Engineering Standard

SAES-T-744 23 April 2017

Design Criteria and Installation of Communication Towers

Document Responsibility: Onshore Structures Standards Committee

Contents

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1 Scope

1.1 This standard covers mandatory requirements governing the design and installation of self-supporting, guyed steel and monopole communication towers. This includes antenna towers used for HF, VHF/UHF, microwave, wireless, FM/TV broadcasting, CATV, and base station antenna installation system.

1.2 This standard is not applicable to aluminum towers.

2 Conflicts and Deviations

Any deviations, providing less than the mandatory requirements of this standard require written waiver approval as per Saudi Aramco Engineering Procedure SAEP-302.

3 References

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

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

SAEP-302	*Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement*

Saudi Aramco Engineering Standards

SAES-A-112	*Meteorological and Seismic Design Data*
SAES-A-202	*Engineering Data and Drawing Systems*
SAES-A-204	*Preparation of Structural Calculations*
SAES-B-063	*Aviation Obstruction Marking and Lighting*
SAES-H-001	*Selection Requirements for Industrial Coatings*
SAES-H-101	*Approved Protective Coating Systems*
SAES-O-202	*Security Fencing*
SAES-P-111	*Grounding*
SAES-P-123	*Lighting*
SAES-Q-001	*Criteria for Design and Construction of Concrete Structures*

SAES-Q-005	*Concrete Foundation*
SAES-T-887	*Telecommunications: Electrical Coordination – Protection at Power Plants and Radio Stations*

Saudi Aramco Materials System Specifications

09-SAMSS-097	*Ready-Mixed Portland Cement Concrete*
12-SAMSS-007	*Fabrication of Structural and Miscellaneous Steel*

Saudi Aramco Standard Drawings

AA-036391	*Equipment Grounding System for Telecommunications Facilities*
AA-036361	*VHF-UHF Antenna Installation on Self Supporting Tower*
AA-036765	*Grounding for Remote Communication Sites*

Saudi Aramco Best Practices

SABP-Q-001	*Anchor Bolt Design and Installation*
SABP-Q-002	*Spread Footings Design Guide*

3.2 Industry Codes and Standards

American Institute of Steel Construction (AISC)

AISC	*Manual of Steel Construction – Allowable Stress Design (ASD)*

American Society for Testing and Materials (ASTM)

ASTM A36	*Specification for Carbon Structural Steel*
ASTM A307	*Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength*
ASTM A325	*Specification for High Strength Bolts for Structural Steel Joints, including Suitable Nuts and Plain Washers*
ASTM A123	*Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*
ASTM A572/A572M	*Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel*

Electronic Industries Association

TIA/EIA-222-G	*Structural Standards for Steel Antenna Towers and Antenna Supporting Structures*
TIA-1019-A	*Installation, Alteration, and Maintenance of Antenna Supporting Structures and Antennas*

4 Design References

4.1 The Structural Standards for Steel Antenna Towers and Antenna Supporting Structures, TIA/EIA-222, Edition G, as published by Electronic Industries Association (EIA/TIA) is hereby adopted as Saudi Aramco Engineering Standard SAES-T-744, Design Criteria for Communication Towers.

4.2 Deviations to TIA/EIA-222 are identified as exceptions or additions in the design section of this standard.

5 Design

The Structural Standard for Steel Antenna Towers and Antenna Supporting Structures, EIA/TIA-222-G is hereby adopted as Saudi Aramco Engineering Standard SAES-T-744 with the following addition or exception:

5.1 Establishing the height of communication tower shall require the review, approval, and concurrence of General Authority of Civil Aviation (GACA).

5.2 All material selection, detailing, shop fabrication, galvanizing, marking for erection, delivery, erection, and assembly of steel structures for communications towers shall comply with 12-SAMSS-007.

5.3 Painting and protective coatings for steel structures of the towers shall also comply with SAES-H-001 and SAES-H-101.

5.4 Communications towers shall not contain hollow tubular steel members as part of their structure.

5.5 Ice loading shall not be considered in the tower loading calculations.

5.6 Annex B: U. S. County Listings of Design Criteria of TIA-222-G shall not be considered. The Design Basic wind speed for the location of the tower shall be determined from SAES-A-112. If such data is not available for a particular location, contact Environmental Engineering Division. 60 miles per hour shall be the operational wind speed requirements for tower structures in Saudi Arabia.

5.7 The default Structure Classification in the design of communications tower shall be Class II with detail description specified in Tables 2-1 and 2-3 of

ANSI/TIA-222-G. However, Information Technology and Engineering Department (ITED) and Consulting Services Department (CSD) in collaboration with Proponent/(s) shall jointly identify communications facilities that would be classified under Structure Class III with Importance Factor of 1.15.

