

# Engineering Standard

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SAES-A-105

30 November, 2003

Noise Control

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## Saudi Aramco DeskTop Standards

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Previous Issue: 28 June, 2000    Next Planned Update: 1 December, 2008

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## 1 Scope

This standard defines the minimum mandatory requirements for the control of noise throughout all Company facilities.

This entire standard may be attached to and made a part of purchase orders.

## 2 Conflicts and Deviations

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

## 3 References

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

### 3.1 Saudi Aramco References

#### Saudi Aramco Engineering Procedures

[SAEP-13](#)

*Project Environmental Assessments*

[SAEP-302](#)

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

#### Saudi Aramco Engineering Standards

[SAES-F-007](#)

*System Design Criteria of Flares*

[SAES-J-605](#)

*Surge Relief Protection System*

#### Saudi Aramco Form and Data Sheet

[7305-ENG](#)

*Equipment Noise Data Sheet*

### 3.2 Government Requirements

Saudi Arabian Standards Organization

*SSA 315/1982, Section 3.2 Noise*

### 3.3 Industry Codes and Standards

American National Standards Institute

*ANSI S1.4 Specification for Sound Level Meters*

## 4 Design

### 4.1 General Design Requirements

4.1.1 Engineering controls shall be used, if feasible, to reduce ambient noise exposure to less than 90 dB(A) as averaged over an 8-hour workshift.

4.1.2 Areas having ambient noise levels exceeding 90 dB(A) shall be classified as Noise Hazard Areas. The area boundaries and entrances shall be posted with warning signs requiring hearing protection (SAMS SAP number 1000131988, formerly stock number 21-565-637). Additional means of delineating the areas may also be used, such as outlining with painted lines or chain link fencing.

### 4.2 New Facilities and Major Modifications

4.2.1 Ambient noise levels shall be considered in the design phase of all projects involving new facilities and major modifications, in accordance with [SAEP-13](#).

4.2.2 The desired noise criterion curves for various indoor areas are listed in Table 1 and the corresponding octave band sound pressure levels are listed in Table 2.

4.2.3 The Proponent shall contact ECD/EPD to request noise level testing during the commissioning process, prior to approval of the Mechanical Completion Certificate (MCC).

4.2.4 If the noise level of any area within the new facility/major modification is likely to exceed 85 dB(A), an "as-built" noise contour diagram showing, as a minimum, noise isopleths of 80, 85, 90, 95, and 100 dB(A), shall be submitted to EPD/ECD.

4.2.5 In all instances where there is a potential for ambient noise levels to exceed 90 dB(A) after feasible engineering controls have been implemented, the Project Manager shall obtain a waiver in accordance with [SAEP-302](#).

4.2.6 Closed or partially closed spaces containing equipment that exceeds 85 dB(A) shall be designed, and construction materials selected, to minimize the effects of echoes and reverberation.

#### 4.3 New Equipment

4.3.1 For each new piece of equipment or integrated unit that will generate noise in excess of 85 dB(A) at a distance of one meter, the Project Manager shall submit a completed Form [7305-ENG](#), Equipment Noise Data Sheet, to ECD/EPD.

4.3.2 New equipment shall not generate noise in excess of 90 dB(A) at a distance of one meter after engineering controls have been implemented. If the noise level will exceed this limit, the Project Manager shall submit a completed Form [7305-ENG](#), Equipment Noise Data Sheet, to ECD/EPD, and shall obtain a waiver in accordance with [SAEP-302](#).

*Exceptions to this requirement are:*

- 1) *Emergency sirens, alarms, and loudspeakers.*
- 2) *Flaring during a single major process unit or major plant upset, which may not exceed 97 dB(A) (refer to [SAES-F-007](#)).*
- 3) *Surge valves that will be used for peak shaving applications, which may not exceed 105 dB(A) at maximum flow capacity (refer to [SAES-J-605](#)).*

#### 4.4 Personnel Exposure Levels

4.4.1 Personnel shall not be exposed to continuous ambient noise levels (i.e., those with a duration of one second or greater) in excess of those listed in Table 3. Sound level measurements shall be made at a distance of one meter from the equipment, using a sound level meter set to "A"-scale weighting and to "slow" response. Sound level meters shall conform to ANSI S1.4 and be calibrated to ensure measurement accuracy.

4.4.2 Personnel shall not be exposed to impulse or impact noise levels (i.e. those with a duration of less than one second) that exceed a peak sound pressure level of 140 dB. All continuous, intermittent and impulsive sound levels from 80 dB to 140 dB shall be integrated into the noise measurements. If an instrument is not available to measure a C-weighted peak, an unweighted peak measurement below 140 dB may be used to imply that the C-weighted peak is below 140 dB.

