micrometers
3.4	Typical Dry Film Thickness Per Coat	: 100 micrometers
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 26.4 m2/L
3.6	Minimum Number of Coats	: 3
3.7	Applicable Substrate	: CS
3.8	Surface Preparation Requirements	: ISO-8501-1 Sa2½

3.9 Drying Time at specified DFT:

For Primer coat:

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To handle	Full Cure See note
10°C	5 days	28 days	36 hours	14 days
15°C	4 days	25 days	36 hours	14 days
20°C	36 hours	21 days	24 hours	10 days
25°C	30 hours	18 days	20 hours	9 days
30°C	24 hours	14 days	16 hours	7 days
35°C	20 hours	10 days	14 hours	6 days
40°C	16 hours	7 days	10 hours	5 days
45°C	12 hours	4 days	8 hours	4 days
50°C	8 hours	3 days	5 hours	4 days

Note: -
- Full cure of Phenguard tank coating system before exposure to media/cargoes without note 4, 7, 8 or 11 and ballast water and tank test with sea water.
- Minimum curing time of Phenguard tank coating system before exposure to media/cargoes with note 4, 7, 8 or 11: 3 months
- For detailed information on resistance and resistance notes, please refer to the latest issue of the Cargo Resistance List (tankselect.sigmacoatings.com).
- For transport of methanol and vinyl acetate monomer, a hot cure is required which cannot be substituted by a service period of 3 months with nonaggressive cargoes

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APCS-2B – Sigma PhenGuard 930/940 (Cont'd)

- Adequate ventilation must be maintained during application *and* curing
- The performance of the applied system strongly depends on the curing degree of the first coat at time of recoating. Therefore, overcoating time between 1st and 2nd coat is extended in comparison between 2nd and 3rd coat (see recoat interval)

For second and third coats:

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To handle	Full Cure See note
10°C	36 hours	28 days	36 hours	14 days
15°C	32 hours	25 days	36 hours	14 days
20°C	24 hours	21 days	24 hours	10 days
25°C	20 hours	18 days	20 hours	9 days
30°C	16 hours	14 days	16 hours	7 days
35°C	14 hours	10 days	14 hours	6 days
40°C	12 hours	7 days	10 hours	5 days
45°C	10 hours	4 days	8 hours	4 days
50°C	8 hours	3 days	5 hours	4 days

3.10 Recommended Application Equipment

Airless (A/L) Spray:	Tip Size: 0.018 to 0.021 inch Fluid Pressure: 2,130 psi
Conventional Spray:	Nozzle Size: 2 mm Nozzle Pressure: 43 psi
Brush:	For touch-up only

4. Physical Properties

4.1	Volume Solids (ASTM D2697)	: 66 ± 2%
4.2	Product Weight (ASTM D1475)	: 1.7 Kg/L
4.3	Viscosity (ASTM D562)	: 102 – 123 KU
4.4	Flash Point (ASTM D93 or D56)	: 23.7°C Base, 29.1°C Hardener

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APCS-2B – Sigma PhenGuard 930/940 (Cont'd)

4.5	Approved Color/s:	Sigma PhenGuard 930	1000194295	Off White
		Sigma PhenGuard 940	1000194352	Grey
4.6	Finish:		Eggshell	

5. Special Instructions:
   - All 2 products / approved shades have the same performance and **are interchangeable**. For example a Grey/Off-White/Grey system is allowed. The re-coating times of any of these products as the first or primer coat will not be affected and need to be treated as per the extended table.
   - Please refer also to PPG/Sigma tank coating procedures
   - 90/10 rule to be followed with regards to applied minimum dry film thickness (DFT)
   - Stripe coating of edges after 1st and 2nd coat required to ensure 300 microns NDFT.
   - Maximum DFT reading for primer should not be over 150 microns
   - Maximum DFT reading for subsequent coats should not be over 200 microns.

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APCS- 2E

Type of Coating	:	Epoxy Phenolic
Manufacturer	:	Sigma Paints S.A Ltd
Product Name	:	Sigma Novaguard 7453
SAP M/N (SAMS S/N)	:	1000608685 (20 L Set), 1000608684 (10L Set), 1000608683 (5L Set)

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	7453
	2.1.2 Hardener (Curing Agent)	:	7453
2.2	Mixing Ratio	:	(78 : 22)
2.3	Thinner	:	No Thinner to be used
	SAP M/N (SAMS S/N)	:	N/A
2.4	Minimum-Maximum Thinning Requirements	:	N/A
2.5	Induction Time	:	N/A
2.6	Pot Life	:	1 hour @ 20^0C 45 minutes @ 30^0C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10-50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:n/a- 80 %
3.3	Typical Wet Film Thickness Per Coat	: 500 microns (see special instructions)
3.4	Typical Dry Film Thickness Per Coat	: 500 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 40 m^2/L

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APCS 2E- Sigma NovaGuard 7453 (Cont'd)

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : CS

3.8 Surface Preparation Requirements : ISO Sa 2 ½, surface profile 50-125 microns

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	36 hours	3 months	30 hours		7 days
20ºC	24 hours	2 months	16 hours		5 days
30°C	16 hours	1 month	10 hours		3 days
40ºC	12 hours	2 weeks	6 hours		2 days
50°C	8 hours	5 days	4 hours		1.5 days

Note : - Full cure is required before exposure to chemicals
- For detailed information on resistance and resistance notes, please refer to the latest issue of the Cargo Resistance List (tankselect.sigmacoatings.com)

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip size 0.021 inch
Use heavy duty single feed airless spray equipment preferably 60:1 pump ratio and suitable high pressure hoses/in-line heating or insulated hoses may be necessary to avoid cooling down of paint in hoses at low air temperature, length of hoses should be as short as possible

Nozzle pressure at 20^0C (paint temperature) min 28MPa (4061 psi approx.)

Nozzle pressure at 30^0C (paint temperature) min 22 MPa (3000 psi approx.)

Conventional Spray : n/a

Brush : For stripe coating / touch-up only
Max. dft by brushing: 150 µm

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APCS 2E- Sigma NovaGuard 7453 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	100%
4.2	Product Weight	(ASTM D1475)	:	1.3 Kg/L
4.3	Viscosity	(ASTM D562)	:	30-50 poise (Rheolab MC1 E100 181)
4.4	Flash Point	(ASTM D93 or D56)	:	n/a (> 65°C)
4.5	Approved Color/s:	Cream, Green (Grey is also possible upon requirement)		
4.6	Finish:	Gloss		

5. Special Instructions:

measuring wet film thickness (WFT)

- a deviation is often obtained between the measured apparent wft and the real applied wft
- this is due to the thixotropy and the surface tension of the paint which retards the release of air trapped in the paint film for some time
- recommendation is to apply a wft which is equal to the specified dft plus 60 µm

measuring dry film thickness (DFT)

- because of low initial hardness, the dft innitially cannot be measured accurately due to the penetration of the measuring device into the soft paint film (time depending on temeprature)
- the dft should be measured using a calibration foil of known thickness placed in between the coating and the measuring device

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APCS-3

Type of Coating	:	Coal Tar Epoxy
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	Sigma C-200a Coal Tar
SAP M/N (SAMS S/N)	:	1000194372 / 100194375

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	3307 Base
	2.1.2 Hardener (Curing Agent)	:	3307 Hardener
2.2	Mixing Ratio	:	86:14 (base : hardener)
2.3	Thinner	:	Thinner 21-06
	SAP M/N (SAMS S/N)	:	1000198441 (09-738-180)
2.4	Minimum-Maximum Thinning Requirements	:	5 to 15%
2.5	Induction Time	:	15 minutes @ 20°C
2.6	Pot Life	:	6 hours @ 20 °C 5 hours @ 25°C 2 hours @ 30°C 1 hour @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10 - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%

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APCS-3 - Sigma C-200a Coal Tar (Cont'd)

3.3 Typical Wet Film Thickness Per Coat : 256 micrometers

3.4 Typical Dry Film Thickness Per Coat : 200 micrometers

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 31.2 m^2/L

3.6 Minimum Number of Coats : 2

3.7 Applicable Substrate : CS, Concrete

3.8 Surface Preparation Requirements : CS – ISO-8501-1 Sa 2½, blasting profile 40 – 70 µm (non-ferrous metals: sweep blast)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service See note	Full Cure
10°C	24 hours	20 days	1 day	Min. 24 hours	24days
15°C	16 hours	14 days	18 hours	Min. 24 hours	14 days
20°C	8 hours	7 days	12 hours	Min. 24 hours	10 days
25°C	7 hours	5 days	9 hours	Min. 24 hours	8 days
30°C	6 hours	4 days	6 hours	Min. 24 hours	5 days
35°C	5 hours	3 days	6 hours	Min. 24 hours	4 days
40°C	4 hours	3 days	5 hours	Min. 24 hours	3 days
45°C	3 hours	2 days	5 hours	Min. 24 hours	3 days
50°C	2 hour	1 days	4 hours	Min. 24 hours	3 days

Note: This product is part of a system, it will reach it maximum physical, and chemical resistance when all layers are fully cured, however is resistant to exposure to water and slightly polluted atmosphere after 24 hours.

3.10 Recommended Application Equipment

Airless (A/L) Spray: Tip Size: 0.019 to 0.023 inch
Fluid Pressure: 2,500 psi to 2,700 psi

Conventional Spray: Nozzle Size: 0.059 to 0.118 inch
Nozzle Pressure: 28 to 57 psi

Brush: Four touch-up only

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APCS-3 - Sigma C-200a Coal Tar (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	78%
4.2	Product Weight	(ASTM D1475)	:	1.28 to 1.32 Kg/L
4.3	Viscosity	(ASTM D562)	:	130 – 160 poises
4.4	Flash Point	(ASTM D93 or D56)	:	26°C Base, 26°C Hardener
4.5	Approved Color/s		:	1000194372 Brown 1000194375 Black
4.6	Finish		:	Eggshell

5. Special Instructions:

On concrete 720 microns to be applied in 2 or 3 coats (in 2 coats overlaps are likely to be over 400 microns which may result in sagging and reduced drying speed)

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APCS-4/6 Primer

Type of Coating	:	Zinc Phosphate Primer
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	Sigmarine 24
SAP M/N (SAMS S/N)	:	1000197976 / 1000198011

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	7135
	2.1.2 Hardener (Curing Agent)	:	n/a
2.2	Mixing Ratio	:	n/a
2.3	Thinner	:	Thinner 20-05
	SAP M/N (SAMS S/N)	:	1000198474
2.4	Minimum-Maximum Thinning Requirements	:	0 - 3%
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10 - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	: 63 micrometers
3.4	Typical Dry Film Thickness Per Coat	: 35 micrometers

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APCS-4/6 Primer - Sigmarine 24 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 22.4 m^2/L

3.6 Minimum Number of Coats : 2

3.7 Applicable Substrate : Carbon Steel

3.8 Surface Preparation Requirements : ISO-8501-1 Sa2½, blasting profile 40 – 70 µm

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle see note **	To Service	Full cure
10°C	36 hours	none*	12 hours		
20°C	24 hours	none*	4 hours		
30°C	12 hours	none*	2 hours		
40°C	8 hours	none*	1.5 hours		
50°C	6 hours	none*	1 hour		

* Coating should be clean (dust, and other contaminant free) before recoating.

** This is an air-drying (oxidative curing) product, hence the applied film thickness has a big effect on the hardness development. Over thickness will not only retard drying but can also result in surface wrinkling.

