



Exploration & Production

GENERAL SPECIFICATION

HVAC

GS HVA 204

Anti-blast HVAC installations
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1. Scope

This specification indicates the minimum requirements for the design and construction of anti-blast Heating, Ventilation and Air Conditioning (HVAC) systems.

This specification shall be used by the HVAC Engineer or the Project Engineer of a CONTRACTOR who designs an anti-blast HVAC system for a building.

This specification addresses the following points:

- The recommendations for defining blast valves
- The recommendations regarding the technology of the blast valves and the pipe/cable penetration sleeves to be selected
- The recommendations for equipment installed downstream of the blast valves in order to control the overpressure from the let-through blast wave.

This general specification may be modified or supplemented by particular project specifications.

Expression in capital characters are defined inside general specification **GS HVA 801**.

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.

Equipment and installations must be in accordance with (in order of precedence):

1. The country local regulations where equipment and/or installations shall be operated
2. Total General Specifications as listed in **GS HVA 000**
3. The International Standards
4. The French Regulation (when Country local regulation does not exist).

International System Units (SI)

Notes:

- In case of discrepancy between documents the more stringent requirements shall apply.
- The HVAC VENDOR or CONTRACTOR may propose proven improvements to the reference documents but shall obtain written approval of the COMPANY prior to implementation.
- A International Standard is a good "engineering practice" which shall be recognised and taken into consideration by VENDOR, SUPPLIER, MANUFACTURER and/or CONTRACTOR. If required, the translation of the standards must be included into HVAC scope.
- The latest revision of Standards, codes, regulations and the published errata if any must be used and applied by VENDOR, SUPPLIER, MANUFACTURER and CONTRACTOR.

Standards

Reference	Title
EN 1886 Rev. 2002 (E)	Ventilation des bâtiments - Caissons de traitement d'air - Performance mécanique

Professional Documents

Reference	Title
ADC	Air Diffusion Institute (All documents)
AFI	American Filtering Institute (All documents)
AGA	American Gas Association (All documents)
AICVF Codes	Association des Ingénieurs de Chauffage, Ventilation Français (All codes)
AMCA	Air Moving and Conditioning Institute (All document)
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers (All documents)
SMACNA	Sheet Metal and Air Conditioning CONTRACTORS' National Association (All documents)

Regulations

Reference	Title
Not applicable	

Codes

Statutory by law or recognised professional body approved by COMPANY.

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS HVA 000	List of HVAC specifications (all applicable)
GS HVA 801	Terminology, definitions, abbreviations

3. Definition of terms

The following expressions are used in this specification or may appear in the context of projects involving blast proofing requirements.

Shock wave: The pressure created by the expansion of hot gases from an explosion which propagates in the surrounding medium (air, water or soil).

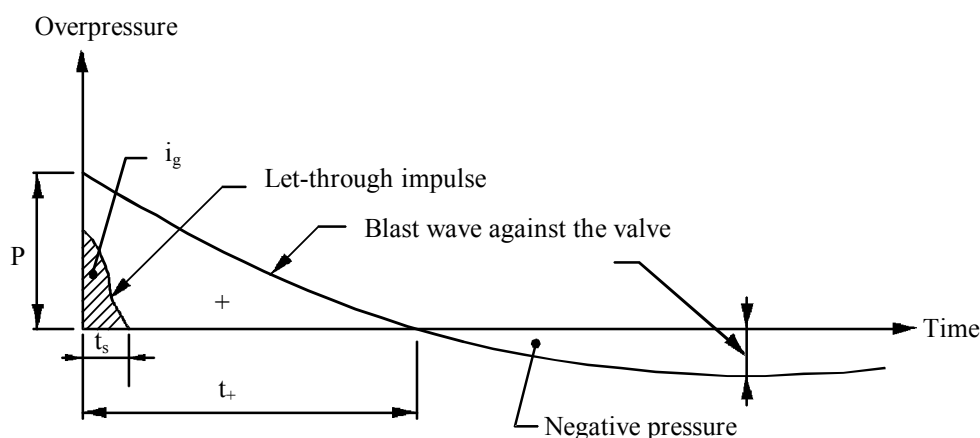
Blast wave: The name generally given to a shock wave in air. The rise in air pressure is characterised by a steep-front impulse, followed by winds and propagates in continuous way from the point of explosion.

Blast load: The load (or force) exerted on an objet when the outward pressure of an explosion strikes it and moves around it. It results from both the static overpressure and the dynamic pressure.

Shock (or blast wave) front or pressure front: The area between the disturbance pressure created by an explosion and the ambient medium.

