



Materials System Specification

01-SAMSS-023

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Intrusive Online Corrosion Monitoring

Document Responsibility: Materials and Corrosion Control Standards Committee

Saudi Aramco DeskTop Standards

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1 Scope

This Specification defines the minimum mandatory requirements for intrusive, recoverable while in operation, online corrosion monitoring systems for the use in Saudi Aramco operations including refineries, terminals, gas plants, producing facilities and fields, pipelines, and other facilities. This Specification covers, field installed hardware, corrosion monitoring server hardware and software features and corrosion monitoring system capabilities.

2 Conflicts and Deviations

- 2.1 Any conflicts between this Specification and other applicable Saudi Aramco Materials System Specifications (SAMSSs), Engineering Standards (SAESs), Standard Drawings (SASDs) or industry standards, codes and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Consulting Services Department, Saudi Aramco, Dhahran.
- 2.2 Direct all requests to deviate from this Specification in writing to the Company or Buyer Representative, who shall follow internal company procedure [SAEP-302](#) and forward such requests to the Manager, Consulting Services Department of Saudi Aramco, Dhahran.

3 References

Material or equipment supplied to this Specification shall also comply with the latest edition of the references listed below, unless otherwise noted.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

[SAEP-302](#)

*Instructions for Obtaining a Waiver of a
Mandatory Saudi Aramco Engineering
Requirement*

Saudi Aramco Materials System Specifications

[34-SAMSS-820](#)

Instrument Control Cabinets – Indoor

[34-SAMSS-821](#)

Instrument Control Cabinets – Outdoor

Saudi Aramco Engineering Standards

[SAES-J-902](#)

Electrical Systems for Instrumentation

[SAES-J-903](#)

Intrinsically Safe System

<u>SAES-L-105</u>	<i>Piping Material Specifications</i>
<u>SAES-L-132</u>	<i>Materials Selection of Piping Systems</i>
<u>SAES-L-133</u>	<i>Corrosion Protection Requirements for Pipelines, and Process Equipment</i>
<u>SAES-L-136</u>	<i>Pipe Selection and Restrictions</i>
<u>SAES-L-310</u>	<i>Design of Plant Piping</i>
<u>SAES-L-410</u>	<i>Design of Pipelines</i>
<u>SAES-T-628</u>	<i>Communications – Underground Cable</i>
<u>SAES-T-631</u>	<i>Communications – Buried Cable and Wire</i>
<u>SAES-T-632</u>	<i>Communications – Cable Terminals</i>

3.2 Industry Codes and Standards

International Organization for Standardization

<i>ISO 15156</i>	<i>Petroleum and Natural Gas Industries Materials for Use in H₂S-Containing Environments in Oil and Gas Production</i>
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American Society of Mechanical Engineers

<i>ASME/ANSI B1.5-1988</i>	<i>Acme screw thread</i>
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➤ EU Equipment Directives

<i>ATEX 94/9/EC</i>	<i>Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres</i>
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<i>EN50014:1998, A1:1999, A2:1999</i>	<i>Electrical Apparatus for Potentially Explosive Atmospheres - General Requirements</i>
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<i>EN50018:2000, A1:2002 Amended 91/263/EEC, 92/31/EEC and 93/97/EEC</i>	<i>Electrical Apparatus for Potentially Explosive Atmospheres. Flameproof Enclosure 'd'</i>
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➤ Product Standards

<i>EN61326:A1:1998, A2:2001</i>	<i>Electrical Equipment for Measurement and Control</i>
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<i>EN61000-4-2:1995, A1:1998, A2:2001</i>	<i>EMC Electrostatic Discharge Immunity Test</i>
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<i>EN61000-4-3:1996,</i>	<i>EMC Radiated, Radio Frequency,</i>
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<i>A1:1998, A2:2001</i>	<i>Electromagnetic Field Immunity Test</i>
<i>EN61000-4-4:1995, A1:2001, A2:2001</i>	<i>EMC Electrical Fast Transient/Burst Immunity Test</i>
<i>EN61000-4-6:1996, A1:2001</i>	<i>EMC Conducted Radio Frequency Immunity Test</i>
<i>EN55011:1998, A1:1999</i>	<i>EMC Radiated Emissions</i>

4 Definitions

Corrosion Monitoring End Device: The component of a corrosion monitoring system that actually monitors the corrosion while exposed to the process environment. Corrosion probes and corrosion coupons are examples of end devices. For this specification only probes will be considered.

Corrosion Monitoring End Device Recovery Equipment: Any and all forms of equipment, such as a service valve and retriever, retraction device, used to remove and or install corrosion monitoring end devices through a system access point, while a system is operational

Corrosion Monitoring System: In this document a corrosion monitoring system includes corrosion monitoring end devices, and all external equipment including but not limited to adapters, transmitters, junction boxes, repeaters, cabling, communications networks and the corrosion management server with its corrosion management software and database.

