

# Acoustic performances with flexible composite membranes





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## Introduction: acoustic principles

### Absorption coefficients - Case of surface coatings

The ability of a surface to absorb is expressed by its absorption coefficient  $\alpha_s$  (Alpha Sabine) between 0 and 1. It is measured for each frequency per third of an octave and per octave according to **EN ISO 354 standard**.

An "average" absorption coefficient,  $\alpha_w$  (in Europe) or NRC (in the USA), is used to summarise the average absorption level of a product over the entire frequency range using a single value

#### Expression of absorption results: Example of Serge Ferrari Aw\_7005 with a 100 mm air gap

Frequency (Hz) By third octave	$\alpha_s^{(1)}$	Frequency (Hz) Per octave	$\alpha_s^{(2)}$
100	0.07	125	0.15
125	0.15		
160	0.16		
200	0.26	250	0.40
250	0.39		
315	0.51		
400	0.61	500	0.75
500	0.74		
630	0.84		
800	0.91	1000	0.85
1000	0.87		
1250	0.83		
1600	0.75	2000	0.65
2000	0.62		
2500	0.63		
3150	0.69	4000	0.65
4000	0.62		
5000	0.62		
		<b><math>\alpha_w^{(3)}</math> (Europe)</b>	<b>0.65</b>
		<b>NRC<sup>(4)</sup> (USA)</b>	<b>0.65</b>

<sup>(1)</sup> "Alpha Sabine coefficients" per third of an octave

<sup>(2)</sup> "Alpha Sabine coefficients" per octave

<sup>(3)</sup> **The  $\alpha_w$  value (Europe, EN 11654 standard)**

The "weighted" absorption coefficient  $\alpha_w$  is a kind of "average" centred on the frequency of 500 Hz. It is determined according to the European standard EN 11654.

<sup>(4)</sup> **The NRC value (USA, ASTM C423 standard)**

The "Noise Reduction Coefficient" is the average of the absorption coefficients at the 4 octave bands 250, 500, 1000 and 2000 Hz calculated according to the ASTM C423 standard and rounded to 0.05.

### Equivalent absorption area - Case of multi-sided or complex objects

Multi-sided elements such as suspended panels, baffles, or furniture elements can absorb sound from more than one side. In this case, the acoustic performance is expressed as the Equivalent Absorption Area (EAA.) in sqm. The equivalent absorption area EAA (sqm) is the sum of the individual surfaces S (in sqm) of the object multiplied by their respective absorption coefficient  $\alpha$ .

Example: If a complex shaped object has an equivalent absorption area of 2 sqm, this means that this object absorbs as 2 sqm of pure absorber ( $\alpha = 1$ ). Thus, the complex shaped object is reduced to a plane surface of known pure absorption ( $\alpha = 1$ ).

## Room acoustic correction

Acoustic correction is intended to promote a comfortable environment, in which people can:

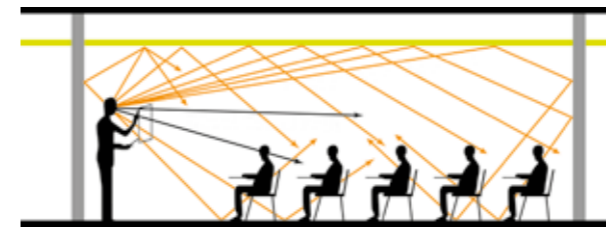
- Understand each other without having to raise their voices
- Preserve an intimacy that promotes discussion
- Avoid stress-related exhaustion and fatigue caused by ambient noise
- Concentrate and work productively.

Cocktail effect: The occupants of a reverberant room (restaurant, public area, etc.) speak louder to make themselves heard. This behaviour is called the "cocktail effect". After acoustic treatment, the occupants no longer need to speak loudly and the sound level drops because of the change in their behaviour.