Mach front: Front formed by the blending of several incident and reflected shock fronts from an explosion. This term implies that the wave propagates in the air and reflects off the ground. The Mach front is almost perpendicular to the reflective surface.

Pressures: The terms pressure and overpressure are generally used to describe the physical phenomena relating to shock waves. These terms may apply to static as well as dynamic effects. Overpressure is generally understood to mean an increase in pressure above the normal atmospheric pressure. Such a pressure increase always comprises a positive phase and a negative phase:



Symbols:

P : Maximum reflection pressure of the blast wave (MPa)

t_+ : Duration of overpressure(s)

P- : Maximum negative pressure of the shock wave (MPa)

T_s : Valve closing time(s)

I_g : Let through reflection impulse per free surface of the valve (Pa)

For estimating purposes, the following approximations can be used:

- $1 \text{ atm} = 1 \text{ kg/cm}^2 = 10 \text{ Nm}^2 (\text{Pa}) = 1 \text{ bar}$
- $1 \text{ kg/cm}^2 = 1.10^4 \text{ kg/m}^2$ or $1 \text{ kg/m}^2 = 1.10^{-4} \text{ kg/cm}^2$

4. Building blast proofing

In case of an explosion occurring in an installation, all the buildings or specific sections of buildings (like control room, laboratory, platform area, electrical substation) would be subjected to the resultant mechanical effects.

The design and construction of the building mechanical structures shall ensure:

- Occupants' survival
- Continuation of the specific activities carried out in these structures.

The following items must be taken into account in the preliminary design:

- The power of the anticipated explosions
- The minimum distances from the centre of the potential explosion
- The purpose of the building
- The level of protection sought.

During an explosion, a shock wave (or a blast wave in air) propagates and the mechanical effects of a blast wave induces:

- An immediate increase in static pressure (static overpressure)
- An immediate increase in dynamic pressure (dynamic overpressure)
- Drag (or thrust) effects and changes in density (reflection-impulse).

The classification of anti-blast protection can cover the range of maximum reflection pressures from 0.1 to 50 bars and overpressure duration in the milliseconds range, or lasting even a second, due to quickly repeated explosions.

For HVAC installations, it is necessary to protect all the openings in structures against penetration by the blast. This protection is provided in the form of (anti-)blast valves. The degree of protection provided by these valves must match the building degree of protection.

Quick-closing "blast valves" are designed to eliminate the damaging effects of the blast wave inside the building and to ensure that the ventilating capacity will not be affected. They shall protect the internal systems against high amplitude impulse loads, of both short and long duration.

5. Anti-blast valves

Any opening is always a vulnerable part of a structure. It is essential that the number and size of openings are reduced to a minimum to limit the total exposure risk. The anti-blast valves must have a very small vulnerable exposure area and may be equipped with protective screens or shields (in this case a calculation sheet must be provided in order to determine the minimum overpressure resulting at the blast valve).

Closure of the blast valve shall be automatic. It shall take place in response to the blast wave alone without use of a detector or electrical contacts. A small fraction of the wave, or a slight "let-through impulse", will pass through the valve before the disc is fully closed. As the closing time shall be very short¹, the let-through impulse shall be of very small magnitude and shall not be harmful to people and equipment located inside the premises. For each type of valve used, the valve MANUFACTURER shall state the let-through impulse values. Whenever possible such impulses shall be withstood by persons and equipment placed very close to the blast valve.

The overpressure resulting from the let-through impulses, behind the valve, shall never exceed **500 Pa²**. If necessary, a decompression plenum shall be placed behind the blast valve(s) to reduce the overpressure to this value or to a smaller value.

All the blast valves shall be designed to withstand a minimum of six consecutive blast loads with no degradation of their performance. They can be used for a single, much more substantial load, but in this case their ventilation performance is reduced.

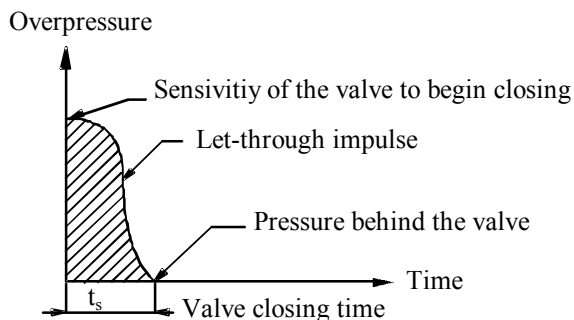
Anti-blast valves can be divided into two groups: one designed to protect against a long-duration load (repeated explosions) and the other to protect against a conventional, short-duration load.

The main characteristic of blast valves intended for long-duration loads is their ability to withstand very strong impulses, whereas those intended for short-duration loads are designed to reduce the impulses created by strong overpressure peaks lasting a short time.

