

# Engineering Standard

SAES-K-002

31 May, 2004

## Air Conditioning Systems for Essential Operating Facilities

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## Saudi Aramco DeskTop Standards

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Revised paragraphs are indicated in the right margin

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## 1 Scope

- 1.1 This Standard defines the supplemental mandatory requirements of Heating, Ventilation and Air Conditioning (HVAC) systems for Essential Operating Facilities, in addition to the general requirements stated in [SAES-K-001](#) for Non-essential Operating Facilities.

Essential Operating Facilities shall mean electrical substations, process interface buildings, satellite instrument houses, control buildings, analyzer shelters, process management centers, switchgear buildings and any other buildings, located onshore or offshore, housing electrical or electronic equipment and control systems that are vital in the production, processing and transportation of hydrocarbons, as defined in [SAES-O-100](#).

- 1.2 Excluded from this Standard are process refrigeration equipment and systems. Buildings used for Non-essential Operating Facilities, such as, office buildings, maintenance facilities, dwellings, dining halls, recreation centers, etc., are also excluded from this Standard.

## 2 Conflicts and Deviations

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

## 3 References

All referenced specifications, standards, codes, forms, drawings and similar material shall be of the latest issue (including all revisions, addenda and supplements) unless stated otherwise.

- 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

<a href="#"><u>SAES-A-112</u></a>	<i>Meteorological and Seismic Design Data</i>
<a href="#"><u>SAES-B-014</u></a>	<i>Safety Requirements for Plant and Operations Support Buildings</i>
<a href="#"><u>SAES-J-801</u></a>	<i>Control Buildings</i>
<a href="#"><u>SAES-J-902</u></a>	<i>Electrical Systems for Instrumentation</i>
<a href="#"><u>SAES-K-001</u></a>	<i>Heating, Ventilating and Air Conditioning (HVAC)</i>
<a href="#"><u>SAES-K-003</u></a>	<i>Air Conditioning Systems for Communications Buildings</i>
<a href="#"><u>SAES-O-100</u></a>	<i>General Requirements Safety and Security</i>
<a href="#"><u>SAES-O-126</u></a>	<i>Blast Resistant Control Buildings</i>
<a href="#"><u>SAES-P-100</u></a>	<i>Basic Power System Design Criteria</i>
<a href="#"><u>SAES-P-103</u></a>	<i>Direct Current and UPS Systems</i>
<a href="#"><u>SAES-P-104</u></a>	<i>Wiring Methods and Materials</i>

### Saudi Aramco Materials System Specification

<a href="#"><u>34-SAMSS-831</u></a>	<i>Instrumentation for Packaged Units</i>
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## 3.2 Industry Codes and Standards

### American Society of Heating, Refrigerating & Air-Conditioning Engineers

<i>ASHRAE STD 52</i>	<i>Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter</i>
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### International Society for Measurement and Control

<i>ISA S71.04</i>	<i>Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants</i>
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### National Fire Protection Association

<i>NFPA 496</i>	<i>Standard for Purged and Pressurized Enclosures for Electrical Equipment</i>
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## 4 Design Basis

### 4.1 Environmental Conditions

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For the design of HVAC systems, covered by this Standard, the environmental conditions listed in [SAES-A-112](#) and the inside air conditions listed in [SAES-K-001](#) shall be used. For communication facilities the inside air design conditions listed in [SAES-K-003](#) shall be used.

## 4.2 Load Calculations

4.2.1 HVAC load calculations shall be prepared in accordance with [SAES-K-001](#).

4.2.2 Heat gain from introducing outside air into a building, shall be included in the HVAC load calculations.

## 4.3 Standby Air Conditioning

4.3.1 All HVAC systems covered by this standard shall be provided with standby units.

4.3.2 Auto changeover switches shall be provided between the operating and standby units. These switches shall be capable of providing changeover and equal wear and tear between the operating and standby units.

### 4.3.3 Capacity

4.3.3.1 If the maximum design capacity of the HVAC system is supplied by two or more normally operating units, at least one standby unit shall be provided with a capacity equal to or greater than the capacity of the largest operating unit.

4.3.3.2 In case the maximum HVAC system demand is satisfied by one operating unit only, the capacity of the standby unit shall be at least equal to the capacity of the operating unit.