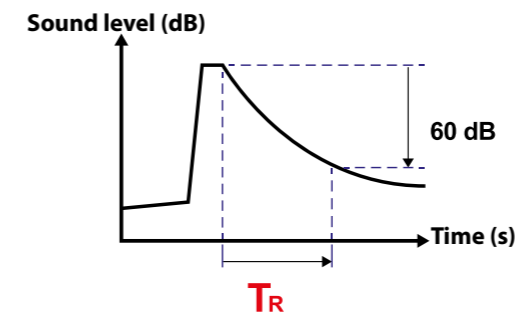
The presence of absorbent materials on the walls or in the room will ensure a reduction in both:

- Reverberation time (for better sound quality and speech intelligibility), and
- Sound level (from 3 to 10 dB) including the famous "cocktail effect".

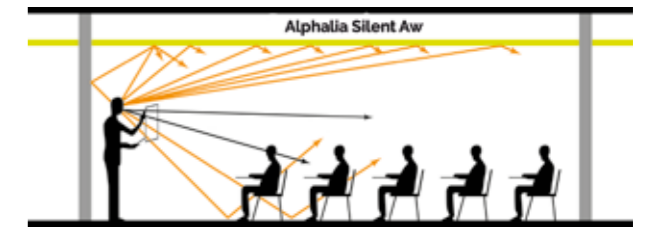
### Non-equipped premises



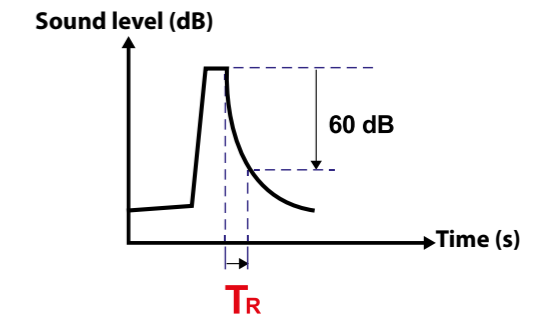
A room is "reverberant" when the sound is reflected by the enclosing surfaces. The sound level is then maintained and drops slowly after the sound source ceases to emit.



### Room equipped with Serge Ferrari AW\_7005

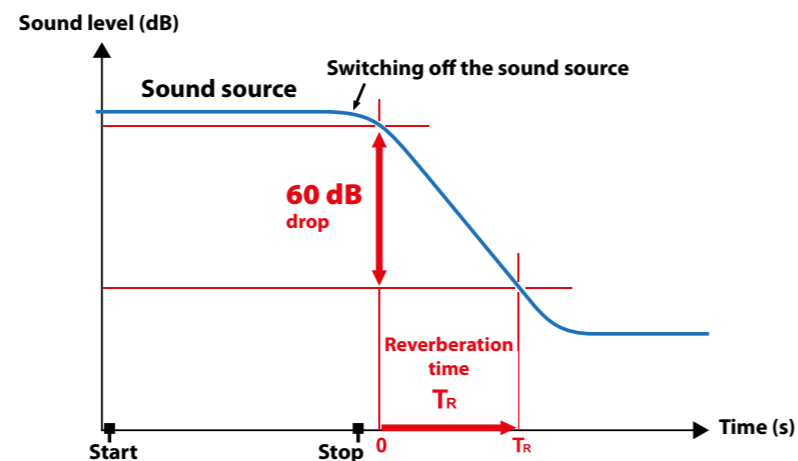


A room is "weakly reverberant" when the sound is absorbed. The sound level drops quickly after the sound source ceases to emit.



## Reverberation time

A room's reverberation time ( $T_R$ ) is the time required for the sound level to drop by 60 dB after the sound source ceases to emit. It is expressed in seconds.



## The reverberation time calculation

The reverberation time can be estimated by calculation using Sabine's equation, which dates back to 1920 but is still used, even though modern calculations allow greater accuracy.

$$T_R = 0,16 \cdot \frac{V}{\text{Sum}(S \alpha_s)}$$

$T_R$  = Reverberation time  
 $V$  = Room volume  
 $S$  = Enclosing surface area (walls, ceilings, floors, etc.)  
 $\alpha_s$  = Enclosing surface absorption coefficient

### This calculation shows that the reverberation time is:

- Proportional to the volume ( $V$ ); hence, the reverberation time of large volumes is always longer (cathedral, station hall, sports hall, etc.) than small volumes benefiting from the same acoustic treatment.
- Inversely proportional to the area  $S$  and to the Sabine sound absorption coefficient  $\alpha_s$  of the absorbent surfaces; hence, reverberation is reduced, if absorbents are applied to many surfaces.

