



Exploration & Production

GENERAL SPECIFICATION

CIVIL WORKS

GS EP CIV 406

Thermal and acoustic insulation

03	10/07	Update of References -Addition of References
02	10/05	Addition of "EP" root to GS identification
01	09/03	Change of Group name and logo
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1. Scope

This specification concerns the thermal and acoustic insulation for buildings and industrial installations dealt with by the COMPANY, either onshore or offshore.

This specification stipulates what the COMPANY considers as an acceptable minimum. However, the COMPANY may consider that certain aspects of the works may be of a particular nature. In this case, the COMPANY reserves the right to make supplementary requirements.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

When local national standards, regulations and codes exist, all design, engineering, materials and construction shall conform to their latest requirements, which complete or modify the present specifications.

In case of lack of obligatory local national standards, international norms and standards will be applied.

In case of lack of international norms and standards, national norms and standards listed hereafter will be applied.

In all cases the system adopted shall be coherent, i.e. the various texts shall present no incompatibility. Any dispute shall be resolved by basing works on the most stringent text for the CONTRACTOR and at his expense.

The list of specifications and norms quoted is not exhaustive: the CONTRACTOR shall respect the secondary standards and regulations, which cover the works described in the present specification.

Certain specifications and norms may be indicated with an issue date. This is for information only and on the understanding that the most recent issue shall be used.

All drawings and documents drawn up by the CONTRACTOR shall be submitted for COMPANY approval, in accordance with general requirements.

Standards

International standards and codes

Reference	Title
ISO 140-4 - 1998	Acoustics - Measurement of sound insulating in buildings and of building elements - Part 4: Field measurements of airborne sound insulation between rooms
ISO 140-5 - 1998	Acoustics - Measurement of sound insulating in buildings and of building elements - Part 5: Field measurements of airborne sound insulation of facades
ISO 140-7 - 1998	Acoustics - Measurement of sound insulating in buildings and of building elements - Part 7: Field measurements of impact sound insulation of floors

Reference	Title
ISO 354 - 2004	Acoustics – Measurement of sound absorption in a reverberation room
ISO 717-1 - 1997	Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation
ISO 717-2 - 1997	Acoustics - Rating of sound insulation in buildings and of building elements - Part 2: Impact sound insulation
ISO 1996-1 - 2005	Acoustics - Description and Measurement of Environmental noise - Part 1: Basic quantities and procedures
ISO 1996-2 - 2005	Acoustics - Description and Measurement of Environmental noise - Part 2: Acquisition of data pertinent to land use
ISO 1996-3 - 2005	Acoustics - Description and Measurement of Environmental noise - Part 3: Application to noise limits
ISO 1999 - 1990	Acoustics - Determination of occupational noise exposure and estimation of noise induced hearing impairment
ISO 10211-1 - 1995	Thermal bridges in building construction - heat flows and surface temperatures - Part 1: General calculation methods
ISO 10211-2 - 2002	Thermal bridges in building construction – Calculation of heat flows and surface temperatures – Part 2: Linear thermal bridges
ISO 12241-1 - 1998	Thermal insulation for building equipment and industrial installations - Calculation rules
ISO 13370 - 1999	Thermal performance of buildings - Heat transfer via the ground - Calculation methods
ISO 13789 - 2000	Thermal performance of buildings - Transmission heat loss coefficient - Calculation methods

European standards and codes

Reference	Title
EN 12354-1 - 2000	Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 1 : airborne sound insulation between rooms
EN 12354-2 - 2000	Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 2: Impact sound insulation between rooms.
EN 12354-3 - 2000	Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 3: Airborne sound insulation against outdoor sound.
EN 12354-4 - 2000	Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 4 : transmission of indoor sound to the outside
EN 12354-6 - 2004	Building acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 6 : sound absorption in enclosed spaces

French standards and codes

Reference	Title
NF S 31-010 - 1996	Acoustics - Environmental noise characterization and measurement. Special measuring methods
NF S 31-050 - 1979	Acoustics. Measurement of the acoustic insulation of building and building components. Specifications relating to laboratories
NF S 31-080 - 2006	Acoustics - Offices and associated areas - Acoustic performance levels and criteria by type of area
NF S 31-084 - 2002	Acoustics - Method of measurement of occupational noise levels for the assessment of self daily noise exposure level of works