3.10 Recommended Application Equipment

Airless (A/L) Spray: Tip Size: 0.017 to 0.019 inch
Fluid Pressure: 1,700 to 2,130 psi

Conventional Spray: Nozzle Size: 1.7-2 mm
Nozzle Pressure: 28 to 42 psi

Brush: For touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 56 ± 2%

4.2 Product Weight (ASTM D1475) : 1.3 – 1.5 Kg/L

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APCS-4/6 Primer - Sigmarine 24 (Cont'd)

4.3	Viscosity	(ASTM D562)	:	83 – 96 KU	
4.4	Flash Point	(ASTM D93 or D56)	:	41°C	
4.5	Approved Color/s		:	1000197976 1000198011	Red Brown Yellow
4.6	Finish		:	Flat	

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APCS-4 Topcoat

Type of Coating	:	Aluminum-Pigmented Topcoat
Manufacturer	:	Sigma Paints S.A. Ltd
Product Name	:	Sigma Aluminum Paint SA35
SAP M/N (SAMS S/N)	:	1000196402

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	0604
	2.1.2 Hardener (Curing Agent)	:	n/a
2.2	Mixing Ratio	:	n/a
2.3	Thinner	:	Thinner 20-05
	SAP M/N (SAMS S/N)	:	1000198474
2.4	Minimum-Maximum Thinning Requirements	:	Nil (Airless Spray)
2.5	Induction Time	:	N/A
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10 -50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	: 65 micrometers

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APCS-4 Topcoat - Sigma Aluminum Paint SA35 (Cont'd)

3.4 Typical Dry Film Thickness Per Coat : 25 micrometers

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 15.2 m2/L

3.6 Minimum Number of Coats : 1

3.7 Drying Time at specified DFT:

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle see note **	To Service	Full cure
10°C	36 hours	none*	3 hours		
20°C	24 hours	none*	2 hours		
30°C	14 hours	none*	1 hours		
40°C	12 hours	none*	¾ hour		
50°C	10 hours	none*	½ hour		

* Coating should be clean (dust, and other contaminant free) before recoating.

** This is an air-drying (oxidative curing) product, hence the applied film thickness has a big effect on the hardness development. Over thickness will not only retard drying but can also result in surface wrinkling.

3.8 Recommended Application

Airless (A/L) Spray: Tip Size: 0.017 to 0.019 inch
Fluid Pressure: 1,700 to 2,100 psi

Conventional Spray: Nozzle Size: 1.8 mm
Nozzle Pressure: 43 to 57 psi

Brush: For touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 38%

4.2 Product Weight (ASTM D1475) : 0.98 to 1.05 Kg/L

4.3 Viscosity (ASTM D562) : 4 – 5 dPa.s

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APCS-4 Topcoat - Sigma Aluminum Paint SA35 (Cont'd)

4.4	Flash Point (ASTM D93 or D56)	:	38 °C	
4.5	Approved Color/s	:	1000196402	Aluminum
4.6	Finish	:	Gloss	

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APCS-6 Topcoat

Type of Coating	:	High Gloss Enamel Topcoat
Manufacturer	:	Sigma Paints S.A. Ltd
Product Name	:	Sigma Enamel SA21
SAP M/N (SAMS S/N)	:	1000195487, 1000195490, 1000195532, 1000195495, 1000195571 1000195577, 1000195631, 1000195637, 1000195650, 1000195683 1000195685, 1000195687, 1000195689, 1000195742, 1000195745 1000195747, 1000195749, 1000195801, 1000195803, 1000195831

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	0649
	2.1.2 Hardener (Curing Agent)	:	n/a
2.2	Mixing Ratio	:	n/a
2.3	Thinner	:	Thinner 20-05
	SAP M/N (SAMS S/N)	:	1000198474 (09-738-340)
2.4	Minimum-Maximum Thinning Requirements	:	8 -12%
2.5	Induction Time	:	n/a
2.6	Pot Life	:	n/a

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10 - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	: 70 micrometers

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APCS-6 Topcoat - Sigma Enamel SA21 (Cont'd)

3.4 Typical Dry Film Thickness Per Coat : 35 micrometers

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 20 m²/L

3.6 Minimum Number of Coats : 1

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle see note **	To Service	Full cure
10°C	24 hours	none*	8 hours		
20°C	20 hours	none*	4 hours		
30°C	16 hours	none*	2 hours		
40°C	14 hours	none*	1½ hours		
50°C	10 hours	none*	1 hour		

* Coating should be clean (dust, and other contaminant free) before recoating.

** This is an air-drying (oxidative curing) product, hence the applied film thickness has a big effect on the hardness development. Over thickness will not only retard drying but can also result in surface wrinkling.

3.8 Recommended Application Equipment

Airless (A/L) Spray: Tip Size: 0.013 inch
Fluid Pressure: 1,700 psi

Conventional Spray: Nozzle Size: 1.8 to 2.0 mm
Nozzle Pressure: 43 to 57 psi

Brush: For touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 47 to 50% (depending on shade)

4.2 Product Weight (ASTM D1475) : 1.0 to 1.2 kg/L

4.3 Viscosity (ASTM D562) : 85 – 103 ku (9 - 12 dPa.s)

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APCS-6 Topcoat - Sigma Enamel SA21 (Cont'd)

4.4	Flash Point	(ASTM D93 or D56)	:	38 °C	
4.5	Approved Color/s:	1000195487		Black	RAL 9011
		1000195490		Violet Blue	RAL 5000
		1000195532		Green	RAL 6005
		1000195495		Grey	RAL 7023
		1000195571		Pale Green	RAL 6021
		1000195577		Orange	RAL 2011
		1000195631		Oxide Red	RAL 3009
		1000195637		Red	RAL 3002
		1000195650		White	RAL 9010
		1000195683		Yellow	RAL 1021
		1000195685		Caterpillar Yellow	SG-3344
		1000195687		Driftwood beige	10YR 8/4
		1000195689		Capri Blue	RAL 5019
		1000195742		Red Lilac	RAL 4001
		1000195745			
		1000195747			2.5Y 9/4
		1000195749			2.5 PB 2/6
		1000195801			10R5/16
		1000195803			10R3/4
		1000195831			2.5Y8/16
4.6	Finish:	Gloss			

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-10

Type of Coating	:	Bituminous coating
Manufacturer	:	Sigma Paints S.A. Ltd
Product Name	:	Sigma Vikote 63
SAP M/N (SAMS S/N)	:	1000194025, 1000194029, 1000194032

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	7102
	2.1.2 Hardener (Curing Agent)	:	n/a
2.2	Mixing Ratio	:	n/a
2.3	Thinner	:	Thinner 20-05
	SAP M/N (SAMS S/N)	:	1000198474
2.4	Minimum-Maximum Thinning Requirements	:	0 to 5% by Volume
2.5	Induction Time	:	Nil
2.6	Pot Life	:	n/a

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 40°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	0 - 80%
3.3	Typical Wet Film Thickness Per Coat	:	800 micrometers
3.4	Typical Dry Film Thickness Per Coat	:	500 micrometers

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APCS-10 – Sigma Vikote 63 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	24.8 m^2/L
3.6	Minimum Number of Coats	:	1
3.7	Applicable Substrate	:	CS & Concrete
3.8	Surface Preparation Requirements	:	CS - ISO-8501-1 Sa2½, Concrete - Sweep blast

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle see note **	To Service
10°C	8 hours	none*	8 hours	8 days
20°C	7 hours	none*	7 hours	8 days
30°C	5 hours	none*	5 hours	5 days
40°C	4 hours	none*	4 hours	5 days
50°C	3 hours	none*	3 hour	3 days

* Coating should be clean (dust, and other contaminant free) before recoating.

** This is a physically drying product (dries by solvent evaporation only), hence the applied film thickness has a big effect on the hardness development. Over thickness will retard drying and can cause surface crocodiling (especially at elevated temperatures).

3.10 Recommended Application Equipment

Airless (A/L) Spray:	Tip Size: 0.023 inch Fluid Pressure: 1,700-2,130 psi 0-5% thinner 20-05
Conventional Spray:	Nozzle Size: 2 – 3 mm Nozzle Pressure: 43-57 psi 5-10% thinner 20-05
Brush:	for touch up and spot repair only 0-5% thinner 20-05

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-10 – Sigma Vikote 63 (Cont'd)

4. Physical Properties

4.1	Volume Solids (ASTM D2697)	: 57 ± 2%	
4.2	Product Weight (ASTM D1475)	: 1.2 Kg/L	
4.3	Viscosity (ASTM D562)	: 40-60 dPa.s	
4.4	Flash Point (ASTM D93 or D56)	: 39°C	
4.5	Approved Color/s	: 1000194025 1000194029 1000194032	Black Black Black
4.6	Finish	: Flat	

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-11A/11B

Type of Coating	:	Silicone Topcoat, self-priming
Manufacturer	:	Sigma Paints S.A. Ltd
Product Name	:	SigmaTherm 540
SAP M/N (SAMS S/N)	:	1000196488

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	9 Months

2. Mixing

2.1	No. of Components	:	1
	2.1.1 Base	:	7564
	2.1.2 Hardener (Curing Agent)	:	n/a
2.2	Mixing Ratio	:	n/a
2.3	Thinner	:	Thinner 21-06 (Cleaning only)
	SAP M/N (SAMS S/N)	:	1000198479
2.4	Minimum-Maximum Thinning Requirements	:	None
2.5	Induction Time	:	n/a
2.6	Pot Life	:	n/a

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10 - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	: 56 micrometers
3.4	Typical Dry Film Thickness Per Coat	: 25 micrometers

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APCS-11A/11B - SigmaTherm 540 (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 18 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : CS & SS

3.8 Surface Preparation Requirements : CS-ISO Sa 2½ & SS – SP-1 & Sweep blast

3.9 Drying Time at specified DFT:

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service see note 1	Full cure see note 2
10°C	36 hours	none	4 hour		
20°C	24 hours	none	3 hour		
30°C	16 hours	none	1 hour		
40°C	12 hours	none	½ hour		
50°C	10 hours	none	½ hour		

Note 1: This product is part of a system, it will reach it maximum physical and thermal resistance when all layers are fully dried and cured, however is resistant to light handling and exposure to sun and rain at the dry to handle time.

Note 2: This silicone topcoat is initially mainly physical drying (solvent evaporation only) which will allow for careful handling (this type of product does not reach the strength of an epoxy coating). Further mechanical strength is achieved after it has been exposed to hot service temperatures.

3.8 Recommended Application Equipment

Conventional Spray: Nozzle Size: 1.5 – 2mm
Nozzle Pressure: 43 - 57 psi

Brush: For touch-up only

* If airless spray is used , extra care should be taken to avoid over thickness

4. Physical Properties:

4.1 Volume Solids (ASTM D2697) : 45 ± 2%

4.2 Product Weight (ASTM D1475) : 1.1 Kg/L

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APCS-11A/11B - SigmaTherm 540 (Cont'd)

4.3	Viscosity	(ASTM D562)	:	16 to 18 seconds DIN cup 4
4.4	Flash Point	(ASTM D93 or D56)	:	26°C
4.5	Approved Color/s		:	Aluminum
4.6	Finish		:	Eggshell

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS 12

Type of Coating	:	Epoxy Primer
Manufacturer	:	Sigma Paints S.A. Ltd
Product Name	:	SigmaCover 410 (Alu)
SAP M/N (SAMS S/N)	:	1000194626

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	6823 Base
	2.1.2 Hardener (Curing Agent)	:	6823 Hardener
2.2	Mixing Ratio	:	80:20 (Base : Hardener) By volume
2.3	Thinner	:	Thinner 91-92
	SAP M/N (SAMS S/N)	:	1000198455 (09-738-280)
2.4	Minimum-Maximum Thinning Requirements	:	5 to 10% by Volume 30 to 40% for miscoat
2.5	Induction Time	:	Nil
2.6	Pot Life	:	4 hours @ 25°C 2 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	:	125 micrometers
3.4	Typical Dry Film Thickness Per Coat	:	100 micrometers
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	32 m^2/L

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APCS- 12 Primer Sigmacover Primer 410 (Alu) (Cont'd)

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : (CS, GS, GI, SS etc
3.8 Surface Preparation Requirements : (CS – ISO Sa 2½, .) blasting profile 40 – 70 µm , GI, SS Sweep blast) ,

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service See note **	Full Cure
10°C	24 Hours	None*	24 Hours		14 Days
20°C	8 Hours	None*	8 Hours		7 Days
30°C	6 Hours	None*	6 Hours		5 Days
40°C	4 Hours	None *	4 Hours		3 Days
50°C	3 Hours	None*	3 Hours		3 Days

* This product has an unlimitedrecoating interval provided the surface is free from chalking and other contamination.
In cases of exposure to direct sunlight or when the surface is contaminated it is recommended that the surface be cleaned and roughened to assure adhesion of the subsequent coating
The optimum intercoat adhesion is obtained when the subsequent coating is applied before the full cure time of the previous coating has elapsed.

** This product is part of a system, it will reach it maximum physical and chemical resitance when all layers are fully cured, however is resistant to light handling and exposure to sun and rain at the dry to handle time.