To summarize: The efficiency depends on the acoustically treated surface area in sqm. See pages 16 and 17 to discover our products.

# Ceiling

## Monolithic stretched ceilings

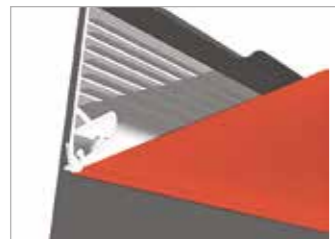
Ideal for combining acoustic gain with thermal gain by lowering the ceiling height



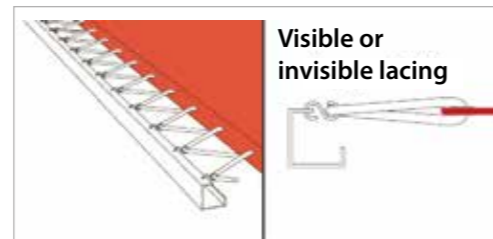
### Advantages of acoustic stretched ceilings:

- **Sobriety:** monolithic surfaces
- **Lower ceiling:** heating or air-conditioning savings
- **Camouflaging** of technical components or imperfections
- **High resistance** to impacts, dampness and washable
- **Quick installation** and minimal maintenance

**Option:** Improved light diffusion with Serge Ferrari AW Lux\_7005 + LED system



- Clip-based system



- Silcord: Lacing-based tensioning system well adapted to swimming pools or ice rinks

**Examples of applications:** large scale buildings (new or renovation), sports halls and especially swimming pools and ice rinks, auditoriums, events facilities, retails, airports...

### Acoustic performance characteristics

Monolithic stretched ceilings with Serge Ferrari AW_7005 fabrics								
Frequency (Hz)	125	250	500	1000	2000	4000	$\alpha_w$	NRC
Configuration	Absorption coefficients $\alpha_w$							
Serge Ferrari AW_7005 with variable air gap (AG)								
Air gap 50 mm	0.15	0.15	0.35	0.65	0.80	0.55	0.40	0.50
Air gap 100 mm	0.15	0.40	0.75	0.85	0.65	0.65	0.65	0.65
Air gap 200 mm	0.40	0.65	0.80	0.60	0.60	0.60	0.65	0.65
Air gap 400 mm	0.55	0.75	0.60	0.65	0.65	0.65	0.65	0.65
Air gap 1000 mm	0.56	0.59	0.64	0.66	0.66	0.67	0.65	0.65
Serge Ferrari AW_7005 in contact with 45 mm thick Rockwool* (MW)								
45 mm MW on 100% surface	0.30	0.80	1.00	1.00	0.95	0.90	1.00	1.00
Serge Ferrari AW_7005 in contact 100 mm Rockwool* (MW)								
100 mm MW on 100% surface	1.00	1.00	1.00	0.95	0.90	0.90	1.00	1.10

Tested in compliance with standards EN ISO 20354 and ISO 11654. Serge Ferrari AW\_7005 tensioned on a 10 à 12 sqm frame with either an air gap (AG) behind or with mineral wool (MW)(density 36kg/m<sup>3</sup>) behind, covering a variable surface area

# Ceiling

## Suspended panels

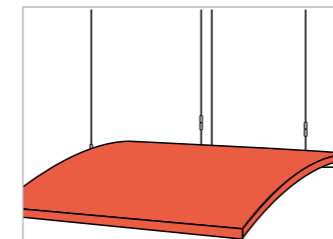
Ideal for highlighting your ceilings by playing on panel dimensions, shapes and suspension heights



### Advantages of suspended panels:

- **Installation** is simple and quick
- **High adaptability** to project constraints (lighting, smoke extraction, ductwork, etc.)
- **Design:** customised dimensions, shapes, colour schemes, printing
- **Cost control:** adaptable performance with single skin, double skin or double skin combined with insulating material, based on targeted objective
- **Resistance** to impacts, dampness and washable

**Option:** Luminous panels (Serge Ferrari AW Lux\_7005 + LED) or customization by digital printing



- Aluminium or wood frame
- Standard white or black aluminium frame
- Any shape
- Suspended by cable fixed to ceiling