Professional Documents

Reference	Title
D.T.U.P 50-702 - 1997	Règles Th-K de calcul des caractéristiques thermiques utiles des parois de construction et des déperditions de base des bâtiments TH-K 77 rules. Rules for calculating the thermal characteristics of structural walls
D.T.U.P 50-703 - 1991	Règles Th-D de calcul des déperditions de base des bâtiments TH-D rules. Rules for calculating basic heat losses in buildings
D.T.U.P 50-704 - 1991	Règles Th-G de calcul du coefficient GV des bâtiments d'habitation et du coefficient G1 des bâtiments autres que d'habitation Rules TH-G. Rules for calculating the gv factor for residential buildings and the g1 factor for non residential buildings

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP HVA 100	Basis of design

3. Acoustic insulation

3.1 General

This specification is to attract attention to the intensity of noise that personnel are subjected to, the discomfort that certain noises produce and the risks involved in prolonged exposure to such noise (relative or permanent loss in audition).

This document recommends the maximum noise limits that should not be exceeded.

The optimal acoustic comfort would not be obtained by silence (uneasy sensation), but by an acceptable ambient noise within the limits of 35 to 40 dB(A), with a maximum of 45 dB(A), not to be exceeded in rest areas.

However for acoustic studies, noise analysis shall be carried out over frequency noise bands ranging from 63 Hz to 8 kHz.

The noise spectre shall be reproduced on a curve network (noise rating curves, see standards [ISO 1996](#) or [NF S 31-010](#)), and as a first approximation the Engineering CONTRACTOR shall take the parameter of the highest curve, which touches a point on the spectre, as being the representative noise value.

The result shall be expressed in NR (noise rating), see figure 1 attached as appendix.

The values that should not be exceeded, according to the use of the building concerned, shall be thus defined, along with corrections to be added in order to take into account the type of noise (intermittent noise, impulsive noise, pure sounds, etc.).

3.2 NR and dB(A) equivalence

Equivalence between NR and dB(A) for octave bands is as follows:

dB(A)	NR	Hz Octave bands							
		63	125	250	500	1K	2K	4K	8K
90	85	103	96	91	88	85	83	81	80
88	83	101	94	89	86	83	81	79	78
70	65	87	79	72	68	65	63	61	59
60	55	79	70	63	58	55	52	50	49
55	50	75	66	59	50	50	47	45	44
50	45	71	61	54	49	45	42	40	38
45	40	67	57	49	44	40	37	35	33

Noise intensity should be reduced to a minimum.

3.3 Noise limits

The maximum noise limits not to be exceeded for the following zones are:

Working areas	Mixed platform	Living quarters platform and/or onshore building
Workshops, stores	70 dB(A)	70
Kitchens	60 dB(A)	60
Controls rooms, laboratories	55 dB(A)	45
Offices	50-55 dB(A)	40-45
Radio rooms	45 dB(A)	35-40

Relaxation and rest areas	Mixed platform	Living quarters platform and/or onshore building
Toilets and cloakrooms	60 dB(A)	45-50
Dining rooms	55 dB(A)	40-45
Game, theatre and television rooms	50 dB(A)	40-45
Rest rooms and infirmary	45 dB(A)	30-35
Corridors	60 dB(A)	45-50

All of these noise levels are maximum acceptable limits, but wherever these intensities may be reduced, the Engineering CONTRACTOR shall propose corresponding solutions.

In working areas, or in areas which house noisy equipment, the noise level shall be measured one metre away from the equipment. In case where personnel have to work closer than 1 m to the machine, the noise level measurement shall be taken from the machine itself.

Finally, according to French standard [NF S 31-084](#), for all working areas other than those mentioned, level of 85 dB(A) for an eight-hour working day, shall not be exceeded.

In case where the limit is exceeded, these areas shall be defined and indicated, and the personnel that have to work inside shall wear an acoustic helmet.

See figure 2 in appendix.

To obtain this acoustic comfort, two different techniques, based on two different notions shall be used:

- Acoustic insulation i.e. increase in the difference between the noise level emitted and that received
- Acoustic rectification i.e. dosing the intensity of the sound and adapting it to the utilization of the area in question.