5.8 Seismic load consideration in the design of communication towers shall be dependent on the tower zone location as defined and elaborated in SAES-A-112.

5.9 Loading capacity of the tower shall be calculated for the known loading to be on the tower at its commissioning plus any additional loading expected to occur within one year after commissioning.

5.10 For new communications tower, aside from the loading provisions mentioned in section item 5.8 above, provide future tower loadings equivalent to 300% of the identified loadings or six (6) 1,200 mm (4 ft) diameter sets microwave antennas with two (2) 32 mm (1-¼ in) diameter coaxial transmission cables per antenna, which ever will result to greater stresses to the communications tower's members. Antennas' locations of future loads shall be established as per the instruction of Saudi Aramco representative/(s).

5.11 Antenna mounting bracket support/(s) assembly shall be considered as an additional load of the communications tower aside from the self-weight of antenna/(s). These collateral loads shall be considered in the tower loading for both dead load and wind load.

For wind load calculation of the mounting bracket support, derivation of the Projected Effective Area (EPA) shall follow the procedure specified in TIA-222G.

5.12 Foundations and concrete shall comply with 09-SAMSS-097, SAES-Q-001, and SAES-Q-005.

5.13 Communications towers erected on roof top of building shall require the acceptance and concurrence of the Proponent or Building Owner. The maximum tower reactions (vertical upward and downward, horizontal and moments) shall be furnished to the Proponent or Building Owner for structural study and evaluation of roof deck to ensure the structural adequacy of the roof deck structure to support these additional loadings.

5.14 To eliminate corrosion, all anchor rods shall be fusion bonded epoxy coated. The coating shall be 500 to 625 micrometers (20 to 25 mils) dry film thickness.

5.15 Guyed towers shall not be installed on offshore structures.

5.16 All guyed tower masts for communication sites require separate SSD/1 or SSD/2 security fencing for each guy if not included in perimeter security fence for tower. Refer to SAES-O-202.

6 Installation

6.1 All tower legs and anchors shall be bonded to form a grounding electrode system, which shall be bonded to the building grounding system per SAES-P-111, SAES-T-887 and Standard Drawing AA-036391.

6.2 Each tower leg and anchor shall be identified with labels. The labels shall be located in a clear location such as the bottom of the tower and top of anchor.

6.3 Marking and lighting of communications towers shall comply with SAES-B-063 and SAES-P-123.

6.4 All structural steel members shall be coated with hot dipped galvanization in accordance with ASTM A123 with minimum thickness of 120 microns. For offshore communications towers, minimum thickness shall be 140 microns.

6.5 All electrical power cables of tower lightings shall be installed using rigid steel conduit (RSC) and/or heat resistance armored cable wire.

6.6 All newly erected communications towers shall be provided with a unique tower identification by providing nameplate tag that includes the Saudi Aramco asset number. Other information to be included in the name tag are manufacturer's name, date of manufacture, type of tower, tower height and site location name. This name tag information will be installed in one of the leg's tower approximately 1 meter high from the tower's base plate.

6.7 All bolts of newly erected and modified towers shall be tightened to the required torque values as per requirements of ASTM A325 or approved equivalent bolts with corresponding torque values.

6.8 Installation of antenna transmission cables or waveguides shall comply with the recommended manufacturer's standard requirements and procedures. This comprises, but not limited to complete assembly of hanger clips, support brackets and/or pillows,

6.9 Transmission cables or waveguides shall be provided with hoisting grip located at least 1.50 meters (5.00 feet) from the antenna connector. Allow a sufficient length of cable or waveguide leader between the connector and the grip to reach the antenna input when hoisting is completed.

Do not use one (1) hoisting grip for hoisting two (2) or more cables or waveguides. Use hoisting grips at intervals of no more than 60 meters (200 feet).

6.10 Transmission cables or waveguides shall be provided with label lead tag material.

6.11 Transmission cable lines shall be grounded along the vertical run near the top, near the bus bar or above the entry of waveguide and at the entrance of the line (port entry) into the equipment shelter.

The midpoint of the vertical run of transmission should also be grounded if the height of the line exceeds 60.00 meters (200 feet).

7 Testing and Inspection

Testing and inspection of towers shall be in accordance with Section 14 and Appendix E of EIA/TIA-222-G.

Revision Summary

10 September 2011	Revised the "Next Planned Update." Reaffirmed the content of the document, and reissued with no other changes.
2 May 2012	Editorial revision to change the primary contact.
23 April 2017	Major revision considered tower loadings requirements from Global System for Mobile Radio (GSM) Service Providers, security surveillance cameras and monitoring equipment, and to meet present and future communications radio and wireless technological advancements, such as Tetra, Vessel Traffic Management System antennas, etc.