**Examples of applications:** reception areas, atriums, offices, hotels & restaurants, shops & shopping centres, teaching areas

### Acoustic performance characteristics

Suspended panels with Serge Ferrari AW_7005 fabrics									
Frequency (Hz)		125	250	500	1000	2000	4000	$\alpha_w$	NRC
Configuration	Panel dimensions (mm)	Absorption coefficients $\alpha_w$ / reduce to sqm of suspended panel							
Single skin - 100 mm AG	1200 x 1200	0.11	0.28	0.56	0.58	0.60	0.57	0.55	0.50
Single skin - 400 mm AG	1200 x 1200	0.24	0.45	0.43	0.54	0.65	0.63	0.55	0.55
Double skin, no absorbent - 100 mm AG	1200 x 1200	0.15	0.38	0.74	0.87	0.90	0.83	0.65	0.70
Double skin, no absorbent - 400 mm AG	1200 x 1200	0.25	0.57	0.65	0.82	1.01	0.95	0.75	0.75
Double skin, 50 mm padding - 100 mm AG	1200 x 1200	0.35	0.73	1.21	1.23	1.16	1.05	1.00	1.10
Double skin, 50 mm padding - 400 mm AG	1200 x 1200	0.48	0.87	1.03	1.24	1.37	1.25	1.00	1.15
Double skin, 50 mm padding - 400 mm AG	1200 x 2400	0.52	0.86	1.03	1.23	1.32	1.22	1.00	1.10

AG : Air Gap

Tested in compliance with standards EN ISO 20354 and ISO 11654.

# Ceiling

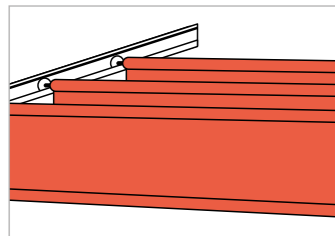
## Baffles

Ideal for combining acoustic comfort and natural light filtering, a solution particularly suitable for glass roofs



### Advantages of acoustic baffles:

- Natural light filtration **gain** and solar protection beneath glass roofs
- **Free access** to "ceiling-based" technical components beneath opaque roofs
- **Air conditioning**: keeping space open to benefit from thermal inertia of concrete
- Adaptable **absorption** according to required result: single or double skin baffles
- **Enhancement** of spaces by playing on baffle dimensions / heights
- Digital or serigraphic **printing**



- Fabric-covered frames and cable hangers
- Free suspension of single skin without frames, or double skin
- Stainless steel cables, chains and turnbuckles

**Examples of applications:** buildings open to the public and industrial buildings, atriums, canopies, greenhouses, transparent roofs

### Acoustic performance characteristics

Baffles with Serge Ferrari AW_7005 fabrics										
Frequency (Hz)			125	250	500	1000	2000	4000	$\alpha_w$	NRC
Configuration	Distance between fabrics	Extra absorbent	Absorption coefficients $\alpha_w$ / reduce to sqm of baffles (1200 x 600 mm)							
Single fabric	-	-	0.21	0.25	0.28	0.30	0.32	0.32	0.40	0.30
Double fabric	50 mm	-	0.28	0.28	0.35	0.40	0.47	0.44	0.50	0.40
Double fabric	50 mm	45 mm MW	0.38	0.34	0.61	0.70	0.65	0.60	0.85	0.60

MW: Mineral Wool density 36 kg/m<sup>3</sup>

Report available on request. Tested in compliance with standards ISO 11654 and ISO 354 Appendix B, assembly type J.  
Rows of three 1200x600 mm baffles spaced at 600 mm and 300 mm gap between fabric and edge of frame.