Electrochemical noise: naturally occurring fluctuations in corrosion potential and corrosion current flow

Electrical Resistance (ER): a measure of the degree to which an object opposes an electric current through it. The SI unit of electrical resistance is the ohm

Electrical Resistance Probe: a probe that monitors corrosion by identifying the changes in the electrical resistance of a corroding metal element associated with a loss of mass, i.e. corrosion of the element.

Intrusive probe: is one that penetrates the pressure boundary of the pipework, vessel, or process.

Linear Polarization Probe (LPR): is the standard electrochemical probe used in conductive liquid environments such as produced waters and cooling water systems.

System Access Point: The piping component, which allows corrosion monitoring end devices to be exposed to the process system being monitored, providing a non-leaking penetration of the process system pressure barrier. Typically this is as an “access

fitting” for high pressure systems and as a stuffing box and valve for low and intermediate pressure systems.

5 General Requirement

- 5.1 Corrosion monitoring systems to be supplied to this Specification shall be submitted to and approved by the Supervisor, Corrosion Technology Unit and the corrosion engineer responsible for the facility prior to a final commitment to purchase being issued by a project team or other funding authority.
- 5.2 Only corrosion monitoring instruments specifically approved by the Supervisor, Corrosion Technology Unit may be purchased and installed as components of new corrosion monitoring systems, replacement or additions to existing systems or as long term, single device, stand alone installations. However, for field trials or evaluations, intended to obtain situation specific performance information over a short term, i.e. 12 months or less, environment exposures; approval is not required.
- 5.3 This specification is not intended to preclude the installation of corrosion monitoring systems of configurations other than described in this document. For corrosion monitoring systems that do not meet the specific requirements of this document or when there is doubt concerning alternate corrosion monitoring systems or system component, prior written approval shall be obtained from the Supervisor, Corrosion Technology Unit and the facility corrosion engineer, before such systems or components may be considered for use.
- 5.4 All system access points, pipe fittings, and pressure retaining parts shall be designed and manufactured from metallurgies compatible with the service. For example, for sour environments as defined in [SAES-L-133](#), materials meeting the requirements of ISO 15156 shall be used.
- 5.5 Where new corrosion monitoring systems are being installed as part of a capital project, existing obsolete corrosion monitoring systems shall be upgraded and integrated into the new corrosion monitoring system.

6 System Requirement

- 6.1 Field-mounted Hardware
 - 6.1.1 All online intrusive probes shall be ordered with monitoring elements, which would provide an estimated useful measurement life of a minimum of 6 months; preferably 12 months, based on expected corrosion rate. Selection of monitoring elements which would exceed 36 months useful measurement life is not recommended; as the efficiency of detection of corrosion rate excursions is reduced. Where
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expected corrosion rates will be very low, selection of the minimum commercially available element thickness is acceptable.

- 6.1.2 All intrusive probes shall have pressure and temperature ratings compatible with the process environment in which they will be installed.
 - 6.1.3 Probes shall be exposed to the process environment through an approved system access point that allows online installation or removal of the probe. Approved access point equipment included the Cosasco or equivalent 2 inch high pressure access fittings and the Cosasco or equivalent retractable system (intermediate pressure). All system access points shall have pressure and temperature ratings compatible with the process equipment on which they will be installed.
 - 6.1.4 Electrical Resistance monitoring probes shall be advanced high resolution metal loss type, at least equivalent to Microcor[®] systems, except as otherwise specified for clean water systems.
 - 6.1.5 Probe elements shall be available in different alloys. For individual probes, the element alloy selected shall be representative of the facility to be monitored. The probe body shall be available in higher alloys, if required to maintain the integrity of the probe through the life of the probe element.
 - 6.1.6 Probe elements shall have the highest thermal stability possible for the element thickness selected, to provide the maximum sensitivity.
 - 6.1.7 Probes shall have been proven to operate successfully for long periods, typically many months, without bridging or the need for cleaning when operating in sour service process conditions.
 - 6.1.8 The transmitter shall be capable of operating over an ambient temperature range of -40°C to +70°C.
 - 6.1.9 The probe and transmitter shall be explosion-proof rated by a third party certification authority to be Class 1 Div 1 and Div 2, Groups A, B, C, and D, Class 1 Zone 1 and Zone 2 AEx d IIC T6 or Ex d IIC T6 with ambient temperature range of -40 to +70°C.
 - 6.1.10 Hard-wired explosion-proof transmitters shall operate over a multi-drop 24 VDC power supply and RS485 two-wire communication cable with up to 32 transmitters on each multi-drop cable and 4000 ft (1200 m) maximum cable length per cable run to minimize cable and installation costs. For longer communication lengths repeater modules are
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permitted. Cables and junction boxes shall be explosion-proof for hazardous areas. Wireless connection is also recommended when available.