3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip Size: 0.018-0.021 inch
Fluid Pressure: 2800 -3500 psi

Conventional Spray : Nozzle Size: 1.5 - 3 mm
Nozzle Pressure: 43 - 57 psi

Brush : For touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 78 to 82%

4.2 Product Weight (ASTM D1475) : 1.5 to 1.9 kg/l

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APCS- 12 Primer Sigmacover Primer 410 (Alu) (Cont'd)

4.3	Viscosity	(ASTM D562)	:	12-17 dPa.s depending on color
4.4	Flash Point	(ASTM D93 or D56)	:	20°C
4.5	Approved Color/s	:	Aluminium Grey	
4.6	Finish	:	Flat	

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-12 Intermediate / Top Coat

Type of Coating	:	Epoxy Topcoat: Polyamide-Cured
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	SigmaCover 410
SAP M/N (SAMS S/N)	:	1000194629 Red Brown RAL 8012 1000194797 Light Grey RAL 7038 1000194960 Safety Yellow RAL 1023

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum		:	1 year

2. Mixing

2.1	No. of Components		:	2
	2.1.1	Base	:	6823 Binder
	2.1.2	Hardener (Curing Agent)	:	6823 Hardener
2.2	Mixing Ratio		:	80:20 (Base:Hardener) By volume
2.3	Thinner		:	Thinner 91-92
	SAP M/N (SAMS S/N)		:	1000198452 (09-738-260)
2.4	Minimum-Maximum Thinning Requirements		:	0 to 10% by volume 30 to 40% for miscoat
2.5	Induction Time		:	Nil
2.6	Pot Life		:	4 hours @ 25°C 2 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10°C - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	:	125 micrometers
3.4	Typical Dry Film Thickness Per Coat	:	100 micrometers

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APCS- 12 Sigmacover 410 Intermediate / Top Coat (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 32 m^2/L

3.6 Minimum Number of Coats : 2

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service See note **	Full Cure
10°C	24 Hours	None*	24 Hours		14 Days
20°C	8 Hours	None*	8 Hours		7 Days
30°C	6 Hours	None*	6 Hours		5 Days
40°C	4 Hours	None *	4 Hours		3 Days
50°C	3 Hours	None*	3 Hours		3 Days

* This product has an unlimitedrecoating interval provided the surface is free from chalking and other contamination.
In cases of exposure to direct sunlight or when the surface is contaminated it is recommended that the surface be cleaned and roughened to assure adhesion of the subsequent coating
The optimum intercoat adhesion is obtained when the subsequent coating is applied before the full cure time of the previous coating has elapsed.
The optimum intercoat adhesion is obtained when the subsequent coating is applied before the full cure time of the previous coating has elapsed.

** This product is part of a system, it will reach it maximum physical and chemical resitance when all layers are fully cured, however is resistant to light handling and exposure to sun and rain at the dry to handle time.

3.8 Recommended Application Equipment

Airless (A/L) Spray : Tip Size: 0.018-0.021 inch
Fluid Pressure: 2800 -3500 psi

Conventional Spray : Nozzle Size: 1.5 - 3 mm
Nozzle Pressure: 43 - 57 psi

Brush : For touch-up only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 78 to 82%

4.2 Product Weight (ASTM D1475) : 1.5 to 1.9 kg/l

4.3 Viscosity (ASTM D562) : (12-17 dPa.s depending on color)

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APCS- 12 Sigmacover 410 Intermediate / Top Coat (Cont'd)

4.4	Flash Point	(ASTM D93 or D56)	:	20°C
4.5	Approved Color/s:		:	Red Brown RAL 8012, Grey RAL 7038 Safety Yellow RAL 1023 (Other Color/s on request)
4.6	Finish		:	Flat

Manufacturer - Approved Saudi Aramco Data Sheet

Saudi Aramco: Company General Use

APCS-22A Primer

Type of Coating	:	Epoxy Primer: Polyamide-Cured
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	SigmaCover 410 (Alu)
SAP M/N (SAMS S/N)	:	1000194626

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	6823 Base
	2.1.2 Hardener (Curing Agent)	:	6823 Hardener
2.2	Mixing Ratio	:	80:20 (Base : Hardener) By volume
2.3	Thinner	:	Thinner 91-92
	SAP M/N (SAMS S/N)	:	1000198455 (09-738-280)
2.4	Minimum-Maximum Thinning Requirements	:	0 to 10% by Volume
2.5	Induction Time	:	Nil
2.6	Pot Life	:	12 hours @ 10°C 6 hours @ 20°C 4 hours @ 25°C 3 hours @ 30°C 2 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10°C - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	: 125 micrometers

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A Primer – Sigmacover Primer 410 (Alu) (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	: 100 micrometers
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 32 m^2/L
3.6	Minimum Number of Coats	: 1
3.7	Applicable Substrate	: CS (non-ferrous possible)
3.8	Surface Preparation Requirements	: CS – ISO-8501-1 Sa 2½, blasting profile 40 – 70 µm (non-ferrous metals: sweep blast)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service see note **	Full cure
10°C	24 hours	none*	24 hours		14 days
20°C	8 hours	none*	8 hours		7 days
30°C	6 hours	none*	6 hours		5 days
40°C	4 hours	none*	4 hours		3 days
50°C	3 hours	none*	3 hours		3 days

* This product has an unlimited recoating interval provided the surface is free from chalking and other contamination.
In cases of exposure to direct sunlight or when the surface is contaminated it is recommended that the surface be cleaned and roughened to assure adhesion of the subsequent coating.
The optimum intercoat adhesion is obtained when the subsequent coating is applied before the full cure time of the previous coating has elapsed.

** This product is part of a system, it will reach it maximum physical and chemical resistance when all layers are fully cured; however, is resistant to light handling and exposure to sun and rain at the dry to handle time.

3.10 Recommended Application Equipment

Airless (A/L) Spray: Tip Size: 0.018-0.021 inch
Fluid Pressure: 2,800 - 3,500 psi

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APCS-22A Primer – Sigmacover Primer 410 (Alu) (Continued)

Conventional Spray:	Nozzle Size: 1.5 - 3 mm Nozzle Pressure: 43 - 57 psi
Brush:	For touch-up only

4. Physical Properties

4.1	Volume Solids (ASTM D2697)	:	78 to 82%
4.2	Product Weight (ASTM D1475)	:	1.5 to 1.9 kg/l
4.3	Viscosity (ASTM D562)	:	(12-17 dPa.s depending on color)
4.4	Flash Point (ASTM D93 or D56)	:	20°C
4.5	Approved Color/s	:	Aluminium Grey
4.6	Finish	:	Flat

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-22A Top Coat

Type of Coating	:	Epoxy Topcoat, Polyamide-Cured		
Manufacturer	:	Sigma Paints S.A. Ltd.		
Product Name	:	SigmaCover 410		
SAP M/N (SAMS S/N)	:	1000194629	Red Brown	RAL 8012
		1000194797	Light Grey	RAL 7038
		1000194960	Safety Yellow	RAL 1023

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	6823 Base
	2.1.2 Hardener (Curing Agent)	:	6823 Hardener
2.2	Mixing Ratio	:	80:20 (Base:Hardener) By volume
2.3	Thinner	:	Thinner 91-92
	SAP M/N (SAMS S/N)	:	1000198452 (09-738-260)
2.4	Minimum-Maximum Thinning Requirements	:	0 to 10% by volume 30 to 40% for mist-coat
2.5	Induction Time	:	Nil
2.6	Pot Life	:	12 hours @ 10°C 6 hours @ 20°C 4 hours @ 25°C 3 hours @ 30°C 2 hours @ 40°C

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APCS-22A Top Coat - SigmaCover 410 (Cont'd)

3. Application

3.1 Minimum-Maximum Allowable Substrate Temperature : 10°C - 50°C

3.2 Minimum-Maximum Allowable Relative Humidity : n/a - 80%

3.3 Typical Wet Film Thickness Per Coat : 125 micrometers

3.4 Typical Dry Film Thickness Per Coat : 100 micrometers

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 32 m^2/L

3.6 Minimum Number of Coats : 2

3.7 Drying Time at specified DFT:

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service see note **	Full cure
10°C	24 hours	none*	24 hours		14 days
20°C	8 hours	none*	8 hours		7 days
30°C	6 hours	none*	6 hours		5 days
40°C	4 hours	none*	4 hours		3 days
50°C	3 hours	none*	3 hours		3 days

* This product has an unlimited recoating interval provided the surface is free from chalking and other contamination.
In cases of exposure to direct sunlight or when the surface is contaminated it is recommended that the surface be cleaned and roughened to assure adhesion of the subsequent coating.
The optimum intercoat adhesion is obtained when the subsequent coating is applied before the full cure time of the previous coating has elapsed.

** This product is part of a system, it will reach it maximum physical and chemical resistance when all layers are fully cured; however, is resistant to light handling and exposure to sun and rain at the dry to handle time.

3.8 Recommended Application Equipment

Airless (A/L) Spray: Tip Size: 0.018-0.021 inch
Fluid Pressure: 2800 -3500 psi

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APCS-22A Top Coat - SigmaCover 410 (Cont'd)

Conventional Spray:	Nozzle Size: 1.5 - 3 mm Nozzle Pressure: 43 - 57 psi
Brush:	For touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	78 to 82%
4.2	Product Weight	(ASTM D1475)	:	1.5 to 1.9 kg/l
4.3	Viscosity	(ASTM D562)	:	(12-17 dPa.s depending on color)
4.4	Flash Point	(ASTM D93 or D56)	:	20°C
4.5	Approved Color/s:	1000194629 1000194797 1000194960		Red Brown RAL 8012 Light Grey RAL 7038 Safety Yellow RAL 1023 (Other Color/s on request)
4.6	Finish:			Flat

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26 Primer / Top Coat

Type of Coating	:	Epoxy Primer / Topcoat, Polyamide-Cured
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	SigmaCover 410 (Alu) – Primer / Sigmacover 410
SAP M/N (SAMS S/N)	:	1000194626 SigmaCover 410 (Alu) – primer 1000194629 Red Brown RAL 8012 1000194797 Light Grey RAL 7038 1000194960 Safety Yellow RAL 1023

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	: 1 years

2. Mixing

2.1	No. of Components	: 2
	2.1.1 Base	: 6823 Base
	2.1.2 Hardener (Curing Agent)	: 6823 Hardener
2.2	Mixing Ratio	: 80:20 (Base:Hardener) By volume
2.3	Thinner	: Thinner 91-92
	SAP M/N (SAMS S/N)	: 1000198452 (09-738-260)
2.4	Minimum-Maximum Thinning Requirements	: 0 to 10% by volume 30 to 40% for mist-coat
2.5	Induction Time	: Nil
2.6	Pot Life	: 4 hours @ 25°C 2 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	: 10°C - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	: n/a - 80%

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APCS-26 Primer / Top Coat - SigmaCover 410 (Alu) / Sigmacover 410 **(Cont'd)**

3.3	Typical Wet Film Thickness Per Coat	: 190 micrometers
3.4	Typical Dry Film Thickness Per Coat	: 150 micrometers
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	: 32 m^2/L
3.6	Minimum Number of Coats	: 2
3.7	Applicable Substrate	: (CS, GS, SS etc.)
3.8	Surface Preparation Requirements	: (CS – ISO Sa 2½, GS, SS - Sweep blast)

3.9 Drying Time at specified DFT:

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service see note **	Full cure
10°C	24 hours	none*	24 hours		14 days
20°C	8 hours	none*	8 hours		7 days
30°C	6 hours	none*	6 hours		5 days
40°C	4 hours	none*	4 hours		3 days
50°C	3 hours	none*	3 hours		3 days

* This product has an unlimited recoating interval provided the surface is free from chalking and other contamination.
In cases of exposure to direct sunlight or when the surface is contaminated it is recommended that the surface be cleaned and roughened to assure adhesion of the subsequent coating.
The optimum intercoat adhesion is obtained when the subsequent coating is applied before the full cure time of the previous coating has elapsed.

** This product is part of a system, it will reach it maximum physical and chemical resistance when all layers are fully cured; however, is resistant to light handling and exposure to sun and rain at the dry to handle time.