# Ceiling

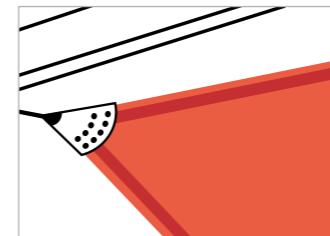
## Indoor sails

Ideal for creating an airy space and boldly contemporary setting



### Advantages of acoustic sails:

- **Quick installation** without disturbing ongoing activity
- **Free access** to "ceiling-based" technical components
- **Enhancement of spaces** by playing with superposition and colours
- **Installation** on lightweight structures
- Digital and serigraphic **printing**



- Attachment points featuring stainless steel turnbuckle and rings
- Reinforced fabric apices
- Steel cables

**Examples of applications:** buildings the public, atriums, offices, teaching areas, healthcare facilities, sports buildings

### Acoustic performance characteristics

Indoor sails with Serge Ferrari AW_7005 fabrics									
Frequency (Hz)		125	250	500	1000	2000	4000	$\alpha_w$	NRC
Configuration		Absorption coefficients $\alpha_w$							
400 mm air gap (plenum)		0.25	0.55	0.55	0.60	0.65	0.70	0.60	0.55
Centre of room (infinite air gap)		0.30	0.55	0.65	0.70	0.75	0.80	0.60	0.65

Report available on request. Tested in compliance with standards ISO 11654 and ISO 354 Appendix B.

# Ceiling

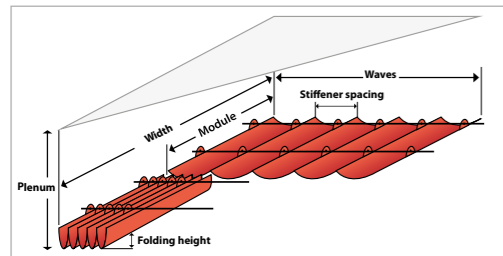
## Velums

Ideal for adjusting natural light and acoustic comfort at any time



### Advantages of acoustic velums:

- Retractable to ally visual and acoustic comfort
- Fixed: to combine design acoustic comfort
- Free access to "ceiling-based" technical components
- Installed on a lightweight structure
- Digital and serigraphic printing



- A cable-supported velum will be ideal for small-medium area roofs beneath veranda and pergola structures
- Free, frame-less suspension with single or double skin
- Stainless steel cables, chains and turnbuckles

Examples of applications: buildings open to the public and for commercial use, offices, teaching areas, healthcare facilities, sports buildings

### Acoustic performance characteristics

Velums with Serge Ferrari AW_7005 fabrics								
Frequencies (Hz)	125	250	500	1000	2000	4000	$\alpha_w$	NRC
Configuration	Absorption coefficients $\alpha_w$							
Flat-suspended 25 mm plenum	0.00	0.05	0.10	0.35	0.65	0.80	0.20	0.30
Flat-suspended 100 mm plenum	0.05	0.20	0.50	0.75	0.65	0.65	0.50	0.50
Flat-suspended 400 mm plenum	0.25	0.55	0.55	0.60	0.65	0.70	0.60	0.60
400 mm plenum including 12 waves of 105 mm high	0.23	0.52	0.68	0.79	0.84	0.84	0.75	0.70
400 mm plenum including 12 waves of 250 mm high	0.25	0.71	0.97	1.13	1.13	1.14	0.95	1.00

Reports available on request. Tested in compliance with standards ISO 11654 and ISO 354, Appendix B, assembly type J. Minimum values obtained in each configuration with velum slightly undulated. The larger the undulations, the higher the  $\alpha_w$  value.

# Design

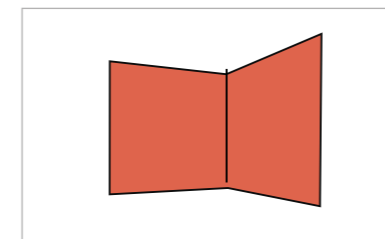
## Wall coverings

Ideal in renovation or new installations



### Advantages of acoustic wall coverings:

- Ease of installation
- Adapted to all locations and specific features (doors, windows, power outlets, etc.)
- Especially recommended when ceiling acoustic treatment is impossible
- Resistant to abrasion and impacts
- Easy upkeep
- Design: creating a unique setting by digital printing (Please consult us for printing compatibility)



- Wallpaperer's technique - wood grounds - stapling
- Nicking on clip strip system

Examples of applications: buildings open to the public and for commercial usage, offices, teaching areas, healthcare facilities, sports buildings