- 6.1.11 Any transmitters for water systems that are specified to be galvanic probes or solution resistance compensated LPR probes shall be capable of operating over the same power communication multi-drop cable as the metal loss probes.
- 6.1.12 Transmitters shall be connected to local explosion-proof junction boxes with hazardous area rated flexible explosion-proof cables.
- 6.1.13 Local transmitter junction boxes for marine environments shall be PVC coated.
- 6.1.14 Long distance communication shall be provided through fiber-optic networks and links, Ethernet networks, Internet connections, lease-line modems, dial-up modems, wireless modems or existing transparent communication links as available to the corrosion monitoring system being installed.

6.2 Corrosion Management Server

- 6.2.1 The Corrosion Management Server shall be capable of operating with up to 25,344 probes (256 ports at 99 probes per port). The corrosion management server shall be capable of supporting input of a minimum of 1,000 different process parameters. It shall have a client/server capability to provide multiple client users in multiple offices over the Saudi Aramco intranet.
 - 6.2.2 The Corrosion Management Server shall operate on a Microsoft[®] SQL Server or Oracle[®] database, and be capable of interfacing with the SCADA and PI systems for data exchange, to send process data to corrosion server and corrosion data to the SCADA or PI system.
 - 6.2.3 The Corrosion Management Server shall compute corrosion rate from metal loss probes with no limitations on the computed range. LPR instruments, where used, directly measure corrosion rate in water systems and shall be capable of measuring up to 200 mpy corrosion rate.
 - 6.2.4 Signal information from probes will be fed to a corrosion management server and data management software to process and store data. This corrosion management software shall accommodate both local and remote access
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- 6.2.5 This server may be located at another site if spare capacity already exists and the involved operating organizations concur.

Microcor[®] - Product of Rohrback Cosasco Systems Inc.

6.3 Corrosion Management Software

The corrosion management software shall be capable of monitoring unlimited numbers of data points and have the following features:

- 6.3.1 Enables the administrator to create and add monitoring points to the database.
- 6.3.2 Stores at least three years of historical data for immediate access.
- 6.3.3 Allows multiple databases to be used on the same corrosion server.
- 6.3.4 General corrosion rates shall be accommodated in industry standard units, however initial configuration shall be provided in the units “mils per year.”
- 6.3.5 Has administrative and user accounts for different access rights.
- 6.3.6 Provides the system capability in one integrated software package.
- 6.3.7 Allows process points and corrosion points to be monitored.
- 6.3.8 Allows any units to be assigned to any parameter in the database.
- 6.3.9 Allows coupon data to be input with in-built data input screen to plot corrosion rates.
- 6.3.10 Allows manual data input of any type, such as laboratory analysis results.
- 6.3.11 Allows ultrasonic thickness measurement input direct from common UT data loggers.
- 6.3.12 Allows import and export in Excel format of any data points.
- 6.3.13 Provides menu tree and mimic diagram access to data points.
- 6.3.14 Provides for mimic displays with live data.
- 6.3.15 Provides corrosion rate and metal loss for each corrosion probe point.

- 6.3.16 Provides graphical display of parameters against time for up to 6 points on one graph in different colors.
- 6.3.17 Allows graphs with single plot, multi-plot, 2Y-axes, overlay, correlation, histogram, and live update.
- 6.3.18 Provides multi-function calculator function for operator (administrator) set up of custom derived parameters and KPI's (Key Performance Indicators).
- 6.3.19 Provides adjustable reading frequency for on-line data points from 1 minute to 1 hour.
- 6.3.20 Provides multiple low and high level alerts and alarms for each data point, with separate enable/disable.
- 6.3.21 Provides Logbook capability for any data point or total system.
- 6.3.22 Allows reports and to be saved to any data point or total system capable of viewing from links on graphical displays.
- 6.3.23 Provides customizable searchable property fields for every data point.
- 6.3.24 Provides built-in standard reports for point history, detail history with graphs, points in alarm, alarm system status, and current status for any selected points.
- 6.3.25 Have automatic scheduled, and customized report preparation and e-mailing capabilities

7 System Maintenance

- 7.1 The vendor shall be capable of providing after sale maintenance for at least five years. This maintenance may be covered by a separate maintenance contract. An option shall be available for software maintenance and upgrade to keep the software current.
- 7.2 The vendor shall be able to provide spares for the whole system including replacement probes in varying sensitivities and metallurgies as required by the user.

Revision Summary

11 April 2009
10 May 2011

New Saudi Aramco Materials System Specification.
Editorial revision to delete the committee members' list.