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- 4.4.3 When personnel are exposed to noise levels equal to or exceeding an 8-hour time-weighted average (TWA) of 85 dB(A) or, equivalently, a dose of fifty percent (50%) of the values shown in Table 3, they shall be enrolled in the Saudi Aramco Hearing Conservation Program. Company-approved hearing protection devices shall be provided and their use strictly enforced by supervisory personnel.
- 4.4.4 Noise level monitoring by ECD/EPD will be conducted periodically in conjunction with regularly scheduled facility surveys and whenever personnel noise exposure changes to the extent that additional employees may need to be added to the Hearing Conservation Program. Monitoring shall also be conducted at the request of facility management.
- 4.4.5 The monitoring requirement for hearing conservation purposes shall be met by either area monitoring or personal monitoring that is representative of the employee's exposure.

#### 4.5 Community Noise Levels

##### 4.5.1 General

The noise level from Saudi Aramco facilities and operations shall not exceed 65 dB(A) during daytime hours (0600-2200) or 55 dB(A) during nighttime hours (2200-0600) when measured at the property line of any residential area. Emergency sirens and alarms may cause the level to temporarily exceed these limits. The corresponding octave band limits are given in Table 4. Additional requirements for Royal Commission areas in Yanbu and Jubail are given below.

##### 4.5.2 Yanbu Regulations

Noise levels from facilities within the Royal Commission of Jubail and Yanbu, Yanbu area, shall not exceed the limits in Tables 5 and 6 when measured at their property boundary. The noise levels shall be determined by averaging the instantaneous hourly measurements taken during the time period. The noise levels are those produced only by the facility or activity under consideration, without regard to the background noise levels produced by other sound sources in the community.

##### 4.5.3 Jubail Regulations

Noise levels from facilities within the Royal Commission of Jubail and Yanbu, Jubail area, shall not exceed the limits of Table 7 when measured at their property boundary. Facilities that operate equipment with noise

levels in excess of 85 dB(A) shall conduct an annual perimeter noise survey and submit the results within thirty days to ECD/EPD.

## 5 Definitions

**Ambient Noise:** A measure of the intensity, duration, and character of sounds from all sources that affect a given location.

**Community Noise:** A measure of the overall noise which is associated with outdoor sound levels in the community.

**Decibel (dB):** The standard unit of sound intensity measurement.

**dB(A):** The sound level in decibels read on the "A"-scale of a sound level meter. The "A"-scale weighting best approximates the response of the human ear to sound.

**DB(C):** The sound level in decibels read on the C-scale of a sound level meter. The C-scale discriminates very little against very low frequencies. It is best used in engineering control and hearing conservation applications.

**Engineering Controls:** A physical means of reducing noise exposure which does not include the use of personal hearing protection. Examples are: 1) substitution of manufacturing equipment or processes, 2) isolation brought about by barriers, enclosures, and the like, or 3) modification of the equipment, including the addition of materials such as absorbers and damping materials.

**Hearing Conservation Program (HCP):** An effective HCP includes, as a minimum: 1) noise exposure monitoring, 2) audiometric testing and analysis, 3) provision and effective use of hearing protection, 4) training on the effects of noise, the care and use of hearing protection, etc., and 5) recordkeeping. Saudi Aramco's HCP is administered by the Preventive Medicine Services Division/SAMSO, the Loss Prevention Department, and the Environmental Compliance Division/Environmental Protection Department.

**Impulse Noise:** A noise of short duration (typically less than one second), especially of high intensity, abrupt onset and rapid decay, and often rapidly changing spectral composition. Impulse noises are characteristically associated with such sources as explosions, impacts, firearm discharges, sonic booms, and many industrial processes.

**Noise:** A sound which is unwanted, either because of its effect on humans, its effect on fatigue or malfunction of physical equipment, or its interference with the perception or detection of other sounds.

**Noise Criterion Curve:** An established noise level which is intended to permit adequate speech communications for a given area and also used to minimize human annoyance.

**Noise Exposure:** A cumulative acoustic stimulation which reaches the ear of a person over a specified period of time such as a work shift, a day, a working life, or a lifetime.

**Noise Hazard:** An acoustic stimulation of the ear which is likely to produce noise induced permanent hearing loss in some of the exposed population.

**Noise Isoleth:** A line connecting noise levels of the same value. When isopleths are drawn for various noise levels, a noise contour diagram results.

**Octave Band Sound Pressure Levels:** The sound pressure level in decibels measured at each octave band center frequency.

**Slow Response:** A setting on the sound level meter which causes it to average out high level noises of short duration.

**Sound Pressure Level (SPL):** A measure of sound intensity. Expressed in decibels, it is equal to 20 times the logarithm to the base ten of the ratio of a sound pressure to the reference sound pressure of 20 micropascals.  $[SPL = 20\log_{10}(SP/20)]$ , where SP is the sound pressure in micropascals]

**Time Weighted Average (TWA):** That sound level, which if constant over an 8-hour exposure period, would result in the same noise dose as is measured.