### Acoustic performance characteristics

Wall coverings with Serge Ferrari AW_7005 fabrics								
Frequencies (Hz)	125	250	500	1000	2000	4000	$\alpha_w$	NRC
Configuration	Absorption coefficients $\alpha_w$							
Serge Ferrari AW_7005 with variable air gap (AG)								
50 mm AG	0.15	0.15	0.35	0.65	0.80	0.55	0.40	0.50
100 mm AG	0.15	0.40	0.75	0.85	0.65	0.65	0.65	0.65
200 mm AG	0.40	0.65	0.80	0.60	0.60	0.60	0.65	0.65
Serge Ferrari AW_7005 in contact with 45 mm thick Mineral wool (MW45)								
MW45 on 100% of surface	0.30	0.80	1.00	1.00	0.95	0.90	1.00	1.05
Serge Ferrari AW_7005 in contact with 100 mm thick Mineral wool (MW100)								
MW100 on 100% of surface	1.00	1.00	1.00	0.95	0.90	0.90	1.00	1.10

AG: Air Gap

MW: Mineral Wool

Tested in compliance with standards EN ISO 20354 and ISO 11654. Serge Ferrari AW\_7005 tested when stretched on a 10 - 12 sqm frame with either an air gap in front of wall or in contact with Rockwool® (density 36 kg/m³) covering a variable area.



# Design

## Undulating curtains

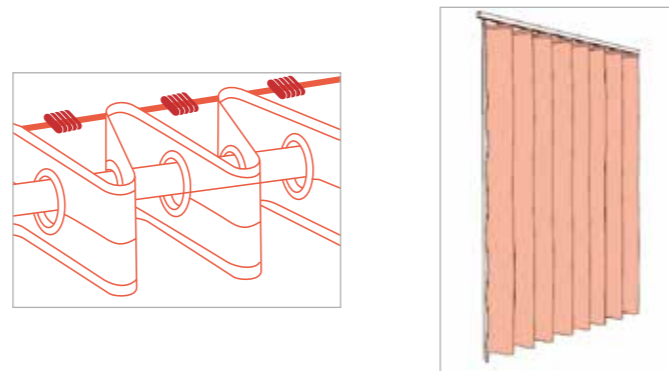
Ideal for combining acoustic comfort and spatial separation



### Advantages of acoustic curtains:

- **Unique combination of 3 functions:**
  - reducing reverberation level
  - providing thermal insulation
  - modulating spaces
- Washable and odourless
- Fire rating B-s2, d0 (European standard)
- Economical solution that is efficient, simple, practical and aesthetic

- Curtains with eyelet tops
- Rail-based solutions



Examples of applications: buildings open to the public and for commercial usage, offices, teaching areas, healthcare facilities, sports buildings, festival halls

### Acoustic performance characteristics

Undulating curtains with Serge Ferrari AW_7005 fabrics								
Frequencies (Hz)	125	250	500	1000	2000	4000	$\alpha_w$	NRC
Configuration	Absorption coefficients $\alpha_w$							
Flat - 150 mm air gap	0.16	0.42	0.60	0.54	0.55	0.52	0.60	0.55
Length reduced by 2 to form gentle undulations	0.31	0.68	0.69	0.78	0.81	0.75	0.80	0.75
Length reduced by 4 to form deep undulations	0.61	0.90	0.95	1.08	1.08	0.95	1.00	1.00
Length reduced by 13 to form extreme undulations	1.26	1.44	1.78	2.00	1.90	1.46	1.00	1.00

Report available on request - Tested in compliance with standards ISO 11654 and ISO 354, Appendix B, assembly type J.

# Design

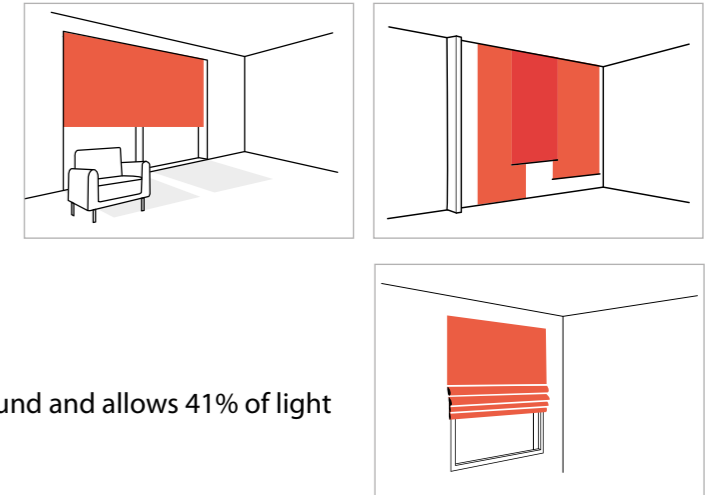
## Indoor blinds or flat curtains

Truly additional tools for providing solar protection as well as acoustic comfort