3.4 Definitions

- Decibel (dB) measures acoustic pressure level or sound level; it is equal to:

$$N(\text{dB}) = 10 \log \left(\frac{P_1}{P_0} \right)^2 = 20 \log \frac{P_1}{P_0}$$

P_1 = acoustic pressure of sound wave in Pascal

P_0 = reference acoustic pressure = $2 \cdot 10^{-5}$ Pascal

- Balanced decibel (dB(A)) represents the sound sensation level produced by an acoustic pressure level (included between 0 and 55 dB)
- Low frequencies : 125-250 Hz
- Medium frequencies : 500-1,000 Hz
- High frequencies : 2,000-8,000 Hz

4. Acoustic rectification

4.1 Absorbent materials

The absorption factor (or coefficient) of materials selected shall always be given depending on the frequency bands (low, medium, high).

This coefficient represents the ratio of acoustic energy absorbed by incidental acoustic energy.

It shall be measured according to the method described in standard [EN 20354](#), and it is known as the SAB coefficient (measurement of re-echoing in a naked room and in a room coated with a certain surface material). Any other method shall be submitted for COMPANY approval.

5. Principles of acoustic rectification

5.1 General

Acoustic rectification of a building enables mainly to solve two problems:

- Lower the sound level due to unpleasant noise sources
- Obtain a pleasant sound by adjusting the re-echoing duration of the building to its use.

Within industrial installations, it is difficult to master the power and the characteristics of noise sources from miscellaneous equipment.

5.2 Optimum re-echoing duration within a building

For acoustic treatment within a building the Engineering CONTRACTOR shall take the following factors into consideration:

- Use to be made of the building and its volume
- Surface and nature of walls
- Type of furnishing and number of occupants.

6. Insulation against airborne noises

The insulation of external walls shall enable the sound level to be lowered between the outside and the inside by 45 dB(A) for an acoustic external pressure level of approximately 80 to 90 dB.

Insulation of doors and windows shall be carefully studied accordingly, especially that of doors which shall be in the range of 33 dB with the possibility of reaching 40 dB due to neoprene sill grooves and joints.

The problems of secondary transmissions shall be dealt with in a detailed study and the solutions envisaged shall be submitted for COMPANY approval.

7. Insulation against impact noises

Insulation against impact noises is an essential function of the type of floor covering selected.

The values of damped sound to be obtained shall be defined in particular specifications.

8. Thermal insulation

8.1 General

The thermal characteristics for construction shall be such that, combined with heating, air conditioning and ventilation installations, thermal comfort may be obtained at a global cost which suits the investment, the maintenance costs and the duration of the installation.

The range for comfort should lie around an effective temperature of 24°C for an air temperature of 27° to 28°C with an average humidity rate of 50%.

Reference should be made to specification **GS EP HVA 100**.

8.2 Definitions

- Coefficient "K": heat transfer coefficient through walls, in $W/m^2.K$
- Coefficient "GV": loss volume factor of houses, in W/K
- Coefficient "G1": loss volume factor through, in W/m^3K
- Required temperature: temperature which occurs 1 day/year with 10 year return period.
- Design temperature: temperature of 4°C more than required temperature

These definitions are extracted from the following French documents:

- **D.T.U.**: "Règle de calcul des caractéristiques thermiques utiles des parois de construction et des déperditions de base des bâtiments" (Rules for calculating practical thermal characteristics of structural components)
- **C.S.T.B.**: Documentation - "Règles de qualité". "Directives communes de l'Union Européenne pour l'Agrément Technique dans la Construction" (UEATC).

9. Rules for construction insulation quality

The particular specifications shall stipulate the values of coefficients K and G to be obtained. They shall take into account the environment and heating method selected.

Coefficient K is very important and shall be calculated according to the materials of which the building will actually be made.

The internal superficial thermal resistance ($1/h_i$), as well as the external superficial thermal resistance ($1/h_e$), are thus defined.

The value " h_i " is usually taken equal to:

- $9.1 \text{ W/m}^2.\text{K}$ for vertical panels
- $11.1 \text{ W/m}^2.\text{K}$ for horizontal panels upwards
- $5.9 \text{ W/m}^2.\text{K}$ for horizontal panels downwards.

The value " h_e " is usually taken equal to:

- $16.7 \text{ W/m}^2.\text{K}$ for vertical panels
- $20. \text{ W/m}^2.\text{K}$ for horizontal panels.

In hot and wet climates, the temperature is rarely very high and the daytime differences in temperatures are slight. Wall thermal inertia is not very effective. It will be unuseful to have strong inertia walls.

10. Characteristics of structural elements

The problems involved in determining coefficient "K" are essentially depending upon the heterogeneity of the partitions (walls, partition walls, floors, roofs).