### 4.3.4 Alarms

4.3.4.1 Alarms shall be provided for all HVAC systems covered by this standard to provide warning of power loss (from the normal supply) and failure of any portion of the HVAC system.

4.3.4.2 All alarm devices shall be independent of the normal power supply of the HVAC system.

4.3.4.3 Individual alarm devices shall be connected to a master alarm in a location where they can be conveniently

observed by an attendant or other responsible person designated by the management of this essential operating facility. In cases where the facility is not attended full time, the system shall be connected to an alarm at the security office, utilities office, fire station or other full-time service unit with which arrangements can be made to alert the person in charge of this facility.

## 5 Building Pressurization

### 5.1 Buildings Located in Hazardous (Class I, Zone 2 or Class I, Division 2) Areas

5.1.1 In buildings which are located in Class I, Zone 2 or Class I, Division 2 electrical areas, the HVAC system shall be designed to prevent the entry of flammable vapors or gases in accordance with the requirements of NFPA 496, Chapter 5, "Pressurized Control Rooms".

5.1.2 Air intake of the HVAC system in these buildings shall be located in accordance with the requirements of [SAES-B-014](#).

5.1.3 HVAC equipment, located in hazardous (Class I, Zone 2 or Class I, Division 2) area, shall meet the requirements of [SAES-P-100](#) and [SAES-J-902](#) for such locations.

### 5.2 Control Buildings

The HVAC system of all control buildings shall be designed in accordance with the requirements of [SAES-O-126](#); "Blast Resistant Control Buildings". In these buildings the minimum outside air flow rate available for building pressurization, as defined by paragraph 5.4.4 of this standard, shall equal to 2.0 air changes per hour of the total pressurized space and the buildings shall be capable of maintaining an internal building pressure of 0.25 inch water gauge.

### 5.3 Building Risk Assessment

For essential operating facilities defined in the scope of this standard, other than those stated in paragraph 5.1 and 5.2 above, building pressurization shall be provided if deemed necessary by the building risk assessment, in accordance with [SAES-B-014](#).

### 5.4 Requirements for Pressurized Buildings

5.4.1 Pressurization fans, or air-handling units providing building pressurization, shall be provided with 100% standby units, powered

from a separate or emergency power supply, in accordance with [SAES-B-014](#).