### Advantages of acoustic blinds:

- Placed in front of a window or glazed area, blinds and curtains absorb sound and also subdue light
- Fire rating B-s2, d0 (European standard)
- Adapt to all locations through wide choice of colours
- Economic solution
- Resistance and easy upkeep



Option: Serge Ferrari AW Lux\_7005 absorbs 65% of sound and allows 41% of light to pass

Examples of applications: buildings open to the public and for commercial usage, offices, teaching areas, healthcare facilities, sports buildings

### Acoustic performance characteristics

Indoor blinds or flat curtains with Serge Ferrari AW_7005 fabrics								
Frequencies (Hz)	125	250	500	1000	2000	4000	$\alpha_w$	NRC
Configuration	Absorption coefficients $\alpha_w$							
Suspended 25 mm from wall	0.00	0.05	0.10	0.35	0.65	0.80	0.20	0.30
Suspended 100 mm from wall	0.05	0.20	0.50	0.75	0.65	0.65	0.50	0.50
Suspended 400 mm from wall	0.25	0.55	0.55	0.60	0.65	0.70	0.60	0.60
Suspended at the room centre	0.30	0.55	0.65	0.70	0.75	0.80	0.60	0.65

Report available on request - Tested in compliance with standards ISO 11654 and ISO 354, Appendix B.

# Fixtures and fitting



## Claustras or partition walls

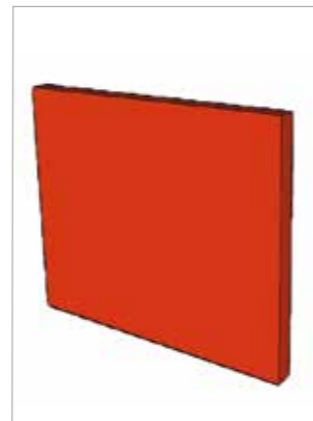
Ideal for limiting noise propagation in locations requiring extreme modularity



### Advantages of acoustic claustras:

- Easy to move and reinstall in accordance with needs
- Adaptability to all types of location thanks to a broad choice of colours
- Personalisation by digital printing
- Economic solution
- Resistance to impacts and abrasion
- Easy upkeep

- Aluminium panels with or without casters, single or double skin with padding
- Or, for single skin, metal rail and tube within sleeve



Examples of applications: canteens, company restaurants, call centres

### Acoustic performance characteristics

Claustra or partition wall with Serge Ferrari AW_7005 fabrics								
Frequencies (Hz)	125	250	500	1000	2000	4000	$\alpha_w$	NRC
Configuration	Absorption coefficients $\alpha_w$							
Double skin, 47 mm frame - no additional absorbent	0.23	0.36	0.38	0.46	0.58	0.51	0.45	
Double skin, 47 mm frame - 50 mm padding	0.29	0.50	0.64	0.76	0.83	0.78	0.70	
Double skin, 47 mm frame - 50 mm Rockwool®	0.28	0.50	0.72	0.89	0.87	0.77	0.75	

Report available on request Tested in compliance with standards ISO 11654 and ISO 354, Appendix B, assembly type J.

# Covered outdoor sound absorber

## Ceiling or walls

Ideal for large span ceilings and walls of non-enclosed public buildings



### Advantages of acoustic ceiling or walls:

- High acoustic absorption to reduce reverberation effect, 65% sound absorption without any additional absorbent
- High resistance and durability: 8 T/lm
- Unlimited creativity for versatile design

Examples of applications: arenas, stadiums, airport & station halls, retail malls, covered schoolyards

### Acoustic performance characteristics

Ceiling or wall with Serge Ferrari SW_7006 fabrics								
Frequencies (Hz)	125	250	500	1000	2000	4000	$\alpha_w$	NRC
Configuration	Absorption coefficients $\alpha_w$							
Air gap 100 mm	0.15	0.35	0.65	0.80	0.70	0.60	0.65	0.65
Air gap 400 mm	0.55	0.60	0.65	0.65	0.65	0.65	0.65	0.65
Air gap 1000 mm	0.55	0.55	0.70	0.70	0.70	0.65	0.70	0.65

Report available on request Tested in compliance with standards ISO 11654 and ISO 354, Appendix B, assembly type J.