3.10 Recommended Application Equipment

Airless (A/L) Spray:	Tip Size: 0.018-0.021 inch Fluid Pressure: 2,800 -3,500 psi
Conventional Spray:	Nozzle Size: 1.5 - 3 mm Nozzle Pressure: 43 - 57 psi
Brush:	For touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26 Primer / Top Coat - SigmaCover 410 (Alu) / Sigmacover 410 **(Cont'd)**

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	78 to 82%
4.2	Product Weight	(ASTM D1475)	:	1.5 to 1.9 kg/l
4.3	Viscosity	(ASTM D562)	:	(12-17 dPa.s depending on color)
4.4	Flash Point	(ASTM D93 or D56)	:	20°C
4.5	Approved Color/s:	1000194626 1000194629 1000194797 1000194960		SigmaCover 410 (Alu) – primer Red Brown RAL 8012 Light Grey RAL 7038 Safety Yellow RAL 1023 (Other Colors on request)
4.6	Finish:	Flat		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS 26T Primer / Intermediate

Type of Coating	:	Polyamide Cured Epoxy Primer/Topcoat
Manufacturer	:	Sigma Paints S.A. Ltd.
Product Name	:	SigmaCover 410 (Alu) – Primer / Sigmacover 410
SAP M/N (SAMS S/N)	:	1000194626 SigmaCover 410 (Alu) – primer 1000194629 Red Brown RAL 8012 1000194797 Light Grey RAL 7038 1000194960 Safety Yellow RAL 1023

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	6823 Base
	2.1.2 Hardener (Curing Agent)	:	6823 Hardener
2.2	Mixing Ratio	:	80:20 (Base:Hardener) By volume
2.3	Thinner	:	Thinner 91-92
	SAP M/N (SAMS S/N)	:	1000198452 (09-738-260)
2.4	Minimum-Maximum Thinning Requirements	:	0 to 10% by volume 30 to 40% for mist-coat
2.5	Induction Time	:	Nil
2.6	Pot Life	:	4 hours @ 25°C 2 hours @ 40°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 - 50°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	n/a - 80%
3.3	Typical Wet Film Thickness Per Coat	:	190 micrometers
3.4	Typical Dry Film Thickness Per Coat	:	150 micrometers

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS 26T Primer/Intermediate – SigmaCover 410 (Alu) / Sigmacover 410

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 32 m^2/L

3.6 Minimum Number of Coats : 2

3.7 Applicable Substrate : (CS, GS, SS)

3.8 Surface Preparation Requirements : (CS – ISO Sa 2½, GS, SS - Sweep blast)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service See notes*	Full Cure
10°C	24 Hours	None*	24 Hours		14 Days
20°C	8 Hours	None*	8 Hours		7 Days
30°C	6 Hours	None*	6 Hours		5 Days
40°C	4 Hours	None *	4 Hours		3 Days
50°C	3 Hours	None*	3 Hours		3 Days

*This product has an unlimitedrecoating interval provided the surface is free from chalking and other contamination.In cases of exposure to direct sunlight or when the surface is contaminated it is recommended that the surface be cleaned and roughened to assure adhesion of the subsequent coating .The optimum intercoat adhesion is obtained when the subsequent coating is applied before the full cure time of the previous coating has elapsed.

This product is part of a system, it will reach it maximum physical and chemical resistance when all layers are fully cured; however, is resistant to light handling and exposure to sun and rain at the dry to handle time.

. 3.10 Recommended Application Equipment

Airless (A/L) Spray : Tip Size: 0.018-0.021 inch
Fluid Pressure: 2800 -3500 psi

Conventional Spray : Nozzle Size: 1.5 - 3 mm
Nozzle Pressure: 43 - 57 psi

Brush : For touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS 26T Primer/Intermediate – SigmaCover 410 (Alu) / Sigmacover 410

4.0. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	78 to 82%
4.2	Product Weight	(ASTM D1475)	:	1.5 to 1.9 kg/l
4.3	Viscosity	(ASTM D562)	:	12 to 17 dPa.s
4.4	Flash Point	(ASTM D93 or D56)	:	20°C

4.5 Approved Color/s : 1000194626 SigmaCover 410 (Alu) – primer
1000194629 Red Brown RAL 8012
1000194797 Light Grey RAL 7038
1000194960 Safety Yellow RAL 1023
(Other colours on request)

4.6 Finish : Flat

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-113A

Type of Coating	:	100% Solids Phenolic Epoxy
Manufacturer	:	Sigma Paints Saudi Arabia Ltd.
Product Name	:	Sigmaline 2000
SAP M/N (SAMS S/N)	:	1000686070 (09-000-497)

1. Storage

1.1	Shelf life, sheltered storage at 35°C maximum	:	1 year

2. Mixing

2.1	No. of Components	:	2
2.2	Mixing Ratio	:	78:22 by volume; base: hardener
2.3	Thinner	:	None
2.4	Thinning Requirements	:	N/A
2.5	Induction Time	:	Nil
2.6	Pot Life	:	50 minutes at 25°C 20 minutes at 40°C

3. Application

3.1	Maximum Allowable Substrate Temperature	:	70°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	n/a – 80%
3.3	Typical Wet Film Thickness Per Coat	:	600 microns
3.4	Typical Dry Film Thickness (DFT) Per Coat	:	550 microns
3.5	Theoretical Coverage at 25 Micrometers DFT	:	40 M^2/L
3.6	Minimum Number of Coats	:	1

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-113A - Sigmaline 2000 (Cont'd)

3.7 Applicable Substrate : CS.

3.8 Surface Preparation Requirements ISO Sa2½
Blast profile 50 -100 microns

3.9 Drying Time:

Substrate Temperature	To Handle	Recoat Interval Minimum	Recoat Interval Maximum	To Immersion Water	To Immersion Buried
10°C	30 Hours	1-½ Days	90 Days	1 Day	1 Day
30°C	10 Hours	16 Hours	30 Days	12 Hours	7 Hours
50°C	4 Hours	4 Hours	10 Days	6 Hours	4 Hours

3.10 Recommended Equipment

Airless Spray : Tip Size: 0.021 inch
Fluid Pressure: 3,000 psi

Conventional Spray : N/A

Brush : for touch-up, repairs, and stripe coating

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 100%

4.2 Product Weight (ASTM D1475) : 1.28 to 1.32 Kg/L

4.3 Viscosity (ASTM D562) : 35 to 40 poise

4.4 Flash Point (ASTM D93 or D56) : 65°C

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q. Super Therm – Approved Products

APCS-5A
SuperTherm *

*Note: Refer to coating manufacturer's product date sheet.

Saudi Aramco: Company General Use

r. Tesla – Approved Products

APCS-1B

Teslan 1101 ZN-CNT Low Voc Epoxy Primer	Inorganic Zinc Primer: Solvent Based
Teslan 3100 Low Voc Epoxy-CNT Top Coat	Epoxy Topcoat

APCS-22A

Teslan 1101 ZN-CNT Low Voc Epoxy Primer	Inorganic Zinc Primer: Solvent Based
Teslan 3100 Low Voc Epoxy-CNT Top Coat	Epoxy Topcoat

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Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 22A CNT-Primer

Type of Coating	:	Zinc-CNT Epoxy primer, Solvent-based Nanocoatings
Manufacturer	:	Tesla Nanocoatings Inc.
Product Name	:	Teslan 1101 ZN-CNT Low Voc Epoxy Primer
SAP M/N (SAMS S/N)	:	1000194560; 1000195239

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	1101 – A
	2.1.2 Hardener (Curing Agent)	:	1101 – B
2.2	Mixing Ratio	:	4 Base : 1 Hardener
2.3	Thinner	:	Teslan 0901 Type II Low VOC Epoxy Reducer
	SAP M/N (SAMS S/N)	:	1000198471
2.4	Minimum-Maximum Thinning Requirements	:	0% up to 10 % by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	2 hrs @ 100°F/38°C 4 hrs @ 77°F/25°C 6 hrs @ 50°F/10°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 50 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	40 – 90 %
3.3	Typical Wet Film Thickness Per Coat	:	312 microns
3.4	Typical Dry Film Thickness Per Coat	:	200 microns
3.5	Theoretical Coverage @ 25 Microns (DFT)	:	25.60 m^2/L

Manufacturer - Approved Saudi Aramco Data Sheet

Saudi Aramco: Company General Use

APCS- 22A CNT-Primer - Teslan 1101 ZN-CNT Low Voc Epoxy Primer (Cont'd)

3.6 Minimum Number of Coats : 1

3.7 Applicable Substrate : Carbon Steel (CS), Galvanized Steel (GS)

3.8 Surface Preparation Requirements

Carbon Steel (CS) - Immersion Service
SSPC SP10/NACE 2 Near-White Blast Cleaning OR ISO8501-1 : Sa 2.5
Surface Profile: 2-4 mil (50-100 micron)
(NOTE: Where blasting is not practical, and conditions allow, prepare surface per SSPC SP11 Power Tool Cleaning to Bare Metal, achieving a minimum 2 mil (50 micron) profile).

Carbon Steel (CS) - Atmospheric Service
SSPC SP6 /NACE 3 Commercial Blast OR ISO8501-1 : Sa 2
Surface Profile: 2-4 mil (50-100 micron)
(NOTE: Where blasting is not practical, and conditions allow, prepare surface per SSPC SP15 Commercial Grade Power Tool Cleaning, or an ISO St 3, achieving a min. 2 mil (50µm) profile).

Galvanized Steel (GS) - Atmospheric Service
ASTM D6386 Standard practice for preparation of zinc (Hot-Dip Galvanized) coated iron and steel product and hardware surfaces for Paint.
Surface Profile: 1.0 – 1.5 mil (25 – 125 micron)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	1 hrs	6 months	24 hrs	10 days	10 days
20ºC	0.5 hrs	6 months	12 hrs	7 days	7 days
30°C	0.5 hrs	6 months	10 hrs	7 days	7 days
40ºC	0.5 hrs	6 months	4 hrs	7 days	7 days
50°C	0.5 hrs	6 months	2 hrs	7 days	7 days

* Topcoat/Overcoat can be applied over wet primer coat (wet-on-wet application). If wet on wet application method is not used, primed surface may need high pressure fresh water washing. The topcoat may then be applied to a clean, dry, and contaminate free primed surface.

Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 22A CNT-Primer - Teslan 1101 ZN-CNT Low Voc Epoxy Primer (Cont'd)

Saudi Aramco: Company General Use

3.10 Recommended Application Equipment

Airless Spray

Pressure:	3000-5000 psi (207-345 bar)
Hose:	1/4 - 1/2 inches (6.4 - 13 mm)
Tip:	0.017-0.021 inches (430-535 microns)
Filter:	Not Required
Reduction:	As needed up to 10% by volume

Conventional Air-Spray

Air Pressure:	40-50 psi (2.8-3.4 bar)
Material Pressure:	30-40 psi (2.1-2.8 bar)
Hose:	Minimum 3/8 inches (9.5 mm)
Tip Orifice:	0.070 inches (1.8 mm)
Air Cap:	Pressure Feed High Atomization Combination
Filter:	Not Required
Reduction:	As needed up to 10% by volume

Brush
For areas where spray application is not feasible. Use a natural bristle brush.

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	64 ± 2 %
4.2	Product Weight	(ASTM D1475)	:	A part 2.58Kg/L / B part 0.96Kg/L
4.3	Viscosity	(ASTM D562)	:	100 Krebs Units
4.4	Flash Point	(ASTM D93 or D56)	:	1101 – A 54.4°C / 1101 – B 39°C
4.5	Approved Color/s	:	Dark Gray	
4.6	Finish	:	Semi-Gloss	

5. Special Instructions:
Mix component A and component B individually until a smooth uniform consistency is achieved using a powered agitator with a clean all steel spiral ribbon mixer. Slowly mix component B into component A while component A is under agitation. For additional information, consult Manufacturer Product Data Sheets.

Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 22A CNT-Topcoat

Saudi Aramco: Company General Use

Type of Coating	:	Epoxy-CNT Topcoat, Two-Component, Solvent-based Nanocoatings
Manufacturer	:	Tesla Nanocoatings Inc.
Product Name	:	Teslan 3100 Low Voc Epoxy-CNT Topcoat
SAP M/N (SAMS S/N)	:	1000194565; 1000195273; 1000194568; 1000194590; 1000195277; 1000195314

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	2
	2.1.1 Base	:	3100-A
	2.1.2 Hardener (Curing Agent)	:	3100-B
2.2	Mixing Ratio	:	1 (Base) : 1 (Hardener)
2.3	Thinner	:	TESLAN 0901 Type II Low VOC Epoxy Reducer
	SAP M/N (SAMS S/N)	:	1000198471
2.4	Minimum-Maximum Thinning Requirements	:	0% up to 10 % by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	2 hrs @ 100°F/38°C 4 hrs @ 77°F/25°C 6 hrs @ 50°F/10°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 50 °C
3.2	Minimum-Maximum Allowable Relative Humidity	:	40 – 90 %
3.3	Typical Wet Film Thickness Per Coat	:	350 microns
3.4	Typical Dry Film Thickness Per Coat	:	200 microns

Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 22A CNT-Topcoat - Teslan 3100 Low Voc Epoxy-CNT Topcoat (Cont'd)

Saudi Aramco: Company General Use

3.5 Theoretical Coverage @ 25 Microns (DFT) : 23.20 m^2/L

3.6 Minimum Number of Coats : 1

3.7 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	1 hrs	6 months	24 hrs	10 days	10 days
20°C	0.5 hrs	6 months	12 hrs	7 days	7 days
30°C	0.5 hrs	6 months	10 hrs	7 days	7 days
40°C	0.5 hrs	6 months	4 hrs	7 days	7 days
50°C	0.5 hrs	6 months	2 hrs	7 days	7 days

* Topcoat/Overcoat can be applied over wet primer coat (wet-on-wet application). If wet on wet application method is not used, primed surface may need high pressure fresh water washing. The topcoat may then be applied to a clean, dry, and contaminate free primed surface.

3.8 Recommended Application Equipment

Airless Spray

Pressure:	3000-5000 psi (207-345 bar)
Hose:	1/4 - 1/2 inches (6.4 - 13 mm)
Tip:	0.015-0.017 inches (381-431 microns)
Filter:	Not Required
Reduction:	As needed up to 10% by volume

Conventional Air-Spray

Air Pressure:	40-50 psi (2.8-3.4 bar)
Material Pressure:	30-40 psi (2.1-2.8 bar)
Hose:	Minimum 3/8 inches (9.5 mm)
Tip Orifice:	0.070 inches (1.8 mm)
Air Cap:	Pressure Feed High Atomization Combination
Filter:	Not Required
Reduction:	As needed up to 10% by volume

Brush

For areas where spray application is not feasible use of a natural bristle brush.

Manufacturer - Approved Saudi Aramco Data Sheet

APCS- 22A CNT-Topcoat - Teslan 3100 Low Voc Epoxy-CNT Topcoat (Cont'd)

4. Physical Properties

Saudi Aramco: Company General Use

4.1	Volume Solids	(ASTM D2697)	:	58 ± 2 %
4.2	Product Weight	(ASTM D1475)	:	3100-A 1.29 Kg/L 3100-B 1.33 Kg/L
4.3	Viscosity	(ASTM D562)	:	70 Krebs Units
4.4	Flash Point	(ASTM D93 or D56)	:	3100-A 4.4°C / 3100-B 54°C
4.5	Approved Color/s	: Gray		
4.6	Finish	: Semi-Gloss		

5. Special Instructions:
Mix component A and component B individually until a smooth uniform consistency is achieved using a powered agitator with a clean all steel spiral ribbon mixer. Slowly mix component B into component A while component A is under agitation. For additional information, consult Manufacturer Product Data Sheets.

s. Thermo-Shield – Approved Products

Saudi Aramco: Company General Use

APCS-5A

Tank Shield*
Thermoshield Clear*

*Note: Refer to coating manufacturer's product date sheet.

Saudi Aramco: Company General Use

t. Tnemec – Approved Products

APCS-1A

Tnemec-Zinc Series 90-98	Inorganic Zinc Primer: Solvent Based
Hi-Build Epoxoline Series 66	Epoxy Topcoat

APCS-1B

Hi-Build Epoxoline Series 66	Epoxy Primer and Topcoat

APCS-1D

Use APCS-1A as primer and intermediate coat

Endura-Shield Series 73	Polyurethane Topcoat

APCS-1E

Use APCS-1B as primer and intermediate coat
Use Polyurethane Topcoat of APCS-1D

APCS-4

Chem-Prime H.S. Series 37H	Alkyd Primer
Chrome Aluminum Series 43-36	Alkyd Topcoat

APCS-6

Use Alkyd Primer of APCS-4 as primer

Hi-Build Tneme-Gloss Series 2H	Alkyd Topcoat

APCS-12

Use APCS-1B as Primer and Topcoat

APCS-26

Chembuild Series 135	Epoxy Mastic

APCS-26T

Use APCS-26 as primer and Polyurethane Topcoat of APCS-1D as topcoat

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D Primer

Type of Coating	:	Inorganic Zinc
Manufacturer	:	Tnemec Company, Inc.
Product Name	:	Tneme-Zinc Series 90-98
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	1 years

2. Mixing

2.1	No. of Components	:	Two (liquid and zinc dust)
	2.1.1 Base	:	F090-0098A (liquid) and F090-0098B (zinc dust)
	2.1.2 Hardener (Curing Agent)	:	N/A
2.2	Mixing Ratio	:	N/A
2.3	Thinner	:	F041-0018
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	0–9% by Volume
2.5	Induction Time	:	N/A
2.6	Pot Life	:	7 hours at 38°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 49°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	30 – 85%
3.3	Typical Wet Film Thickness Per Coat	:	100 microns

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APCS-1A/1D Primer – Tneme-Zinc Series 90-98 (Cont'd)

3.4	Typical Dry Film Thickness Per Coat	:	65 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	25.6 m^2/L
3.6	Minimum Number of Coats	:	One
3.7	Applicable Substrate	:	CS
3.8	Surface Preparation Requirements	:	SSPC-SP6 or SP10

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	36h	N/A	2h	2h	2h
30°C	16h	N/A	1h	1h	1h
50°C	16h	N/A	30m	30m	30m

3.10 Recommended Application Equipment

Airless (A/L) Spray:	2,000 - 3,000 psi, 535 – 585 micron tip
Conventional Spray:	DeVillbis MBC, 30 – 40 psi
Brush:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	65%
4.2	Product Weight	(ASTM D1475)	:	2.46 Kg/L
4.3	Viscosity	(ASTM D562)	:	85 – 89 KU
4.4	Flash Point	(ASTM D93 or D56)	:	12°C (Part A)

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1D Primer – Tneme-Zinc Series 90-98 (Cont'd)

4.5	Approved Color/s	:	Gray
4.6	Finish	:	Flat

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1D/1E

Type of Coating	:	Polyamide Epoxy, Primer/Topcoat
Manufacturer	:	Tnemec Co., Inc.
Product Name	:	Hi-Build Epoxoline Series 66
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years (Part A) 1 year (Part B)

2. Mixing

2.1	No. of Components	:	Two
	2.1.1 Base	:	F066-00WHA (white color)
	2.1.2 Hardener (Curing Agent)	:	F066-0066B
2.2	Mixing Ratio	:	1 : 1 by volume
2.3	Thinner	:	F041-0004
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	0 – 10% by Volume
2.5	Induction Time	:	None @ >16°C
2.6	Pot Life	:	4 hours at 38°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 57°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	0 – 85%
3.3	Typical Wet Film Thickness Per Coat	:	180 microns
3.4	Typical Dry Film Thickness Per Coat	:	100 microns

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APCS-1A/1B/1D/1E - Hi-Build Epoxoline Series 66 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	22 m^2/L
3.6	Minimum Number of Coats	:	One
3.7	Applicable Substrate	:	CS, GS, SS, Al, CI/DI, Concrete
3.8	Surface Preparation Requirements	:	SSPC-SP6 or SP10 (CS), SSPC-SP13 (Concrete)

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	36h	Varies*	30h	16d	16d
20°C					
30°C	10h	Varies*	8h	5d	5d
40°C					
50°C	4h	Varies*	3h	3d	3d

* Maximum recoat window varies according to topcoat. Please see data sheet of applicable topcoat for more information. To recoat Series 66 with itself, the maximum recoat interval is 60 days for immersion and unlimited for non-immersion service.

3.10 Recommended Application Equipment

Airless (A/L) Spray:	3,000 – 4,000 psi, 380 - 485 micron tip
Conventional Spray:	DeVillbiss JGA, 75 - 100 psi
Brush:	For stripe coating / touch-up only

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1A/1B/1D/1E - Hi-Build Epoxoline Series 66 (Cont'd)

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	56%
4.2	Product Weight	(ASTM D1475)	:	1.5 Kg/L
4.3	Viscosity	(ASTM D562)	:	78 – 84 KU (Part A) 66 – 71 KU (Part B)
4.4	Flash Point	(ASTM D93 or D56)	:	28°C (Part A) 18°C (Part B)
4.5	Approved Color/s	:		
4.6	Finish	: Satin		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/26T Topcoat

Type of Coating	:	Aliphatic Acrylic Polyurethane
Manufacturer	:	Tnemec Co., Inc.
Product Name	:	Endura-Shield Series 73
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years (Part A) 1 year (Part B)

2. Mixing

2.1	No. of Components		:	Two
	2.1.1	Base	:	F073-11WHA (White)
	2.1.2	Hardener (Curing Agent)	:	F073-0073B
2.2	Mixing Ratio		:	4 : 1 by Volume
2.3	Thinner		:	F041-0048 or F041-0042
	SAP M/N (SAMS S/N)		:	
2.4	Minimum-Maximum Thinning Requirements		:	0–10% by Volume
2.5	Induction Time		:	None
2.6	Pot Life		:	2 hours at 38°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 49°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	0 – 80%
3.3	Typical Wet Film Thickness Per Coat	:	115 microns
3.4	Typical Dry Film Thickness Per Coat	:	65 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/26T Topcoat - Endura-Shield Series 73 (Cont'd)

3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	22.8 m^2/L
3.6	Minimum Number of Coats	:	One
3.7	Applicable Substrate	:	
3.8	Surface Preparation Requirements	:	

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	18h	Unlimited	12h	12h	12h
30°C	12h	Unlimited	8h	8h	8h
50°C	7h	Unlimited	5h	5h	5h

3.10 Recommended Application Equipment

Airless (A/L) Spray:	2700–3000 psi, 330-430 micron tip
Conventional Spray:	DeVillbiss JGA, 75–90 psi
Brush:	Small areas only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	58%
4.2	Product Weight	(ASTM D1475)	:	1.45 Kg/L
4.3	Viscosity	(ASTM D562)	:	105–115 KU (Part A) 19 seconds [#4 Ford Cup] (Part B)
4.4	Flash Point	(ASTM D93 or D56)	:	13°C (Part A) 40°C (Part A)

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-1D/1E/26T Topcoat - Endura-Shield Series 73 (Cont'd)

4.5	Approved Color/s	:	
4.6	Finish	:	Semi-Gloss

Saudi Aramco: Company General Use

Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4/6 Primer

Type of Coating	:	Phenolic Alkyd
Manufacturer	:	Tnemec Co., Inc.
Product Name	:	Chem-Prime H.S. Series 37H
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	One
	2.1.1 Base	:	F037-0078 (Gray)
	2.1.2 Hardener (Curing Agent)	:	
2.2	Mixing Ratio	:	
2.3	Thinner	:	F041-0002
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	0 – 9% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 49°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	0 – 80%
3.3	Typical Wet Film Thickness Per Coat	:	115 microns
3.4	Typical Dry Film Thickness Per Coat	:	65 microns

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4/6 Primer - Chem-Prime H.S. Series 37H (Cont'd)

3.5 Theoretical Coverage @ 25 Micrometers Dry Film Thickness : 22.8 m^2/L

3.6 Minimum Number of Coats : One

3.7 Applicable Substrate : CS, Cast/Ductile Iron

3.8 Surface Preparation Requirements : SSPC-SP6

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	16h	Unlimited	4h	16h	16h
30°C	12h	Unlimited	2h	12h	12h
50°C	8h	Unlimited	1h	8h	8h

3.10 Recommended Application Equipment

Airless (A/L) Spray:	380–485 micron tip, 2,700 – 3,000 psi
Conventional Spray:	DeVillbiss JGA Gun, 75 – 90 psi
Brush:	For stripe coating / touch-up only

4. Physical Properties

4.1	Volume Solids	(ASTM D2697)	:	58%
4.2	Product Weight	(ASTM D1475)	:	1.48–1.56 Kg/L
4.3	Viscosity	(ASTM D562)	:	85–89 KU
4.4	Flash Point	(ASTM D93 or D56)	:	18°C
4.5	Approved Color/s	:		
4.6	Finish	: Flat		