The method for determination of "K" coefficient is given in [D.T.U.](#) entitled "Rules for calculating practical thermal properties of structural components" (see above).

The "DBR" value is equal to the thermal waste due to the air renewal system.

The coefficient "GV" corresponds to the value of thermal waste due to thermal exchange and to air renewal when temperature difference between inside and outside is one degree. It is given in W/K (Watt per Kelvin).

The Engineering CONTRACTOR shall make reference to this document or any other equivalent document, which shall be submitted for COMPANY approval.

11. Radiation from the sun

11.1 General

In consideration of local sunny conditions, the COMPANY may request the installation of a sun-shield.

11.2 Sun-shield

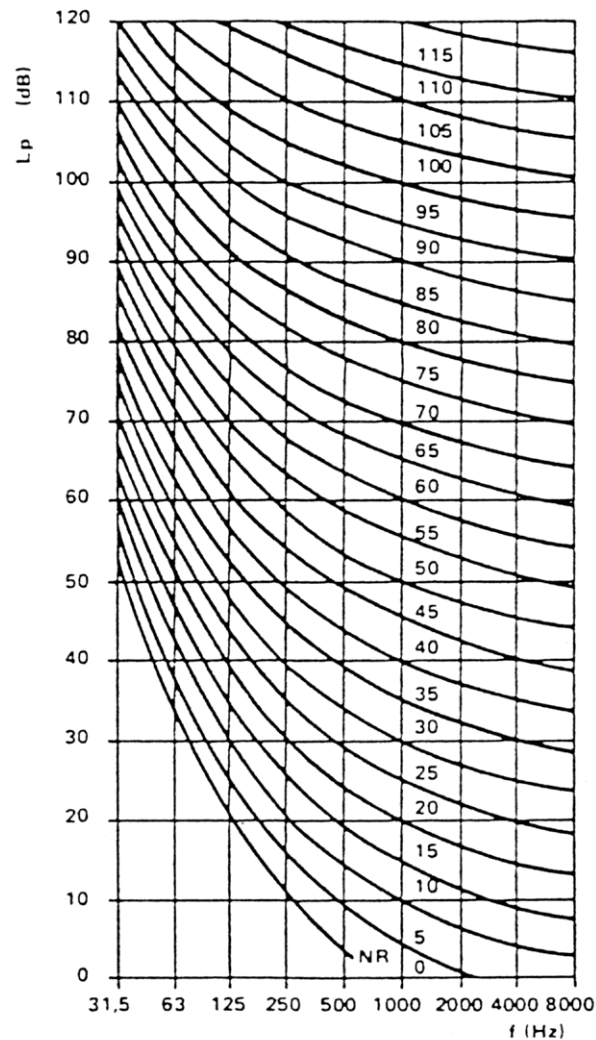
The type of sun shield shall be submitted for COMPANY approval.

11.3 Orientation

It shall be avoided that in hot countries greatly exposed main frontages are oriented East/West. North/South orientation shall be preferable.

Where this is not possible, openings shall be reduced on the West frontage.

Figure 1 - Noise evaluation curve (according to ISO 1996)



f = Medium frequency octave bands

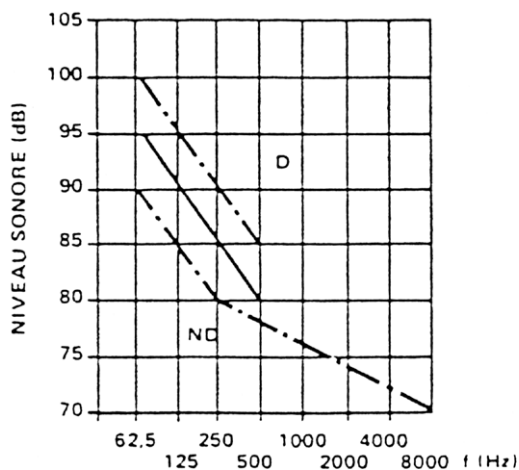
L_p = Level of acoustic pressure

NR = Noise rating

The curves are iso-discomfort curves.

The spectre of noise represented gives a value of NR equal to 50.

Figure 2 - Curve limits for exposure to noise



f = Medium frequency band. In ordinate, level of acoustic pressure L_p

Curves ND and D represent values under which one may consider that there is no danger (ND) and above which there is danger (D) for a daily exposure of 8 hrs.