5.1 Fresh air valves

Anti-blast valves for outside air intakes are not designed for high ambient temperatures (> 150°C). If there is a risk of exposure to high ambient temperatures, special or stainless steel versions shall be considered. All elements of the environment like temperature, exposure time, pollutants shall be defined to specify a suitable product.

¹ Closing time: the time after which the pressure behind the valve becomes null. It is the time measured from the start of the pressure increase in front of the valve.



² This pressure can in some cases be increased, up to a maximum of 1500 Pa.

Bar valves must have bars visible from both sides.

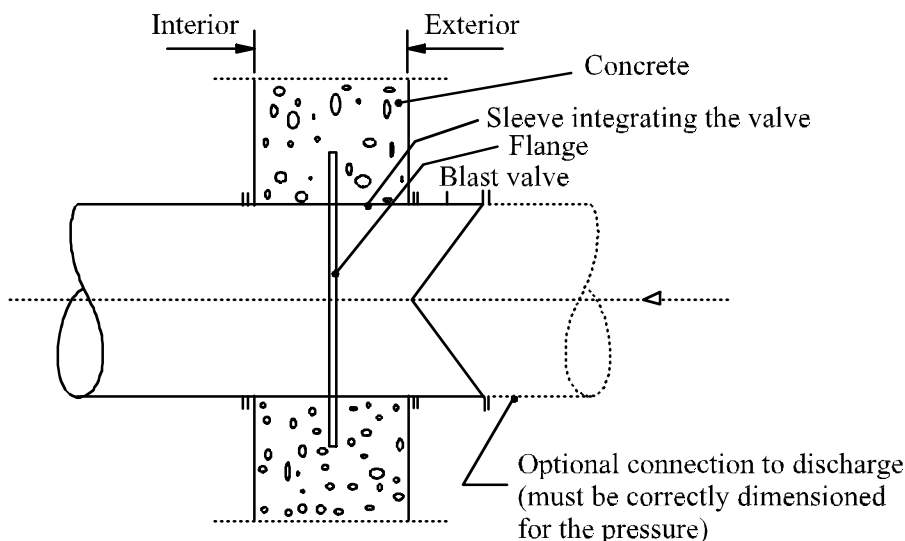
Circular valves shall be designed for inspection from upstream or from downstream (and sometimes from both sides).

5.2 Diesel exhaust extraction valves

Generally the hot exhaust gases from a diesel engine can be diluted with air at ambient temperature to reduce the temperature of the mixture passing through the valve to 150°C. Then the anti blast valve would only require corrosion resistance treatment and can be fitted directly on the structure.

If it is not practical to cool the exhaust gas, isolation on the anti blast valve would be necessary as high temperatures would affect the resistance of the blast wall (concrete or steel).

In this case, the MANUFACTURER shall develop a special valve to exhaust gases up to + 500°C, that allows the fluid to flow without reducing the level of protection. For diameters greater than 60 mm the valves shall be embedded in the wall, heat insulated and made entirely of acid-resistant stainless steel. The temperature of the adjacent steel or concrete shall not exceed 150°C. For diameters smaller than 60 mm the valve MANUFACTURER shall supply a special valve for exhausting gas at up to 500°C. This valve shall be mounted directly on the exhaust pipe.



5.2.1 Maintenance

Diesel gas exhaust valves require frequent cleaning as they are exposed to corrosive fumes and soot. To simplify maintenance their inner casing shall be removable from inside the building.

5.3 Stale air exhaust valves

These are similar to the fresh air valves but care shall be taken regarding the polluting nature of the exhausted air. The parameters of temperature, relative humidity and dilution of the pollutant (like acid), if any, shall not induce corrosion effects on any part of the valve or its support.

5.4 Valves on smoke-controlled discharge

Shall be selected as the fresh air valves, with the possibility of replacing damaged valve parts.

6. Testing of anti-blast valves

All the valves shall be tested by the MANUFACTURER in an approved laboratory of his own choice. The test certificates shall clearly indicate the actual performances of the equipment and should be transmitted to the COMPANY upon request.

7. Corrosion protection

The valves shall be protected by corrosion-proof paint in accordance with COMPANY specifications.

8. Information to be given to MANUFACTURER

The following parameters shall be communicated to the MANUFACTURER:

- Maximum reflection pressure (in bar)³
- Number of impulses considered³
- Minimum interval between two impulses³
- Duration of overpressure impulses (in milliseconds or seconds)³
- Type of application (operation in fresh air ducts, in flue or diesel exhaust ducts)
- Type of serviceability expected (e.g. serviceable from exterior or from interior)
- Nominal flow rate (in m³/h) and maximum allowable pressure loss (in Pa)
- Temperatures of the air passing through the valve (steady state)
- Nature and concentration of any pollutant which might pass through the valve
- Special precautions to be taken against corrosion.