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4 Topcoat

Type of Coating	:	Alkyd Aluminum
Manufacturer	:	Tnemec Co., Inc.
Product Name	:	Chrome Aluminum Series 43-36
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	One
	2.1.1 Base	:	F043-0036
	2.1.2 Hardener (Curing Agent)	:	
2.2	Mixing Ratio	:	
2.3	Thinner	:	F041-0001
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	0 – 3.5% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 49°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	0 – 80%
3.3	Typical Wet Film Thickness Per Coat	:	75 microns
3.4	Typical Dry Film Thickness Per Coat	:	25 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	14.55 m^2/L

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-4 Topcoat - Chrome Aluminum Series 43-36 (Cont'd)

3.6 Minimum Number of Coats : One

3.7 Applicable Substrate : CS

3.8 Surface Preparation Requirements :

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	36h	*	24h	36h	36h
30°C	24h	*	16h	24h	24h
50°C	16h	*	8h	16h	16h

* Varies by topcoat

3.10 Recommended Application Equipment

Airless (A/L) Spray: 380 – 485 micron tip, 1,800 – 3,000 psi

Conventional Spray: DeVillbiss JGA or MBC, 60 – 80 psi

Brush: High quality nylon or synthetic

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 37%

4.2 Product Weight (ASTM D1475) : 3.54 Kg/L

4.3 Viscosity (ASTM D562) : 50 – 54 KU

4.4 Flash Point (ASTM D93 or D56) : 32°C

4.5 Approved Color/s :

4.6 Finish : Low Sheen

Manufacturer - Approved Saudi Aramco Data Sheet

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APCS-6 Topcoat

Type of Coating	:	Alkyd
Manufacturer	:	Tnemec Co., Inc.
Product Name	:	Hi-Build Tneme-Gloss Series 2H
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	One
	2.1.1 Base	:	F02H-11WH (White)
	2.1.2 Hardener (Curing Agent)	:	
2.2	Mixing Ratio	:	
2.3	Thinner	:	F041-0001 or Mineral Spirits
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	0–8% by Volume
2.5	Induction Time	:	None
2.6	Pot Life	:	N/A

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10–49°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	0 – 80%
3.3	Typical Wet Film Thickness Per Coat	:	75 microns
3.4	Typical Dry Film Thickness Per Coat	:	40 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	19.3 m^2/L

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-6 Topcoat - Hi-Build Tneme-Gloss Series 2H (Cont'd)

3.6 Minimum Number of Coats : One

3.7 Applicable Substrate : CS, GS, SS

3.8 Surface Preparation Requirements :

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Maximum	To Handle	To Service	Full Cure
10°C	36h	*	24h	36h	36h
30°C	24h	*	16h	24h	24h
50°C	16h	*	8h	16h	16h

* Varies by topcoat

3.10 Recommended Application Equipment

Airless (A/L) Spray: 330 – 430 micron tip, 2,800 – 3,500 psi

Conventional Spray: DeVillbiss JGA or MBC, 40 – 70 psi

Brush: High quality natural or synthetic

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 49%

4.2 Product Weight (ASTM D1475) : 4.35 Kg/L

4.3 Viscosity (ASTM D562) : 86–95 KU

4.4 Flash Point (ASTM D93 or D56) : 38°C

4.5 Approved Color/s :

4.6 Finish : Gloss

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26/26T

Type of Coating	:	Modified Polyamidoamine Epoxy
Manufacturer	:	Tnemec Co., Inc.
Product Name	:	Chembuild Series 135
SAP M/N (SAMS S/N)	:	

1. Storage

1.1	Shelf life, sheltered storage @ 35°C maximum	:	2 years

2. Mixing

2.1	No. of Components	:	Two
	2.1.1 Base	:	F135-DC74A (White)
	2.1.2 Hardener (Curing Agent)	:	F135-0135B
2.2	Mixing Ratio	:	4 : 1
2.3	Thinner	:	F041-0062
	SAP M/N (SAMS S/N)	:	
2.4	Minimum-Maximum Thinning Requirements	:	0–15% by Volume
2.5	Induction Time	:	None @ >16°C
2.6	Pot Life	:	2 hours at 38°C

3. Application

3.1	Minimum-Maximum Allowable Substrate Temperature	:	10 – 57°C
3.2	Minimum-Maximum Allowable Relative Humidity	:	0 – 80%
3.3	Typical Wet Film Thickness Per Coat	:	150 microns
3.4	Typical Dry Film Thickness Per Coat	:	125 microns
3.5	Theoretical Coverage @ 25 Micrometers Dry Film Thickness	:	33.1 m^2/L

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Manufacturer - Approved Saudi Aramco Data Sheet

APCS-26/26T - Chembuild Series 135 (Cont'd)

3.6 Minimum Number of Coats : One

3.7 Applicable Substrate : CS, GS, Previously Painted

3.8 Surface Preparation Requirements : SSPC-SP6, or SSPC-SP2/SP3

3.9 Drying Time at specified DFT

Substrate Temperature	Recoat Interval Minimum	Recoat Interval Maximum	To Handle	To Service	Full Cure
10°C	48h	60d	36h	48h	48h
30°C	24h	60d	18h	24h	24h
50°C	12h	60d	9h	12h	12h

3.10 Recommended Application Equipment

Airless (A/L) Spray: 3,000 – 4,200 psi, 430 – 435 micron tip

Conventional Spray: DeVillbis JGA gun, 70 – 90 psi

Brush: Use high quality brushes only

4. Physical Properties

4.1 Volume Solids (ASTM D2697) : 84%

4.2 Product Weight (ASTM D1475) : 1.38 – 1.47 Kg/L

4.3 Viscosity (ASTM D562) : 84 – 94 KU (Part A)
58 – 105 KU (Part B)

4.4 Flash Point (ASTM D93 or D56) : 24°C (Part A)
94°C (Part B)

4.5 Approved Color/s :

4.6 Finish : Semi-Gloss

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Document History

30 June 2021	Major revision. Clarified the standard's requirements, added relevant references, provided approved coatings list by APCS, updated information in existing data sheets, added recently qualified coatings and corresponding data sheets, and included approved new coating technologies.
16 October 2017	Major revision. Enhance the data sheets and update the list of approved protective liquid coatings and manufacturers for SAES-H-001, SAES-H-002, SAES-H-003, and SAES-H-004.

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ATTACHMENT-11

Engineering Procedure

12 January 2021

SAEP-1151

Inspection Requirements for Contractor Procured Materials and Equipment

Document Responsibility: Project Quality Standards Committee

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Summary of Changes

Paragraph Number		Change Type (Addition, Modification, Deletion)	Technical Change(s)
Previous Revision (03 November 2017)	**Current Revision** (13 January 2021)		
3.1	NA	Deletion	Deletion of Saudi Aramco Inspection Req. 175-32440 form reference
5	5	Modification	Modified to include RBI: This section is applicable to all Type-A and Type-B projects with the intent of providing a systematic approach to manage and implement risk-based inspection coverage, in line with ISO 9001:2015 requirements.
-	5.1	Addition	New paragraph to start with risk level definition
5.2	5.2	Modification	Changed to add further explanation on used RBI method
5.1	5.3	Modification	Re-arrangement of paragraph only and no change
-	5.4	Addition	This to identify Contractor risk register minimum requirement
-	5.5	Addition	New paragraph added to illustrate SAIR communication with related Stakeholder
Table 1	Table 1	Modification	Redistribution of weight % as per revised RBI WI
-	5.6, 5.7	Addition	PQM concurrence on final RBI list and authorization to change risk level
-	5.8	Addition	Final Risk levels relayed to Responsible Inspection Office (RIO)
Table 2	Table 2	Modification	Removal of frequency of technical and quality focused assessments for bulk material
6.2.2	-	Deletion	Deleted as changes will require to follow para 6.2.1

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6.3	6.3	Modification	Modification to clarify Sub-vendor list review and approval by company
-	7.2.4	Addition	Identification of ITP minimum requirement
-	7.6	Addition	For contractor to insure final approved ITP is shared with all relevant parties
8.3	8.3	Modification	Special 175 form approval by SCC
8.4	-	Deletion	Editorial change as this paragraph is cleared in other section
8.5	8.4	Modification	Changes made to identify requirement of separate 175-forms as applicable for engineered equipment such as Skids, Vessel and insure compliance to SAMSS
9.7	9.7	Modification	Proposed Inspection level for non-listed materials/ equipment shall be approved by SCC
-	9.9	Addition	Identify SAIR escalation process during release of equipment with punch items
10.1	10.1	Modification	Proposed Inspction level for non-listed materials/ equipment shall be approved by SCC
Appendix	Appendix	Addition & Modification	Modification: • Procurement Risk Evaluation Guidelines changed as per RBI WI • Procurement Risk Mitigation Guidelines Addition: • Project Management Evaluation Guidelines • Proponent Evaluation Guidelines • 30%, 60% and 90% PO Focused Assessment Checklist

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1. Scope

This document, together with the purchase order and appropriate project specifications define the minimum mandatory inspection requirements for Contractor procured materials and equipment on projects.

Commentary Note:

As per the Procurement Manual 3.1.2, Short-form and Mid-form Contracts are also within the scope of this procedure.

2. Conflicts and Deviations

Any conflicts between this document and other applicable Mandatory Saudi Aramco Engineering Requirements (MSAERs) shall be addressed to the EK&RD Manager.

Any deviation from the requirements herein shall follow internal company procedure SAEP-302.

3. References

All referenced specifications, standards, codes, drawings, and similar material are considered part of this (Engineering Procedure, Engineering Standard, Material System Specification) to the extent specified, applying the latest version, unless otherwise stated.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedures

SAEP-71	Portfolio Execution Planning (PXP)
SAEP-302	Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirements
SAEP-1150	Inspection Coverage on Projects

3.2 Industry Codes and Standards

International Organization for Standardization

ISO 9001	Quality Management Systems – Requirements

3.3 Other References

Schedule Q	Quality Requirements

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4. Terminology

4.1 Acronyms

Quality Assurance (QA): All the planned and systematic activities implemented within the quality system, and demonstrated as needed, to provide adequate confidence that an entity will fulfill requirements for quality.

Quality Control (QC): The operational techniques and activities that are used to fulfill requirements for quality.

Quality Control Procedure (QCP): A QCP is a documented procedure detailing the processes necessary to complete a specific work activity.

PIM: Pre-inspection Meeting

Type-A & Type-B Projects: As defined in SAEP-71.

Inspection and Test Plan (ITP): An ITP is a document based on the detailed manufacturing, fabrication and, construction program and identifies each process description. The ITP will set out related sequence of activities to be inspected, examined, and tested.

RIO: Responsible Inspection Office

Project Quality Manager (PQM): The senior Inspection Representative responsible for coordinating all inspection requirements on behalf of the Inspection Department with PM throughout all project phases.

SAIR: Saudi Aramco Inspection Representative

VID: Saudi Aramco Vendor Inspection Division

PMT: Project Management Team

SME: Special Matter Expert (usually from CSD and P&CSD)

NDT: Non-destructive Testing

EPM: Enterprise Project Management

MSAER: Mandatory Saudi Aramco Engineering Requirement

VQI: Vendor Quality Index in SAP

IAP: Inspection Assignment Package

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EDR: Equipment Deficiency Report

NCR: Non-Conformity Report

PO: Purchase order

SCC: Standard Committee Chairman

Procurement Risk Register: A list of contractors planned and actual POs with assigned level of risk (i.e., critical, high, moderate, or low).

Risk Based inspection (RBI): An analysis methodology and process that requires qualitative or quantitative assessment of probability and impact of failures associated with project Procurement and Construction works.

Commentary note:

Additional related terminologies are in SAEP-1150.

4.2 Definitions

Quality System: Organizational structure, procedures, and processes are resources needed to implement quality management.

Hold Point: An inspection point, defined in an appropriate document, beyond which an activity must not proceed without the approval of a designated organization or authority.

Witness Point: An inspection point, defined in an appropriate document, beyond which an activity can proceed after notifying the designated organization or authority.

Review Point: Is the point at which a work activity cannot proceed without first ensuring the review and approval of applicable documents or personnel qualifications by a designated organization or authority.

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5. Procurement Risk Management

This section is applicable to all Type-A and Type-B projects with the intent of providing a systematic approach to manage and implement risk-based inspection coverage in line with ISO 9001:2015.