- 5.4.2 All motorized dampers, gas detectors, sensors and HVAC Direct Digital Controllers (DDCs) relevant to the operation of the pressurization system shall have an independent emergency power supply in addition to the normal power supply.
  - 5.4.3 The electric motors of pressurization fans, or air handling unit fans providing building pressurization, shall be selected for the peak power demand of the fan's full capacity range. This is to ensure a non-overloading operating condition for these electric motors in case of momentary building pressure loss at the time of opening an exterior door.
  - 5.4.4 The outside air available for pressurization shall be the difference between the total air supply into, and total exhaust air from the pressurized space.
  - 5.4.5 When calculating the flow rate of exhaust air from the pressurized space, the capacity of all exhaust fans (toilets, etc.) shall be included on a continuous basis, even if not all exhaust fans operate continuously.
  - 5.4.6 Exhaust fan capacity rating shall be modified for the backpressure represented by the pressurized space and adequate backpressure control devices, such as spring loaded or gravity weighted louvers, shall be installed at the fan discharge to maintain building pressurization.
  - 5.4.7 Analyzer shelters shall be as per the requirements of SAES-J-502.
- 5.5 Controls and Alarms for Pressurized Buildings
- 5.5.1 In pressurized buildings all status indicator lights, manual switches and alarms that are part of the pressurization system shall be located on the process control panel of the building, visible and readily accessible to the operators.
  - 5.5.2 At loss of airflow through the operating fan providing pressurization, the standby fan shall start automatically. An alarm shall alert personnel to such a condition, as described in section 4.3.3 of this standard.
  - 5.5.3 Both the primary and standby fans shall each have a backdraft damper for the prevention of air short-circuiting.
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- 5.5.4 The outside air intake duct shall have motorized shut-off damper interlocked with the pressurization fans and a manually operated volume damper.
  - 5.5.5 For all pressurized buildings a differential pressure sensor shall be installed for measuring the static pressure difference between the interior and exterior of the building. The external static pressure probe shall be shielded from the dynamic effect of the wind.
  - 5.5.6 Failure of the building pressurization system, as measured in 5.5.5 above, shall signal a visible and audible alarm.
  - 5.5.7 In hazardous (Class I, Zone 2 or Class I, Division 2) areas or areas defined by the building risk assessment of [SAES-B-014](#), appropriate gas detectors shall be installed in the outside air intake stream to detect toxic or flammable gases. At gas concentrations specified in [SAES-B-014](#) an alarm shall be activated, as described in section 4.3.3, and all outside air intake into the building shall be shut off automatically.
  - 5.5.8 Monitoring of all HVAC systems covered by this code shall comply with:
    - [SAES-J-801](#) *Control Buildings*
  - 5.5.9 All packaged HVAC control wiring shall comply with:
    - [34-SAMSS-831](#) *Instrumentation for Packaged Units*
  - 5.5.10 Field installed control wiring for HVAC systems shall comply with:
    - [SAES-J-902](#) *Electrical Systems for Instrumentation*
  - 5.5.11 All electrical wiring shall comply with or it is approved equivalent to:
    - [SAES-P-104](#) *Wiring Methods and Materials*
  - 5.6 Air Tightness Requirements for Pressurized Buildings
    - 5.6.1 To ensure proper pressurization, the exterior envelope of the pressurized building shall be constructed as airtight as practically possible.
    - 5.6.2 All doors used for routine entry and exit shall have air locks. Emergency exit doors and maintenance access doors shall be sealed airtight to maintain building pressure but do not require air locks.
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- 5.6.3 All doors shall be equipped with quick acting, adjustable door closer mechanism, as per the requirements of [SAES-B-014](#).
- 5.6.4 Doors shall fit tightly against the jambs without warpage or cracks, and matching tube type rubber seals shall be installed on both doors and jambs.
- 5.6.5 The number of doors and openings through the exterior walls of these types of buildings shall be kept to the minimum, maintaining the safety requirement of SEAS-B-014.
- 5.6.6 All visually detectable cracks, cable, duct and piping penetrations through the building envelope shall be sealed airtight.

## 6 Battery Rooms

- 6.1 Battery rooms shall be air conditioned to maintain a temperature of  $22.5^{\circ}\text{C} \pm 2^{\circ}\text{C}$  ( $72.5^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ ).
- 6.2 Battery rooms shall be ventilated to the outside of the building at a minimum rate of one air change every three hours. At no case shall the exhaust from the battery room be lower than that specified in [SAES-P-103](#) or that necessary to satisfy the cooling requirement for the battery room, whichever is greater.
- 6.3 Air shall not be recycled from battery rooms.
- 6.4 The bottom of the ventilation air inlet into the battery room shall not be higher than 150 mm above the floor, and the air outlet shall be located in the ceiling or its upper edge flush with the ceiling if it is located in a wall. Air inlets and outlets shall be located to provide effective cross ventilation over the batteries.
- 6.5 No false ceilings are allowed in battery rooms.
- 6.6 Pockets for collection of flammable gas within battery room ceilings shall be avoided. However, if not possible, then means shall be provided to withdraw any collected flammable gas from the highest point within this ceiling pocket.

## 7 Indoor Air Quality Requirements

- 7.1 Dust Filters
    - 7.1.1 The HVAC systems of all buildings containing electronic equipment shall be equipped with pre-filters and final filters. The pre-filters shall have a minimum of 25% dust spot efficiency and the final filters shall
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provide a minimum of 85% dust spot efficiency, as defined by ASHRAE STD 52.

7.1.2 Differential pressure gauges shall be provided across the filter assemblies.

## 7.2 Chemical Filters

In all buildings, containing electronic equipment, the concentration of corrosive gases shall be limited to the G1 environmental classification level defined in ISA S71.04, as required by [SAES-J-801](#). When it is confirmed by the Proponent and/or Process Engineering Division that the concentration of corrosive gases in the local plant environment will exceed the G1 classification level, chemical filters shall be provided to limit the concentration of gases inside the rooms, which contain the electronic equipment, to the G1 classification level.

### Revision Summary

31 May, 2004

Revised the "Next Planned Update". Reaffirmed the contents of the document, and reissued with no other changes.