# Our products

## Serge Ferrari AW\_7005

### Ultra-resistant, flexible, absorbent material

Serge Ferrari AW\_7005 is a composite material that is lightweight, flexible, ultra-resistant and sound absorbent. It absorbs up to 65% of sound, when it is tensioned or suspended freely with an air gap of at least 100 mm behind it. It is also very efficient when tensioned or suspended in the centre of the room without a surface behind it. It offers unique acoustic solutions such as: curtains, Japanese partitions, blinds, suspended frames, tensioned indoor sails, velums, baffles, stretched ceilings and walls, etc.



#### More comfort

- Increases acoustic comfort by **absorbing up to 65% of sound without extra absorbent**
- Optimises interior luminosity by reflecting up to 89% of light
- Protects against solar heat under glass roofs by eliminating up to 70% of solar energy
- Preserves incoming natural light under glass roofs with the translucent version (Serge Ferrari AW Lux\_7005)

#### More design

- **Variety of applications** enabling every type of room to be treated
- **Wide freedom of shape** and customisation by printing

#### More durable & safer

- **Fire rating: B-s2-d0, no-drops (European standard)**
- **Tear strength** higher than 5 tonnes/m
- **Insensitive to impacts** (Class: 60 km/h) especially in sports buildings
- **Safety in earthquake areas:** no risk of ceiling collapse due to its lightness and flexibility
- **Suitable for damp environments:** does not develop mould (ISO 846: Class 0) or lose strength
- **Exceptional service life:** ultra-resistant to tension, impacts, abrasion and UV radiation
- **10-year guarantee**

#### More practical

- **Low maintenance:** resists dirt and is easy to clean
- **Easy to dismantle:** permanent easy access to, and maintenance of technical components
- **Modulable:** roll-up/down, retractable or sliding system allowing solutions that adapt acoustic performance to user needs

#### More healthy

- **No volatile fibres**
- **Preserves indoor air quality:** Greenguard Gold and A+ certification

#### More sustainable

- **100% recyclable** (Polyloop)
- Variety of applications allowing adaptation to every type of room
- Low environmental impact
- Life Cycle Assessment (LCA) available on request.

# Our products

## Serge Ferrari SW\_7006

### Covered outdoor sound absorber

A lightweight and resistant sound absorber for tensile ceiling and walls in sheltered space



#### More comfort

- High acoustic absorption to reduce reverberation effect : 65% sound absorption without any additional absorbent
- Unlimited creativity for versatile design

#### More design

- **Variety of applications** enabling every type of room to be treated
- Large span thanks to its high resistance
- **Wide freedom of shape** and customisation by printing

#### More durable & safer

- High resistance & durability: 8 T/lm
- **Fire rating: B-s2-d0, no-drops (European standard)**
- **Tear strength** higher than 5 tonnes/m
- **Insensitive to impacts** (Class: 60 km/h) especially in sports buildings
- **Safety in earthquake areas:** no risk of ceiling collapse due to its lightness and flexibility
- **Suitable for damp environments:** does not develop mould (ISO 846: Class 0) or lose strength
- **Exceptional service life:** ultra-resistant to tension, impacts, abrasion and UV radiation
- **10-year guarantee**

#### More practical

- **Low maintenance:** resists dirt and is easy to clean
- **Easy to dismantle:** permanent easy access to, and maintenance of technical components
- **Modulable:** roll-up/down, retractable or sliding system allowing solutions that adapt acoustic performance to user needs

#### More healthy

- **No volatile fibres**
- **Preserves indoor air quality:** Greenguard Gold and A+ certification

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# Inspirational projects

Fixed, durable and easily dismantlable solutions



# Inspirational projects

Mobile, removable solutions



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