5.1 The risk level for each PO is a product of the probability of failure, and the associated impact of failure.

5.2 Contractor POs are evaluated by the Project Team according to weighed factors, as tabulated in Table.1. The measure of probability and impact of failures are estimated for each PO as shown in Appendix I, Appendix II, and Appendix III.

Table 1 - Contractor POs Risk Assessment Criteria

	Criteria	Evaluation Source	Weight (%)
Probability*	Failure Frequency	SAP, EPM, SME, EDR, NCR	30
	Manufacturing Complexity	MSAER, SME	20
	Vendor/Manufacturer Performance	Vendor VQI	25
	MSAER's Availability	SAP-Material Description	15
	Preservation and Handling	MSAER, Manufacturer	10
Impact	Cost**	Project Management Team SME	25
	Schedule**	Project Management Team SME	25
	Operation Quality, Safety and Reliability***	Proponent's SME	50

Notes :

Appendix I* , ** Appendix II*, * Appendix III*

5.3 Contractor, within one month from developing the Material Takeoff (MTO) list, shall develop the risk register and submit it to Company for review.

5.4 Contractor risk register shall include as a minimum the following: material requisition/PO, 9COM, inspection level and awarded vendor/manufacturer.

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5.5 SAIR shall coordinate with Project Management Team and Proponent to evaluate and score the probability and impact of failures for each PO, noting that scoring mechanisms outlined under Appendix II and Appendix III are general guidelines for Project Management and Proponent and can be modified accordingly to determine the risk levels.

5.6 The final list shall be reviewed and concurred upon in writing by the Project Quality Manager (PQM), with a copy sent to Quality Monitoring Unit Supervisor.

5.7 SAIR and/or PQM shall have the authority to change risk levels or mitigation guidelines based on project stakeholder's (PMT & Proponent) agreement, with proper documented justification.

5.8 Critical and High-Risk POs shall be officially relayed to the Responsible Inspection Office (RIO) upon the approval of a PO's Inspection Assignment Package (IAP). The risk level shall be indicated in the IAP, and noted in the corresponding Inspection Lot by SAIR.

5.9 Contractor shall submit updated risk registries on monthly basis highlighting new POs and/or purchase requisitions, POs progresses, and conducted PO Focused Assessments. Monthly updates shall also consider risk assignments based on technical alerts, major lessons learned, and deteriorating manufacturer performances.

Commentary note:

In case of risk level change, PQM approval is required as per para. 5.7 above.

5.10 Contractor shall closely monitor and assess critical-and high-risk POs, to ensure quality and minimize rework.

5.11 Contractor shall conduct PO Focused Assessments at the specified PO progress in accordance with Table 2, in line with 5.13 requirement. Contractor shall also submit PO Focused Assessments reports to Company highlighting technical and/or quality findings, and required corrective actions plan and agreed completion dates.

5.12 Contractor should notify Company of PO progress milestones at 30%, 60% and 90%, for Critical and High-Risk POs.

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Table 2 - Frequency of Contractor PO's Focused Assessments

Risk	PO Progress		
	30%	60%	90%
Critical	X	X	X
High		X	X
Medium			X

5.13 Risk mitigation guidelines shall be as outlined in Appendix IV, noting that PO Focused Assessments by PMT, Proponent, and Technical SMEs are optional and subject to availability and resources.

5.14 PO Focused Assessments shall follow, as a minimum, the formats outlined under Appendix V, Appendix VI and Appendix VII.

6. Contractor Purchase Requisition

6.1 Purchase requisition originators shall identify the applicable fabrication and 1inspection requirements stated in approved requisition shall be reflected in purchase orders.

6.2 Purchase requisition originators may also modify the content of a coded SA-175 form for certain purchase orders provided the following procedure is followed:

6.2.1 If the modification is to delete or modify an inspection activity specified in Mandatory Saudi Aramco Engineering Requirements, a waiver shall be duly obtained as per SAEP-302 against applicable standards before altering the coded SA-175 form.

Modified SA-175 forms will automatically become "175-SPECIAL" forms. Refer to Section 8 for further instructions on 175-SPECIAL forms.

6.3 After PO award, contractor shall submit sub-vendor list for Company review and approval. It shall include as a minimum the following: material description, specification, 9COM, approved sub-vendor (Name and ID) and inspection level.

7 Inspection and Test Plan

7.1 The vendor and/or sub-vendors shall prepare detailed ITP's for all assigned equipment and materials in accordance with all relevant Saudi Aramco inspection forms (SA-175 forms), Schedule Q, and purchase orders.

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7.2 ITP shall provide:

7.2.1 Detailed inspection activities and the required tests which include, as minimum, inspection hold, witness, review points, inspection frequency as per applicable 175 form and assigned inspection level.

7.2.2 Sampling plan criteria shall be determined based on MSAER and international standards.

7.2.3 Clearly defined roles and responsibilities for each inspection activity.

7.2.4 Identification of requirements for documents and acceptance criteria as applicable (ASME Code, or SAMSS…etc.).

7.3 Sampling plan availability does not relieve the vendor of the responsibility to ensure compliance with Company requirements.

7.4 SAIR reserves the right to increase inspection activities and sampling plan criteria in coordination with Company Subject Matter Expert (SME) based on the criticality of the purchase orders and past performance of selected manufacturers.

7.5 As part of IAP submittal, Contractor shall provide review and approval status of vendor and/or sub-vendor Non Material Requirements (NMR-601 documents), quality control procedures such as welding, NDT, heat treatment, and the required related procedures for that specific purchase order, as required by Company standards and/or project specifications.

7.6 Contractor shall ensure the comments raised and agreed during the PIM on ITP are properly incorporated through new form revision. Contractor shall ensure distribution of revised ITP to all the relevant parties.

8. Special SA-175 Forms

8.1 Some inspectable materials do not have coded SA-175 forms linked to them. When these materials are procured, the purchase requisition originators shall specify source inspection requirements for materials, by filling in the blank special SA-175 form.

8.2 The contractor is responsible to develop and maintain full document control of issued special SA-175 forms during a project in term of numbering and identification, approval, revisions and records preservation.

8.3 The PQM and/or SAIR are responsible to review contractor generated special SA-175 forms, as applicable. special SA-175 forms shall be subject to SCC approval.

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8.4 For packaged, skid mounted equipment or any main equipment, separate SA-175 form shall be applied on each inspectable sub-component in accordance with main SAMSS and SA-175 form, in addition to the SA-175 form for the overall equipment.

9. Minimum Inspection Levels

9.1 Inspection levels shall be assigned on project contractor's materials and equipment to specify the minimum amount of inspection coverage deemed necessary by Saudi Aramco to ensure that a product or service conforms to specifications at a specific supplier's and/or sub-supplier's factory or fabrication site.

9.2 The following system of coding the level of planned inspections shall be used to define the inspection requirements:

Level 0: Documentation requirements only as specified in applicable SA-175 form; no vendor inspection required.

Level 1: Only final inspection including release for shipment is required prior to shipping.

Level 2: Includes pre-inspection meetings, one or more unspecified "in progress" surveillance visit/s, all witness and hold points, final inspection, and release for shipment.

Level 3: Includes pre-inspection meetings, one or more unspecified "in progress" surveillance visits, all witness and hold points, final inspection, and release for shipment. Inspections shall be on a regular basis (daily, weekly or bi-weekly).

Level 4: Resident inspector continually monitoring the work.

All inspectable material covered under the inspection levels as defined above, shall be procured from Saudi Aramco approved manufacturers.

9.3 Minimum inspection levels by project contractor for procured materials and equipment shall be as per the Company provided list of inspection levels extracted from SAP per 9COM at the project cut-off date.

9.4 VID provides quality monitoring and inspection support for projects in accordance with approved ITP. SAIR will determine which purchase orders and vendor activities to be monitored based on guidelines in Appendix IV.

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9.5 Inspection levels might be elevated or lowered by SAIR on case by case basis, based on criticality of procured materials, performance of selected manufacturer and qualification of contractor's inspector, etc.

9.6 When vendor does not meet the specified performance requirements in the purchase order, or Company has placed the vendor on-hold after the Company has issued a "No Objection" letter to contractor, contractor shall increase the inspection level to the next highest level for the purchase order without additional cost to Company, subject to Company approval.

9.7 In case of materials/equipment not listed in the list as described in paragraph 9.3, the SAIR and/or PQM will determine the appropriate inspection level. Inspction level for non-listed materials/ equipment shall be approved by SCC.

9.8 Contractor shall not release material with punch list items unless approval is obtained from Company representative.

9.9 SAIR is responsible to determine the criticality of material and severity of punch list items during the release, and escalate to appropriate Quality Notification as applicable.

10. Roles and Responsibilities

10.1 SAIR and/or PQM is responsible to verify the assignment of appropriate level of inspection. They are also responsible to determine the level of inspection for non-listed materials/ equipment. Inspction level for non-listed materials/ equipment shall be approved by SCC.

10.2 Contractor is responsible to provide enough inspection coverage for Procured Materials, perform the required inspection, track material inspection status and inspection notifications and highlight any deficiencies to Company in timely manner.

10.3 Contractor is responsible to propose the proper level of inspection in accordance with this procedure and/or other contractual documents.

10.4 RIOs are responsible to provide monitoring inspection services when requested by the SAIR.

10.5 SAIR is responsible to escalate to SAIR's management any repetitive major observations from the same vendor for any further actions.

10.6 SAPMT is responsible to provide contractor a list of all inspectable materials with their respective inspection levels, extracted from SAP, as a part of IFB (Issued for Bid) package.

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Document History

18 November 2012	New Saudi Aramco Engineering Procedure.
30 January 2017	Editorial revision to transfer document responsibility from Inspection Engineering to Project Quality Standards Committee and other changes.
1 November 2017	Major revision for two main reasons; (1) to update the listed IR Codes and associated equipment descriptions to reflect the current selection of inspectable materials, and (2) to make inspection levels more dynamic by obtaining inspection levels per the project cut-off date from SAP. This revision will therefore no longer reflect inspection levels.
12 January 2020	Major revision to reflect risk-based inspection requirements and other changes.

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Appendix I

Procurement Risk Evaluation Guidelines

<table>
<tr><th rowspan="2">Score</th><th colspan="5">Criteria</th></tr>
<tr><th>Failure Frequency</th><th>Manufacturing Complexity</th><th>Vendor Performance</th><th>MSAERs Availability</th><th>Preservation and Handling</th></tr>
<tr><td>0</td><td>No Previous EDR or NCR</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>1</td><td>2 EDR/NCR or less</td><td>Final inspection</td><td>RVL with VQI ≥ 85%</td><td rowspan="2">MSAER and SA-175 Forms available</td><td>Normal preservation and handling (e.g. only box packing)</td></tr>
<tr><td>2</td><td>3 EDR/NCR</td><td rowspan="2">In-Process inspection – No special processes review (Score 2 without PIM and 3 with PIM)</td><td>RVL with VQI 85-75%</td><td>Normal preservation and handling with shade requirements</td></tr>
<tr><td>3</td><td>4 EDR/NCR</td><td>RVL with VQI 75-70%</td><td rowspan="2">MSAER available and Special-175 Form required</td><td>Controlled environment</td></tr>
<tr><td>4</td><td>5 EDR/NCR</td><td rowspan="2">First time purchased engineered equipment – Licensed equipment – Special design conditions and metallurgy</td><td>RVL with VQI 70-65% –Non-RVL</td><td>Special preservation (e.g. N2, Oil, VCA)</td></tr>
<tr><td>5</td><td>6 EDR/NCR or more</td><td>RVL with VQI ≤ 65% – RVL on Hold – Newly Approved Vendor</td><td>MSAER not available and Special-175 Form required</td><td>Special preservation and handling</td></tr>
</table>

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Appendix II

Project Management Evaluation Guidelines

Score	Criteria			
	Cost	**Schedule (Option A)**	**Schedule (Option B)**	**Schedule (Option C)**
0	N/A	N/A	N/A	N/A
1	PO value ≤$10MM	Float ≥6 months	Acceptable delay ≥6 months	Bulk material
2	PO value $10-20MM	Float 4-6 months	Acceptable delay 4-6 months	Cladded Pipes and Fittings
3	PO value $20-25MM	Float 2-4 months	Acceptable delay 2-4 months	Engineered Equipment
4	PO value $25-50MM	Float ≤ 1 month	Acceptable delay ≤ 1 month	Rotating and Skid-Mounted Equipment
5	PO value ≥$50MM	Project critical path	Project critical path	Project critical path

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Appendix III

Proponent Evaluation Guidelines

Score	Criteria	
	Operation Quality (Option A)	**Operation Quality (Option B)**
0	N/A	N/A
1	No operation disruption with < 3 mhrs. internal maintenance No production impact	One-Leg operation
2	No operation disruption with > 3 mhrs internal maintenance No production impact	Product spec. loss
3	Operation disruption with internal maintenance No production impact	Unit shutdown – Plant shutdown
4	Operation disruption with external maintenance No production impact	Immediate total plant shutdown
5	Operation disruption with production impact	Fatal hazard – loss of life or assets

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Appendix IV

Procurement Risk Mitigation Guidelines

Risk Level	Company Monitoring	Senior Monitoring Inspector	Purchase Order Focused Assessment											
			Inspection (RIO)			PMT**			Proponent**			Technical SME**		
			30%	60%	90%	30%	60%	90%	30%	60%	90%	30%	60%	90%
Critical	✓	✓	✓	✓	✓	✓		✓		✓			✓	
High	✓	✓	✓		✓		✓							
Medium	✓*													
Low														

*Applicable to Inspection Level 2 material and above, unless otherwise directed by SAIR.
**PO Focused Assessments by PMT, Proponent, and Technical SMEs are optional and subject to availability and resources.