**Table 1 - Category Classification and Suggested Noise Criterion Range for Intruding Mechanical Equipment Noise in Various Indoor Areas**

Category	Area and Acoustic Requirements	Noise Criterion Curve <sup>(1)</sup>
1	Bedrooms, sleeping quarters, hospitals, residences, apartments, etc. (for sleeping, resting, relaxing)	NC-20 to NC-30
2	Auditoriums, theaters, large meeting rooms, large conference rooms, etc. (for good listening conditions)	NC-20 to NC-30
3	Private offices, small conference rooms, classrooms, libraries, etc. (for good listening conditions)	NC-30 to NC-35
4	Large offices, reception areas, cafeterias, etc. (for fair listening conditions)	NC-35 to NC-40
5	Lobbies, laboratory work spaces, drafting and engineering rooms, maintenance shops, etc. (for fair listening conditions)	NC-40 to NC-50
6	Kitchens, laundries, shops, garages, machinery spaces, power plant control rooms, etc. (for minimum acceptable speech communication with no risk of hearing damage)	NC-45 to NC-55

**Note (1):** For corresponding octave band sound pressure levels, see Table 2.

**Table 2 - Octave Band Sound Pressure Levels Associated with the Noise Criterion Curves**

Noise Criterion Curve	Octave Band Sound Pressure Levels, dB							
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
NC-15	47	36	29	22	17	14	12	11
NC-20	51	40	33	26	22	19	17	16
NC-25	54	44	37	31	27	24	22	21
NC-30	57	48	41	35	31	29	28	27
NC-35	60	52	45	40	36	34	33	32
NC-40	64	56	50	45	41	39	38	37
NC-45	67	60	54	49	46	44	43	42
NC-50	71	64	58	54	51	49	48	47
NC-55	74	67	62	58	56	54	53	52
NC-60	77	71	67	63	61	59	58	57
NC-65	80	75	71	68	66	64	63	62

**Table 3 - Permissible Noise Exposure Levels <sup>(1)</sup>**

Duration of Exposure (Hours)	Sound Pressure Level, dB(A)
16	85
12	87
10	88
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

**Note (1):** Calculated from SSA 315/1982, Section 3.2, Noise, and found in 29 CFR 1910.95, Occupational Noise Exposure.

**Table 4 - Octave Band Noise Limits at Residential Areas**

Octave Band Center Frequency, Hz	Daytime (0600-2200 hrs) Sound Pressure Level, dB	Nighttime (2200-0600 hrs) Sound Pressure Level, dB
31.5	96	89
63	82	75
125	74	65
250	67	58
500	63	53
1000	60	50
2000	57	47
4000	55	45
8000	53	43

**Table 5 - Community Noise Standards by Land Use Type for Yanbu Area <sup>(1)</sup>**

Land Use Category	Maximum Sound Pressure Level, dB(A) <sup>(2)</sup>		
	Day <sup>(3)</sup>	Night <sup>(4)</sup>	Other <sup>(5)</sup>
Conservation/recreation area	50	40	45
Suburban (residential), hospital, mosque, and similar zones	55	45	50
Urban (residential) and apartment	60	50	55
Urban (residential) with some commercial, retail, or light industry	65	55	60
Predominantly industrial	70	60	65
Heavy industrial, few dwellings	75	65	70

**Notes:**

- (1) From "Environmental Protection Manual, Volume I, Environmental Regulations and Standards, January 1991", Directorate General for Yanbu Project, Royal Commission for Jubail and Yanbu.
- (2) If the noise is impulsive in character (hammering, clanging, exploding, etc.) or if the noise contains an audible discrete tone (whine, screech, hum, etc.), the values in Table 5 shall be decreased by 5 dB(A). If the noise is present for only a portion of the period under consideration, the values in Table 5 may be increased in accordance with Table 6.
- (3) "Day" represents the period 0600-1900 hours on weekdays.
- (4) "Night" represents the period 2200-0600 hours.
- (5) "Other" represents the period 1900-2200 hours on weekdays and 0600-1900 hours on weekends and holidays.

**Table 6 - Community Noise Level Increases for Noise Present only a Portion of the Time Period under Consideration Yanbu Area <sup>(1)</sup>**

Percentage of Time Present	Amount of Sound Pressure Level Increase, dB(A)
1-3	15.0
4	13.5
5	12.5
7	11.5
10	10.0
15	8.0
20	7.0
30	5.5
40	4.0
50	3.0
70	1.5
100	0.0

**Note (1):** See Note (1) in Table 5.

**Table 7 - Jubail Royal Commission Noise Levels <sup>(1)</sup>**

<b>Category of Zoning District</b>	<b>Maximum Sound Pressure Level, dB(A)</b>
Residential and Institutional	50
Small business and commercial	65
Industrial	75

**Note (1):** From Section 7 of the Royal Commission Environmental Regulations, September 1999, Directorate General of Jubail Project, Royal Commission for Jubail and Yanbu.

**Revision Summary**

30 November, 2003 Revised the "Next Planned Update". Reaffirmed the contents of the document, and reissued with minor changes.