9. Information required from the MANUFACTURER

Based on the parameters given in Section 9:

- The MANUFACTURER shall state the following:
 - The valve type
 - The valve pressure drop
 - Long/short duration protection classifications⁴
 - Number of valves to be installed
 - Layout drawing and installation details
 - Installation and maintenance requirements.
- The MANUFACTURER shall confirm all the parameters given in Section 9, item by item.

³ Parameter defined by the Safety/Environment department

⁴ Certain types of valve are presented for use against one or the other of short or long duration loads. Consequently, they have a protection class adapted to the most severe case. Blast valves lacking any protection class specification can normally withstand strong conventional loads but the let-through impulse will probably be greater than for those with specified characteristics.

- The MANUFACTURER shall verify, during HVAC design, that the valves will be operated under ideal conditions. He shall draw Engineering's attention to possible problems linked with utilisation of the selected valves.

10. HVAC Systems

In an HVAC system inlet, a plenum space for decompression shall be placed downstream of the blast valve in order to limit the overpressure to a maximum of 500 Pa, 1000 Pa or 1500 Pa (also see Section 6).

The volume of this plenum shall be calculated to suit all of the following:

- The maximum reflection pressure
- The pressure corresponding to the let-through shock wave
- The time during which this let-through wave acts
- The shock wave waveform
- The pressure desired downstream of the blast valve.

If for any reason it is impossible to place the said decompression plenum in the system, the following precautions shall be taken:

- **Option 1**
 - Install a suction duct between the blast valves and the central air conditioning plant and use this duct as the decompression plenum
 - The duct itself, the connecting flanges and seals must be designed to withstand the overpressures of 500 Pa, 1000 Pa or 1500 Pa
 - Do not use screw fasteners without a nut system (fixed or movable) on any part of the duct
 - The duct volume must be calculated in the same way as the volume of the plenum.
- **Option 2:** Modifications of the central air conditioning plant.

If it is impossible to install the decompression plenum or the connecting duct within the HVAC equipment room, (if the central air conditioning plant is located directly behind the blast valves), then the air conditioning plant itself must be built in accordance with [EN 1886 Rev. 2002 \(E\)](#).

To consider such option, the following characteristics shall be imposed:

- Frame resistance to a minimum pressure of 1500 to 2000 Pa (values given in the above-stated standard)
- No fixation with screws without a nut system (fixed or movable) of any part of the casing
- Requirement to have a filter carrying platform of the same strength as the casing
- Requirement to hold the bottom and top of the batteries in continuous guide rails fitted on the casing frame uprights by welding or riveting
- Two-position (carrying/operating) safety lugs between the frame of the motor/fan unit supported by anti-vibration springs and the installation cross members
- Portless doors with reinforced hinges and locks. Fitting of doors with compensating springs for the safety valve function

- Fitting of panels when appropriate using spring washers beneath the screw heads
- Panel construction with mineral wool insulation allowing the inside wall to deform temporarily when the let-through wave comes through (no rigid foam that would transfer all the force to the outside wall)
- Reinforced flexible sleeve on suction duct (double casing or fine-meshed outer strength net). Notice: free length of sleeve should be as short as possible.

Note: Whenever possible (according to space available in the equipment room), place a 500/600 mm decompression plenum at the entrance to the central air conditioning plant.

11. Supporting of equipment

Central air handling plants, large pumps or exchangers shall be mounted on pads that absorb a large amount of the energy emitted when the blast wave and (or) the shock wave strikes the building.

All piping must be connected to the machines via flexible systems.

12. Service cable and pipe penetrations

Service cables and pipes are typically fed into installations through the outside walls, or through the various gas-tight blast walls. These penetrations shall be done with transit sleeves. As the number and type of pipe or cable penetrations are not exactly known during the initial building design, margins must be taken to estimate the number and type of sleeves. The sleeves shall be embedded in the concrete during the building construction phase. When the pipes and cables will be laid, they shall then be equipped with suitable cable glands or packing to meet the blast-proofing, liquid tightness and gas tightness requirements.

All unused transits shall be plugged and kept available for future needs.

The transits installed shall permit damaged cables or pipes to be replaced.

The sleeves may be selected for single or multiple cables or pipes. They shall withstand an unlimited number of loading at an overpressure of 5 MPa. The transit inlets shall be delivered in the dimensions appropriate for the cables or pipes they will accommodate. The penetrations themselves shall be of blast, gas and fire resistant design.