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Appendix V - 30% PO Focused Assessment Checklist

SAUDI ARAMCO ID/VID		Rev 1					
30% PO AUDIT CHECKLIST		AUDIT DATE: MM/DD/YYYY					
PROJECT TITLE		WBS / BI / JO #		CONTRACTOR / SUBCONTRACTOR			
Manufacturer Vendor Name		Location		P.O. No.		REV. NO.	
Material Description/9COM#		Applicable 175 forms		Auditors' Name (SAIR/RIO)		RIO	
Item No.	Audit activities	Reference*	Car	Observation	Recommendation	Satisfactory	N/A
1	Review PIM minute of meeting Action Items status & target date	PIM MOM					
2	Verify the Manufacturing Activities conducted in approved location	Vendor's approval					
3	Review Sub-suppliers selection approval	Sch Q					
4	Compare the approved sub-suppliers list with actual materials at supplier's shop and Mill Test Certificates (MTCs)	Sch Q/PO					
5	Verify all applicable requirements were passed to the sub-suppliers of sub-orders	Sch Q & ISO 9001:2015					
6	Confirm with Suppliers' & sub-suppliers' that no deviation after PO placement	PO/ITP					
7	Verify applicable procedures status that require SA approval/review (NDT, WPS, Welding repair, hydro test, PMI, PWHT..etc)	Sch Q/ITP/SA-175 Forms					
8	Verify supplier's/sub-suppliers Drawings approval/review status	PO					
9	Confirm supplier's utilizing approved final Drawings revision during fabrication	PO					
10	Verify Drawings cross check between supplier's & sub-supplier's	PO/Vendor internal procedures					
11	Verify QA/QC personnel approval status (Welders, NDT technicians, PMI)	Sch Q					
12	Ensure that contractor and supplier conduct Materials' Source inspection for sub-orders at sub-suppliers facilities	PO/ITP					
13	Verify that supplier conduct Receiving Inspection for all sub-components	SA-175 forms ITP/Vendor QP					
14	Ensure that supplier Materials' preservations & Handling are maintained	SA-175 forms ITP/Vendor QP					
15	Verify that supplier is maintaining materials/equipment traceability	SA-175 forms ITP/Vendor QP ISO 9001/2015					
16	Confirm Equipment Calibrations are maintained	ISO 9001/2015 Sch Q/Vendor QP					
17	Verify that supplier is conducting internal inspection prior notifying clients	ISO9001-2015 ITP/Vendor QP					
18	Ensure that supplier/contractor review all MTCs for all sub-components	ITP					
19	Verify supplier is Maintaining Inspection records (MTCs, test certificates, third party testing records...etc.)	ITP					
20	Conduct random visual inspection	SA-175 forms/ITP					

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Appendix VI - 60% PO Focused Assessment Checklist

SAUDI ARAMCO ID/VID			Rev 1				
60% PO AUDIT CHECKLIST			AUDIT DATE: MM/DD/YYYY				
PROJECT TITLE			WBS / Bl / JO		CONTRACTOR / SUBCONTRACTOR		
Manufacturer Vendor		Location			P.O. No.		REV. NO.
Material Description/9COM		Applicable 175 forms			Auditors' Name (SAIR/RIO)		RIO
Item No.	Audit activities	Reference*	Car	Observation	Recommendation	Satisfactory	N/A
1	Review 30% Action Items status & target date	30% MOM					
2	Compare the approved sub-suppliers list with actual materials at supplier's shop & (MTCs)	Sch Q/PO					
3	Verify all applicable requirements were passed to the sub-Suppliers for sub-orders	Sch Q & ISO 9001:2015					
4	Confirm with Suppliers' & sub-suppliers' that no deviation after PO placement	PO/ITP					
5	Verify Applicable Procedures status requiring SA approval/review (NDT, WPS, Welding repair, Hydro test, PMI, PWHT, FAT...Etc.)	Sch Q/ITP/SA-175 Forms					
6	Verify supplier's/sub-suppliers Drawings approval/review status	PO					
7	Confirm supplier's utilizing approved final Drawings revision during fabrication	PO					
8	Verify Drawings cross check between supplier's & sub-supplier's	Vendor internal Procedures / PO					
9	Ensure that contractor and supplier conduct Materials' Source inspection for sub-orders at sub-suppliers facilities	PO/ITP					
10	Verify that supplier conduct Receiving inspection for all sub-components	SA-175 forms ITP/Vendor QP					
11	Ensure that supplier Materials' preservations and Handling are maintained	SA-175 forms ITP/Vendor QP					
12	Verify that supplier is maintaining materials/equipment traceability	SA-175 forms ITP/Vendor QP ISO 9001/2015					
13	Confirm Equipment Calibrations are maintained	ISO 9001/2015 Sch Q/Vendor QP					
14	Verify that supplier is conducting internal inspection prior notifying clients	ISO9001-2015 ITP/Vendor QP					
15	Ensure that supplier/contractor review all MTCs for all sub-components	ITP					
16	Verify supplier is Maintaining Inspection records (MTCs, test certificates, third party testing records...etc)	ITP					
17	Verify that contractor/supplier properly Close all Inspection findings	NCRs/Punch list Inspection reports					
18	Preservations, Marking, Packing, & shipment procedures	sch Q					
19	Conduct random visual inspection	SA-175 forms/ITP					
20	Contractor Inspector Performance	N/A					
21	Monitoring Inspector Performance	N/A					

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Appendix VII - 90% PO Focused Assessment Checklist

SAUDI ARAMCO ID/VID		Rev 1	
90% PO AUDIT CHECKLIST	AUDIT DATE: MM/DD/YYYY		
PROJECT TITLE	WBS / BI / JO NUMBER	CONTRACTOR / SUBCONTRACTOR	

Manufacturer Vendor	Location	P.O. No.	REV. NO.
Material Description/9COM	Applicable 175 forms	Auditors' Name (SAIR/RIO)	RIO

Item No.	Audit activities	Reference*	Car	Observation	Recommendation	Satisfactory	N/A
1	Review 60% Action Items status & target date	60% MOM					
2	Compare the approved sub-suppliers list with actual materials at supplier's shop & (MTCs)	Sch Q/PO					
3	Verify supplier's/sub-suppliers Drawings approval/review status	PO					
4	Confirm supplier's utilizing approved final Drawings revision during fabrication	PO					
5	Verify Drawings cross check between supplier's & sub-supplier's	Vendor internal Procedures / PO					
6	Ensure that contractor and supplier conduct source inspection for sub-orders at sub-suppliers facilities	PO/ITP					
7	Ensure that supplier Materials' preservations and Handling are maintained	SA-175 forms ITP/Vendor QP					
8	Verify that supplier is maintaining materials/equipment traceability	SA-175 forms ITP/Vendor QP ISO 9001/2015					
9	Ensure that supplier/contractor review all MTCs for all sub-components	ITP					
10	Verify supplier is Maintaining Inspection records (MTCs, test certificates, third party testing records...etc)	ITP					
11	Verify that contractor/supplier properly Close all Inspection findings	NCRs/Punch list Inspection reports					
12	Preservations, Marking, Packing, & shipment procedures	sch Q					
13	Conduct random visual inspection	SA-175 forms/ITP					
14	Pre-Shipment inspection	receiving insp. SAIC					
15	Status of Inspection Disposition Report	Sch Q attch. III,					
16	Contractor Inspector Performance	N/A					
17	Monitoring Inspector Performance	N/A					

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ATTACHMENT-12

INSPECTION & TESTING REQUIREMENTS SAUDI ARAMCO FORM-175	REVISION: 09/21 REPLACES: 09/15	CODE NUMBER: IR000003	PAGE: 1 of 2

Detailed Instructions of Inspection and Testing Requirements

EXPLANATION OF COLUMN ACTIVITES

Visual Inspection by Buyer Inspection Representative	**Buyer Inspection representative**: Purchaser or purchaser representative for direct procurement and/or project procurement. The **"H"** or "**W**" in this column indicates a hold or witness point defined as follows; **Hold Point (H):** An inspection point beyond which an activity must not proceed without the attendance/approval of Buyer Inspection Representative. **Witness Point (W):** An inspection point where Buyer Inspection Representative shall be notified in advance for inspection or test date and timing. The activity covered in this type of inspection/test request may proceed as scheduled, if the Buyer Inspection representative hasn't attended at or before the agreed upon inspection time. Note; if deemed necessary with realistic and acceptable justification, Buyer Inspection Representative has the right to change "W" to "H" or vice versa.
Review and Verification of Material Certificates and Inspection Records	An **"R"** in this column indicates that: **a)** The Buyer Inspection Representative will verify the Quality Records, Test Certificates, Manufacturing Data and Inspection Reports for full compliance to purchase order specifications & Company specification at the Manufacturer or its approved outsourced plant prior to accepting the material. **b)** The Manufacturer shall provide the necessary Quality Records as indicated in applicable Inspection Plans for review and verification.
Submission of Manufacturing, Inspection and Quality Records	An **"X"** in this column indicates that respective Manufacturing Data Package, Test Certificates and Inspection Reports shall be provided by Manufacturer, Supplier or Vendor to buyer representatives. Such records shall be in duplicate, in English, using Customary or SI system of measurement, and shall reference Company or Project Contractor's P.O. & IL numbers as applicable.
Specification Details / Notes	This column provides detailed inspection procedures, test methods, acceptance criteria, exceptions, verifications or any specific requirements.

EXPLANATION OF LINE ACTIVITES

Pre-Fabrication / Pre-Production Requirements	Manufacturer, Supplier or Vendor shall ensure that incoming materials and components are not utilized or processed unless subject for inspection or verified as compliant to specific requirements in accordance with the quality plan and/or documented procedures. Manufacturer, Supplier or Vendor shall also obtain Company or Project Contractor approval of mandatory technical and quality procedures, as indicated in this section.

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In-Process Inspection & Testing Requirements	Manufacturer, Supplier or Vendor shall notify Buyer Inspection Representative for stage-wise inspection and/or testing as mandated by the approved quality plan and/or documented procedures.
Final Inspection & Testing Requirements	Manufacturer, Supplier or Vendor shall notify Buyer Inspection Representative and carry out final inspection and mandatory testing activities in accordance with the approved quality plan and/or documented procedures to validate full compliance to applicable specifications. No product shall be dispatched until all the activities specified in approved quality plan and/or documented procedures have been satisfactorily completed. As well, Product Manufacturing and Testing Records shall be prepared and submitted to Company or Project Contractor Buyer and Inspection Representatives. Manufacturer shall not proceed with product shipment prior to issuance of a release certificate by Company or Project Contractor responsible Inspection Office.
Additional / Supplementary Requirements	Applicable tests and/or inspection requirements as stipulated and Purchase Order description, drawings, data sheets or referenced specifications.
Acceptance Criteria	Criteria of acceptance or rejection of inspection/testing activity is governed by the applicable purchase order specifications. Any deviation from purchase order and relevant specification shall follow waiver of MSAER procedure SAEP-302 in advance before it can be accepted by Buyer Inspection Representative.

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